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THE NATIONAL GEOGRAPHIC MAGAZINE

Grand Canyon: Nature's Story of Creation

In the Mile-deep Chasm of the Colorado, One of the World's Greatest Wonders, Rocks Reveal the Beginnings of Life on Earth

BY LOUIS SCHELLBACH

Chief Naturalist, Grand Canyon National Park

With Illustrations from Photographs by Justin Locke

"KEEP the reins in your hands at all times," our guide counseled. "Keep your feet in the stirrups, your mind in the middle. Never dismount unless I am at your side. Obey those rules, and your mule will take care of you."

With these words we rode off the brink of the South Rim and down Bright Angel Trail toward the Inner Gorge of the Grand Canyon of the Colorado River, almost a mile below. As park naturalist of the Grand Canyon National Park, I was going along for the ride with a few friends.

A Cowboy Sums It Up

Before and around us stretched a wonderland that has taxed the descriptive powers of poets and other gifted word painters.

"Absolutely unparalleled throughout the rest of the world!" boomed Theodore Roosevelt. Naturalist John Burroughs called it "the world's most wonderful spectacle, ever changing, alive with a million moods." To British novelist E. M. Forster, rock deposits filling the chasm seemed like "sphinxes draped in crimson shawls." He called the canyon "the most astounding natural object I have ever seen."

But in my 20 years of association with the Grand Canyon I have never heard of a comment more apt than the one made by an unlettered cowboy. Riding after hounds in pursuit of a mountain lion, he emerged suddenly from a forest, and the colossal abyss yawned before him.

"Wow!" he exclaimed. "Something sure happened!"

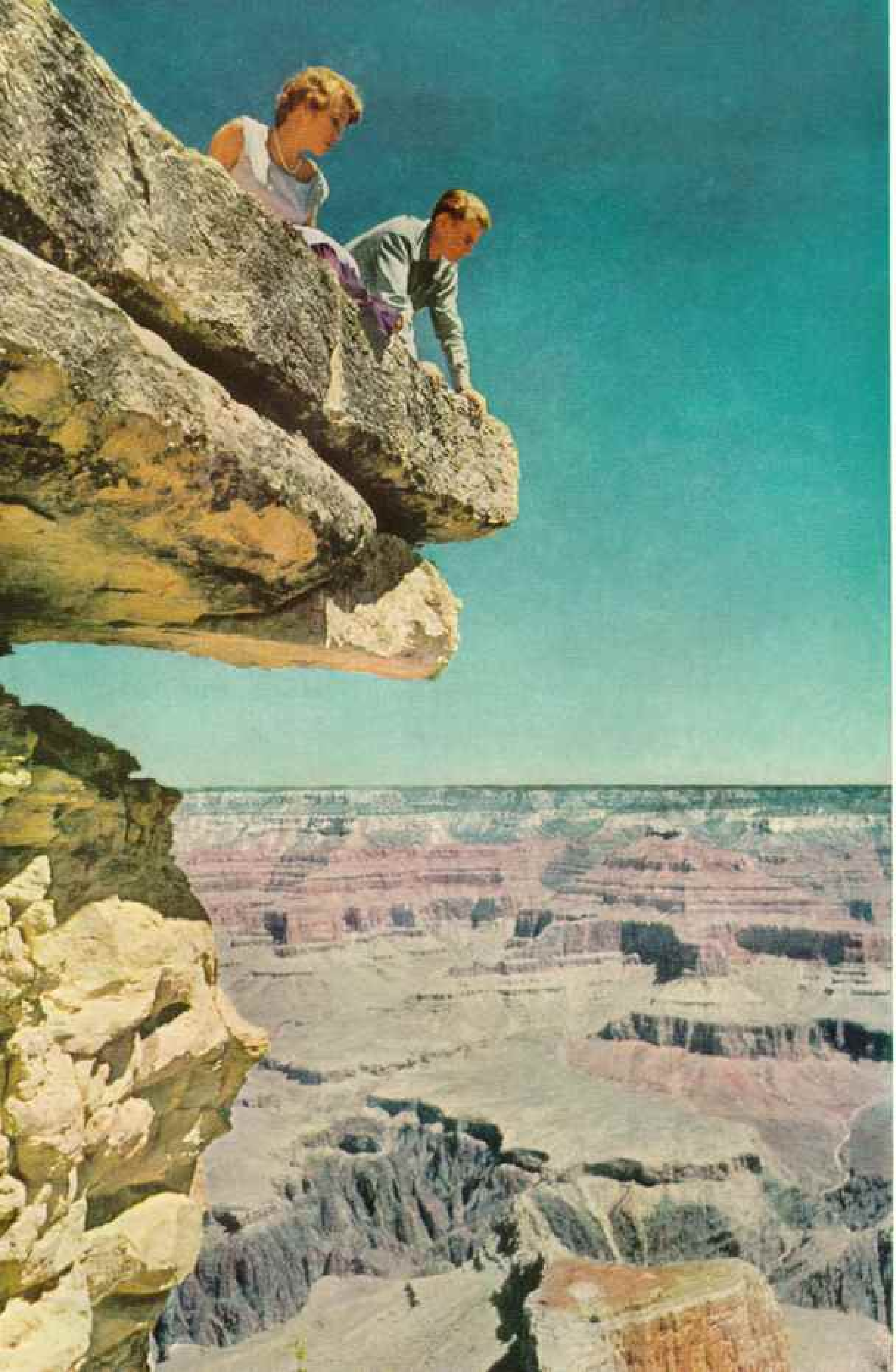
As always during my many trips over Bright Angel and other trails, I experienced an uplifting of the spirit combined with a deep sense of humility as our party started down into the incredible chasm.

Viewed across 10 miles of clear Arizona air, the North Rim stood out with such telescopic clarity that I felt I could all but reach out and touch it. Deva, Brahma, and other fantastic formations named for Old World deities scalloped the rim. Resembling mountains, they were water-sculptured earth shapes known as temples.

Different Spectacle Every Hour

Exposing layers of white and red rocks, these shapes changed colors like a kaleidoscope as the sun spotlighted a different spectacle every hour.

Dawn had gilded these islands in the sky but left the canyons in blue shadow. Noon would expose a pitiless, glaring desert unrelieved by shadow. Evening would set the earth spires afire with alpenglow (page 592). Moonlight would tint the chasm with mystery, and morning's fog, if it came, would fill the canyon with a river of cotton.



Members of our party were taking a ride back through the ages that were required to form the earth's crust; they were descending almost a vertical mile into a different climate. But at this moment they were indifferent to scenery and geology; they thought only of mules and heights. Many had never ridden a mule in their lives.

As long as the mules headed straight down, the trail seemed a comfortable four feet wide. Newcomers got their first shock when we halted for pictures beneath a photographer's studio window overlooking the trail. Each mule did as he was trained: he put his tail to the canyon wall and let his head hang out over space. Nothing but mule intervened between riders and thin air. Frightened tenderfeet clutched saddle horns and leaned back against the rocks.

"Wish I'd written my will," one man said.

On the Edge of Space

Riders were scarcely adjusted to saddles when the caravan abruptly entered a dizzy series of switchbacks cut into sheer cliffs. Approaching a turn jutting off into space, the mules leaned so far over the precipice that it seemed natural to wonder if they intended to round the corner or step off into the abyss. Then, so slowly that to novice riders the fateful seconds seemed interminable, our mounts pivoted, one foot after another.

Renowned in some circles for his obstinacy, the mule is esteemed in Grand Canyon for his patience, endurance, and sagacity. He is petted, curried, and fed until he is almost too fat to straddle. With aplomb he daily goes forth onto an arduous trail with a quaking tenderfoot on his back. Appearances to the contrary, the animal is not bent on suicide. In 50 years of operations, Grand Canyon mules have yet to lose a paying customer to accident.

Fred Harvey company, the concessionaire, keeps 75 to 80 mules. The company considers mules stronger, more stable, and of greater stamina than horses and therefore safer on the trail.

Head roped three feet behind his leader, the trail mule is educated by weeks of carrying loads with the pack trains. If he shows promise, the guides ride and gentle him. To adjust him to surprises, they do everything they think a tenderfoot rider would do: drop a hat over his head, bang cameras against his hide, and get on and off the wrong side.

To go muleback into the canyon, one must weigh not more than 190 pounds, a rule made to spare man and mule. Children under 12 cannot take the ride, and those too advanced in age may be barred. One veteran ranchwoman who confessed to 84 years made three trips down to the river.

Our guide was Howard Pyeatt, who had escorted visitors on the trail for 10 seasons.

"On these first few hundred yards," he said, "a woman may get scared or her husband may decide he has 'heart trouble.' They can dismount and hike to the rim, but very few do.

Girls Freeze to Saddles

"I was guiding a French doctor once, and he leaned so far toward the 'safety' of the canyon wall that he fell out of the saddle. Rather than return in defeat, he hiked along beside us all the way down and back.

"Two girls put on the worst show of fright I ever saw. Riding side by side, against all the rules, they froze stiff in their saddles and grabbed each other about the necks, like drowning persons. Fear gave them such strength that it took two guides to pry them apart. But you'd have thought their mules were statues, so quietly did they stand."

Pyeatt pointed out a peculiarity of Bright Angel Trail: it follows a fault line that cuts across the canyon. Earth forces have broken and shifted the rocks until those on one side stand 180 feet above matching strata on the other.

As the riders turned in their saddles to follow the fault line upward, some observed that they had journeyed a thousand feet below the canyon's rim. Confidence partly restored,

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Page 590

←Suspended Above Space, a Young Couple Surveys Earth's Mightiest Gorge

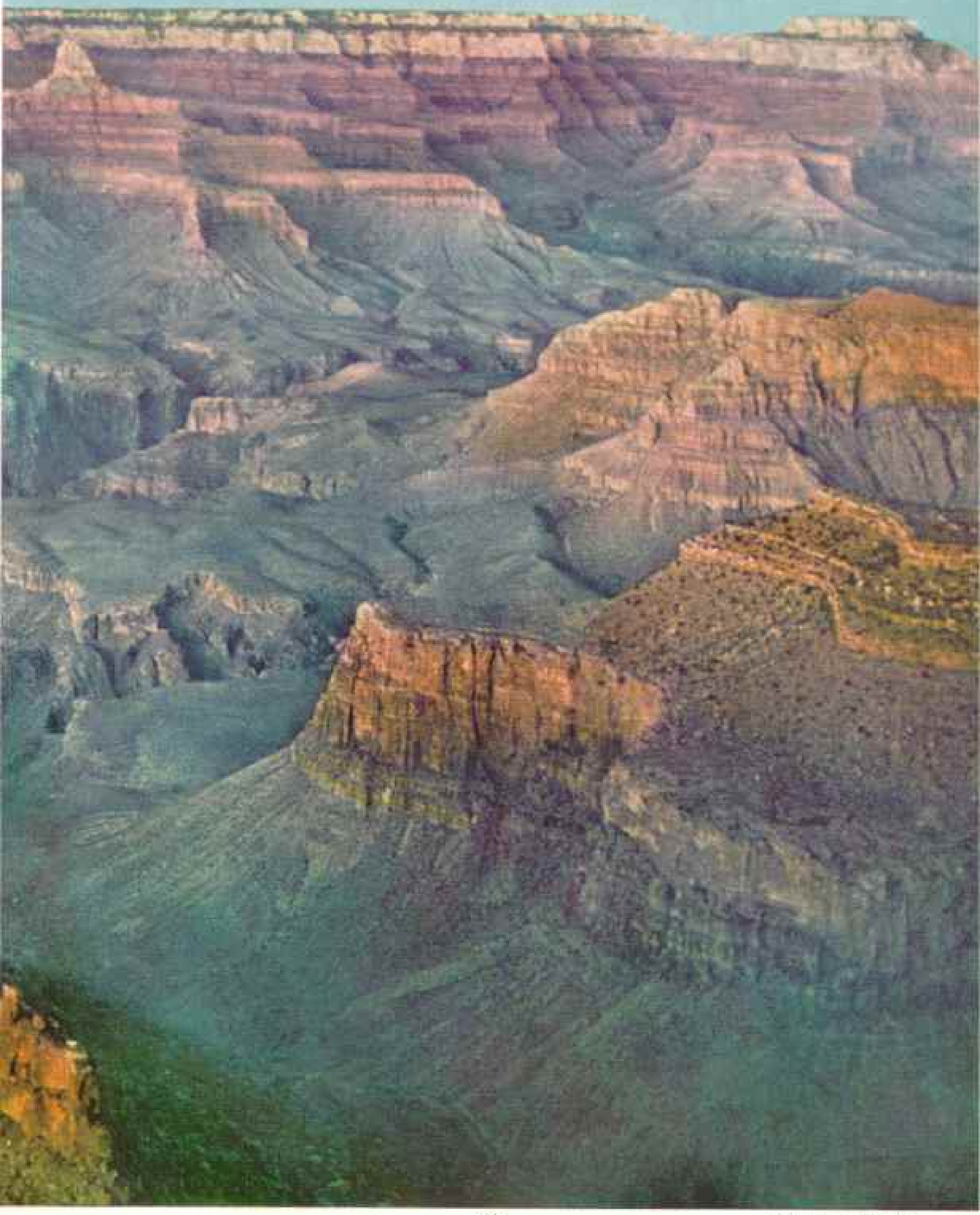
A mile deep, 217 miles long, and an average of 10 miles wide, the Grand Canyon of the Colorado River demonstrates water's power to grind away the hardest rock. Using sand, gravel, and boulders as tools, the river chiseled ever deeper as the land rose, until finally it cut a mile-thick cross section. Its dark Inner Gorge (foreground) exposes the oldest rocks, which were laid down in the Older Pre-Cambrian Era. Erosive rains, frost and thaw, and the probing roots of plants have widened the canyon as much as 18 miles.

This view looks from Hopi Point on the South Rim, open the year round, to the higher North Rim, which snows close in winter. Here the Colorado is lost in its gorge; the stream bed on the right carries water into the river only in flood times.

 Kodachrome by Justin Locke

As Evening Shadows Dim the Chasms, an Eerie Alpenglow Bathes the Canyon's Heights

The camera caught this view 10 minutes after sunset, when the atmosphere had absorbed the blue from the spectrum, leaving a rosy afterglow. The Battleship, a resistant ledge, sails across dry land in the foreground.



593 Kodachrome by Justin Locke

Eroded Red Temples Capped with White Thrones Bear Names from Old World Religions

Deva and Brahma Temples (opposite page) and jagged Zoroaster stand isolated from the North Rim's Walhalla Plateau and Wotans Throne (upper right). Bright Angel Canyon joins the Colorado's gorge on the left.

they began to enjoy the marvelous view. Earth's strata changed colors before their eyes. The gray-white top layer of sea-formed limestone gave way to buff-colored sandstone, hardened wind-blown dunes of an ancient desert landscape.

At last we entered the 550-foot Redwall, a magnificent pink façade whose blue-gray limestone had been stained red by iron oxides washed down from loftier strata.

Grazing Mules Lean over the Abyss

The trail down this perpendicular cliff follows Jacob's Ladder, another series of switchbacks. Our mules chose this alarming stretch to display their appetites. For any clump of green they stuck their heads out over the trail's edge.

"Hold your reins tight; yank his head up," Pyeatt advised a novice rider. "If you let him, your mule will eat anything on the trail —dead sticks, straw hats, old ropes. Sometimes he'll chew on a saddle blanket.

"Your mule will walk out toward the rim of the trail and then he'll lean out into space as far as he dares, just to nibble one worthless blade of grass."

By late morning the less hardened riders were experiencing a sensation almost as painful as fear. Their legs, spread wide apart by the mules' fat backs, lost circulation. Men stood in the stirrups, bore part of their weight with hands on saddle, did anything to ease the torture.

When we stopped for lunch, Pyeatt had to lift a few numb riders out of saddles. They leaned painfully against their mules until blood returned to legs. But they showed no weakness in their throat muscles as they pitched into coffee brewed in a 2-gallon pot.

Our picnic site was Indian Garden, a cottonwood oasis on the Tonto Platform, a wide, almost level plateau two-thirds of the distance from rim to river. Long ago the Havasupai Indians irrigated their farm plots from springs here, and we could still trace the outlines of their ditches.

Indian Garden's springs supply all the water used by Grand Canyon community, headquarters of the National Park Service on the South Rim. A centrifugal pump lifts the load three-fifths of a mile.

Lunch finished, we followed another zigzag trail cut in the rocks, down into Granite Gorge, commonly called Inner Gorge, to the Colorado River, 7.8 trail miles from our starting point. Here we stood 4,400 feet below the South Rim and 5,500 below the North Rim. Manhattan Island could be tucked into a 13-mile stretch of the canyon. If the 1,472-foot Empire State Building were set down on the river bed, only its television tower would stick out of the Inner Gorge.

The Colorado, one of our greatest rivers, is 1,450 miles long, and here at close range, where it is 300 feet wide, it gave an impression of tremendous power and volume.

Held between sheer walls, the river roared in fury as boulders in its grip crashed against one another and bedrock. When the wind is right its mighty voice can be heard as far as the South Rim.

Living up to its Spanish name, *colorado* (red), the stream seemed more mud than water. Half a million tons of soil a day were moving before our eyes, an amount determined by a silt-sampling car riding a cable from bank to bank (page 612). "Too thick to drink and too thin to plow," is the way old-timers describe the Colorado's water.

Kaibab Suspension Bridge, just wide enough for a pack mule, allowed us to cross comfortably to the north bank (page 616).

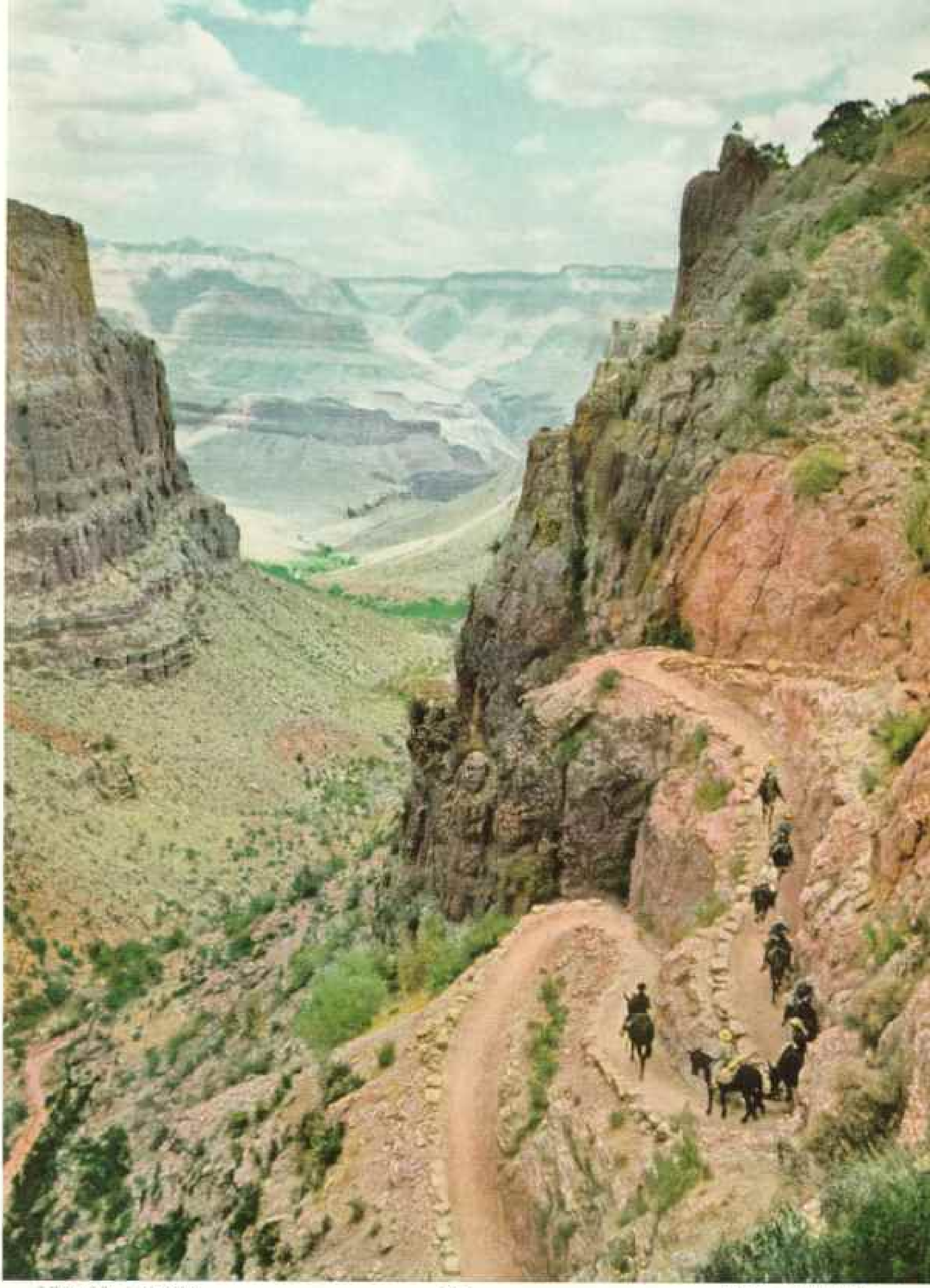
A short ride took us to Phantom Ranch, only resort in the bottom of the canyon, for a cool dip in the swimming pool (page 623), dinner in the main hall, and a relaxing sleep in a guest cabin. Bright Angel Creek, as clear as the Colorado is muddy, made the ranch an oasis.

20 Degrees Warmer at the Bottom

Down there we were in another climate; the air was 20 degrees warmer than on the South Rim. Depending on the temperature and evaporation, it could have been snowing on the lofty North Rim, raining on the South Rim, and merely misting at Phantom Ranch. Daylight was shortened by canyon walls rising high on every side.

"The man who works only from sunup to sunset wouldn't have much of a job here," observed Manford (Slim) Patrick, manager of Phantom Ranch.

"To feed our guests," he remarked, "the ranch has to pack in all its provisions. During a busy summer week the mules must haul 3,500 pounds of supplies. It takes two tons of fuel oil a month to operate the lights, ovens, home freezer, and cabin heaters. Dirty laundry goes out, fresh clothes come in by mule-back. Even our mail arrives by mule express.



Reinforcement by Justin Locke

Down Jacob's Ladder! Guide and Dudes Ride Mules Almost a Vertical Mile to the River

Nerves get a test on Bright Angel Trail's switchbacks. Mules pivoting around sharp turns lean outward, giving riders a clear view of thousand-foot abysses. This party approaches Indian Garden.

THE GRAND CANYON

STATUTE MILES

Galahad Point

Redwall Point

The Dragon

Grama Point

Point Sublime

Dragon Head

Confucius Temple

Menelaus Temple

Shiva Temple

Osiris Temple

Horus Temple

Tiyo Point Trail

Tiyo Point

Widforss Point

Buddha Temple

Isis Temple

Cheops Pyramid

19 miles to U.S. 89

Kaibab Plateau

North Rim

Uncle Jim Point

Grand Canyon Lodge

Bright Angel Point

Kaibab Trail

Deva Temple

Bright Angel Creek

Brahma Temple

Zoroaster Temple

Bright Angel Canyon

Tonto Plateau

Colorado River

Granite Gorge

Granite Rapids

Cocopa Point

Yuma Point

Mesa Eremita

Pima Point

Mohave Point

The Battleship

Hopi Point

Indian Garden

Bright Angel Trail

Yavapai Point

Powell Memorial

Hermit's Rest

The Abyss

Jacob's Ladder

El Tovar Hotel

Grand Canyon

Santa Fe System

Phantom Ranch

Kaibab Suspension Bridge

Camping Station

Yaki Point

Shoshone Point

Inner Gorge

Line of geologic cross section on page 607

Zion National Park

Navajo Mt.

LITAH

ARIZONA

NEVADA

Kanab Cr.

Navajo Bridge

Havasu Creek

Grand Canyon Nat. Mon.

GRAND CANYON NATIONAL PARK

Painted Desert

Navajo Indian Res.

Hopi Indian Res.

Lake Mead

Hoover Dam

Havasupai Indian Reservation

Shadow Mt.

Red Butte 7800

Area of large map

Little Colo. River

Sunset Crater

San Francisco Peaks 12670

Flagstaff

Williams

Kingman

Santa Fe System

Williams 56 miles

Coconino Plateau

South

Drawn by Robert W. Northrop and Victor J. Kelley
Original relief drawn by U.S. Geological Survey

Point Imperial
Natural Bridge
Nankoweap Creek
Nankoweap Mesa
Navajo Indian Reservation
Helicopter Landing
Alsap Butte
Colter Butte
Marble Gorge
Desert Facade
Painted Desert
Vista Encantada
Walhalla Plateau
Atoko Point
Gunther Castle
Siegfried Pyre
Chuar Butte
Little colorado
Cape Solitude
Kuma Point
Owl Point
Ariel Point
Naji Point
Temple Butte
Juno Temple
Cape Final
Jupiter Temple
Venus Temple
Apollo Temple
Honan Point
Thor Temple
Cape Royal
Wotans Throne
Angels Gate
Vishnu Temple
Tanner Canyon
Comanche Point
Colorado River
Cedar Mountain
Granite Gorge
Tonto Trail
Bright Angel Trail
Pinal Point
Lipan Point
Desert View Watchtower
Papago Point
Zuni Point
Moran Point
Coconino Plateau
*Wayside Museum
Grandview Point
Sinking Ship
East Rim Drive
Rim

Grand Canyon: a Bird's-eye View

This map covers the more popular half of Grand Canyon National Park. High lights reflect a summer sun low in the northwest. The Painted Desert north of the Little Colorado is part of the Navajo Reservation. The natural bridge below Point Imperial is a new discovery (page 629).

Smiles in the Corral Hide Many a Fear

Banter prevails on the South Rim every morning as visitors saddle up for a swing down the switchbacks (page 595). "Don't fall into the canyon," nonriding friends counsel the adventurers. Tenderfoot riders, many astride a mule for the first time, shrug off the joshing with an air of bravado. But when the mules make their first pause with heads hanging out over space, the bravest usually clutch saddle horns and lean away from the abyss. At that point a few dismount and climb back to the rim, but others, adjusting to the heights, relax and swear they wouldn't have missed the experience for anything.

Fixed Glasses Point Out the High Spots

Yavapai Observation Station is called the Key to the Canyon. National Park Service men deliver talks there daily (page 601). Fifteen binoculars locked onto scenes of interest bring the "invisible" rushing in to meet the eye. These costumes are not unusual; Grand Canyon visitors wear anything and everything.

"It gets pretty lonely here in winter, when the guests are gone, but we have grown to love the quiet. We took a long vacation tour recently, and the diesel trucks chugging past the auto courts kept us awake half the night. Down here the only wheeled vehicle is the mule cart that hauls trash.

"In our little valley we miss nothing except fresh milk, a daily paper, and the movies. But if one of us ever gets sick or has to have a tooth pulled, then he has to ride all the way up to the rim—and the emergency usually occurs at night.

Squirrels Feast on Apricots

"For fresh fruit we grow our own peaches, figs, plums, and apricots. There is one drawback: it seems as if the squirrels wait until we are ready to pick the apricots, then move in like an army of ants, stripping the crop in no time at all.

"This is sanctuary, and wild animals seem to sense that they have protection.

"My wife found a bull snake in the house the other day. Obeying the National Park Service regulations against killing native wildlife, she picked it up by the tail and carried it out to the rocks.

"We drove a beaver away from our valley because he was felling our trees, two every night. A bobcat used to promenade past the ranch house every evening.

"Deer hang around the corral and steal the mules' hay. Ring-tailed cats prowl for garbage at night. Water ouzels hunting aquatic insects and larvae swim under water in the creek, and ducks camp in our ditches in winter."

Because of the markedly different climatic conditions in the canyon, it acts as a barrier to many of the smaller animals living on the rims. Those on one rim are now of different species or subspecies from their relatives on the other, only a few miles away. This is true of such assorted creatures as squirrels, gophers, porcupines, rabbits, wood rats, chipmunks, coyotes, rattlesnakes, and gopher snakes.

Classic examples are the Kaibab squirrel of the North Rim and its counterpart of the South Rim, the Abert squirrel. Both have tufted ears and a chestnut stripe down the back. But the Kaibab—found nowhere but on the North Rim—has a white tail and black belly parts while the Abert has white belly parts and a gray tail.

Grand Canyon is a barrier to men no less than to animals. Its 217-mile gorge deflects all north-and-south highway and railroad traffic. By muleback, the 10 air miles from rim to rim takes two days and 28 trail miles. An automobile trip via Navajo Bridge is one day faster but more than 200 miles longer.

Should anyone wish to send a letter rim to rim, the transit would take 40-odd hours, but no one known to me ever sends such a communication, for we have a telephone line directly across the canyon.

Of the world's seven life zones ranging from Equator to Poles, six are represented here within a 50-mile radius. The only zone missing is the Tropic.

Now as we rode from Phantom Ranch to the North Rim we passed through four of these life zones, all within 14 miles of trail. To pass through those zones at sea level, we would have to travel from Mexico's lower Sonora desert to southern Canada.

The North Rim, 1,000 to 2,000 feet higher than the South Rim, has climate and vegetation like southern Canada's. Severe winters close North Rim accommodations roughly from October 15 to May 15, but the South Rim remains open the year round.

Up the Ladder of Life

Riding up the trail, we mounted the ladder of the ages. Here in a gigantic cross section of the earth's crust, Nature has written the story of life's development and illustrated it with fossils, or life forms, of extinct animals.

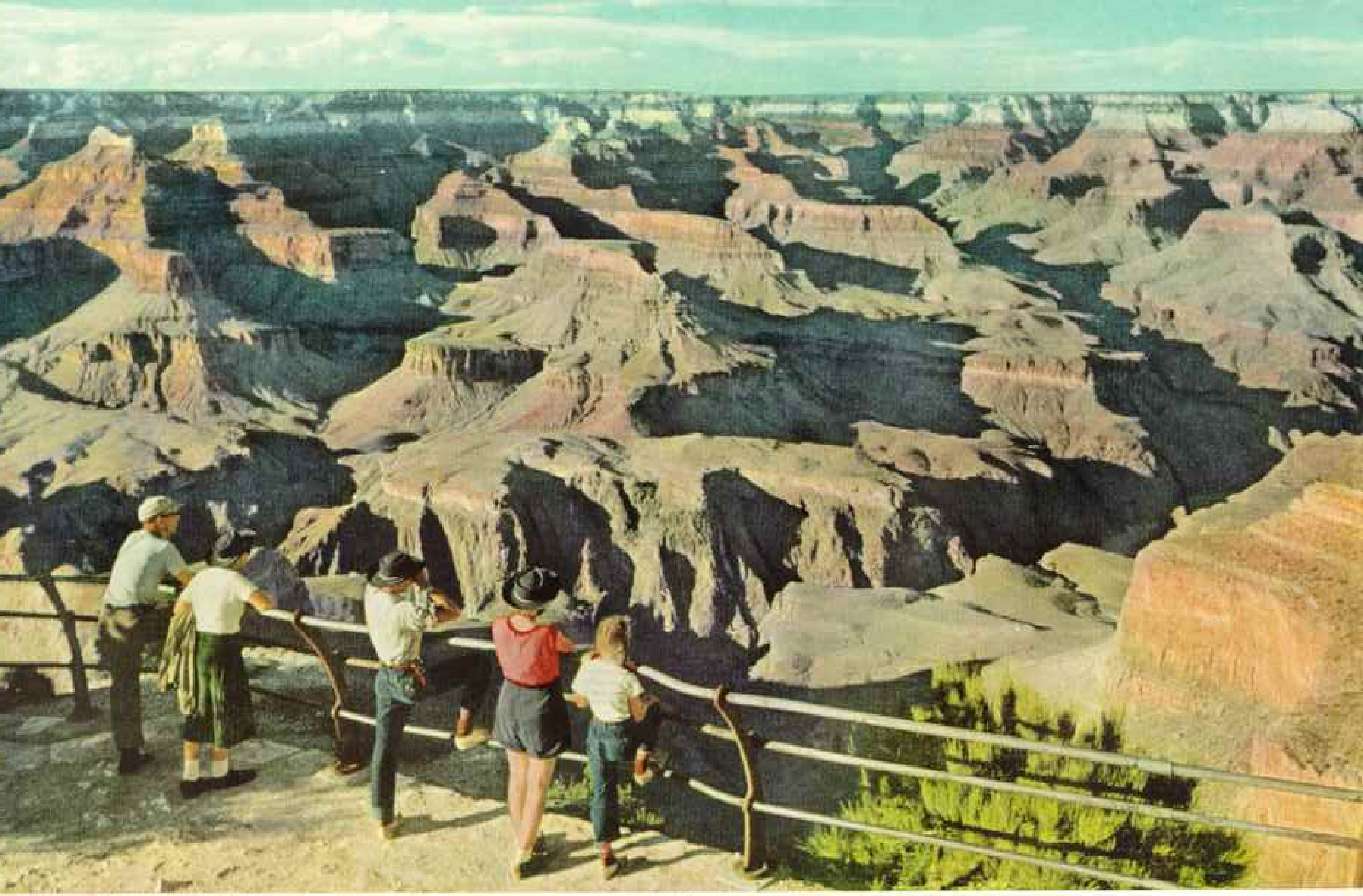
While down in the Inner Gorge, we rode through dark Pre-Cambrian rocks that were formed some 1,500,000,000 years ago.

Life's story from its creation to the present is told in five grand chapters.

During the Older Pre-Cambrian Era, Chapter I, rains swept the primeval landscape and rivers carried silts to sea, but no living thing left so much as a shell to prove its existence. If the most primitive algae did exist then, as geologists suspect, earth's heat and pressure altered their fossil forms beyond positive identification.

Algae left the canyon's first traces of life in the Younger Pre-Cambrian Era, or Chapter II. Tiny globules of jelly like the green scum seen on ponds, these algae extracted minerals from sea water and built limestone reefs.

Erosion has destroyed all traces of the Younger Pre-Cambrian at several spots in the canyon. At these places the third chapter of

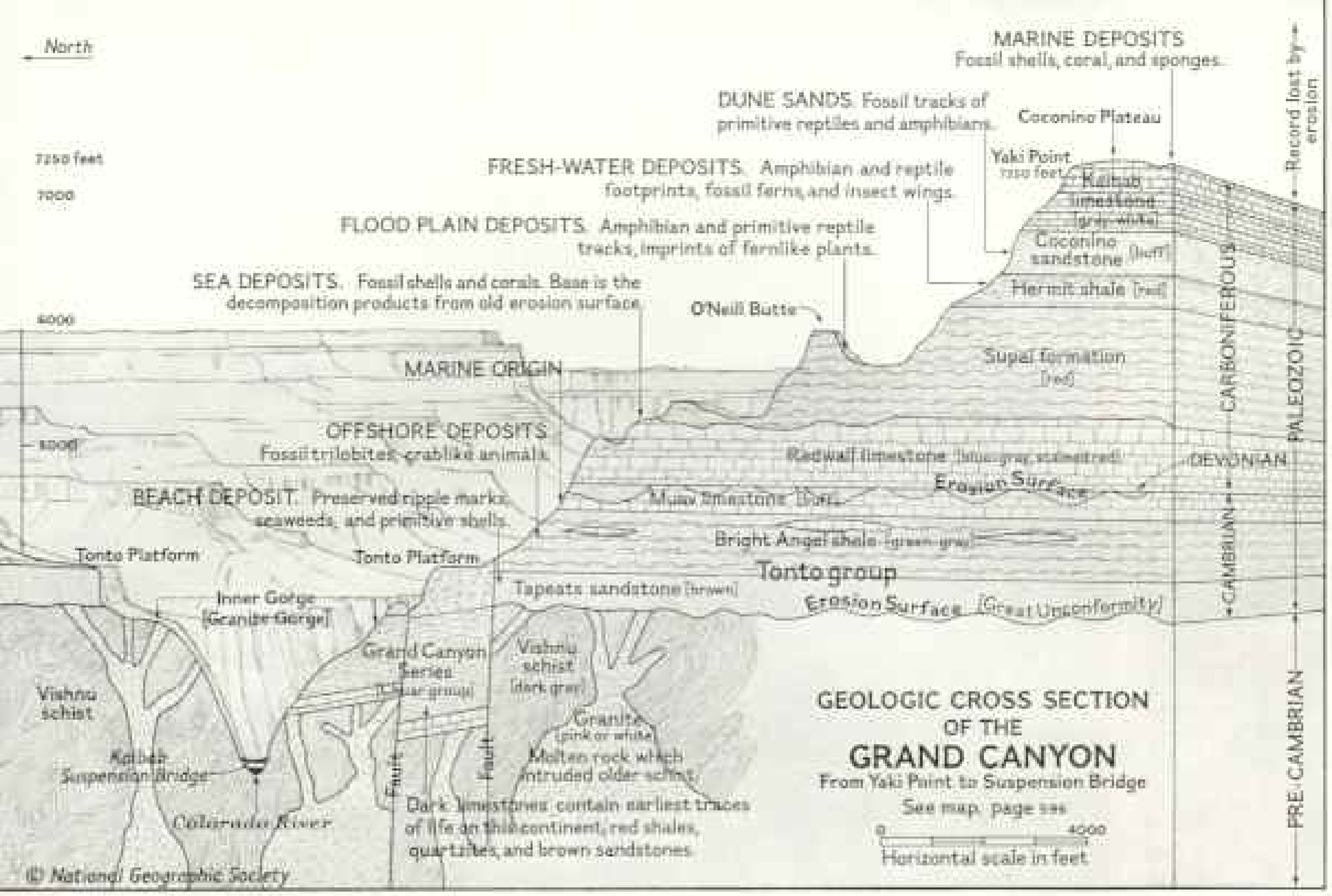


↑ **Afternoon Shadows Creep Up Temples and Buttes: the View from Hopi Point Overlook**

Dawn, noon, or twilight, the canyon shows a different face at every hour. By moonlight it speaks of mystery and enchantment. Snow often mantles the rims, and fog sometimes presents the paradox of clouds deep underfoot.

↓ **"Earth's History from the Beginning Lies Exposed Before You," Says the Ranger-Naturalist**

After pointing out a formation on the scale map, Frank Shaw turns to the window and identifies the corresponding spot 10 miles distant on the North Rim. In 1954, 79,974 visitors heard the talks at Yavapai Observation Station.



602

Grand Canyon in Profile: The Finest Open Record of Earth's History

Here the reader peers, as might a visitor near El Tovar Hotel, into the violent convulsive past of his planet, laid bare by the remorseless gouging of the Colorado River. After millions of years of digging, the torrent now cuts into earth's primeval crust, formed about a billion and a half years ago (page 604).

Exposed rock layers, sweeping up from Kaibab Suspension Bridge to Yaki Point, reveal to the geologist's trained eye a story of mighty cataclysms: of mountains buckling skyward and wearing away; of seas sweeping over the land and laying down vast deposits, then disappearing. Buried deep in the multicolored strata, fossils trace life's development from primitive algae and shells to amphibians and reptiles.

earth's history rests directly upon the first chapter. By skipping the second chapter, the rocks show a gap of millions of years. We spanned it merely by placing a finger tip across the line where the strata meet.

Geologists call that gap in time the "great unconformity," and people come from all parts of the world to see it.

First Amphibians Left Tracks in Stone

Animal life flourished in the Paleozoic Era, earth's Chapter III. Our trail revealed the fossil remains of trilobites, extinct sea creatures resembling horseshoe crabs.

And as we rode up the canyon walls, the fossils disclosed life becoming increasingly complex. Land areas in those times grew ferns and primitive conifers.

Going a little higher, we found telltale signs of animals emerging from the sea: amphibians, descendants of fish, had climbed onto land and left their tracks in mud now turned to stone.

We did not see the dinosaur graveyards of Chapter IV, the Mesozoic, or Age of Reptiles, for they have been worn off the top of Grand Canyon. However, they are represented in the Painted Desert and Zion National Park, both fairly close.

Chapter V, the Cenozoic, or Age of Mammals in which we live, has left no sedimentary deposits in the canyon. It is represented, however, by geologically recent lava flows in Grand Canyon National Monument (page 608).

Man stepped on the geological scene an estimated million years ago, though not in the Grand Canyon. If we could condense earth's story into a movie lasting 24 hours, man's role would occupy the screen only the last 58 seconds, and the canyon's role in history from its discovery four centuries ago would last less than a fortieth of a second.

As the lion-hunting cowboy said, "Something sure happened," and many of today's visitors want to know just *what* happened.

"Did the earth crack open?" they ask. "Did glaciers cut it?"

Indians from the Hopi Reservation Perform Their Feather Dance on the Canyon Rim

Most evenings the Hopis stage four dances. Here their leader, feather-bonneted Porter Timeche, shakes a gourd rattle in time with the drummer. Young palefaces in the tree get a grandstand view.

Simply stated, the Grand Canyon is the story of the power of running water and the wearing away of land. Erosion, given millions of years to do the job, has cut a fissure almost a mile deep, 217 miles long, and 4 to 18 miles wide.

Not many million years ago northern Arizona stood barely above sea level, and through it ran a sluggish river, the ancestral Colorado. And then the region started to rise into an immense plateau. But the ground rose so slowly that it did not change the course of the river; instead, it enabled it to entrench itself.

Increasing elevation gave speed and power to the water. Using silt, sand, gravel, and boulders as abrasives, the Colorado scoured its bed until today it flows a mile below the rims and averages 2,000 feet above the sea.

Even visitors who understand the canyon's erosive origins have false notions about the river. Because the rims are 5,000 to 8,000 feet above sea level, people imagine the Colorado started at those levels and cut its way down. Actually, the stream appears never to have been very much higher. Though the land rose a mile and more, the river maintained more or less its original level. If we liken the earth's crust to a layer cake, then the river by analogy becomes a cake knife. But instead of the knife's slicing downward, the cake rose upward against the blade.

Wind and Gravity Help Erosion

Though the canyon spans an average 10 miles, the river was never that broad. Other forces ate away the walls. Gravity pulled down loose particles. Winds carved caves in soft cliffs. The straining roots of swaying trees dislodged rocks from slopes. Water ran into the cracks, froze and thawed, split off fragments; and water also removed soft strata, leaving hard layers as overhanging ledges, which eventually tumbled down.

Rains battering the sparsely vegetated landscape removed more soil in 20 minutes than an entire season's precipitation in greener regions. No matter how big the boulder, erosive forces finally ground it into pieces, and the river carried away the debris.

Erosion's most startling handiwork occurs on the north wall. All rain there runs off into the canyon; most of that on the south flows away from the canyon. Consequently, the North Rim has been cut back 2½ times as far as the South.

Did you ever hear of deer jams? Grand Canyon has them. At times our Rocky Mountain mule deer browse beside the rim roads, causing traffic hazards.

Visiting motorists catch sight of a deer, jam on the brakes, and pile out of cars with cameras in hand. Other drivers stop one by one, until lines of cars block the highway in both directions. No one thinks of parking off the road or closing the car doors.

Finally a car rounds a turn and, unable to pass or stop in time, rams the line-up. Such is a deer jam.

Visitors occasionally see a pronghorn antelope within the park. This noble animal is as American as the Indian, for it is found nowhere save in North America.

Pronghorns have such keen vision that moving objects as much as four miles away can excite their curiosity. Hunters used to lure them into bullet range by waving a handkerchief on a gun barrel or upright stick.

Pronghorn Outruns Auto

I know of no American wild animal that outruns the pronghorn. Once ranger-naturalist Joe Bryan and I were driving in the volcanic area southeast of the park. A pronghorn on the slope of a cinder cone suddenly took off, running straight for the road ahead of us. Hoping to avoid a collision, Joe stepped on the gas, but the pronghorn was swifter than he thought. Arriving a split second ahead of us, the animal cleared the road with what looked like an 18-foot leap, stopped abruptly, and whirled about to stare as we breezed by.

"Never do it again," I told Joe. "I'd rather try to beat an express train to a crossing."

On our return we met another pronghorn eager to test our speed. Keeping an eye on us, he ran parallel to the road. Joe asked me

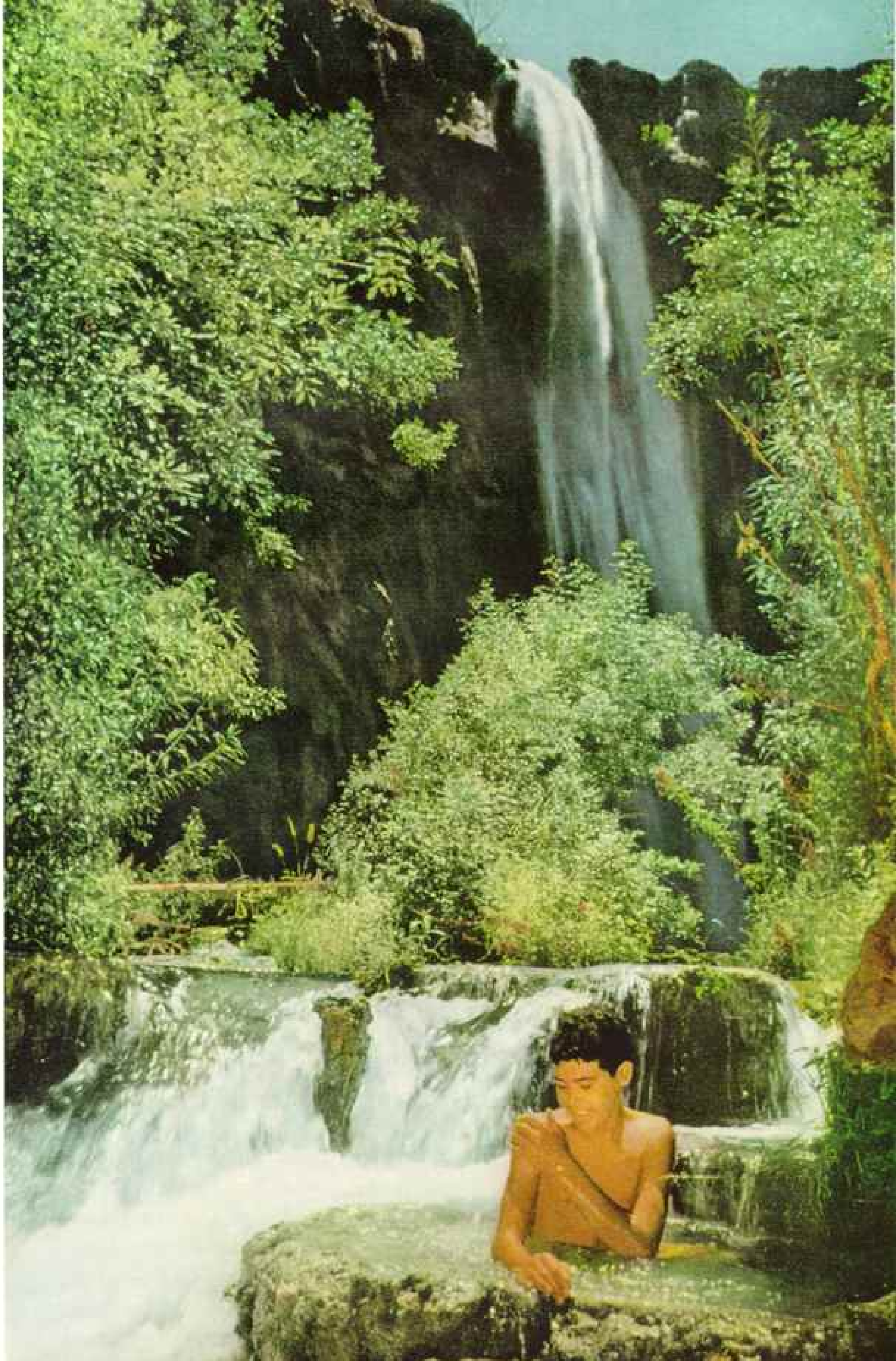
(Continued on page 613)

Page 605

Canyon-born Havasu Creek Plunges 220 Feet Down Mooney Falls

Bubbling out of a dry stream bed, the Havasu gives a verdant, lost-world quality to the Havasupai Reservation (page 606). After watering the Indians' fields, the stream drops down five major cataracts. Mooney Falls, one of these, is named for a prospector who died falling from the end of a rope too short to lower him down the cliff. Today's visitors climb down iron pegs. Before reaching Mooney Falls, the creek becomes highly mineralized, giving the water a beautiful blue-green sheen. This Boy Scout, a camper beside the trail, bathes in a travertine tub deposited by the water.

 Kodachrome by Justin Locke



↑ **Canyon Cliffs Rim Supai, Home of the Havasupais**

A colossal red wall overhangs this isolated Grand Canyon village at every compass point. In flood times terrifying sheets of water and volleys of rocks cascade into the canyon. Twin peaks on the right stand sentinel over the reservation. Legend says that when these rocks topple the tribe will perish, but the younger generation scoffs at the "superstition." Havasu Creek nurtures trees, farms, and pastures.

← Two bright members of the 370 Havasupais are Amelia Rogers (left) and Grace Marshall.

→ Perry Wescogame bathes in the Havasu. Like most of these Indians, he learned to swim when barely more than a baby.

↓ Young Havasupais relax around a fire.

Old Rivers of Lava Darken the Cliffs at Toroweap Overlook

Grand Canyon National Park at its western limit joins Grand Canyon National Monument, a spectacular wilderness area. So rocky are the roads and trails that the monument had only 623 visitors in 1954. Here volcanic action centuries ago streaked the landscape with dark lava.

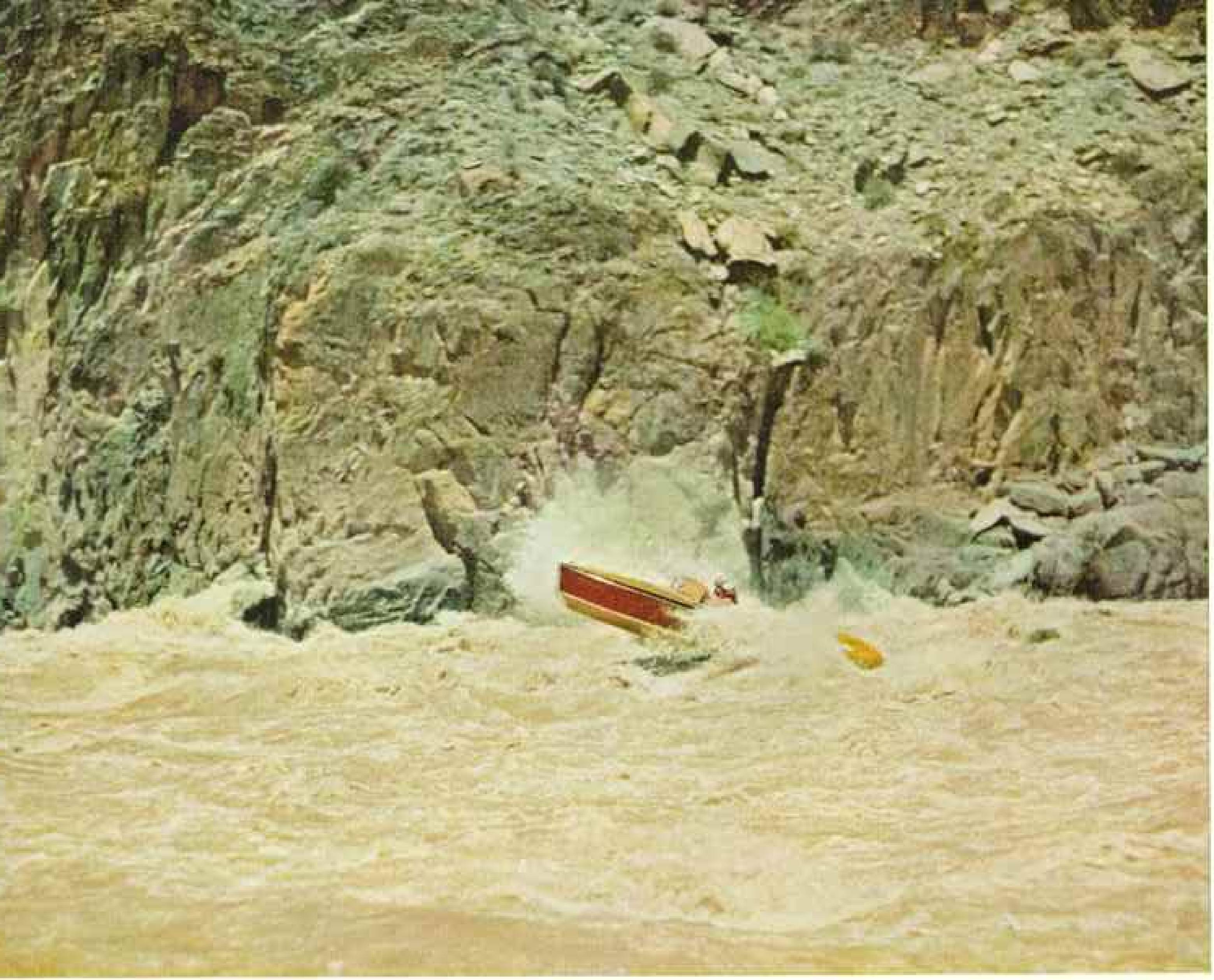
↓ Four Cataract Boats Drift Downriver

Time was when only the hardiest adventurers braved the rapids of the Grand Canyon. Today veteran boatmen think nothing of taking inexperienced passengers through the gorge's 15-foot waves.

Mexican Hat Expeditions, which makes one Grand Canyon trip a year by rowboat, is named for the usual starting point, Mexican Hat, Utah, home of Norman Nevills, founder of the river enterprise. After Mr. Nevills died in an airplane accident in 1949, his work was carried on by two associates, J. Frank Wright (holding oars in lead boat) and James P. Rigg, Jr. (on rock).

Here the boats approach the mouth of Bright Angel Creek.


MEXICAN HAT EXPEDITIONS



A Motorboat Flits Past the Rocks and Eddies of Granite Rapids

"Oars prevailed in the Grand Canyon prior to 1949," writes Otis Marston (at the wheel), a swift-water enthusiast and former submarine commander.

"In 1948, when I ran down the canyon with oars, I studied every rapid and knew I could take a motorboat through. When we made the first motor run through in 1949, the gloom was thick, but that trial presented no serious difficulties. In the 1950 test, two of the 1949 crew predicted that our stock boat would dive to the bottom. She made it, but a special boat did not.

"In 1951 we tried outboards and the gloom was even thicker. We capsized one boat and lost a motor, but two outboards and three inboards came through with all their crews.

"In 1953 we experimented with outboards exclusively. That year our severest critic was photographer Belknap, who told me, 'You made it look too easy.'

"Five parties traversed the canyon in 1954. By the end of that year 218 persons had made the run. There will come a time when a thousand a year will take this magnificent trip."

Canyon Adventurers Camp in the Lagoon of Havasu Creek

When the Colorado is running high, its waters bottle up the mouth of blue-green Havasu Creek, creating a lagoon.

"There is one minor detail in this picture that might make our motorboat special in design," says skipper Marston (left, wearing hat). "You will note the plank which is acting as a shield in front of the cockpit. The glass found in the stock models landed in our laps in the run of the first major rapid."

First to run the entire Grand Canyon were Maj. John Wesley Powell, a one-armed veteran of the Civil War, and five companions on his 1869 expedition.

In 1889 Frank Mason Brown, a financier surveying the canyon banks for a railroad bed, lost his life owing to inadequate boats and lack of life preservers.

In 1928 Glen Hyde and his bride vanished mysteriously while touring Grand Canyon on their honeymoon. Their sweep scow was found snagged in the river.

This "Flying Trapeze" Measures Silt with a Brass Fish

On an average day some half a million tons of suspended material ride the Colorado down to Lake Mead, the huge reservoir created by Hoover Dam. During the flood year of 1927 the river carried 27,600,000 tons of silt past a given point in 24 hours.

"How do you know all that?" Grand Canyon visitors ask.

This Geological Survey hydrographer obtains data giving the answer. Once a day he sails out 50 feet above the Colorado in his cable car, lowers his heavy sampling device 15 feet or more into the river, and takes three samples of water. In his laboratory he evaporates the water and weighs the residue, thus learning the percentage of silt. Though he cannot measure the gravel, boulders, and driftwood rolling past, his reports do help the United States Geological Survey to estimate the years before silt will fill Lake Mead.

Two hundred and sixty-seven miles from Hoover Dam, the gauging station is the first sampling point upstream from the lake. Inaccessibility and expense make it perhaps the most famous of its kind. Its operator sees the outside world only when he rides or hikes up the South Rim each month.

Here Charles Cox winds up a 100-pound sampler on his windlass. His "sail" is no more than a sun canopy. Gravity carries his car from north shore to south. On the return journey he propels the contraption with a hand lever attached to the cable, a sort of overhead oar.

←Mr. Cox removes the sampler's heart, a pint bottle of muddy water.

Sometime after this picture was taken, Dean Tidball was assigned as hydrographer to the station.

A visitor pointed to one of Mr. Tidball's milk bottles and quipped, "Any cream this trip?"

"Life is funny," he replied. "For 20 years I ran a creamery in Montana. Down here in the Colorado's gorge I never see a cow, but I still handle milk bottles."

to watch the speedometer. At 25 miles an hour the animal's motion seemed effortless. We speeded up to 35, then to 40, but could not shake the pursuit. At 45 he broke off the game by putting on an extra burst, crossing the road in front of us, and running up the slope of another cinder cone.

One night Joe and I had another adventure with wildlife. Hiking along the abandoned Grandview Trail, we camped at dusk, cooked a hasty meal, left the dishes unwashed, and lay down on our blankets.

I must have been asleep several hours when something brought me to life by tickling my nose. Opening my eyes, I stiffened.

Clearly outlined in the moonlight, a small spotted skunk was sitting on my chest and licking perspiration from my face, apparently for the sake of the salt it contained. I dared not twitch even my anguished nose; not that I feared a bite, but something worse.

Finally the stalemate was broken by the rhythmic tapping of metal against stone. Turning its attention, the skunk daintily stepped from my chest and walked in the direction of the sound. When I rolled over, I saw another skunk licking the bacon grease from our unwashed frying pan.

Wild Donkeys Disturb Mules

"Wild burros!"

Uttered by a professional guide, the cry electrified a party of mule riders that I happened to be traveling with recently.

As we followed the guide's pointing arm, we counted seven little donkeys a mile distant. Movement alone distinguished them from shadowy rocks and plants. Any doubt about their identity faded when a violent heehaw shattered the canyon's quiet. Such were the acoustics that the burro sounded only yards away.

Our hybrid mounts stopped, pricked up their ears, and faced the cause of their disquiet.

"Keep a tight rein," the guide warned. "Mules have been drawn off the trail by wild jackasses. They have gone crazy, thrown their riders, and broken up trail parties."

No animal is better suited to arouse visitors' sympathy than the inoffensive little burro, a wild descendant of the faithful donkeys brought in by old-time prospectors. Newcomers express indignation when they learn that we consider the wild burro an exotic and a nuisance.

"Why do you condemn the poor little burros?" they ask. "Why not track down those killers, the mountain lions?"

Well, for one thing, the burros multiply, eat up the sparse vegetation, and pollute water holes until deer and bighorn sheep cannot get a drink. By the time Grand Canyon National Park was created in 1919, herds of wild burros had virtually destroyed the natural vegetation on the Tonto Platform.

Deer May Starve for Lack of Lions

The "bloodthirsty" mountain lion that kills the "innocent" deer is one of Nature's instruments for keeping her affairs in order. During the times when grazing was permitted in the Kaibab forest, professional hunters were engaged to kill off the predatory animals so as to prevent the loss of domestic stock. As a result, deer multiplied beyond the range's capacity to support them.

Therefore, kill off mountain lions, and deer become so numerous they deplete the range. Rearing on hind legs as high as they can reach, they crop off the lower branches of the juniper tree and the cliff rose. That food gone, they grow thin, and some die of hunger.

A prime target of the starving deer is the young aspen tree. One of the first trees to come back after a forest fire, the aspen covers burned patches, protecting the soil from erosion (page 626). Spruce and fir saplings spring up in the aspens' shelter. When the short-lived aspens die, the conifers take over and form the magnificent climax forest whose vegetation represents the highest type that can be supported by this region's climate.

So—no mountain lions, too many deer; no aspens, no climax forest.

Lacking forest, the land erodes, the water table drops, and a different landscape results, all for lack of a predator to keep the deer in balance.

Foxes Help Save the Century Plant

Strange as it may seem, the park's weird and magnificent century plant might not exist without protection of the gray fox, one predator limiting the number of squirrels.

Old-timers called the agave a "century" plant because they never seemed to live long enough to see a young planted specimen bloom. Actually, the park's agaves blossom in 10 to 20 years. Using the energy stored up all during a lifetime, the maturing plants send up 12-foot stalks ending in clusters of

Union Pacific Railroad

The Canyon's Glass Face Gets a Shine

North Rim's Grand Canyon Lodge looks down into The Transept. Deva, Brahma, and Zoroaster Temples rise in the middle distance (page 592). Shadowy domes beyond the South Rim mark the volcanic San Francisco Peaks. High and isolated, the North Rim appeals to wilderness lovers.

flowers. Once their seeds have formed and ripened, stalks wither and plants die.

However, not all century plants fulfill their destiny. Before the seeds can form and scatter, a ground squirrel may jump across the spiny leaves and chew down the succulent stalk, his giant piece of asparagus.

So, once again, by killing off the fox you protect the squirrel and prevent the century plant from holding its own.

Our national parks were set aside to preserve bits of wilderness just as Nature made them. Everything natural is rigidly protected; anything unnatural or exotic must go. The only exotics we encourage are men and mules on the trails.

Grand Canyon's discoverer was Don García López de Cárdenas, who with his Hopi guides and 12 Spanish followers arrived on the South Rim in 1540, only 48 years after Columbus discovered America and 67 years before Englishmen settled Jamestown, Virginia.

López, a lieutenant of Francisco Vásquez de Coronado, helped to make the vain search for the fabled golden Seven Cities of Cíbola, but instead of gold he found a mighty canyon that barred further progress. Before retreating, some of his soldiers ventured into the gorge. The chronicler of the Coronado expedition, Don Pedro de Castañeda, left this recorded description:

"Those who stayed above had estimated that some huge rocks on the sides of the cliffs seemed to be about as tall as a man, but those who went down swore that when they reached these rocks they were bigger than the great tower of Seville."

Like many visitors today, the Spaniards did not appreciate the canyon's size until they ventured into it.

The next European visitors did not arrive until 1776, when American colonists were fighting for their independence. The outstanding figure was Father Francisco Tomás Garcés, a missionary-explorer. Observing the

river's heavy load of reddish mud, he called it "Colorado."

First Anglo-Saxons on record to see the gorge were beaver-trapping James Ohio Pattie and his father, who explored the rim country in 1825-26 and viewed the Colorado swirling between "horrid mountains."

Seeking to open the Colorado to navigation, the United States War Department organized an expedition, built a river steamer named the *Explorer*, and placed Lt. Joseph C. Ives in command. Ives set out in 1857 from the river's mouth in the Gulf of California. Running against a rock, the *Explorer* reached journey's end not far from the present site of Hoover Dam. Exploring the land, Ives took a dim view of the canyon's future.

"Ours has been the first, and will doubtless be the last, party of whites to visit this profitless locality," he reported. "It seems intended by nature that the Colorado river, along the greater portion of its lonely and majestic way, shall be forever unvisited and undisturbed."

Grand Canyon's 814,130 visitors in 1954 made Ives a poor prophet.

The Colorado's most significant name is that of Maj. John Wesley Powell, one-armed Civil War veteran and geologist. Undeterred by frightening tales of underground channels, he left Green River, Wyoming, on May 24, 1869, with nine men and four boats to explore and chart the river.

First Conqueror of the Colorado River

Mile after mile the boats twisted through whirlpools and crashed against rocks. Day after day the men endured skimpy rations, damp clothing, and weary portages. Despite the loss of an arm in battle, Powell frequently climbed canyon walls to survey the terrain.

The first part of August found the voyagers entering the Grand Canyon. On the 28th of that month three men quit rather than face the unknown perils ahead. Making their

Coyotes Roam the Canyon. Visitors See a Mounted Specimen in the Author's Workshop

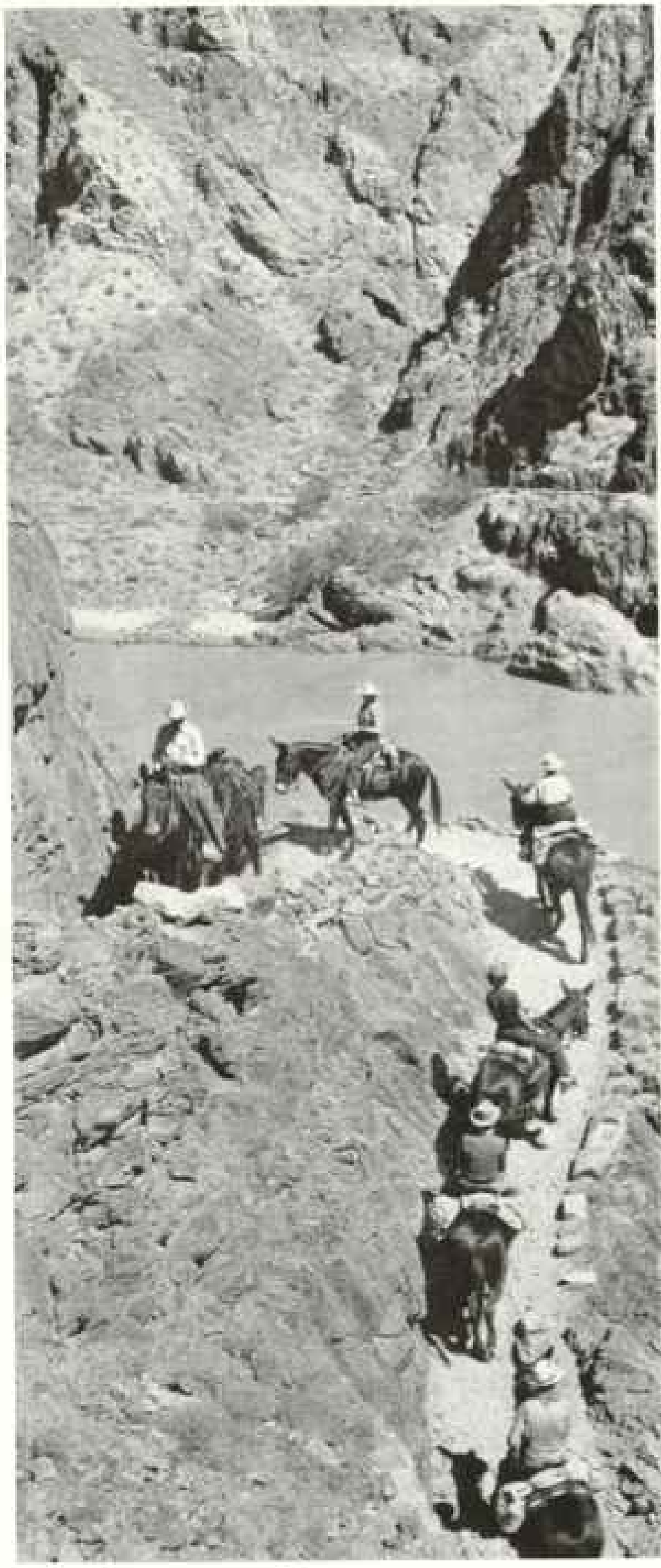
Louis Schellbach, an archeologist, has been Grand Canyon's chief park naturalist since 1941. He is a Fellow of the American Association for the Advancement of Science and holds the United States Interior Department's Distinguished Service Award. As one of his duties, he helps protect the park's wildlife.

Peter Hoffstrom, Western Ways

Mule-wide Kaibab Suspension Bridge Is the Only Crossing in 217 Miles

These riders follow south Kaibab Trail out of the Inner Gorge. Here the rise is so steep they must rest their mules about every quarter-mile. When the 440-foot span was built in 1928, laborers carried its cables like writhing serpents from rim to river. To cross the Colorado, Grand Canyon motorists must go to Hoover Dam or Navajo Bridge (map, page 596).

Ray Manley, Western Ways



farewells in good faith, each party felt sure the other had chosen certain death. Powell and his remaining men triumphantly emerged from the canyon the very next day. The three who quit the whirlpools had barely made their way out of the canyon when Indians killed them.

Major Powell's bright imagination was responsible for many of the canyon's picturesque place names. Discovering a muddy, odoriferous side stream above the canyon, he named it Dirty Devil river. Later, on finding a clear and beautiful creek flowing into the canyon, he wrote:

"We have named one stream, away above, in honor of the great chief of the 'Bad Angels' and, as this is in beautiful contrast to that, we concluded to name it 'Bright Angel.'"

By extension, we now have Bright Angel Point, Bright Angel Canyon, Bright Angel Fault, Bright Angel Shale, Bright Angel Trail, and Bright Angel Lodge.

Paying Passengers Ride the Rapids

As highways of commerce and communication, other rivers are servants to man; but not the Colorado though its Hoover Dam provides power and irrigation. Rivermen have catalogued 365 dangerous rapids, one for every day of the year.

Emery Kolb was one of those who could not look upon the Colorado without longing to challenge it. Having faced its perils on three major runs, he is today the dean of Grand Canyon residents. From a window in his studio home, Kolb and his assistants photograph Bright Angel Trail parties.

Today the river is so well charted and boats are so sturdy that experienced pilots take paying passengers down the canyon (pages 608-611). But when Kolb was running the rapids, a man took his life into his hands by venturing on the river.

In 1911-12 Emery and his brother Ellsworth made the first movies of the Colorado, from Green River, Wyoming, to Needles, California.* Those old films still draw crowds to the Kolb Brothers studio, and Emery has delivered more than 30,000 lectures.

"Fifty years ago," he recalls, "Grand Canyon community was little more than the end of the line, where the Atchison, Topeka and Santa Fe Railroad let out its passengers. One excursion train brought 250 people, only

* See "Experiences in the Grand Canyon," by Ellsworth and Emery Kolb, NATIONAL GEOGRAPHIC MAGAZINE, August, 1914.

to have them marooned by a flash flood that washed out the tracks. By the time the rails were repaired three days later, provisions ran so short that guests got skimpy rations.

"In those days my wife and I lived in one room. For water, we melted snow in winter and hauled from a cattle tank in summer."

Kolb confesses he feels the burden of advancing years, but he remains an adventurer at heart.

"I believe I have covered more parts of the canyon than any other living man," he says. "Today I am rim-bound, but whenever I look into the gorge I can still sense the danger down there. Every time I look off into the forbidding plateaus and buttes I

Barry M. Goldwater

U. S. Senator Barry M. Goldwater, Flown In by Helicopter, Discovered This Natural Bridge

The Arizona Senator believes this fork of Nankoweap Canyon was once a cavern, but its roof fell in, leaving an arching span. "Shadows are so thick," he says, "that a flyer is not likely to see the bridge unless he is to the east of it at midday. This shot was made at 1:30, and the gloom is already gathering." A dry waterfall towers above and beyond the arch. Above: The bridge appears as a small shadow at the head of the canyon (page 629).

think how awful it would be to be lost in those badlands."

Kolb is not alone; everyone who has glimpsed the canyon's spires and gullies and impassable walls must have been struck by the thought, "What a dreadful place for a parachute landing!" But no one knew what the experience was like until three World War II aviators plummeted into the canyon in the dark of night.

On June 21, 1944, 2d Lt. Charles Goldblum, Flight Officer Maurice J. Cruickshank, Jr., and Cpl. Roy W. Embanks were flying from their base at Tonopah, Nevada, when their B-24 developed engine trouble at 18,000 feet. On the pilot's orders, the men jumped out into a 75-mile-an-hour wind. They did not know where they were heading, but the lights of a town (Grand Canyon community) faded out dramatically as they dropped below its level.

Cruickshank injured a foot when landing on a slope and dared not move until morning. Goldblum, whose parachute caught in the arm of a jagged cliff, decided to sleep where he was; daylight showed him that had he removed the harness he would have fallen 1,200 feet into the Colorado. Embanks, landing safely on the Tonto Platform, spread his parachute as a signal to searchers.

Deer Tracks Guide Rescuers

On the next day Cruickshank, using a tree branch as a crutch, got together with Goldblum. They discovered a spring and drank, using shoes as cups. After spending the night in a small cave, they spotted Embanks's signal and made their way up to him.

On the fourth day smoke bombs told the men they had been sighted. K rations, blankets, and canteens were dropped the fifth day. The flyers waited out five more days in comparative ease.

So rugged is this country that it took search parties five days to bring out the lost men. An impassable side canyon defeated a well-equipped rescue party that set out from the South Rim. An aerial reconnaissance of the North Rim offered a clue, a talus slope breaking the perpendicular Redwall limestone. This news was relayed to ranger Ed Laws, who joined Dr. A. A. MacRae on the North Rim.

Descending from Point Sublime to a spot above the slope, Laws and MacRae searched the rockslide with field glasses, but no passage appeared until they spotted deer tracks close by. These led the rescue party down the slope to a spring, thence down the Redwall and into the flyers' camp. New shoes had to be parachuted to injured Goldblum before he could walk out.

In contrast to these hardships, visitors can look down into the canyon's lost world from their hotels' rim-side windows.

One of my favorite views is the panorama from Desert View Watchtower, a simulated Indian ruin on East Rim Drive (page 621). Looking out of the tower, I can see the gorge of the Little Colorado, which flows into the parent stream north of Cape Solitude.

Beyond the Little Colorado lies the Painted Desert, a wasteland that changes hues with the receding sunlight. The Navajos, whose reservation extends across northeastern Arizona, wander through the Painted Desert with their flocks of sheep. In 1867 the Navajos numbered a little more than 7,000. Today the tribe has multiplied beyond 50,000. Talk about the vanishing American!

Navajo Mountain, a sacred spot to Indians, can often be seen from the tower, though it lies 85 miles away, half in Arizona, half in Utah. Closer by, Shadow Mountain's dark cinder cone looks as if it were always in cloud shadow, no matter what the sun's angle.

Fifty miles to the south, the volcanic-built San Francisco Peaks, Arizona's highest, rise 12,670 feet. Action in the San Francisco volcanic field occurred in such geologically recent times that Indian ruins have been found beneath the ash of Sunset Crater. Tree rings tell us that the Indians cut the beams for their houses in the year 1064.

Old-timers Built "Cheapest Fence"

Down in the gorge below the Watchtower I can see the point where the old Tanner Trail crosses the only ford in Grand Canyon. This crossing was once known as Horse Thief Ford, in reference to its use by outlaws who ran stolen horses between Arizona and Utah.

High above the river, Walhalla Plateau juts out like a peninsula from the North Rim. Girded by sheer cliffs, it is connected to the mainland by a narrow neck. To fence in Walhalla's 25,000 acres, old-time cattlemen closed the neck of land with half a mile of barbed wire, reputedly the cheapest fence ever built to enclose so large an area.

To the Indians, Grand Canyon meant food, water, and shelter. We have catalogued some 600 of their sites within the park's 1,009 square miles.

But we have no lack of live Indians. Some 200 Hopis, Havasupais, Walapais, and Navajos work in Grand Canyon community.

The Fred Harvey company retains about 150 Hopis, mostly as bellboys, maids, and kitchen help. One of the most incongruous sights in the canyon is El Tovar Hotel's Hopi bellboy in his blue-velveteen jacket and bright headband running a vacuum cleaner across the lobby carpet.

Grand Canyon National Park encloses the home of the Havasupais, possibly the smallest and certainly the most isolated Indian reservation in the United States (pages 605-607). A few square miles in a side canyon support the tribe of some 370 members.*

Havasupais are not celebrated as warriors, philosophers, dancers, or artists, but they know a good thing when they see it, and that is Supai, the tribe's headquarters.

Havasupais Work Little, Fret Less

In a green valley surrounded by red stone walls, Supai is a sort of lost world where no one worries much about the hydrogen bomb or anything else.

Avoiding the heat of the day, the Havasupais till their farms no more than they have to, but they work hard at having a good time. Horseback riding, card games, rodeos, sweat baths, and idle conversation fill their days. So far as I can tell, they suffer just two indignities: boys must go to school and their fathers must buy licenses to hunt.

From a boy's point of view, Supai must be a utopia. When scarcely more than two years old he learns to swim and ride, and no elder tells him nay. Football and baseball absorb his afternoons.

About twice a month the tribal council presents a movie in the schoolhouse. Cowboy dramas are favorites; Indian pictures rock the auditorium with cheers and yells.

Havasupais on the trail sometimes yell just to hear their echoes bounce off canyon walls. Within the village the brays of mules, barks of dogs, and crows of roosters make similar reverberations.

Supai lies at the end of one of the star routes—those maintained by private contractors. Foster Marshall, a Havasupai, is the mailman, and if you want to visit Supai he will haul you in his truck across 53 bumpy miles from Grand Canyon community to Hilltop, start of the 14-mile Topocoba Trail.

There mail sacks are transferred to the back of a horse. Could these sacks reveal their contents, you would see cowboy boots, spurs, guitars, boxing gloves, jujitsu instructions, and other mail-order goods that fascinate the young men.

Marshall introduces your guide, a young Indian, who points to your mount, a pony so lean and sad-eyed you hesitate to burden him with your weight.

Topocoba Trail no more than rounds a corner before it starts plunging down the switchbacks of Lee Canyon. Its sharp turns, steep grades, and yawning chasms hold no terror to equal its "paving"—loose, slippery rocks. But your pony never advances until he is sure of his footing.

As you reach level ground, you find your troubles only beginning. Your guide, in the lead, has a friend mounted behind you, and this man, hoping to speed your arrival, continually flogs your pony with the end of a rope. The result is a spine-jarring half-walk, half-gallop.

You wonder what all the hurry is about. Later you learn: the Indians want to get home to saddle fresh mounts so they can take their afternoon gallop through the village.

Havasu Creek Bursts Out of Ground

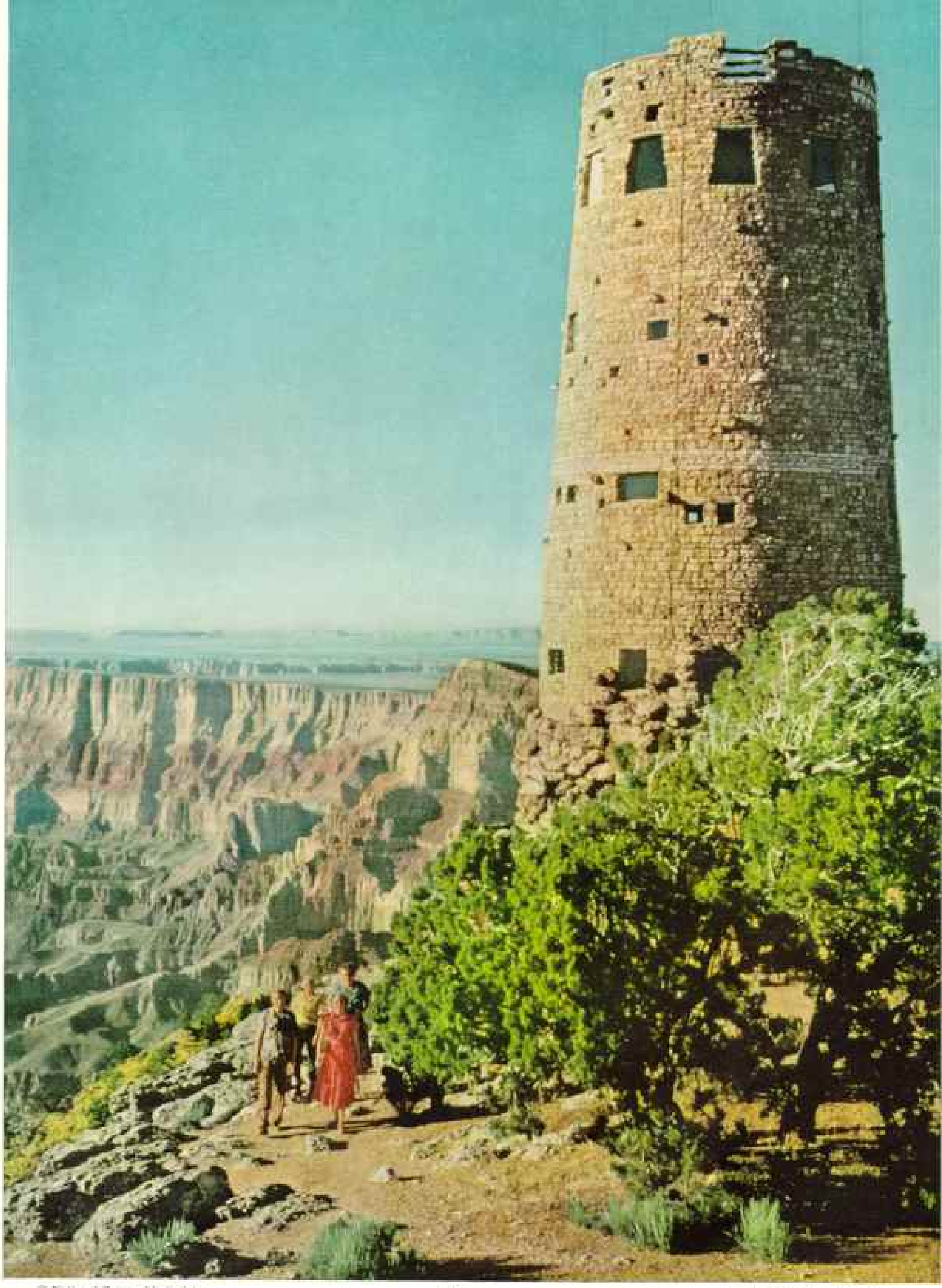
For about 12 miles the trail follows a dry wash through spectacular canyon walls. Then suddenly the barren country bursts into green. Springs gushing out of gravel give birth to Havasu Creek, the lifeblood of Supai village. Twin diversion ditches water fruit orchards, farms, and pastures. In springtime cottonwood trees, the Indians' source of firewood and corral posts, cast fluffy seed-bearing parachutes to the breeze.

Dan Hanna is the tribe's official greeter. His title, of all things, is tourist manager. Supai, Grand Canyon's hideaway Eden, encourages travelers for the revenue they bring.

Last spring the village counted a score of strangers. Some lodged in the hospital or the new hostel. Others camped out beneath moon and stars in the Havasu Canyon. There at evening they enjoyed the canyon wren's startling but melodious song and Havasu Creek's gurgling lullaby.

(Continued on page 629)

* See, in the NATIONAL GEOGRAPHIC MAGAZINE: "Land of the Havasupai," by Jack Breed, May, 1948, and "Indian Tribes of Pueblo Land," by Matthew W. Stirling, November, 1940.



Kodachrome by Justin Locke

Desert View Watchtower Looks Out upon the Beginnings of Grand Canyon

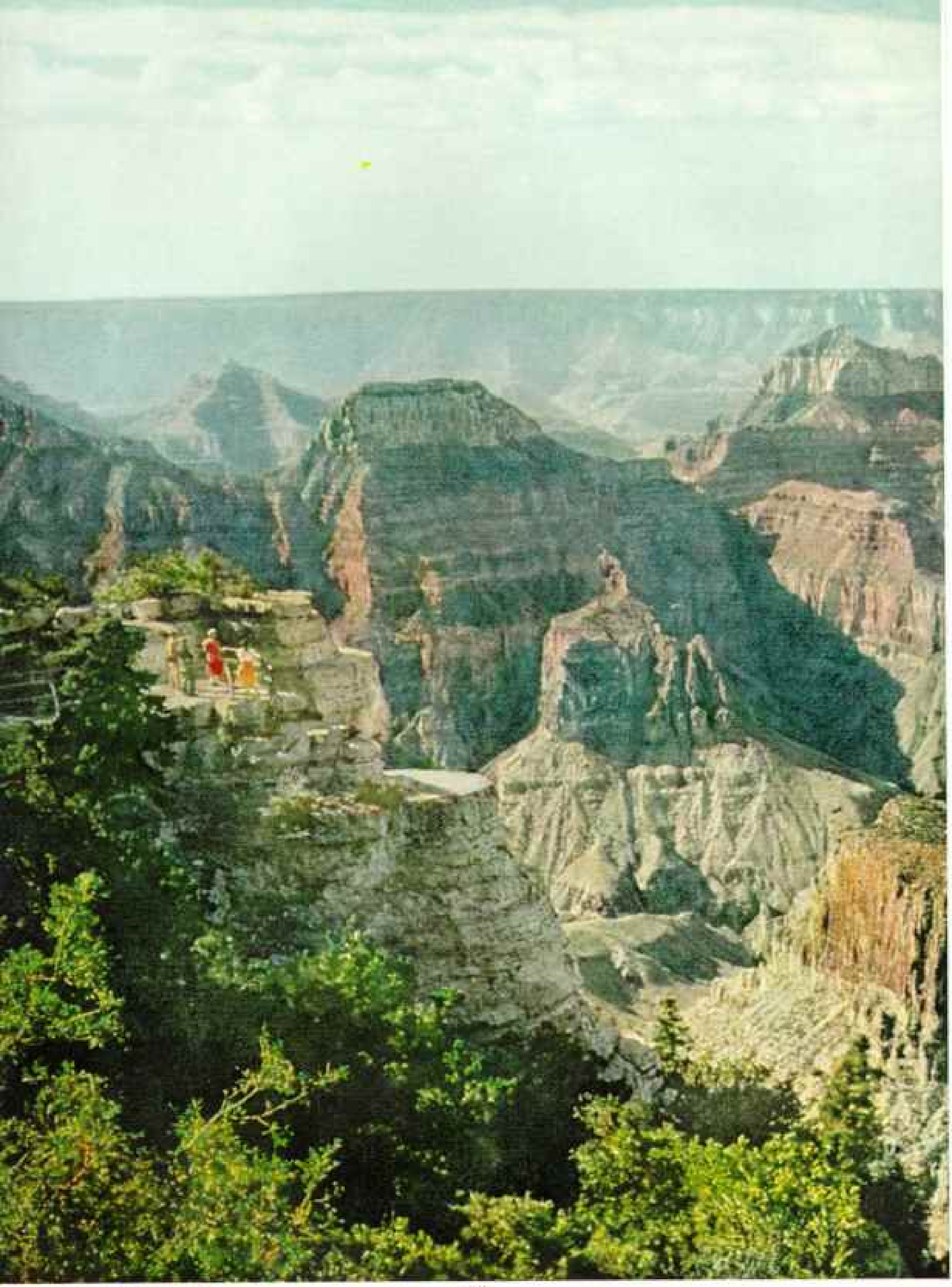
Soaring above South Rim's East Drive, the tower surveys the Painted Desert, the Navajo and Hopi reservations, and the gorge of the Little Colorado. Built by a park concessionnaire, the structure copies Indian ruins.

↑ **Mohave Point Looks Down Four Miles to the Colorado**

Powell Saddle breaks the sky line on the right. The notch in the distant center contains the Colorado. Down below, the river is 400 feet wide.

↓ **Phantom Ranch's Pool Rewards Weary Trail Riders**

Bright Angel Creek waters this spot in the canyon. Here the air is 20 degrees warmer than that on the South Rim, seen 4,366 feet above.



Bright Angel Point on North Rim Commands a Spectacular Close-up of the Temples

This celebrated vista is seen from Grand Canyon Lodge. It appears on the 2-cent stamp of the 1934 National Parks issue. Angels Gate, Deva Temple, and Brahma Temple wear bands of varicolored rocks (page 592).

Kodachrome by Justin Locke

Distant South Rim Shows Geology's Layer Cake of Sediments Laid Down Eons Ago

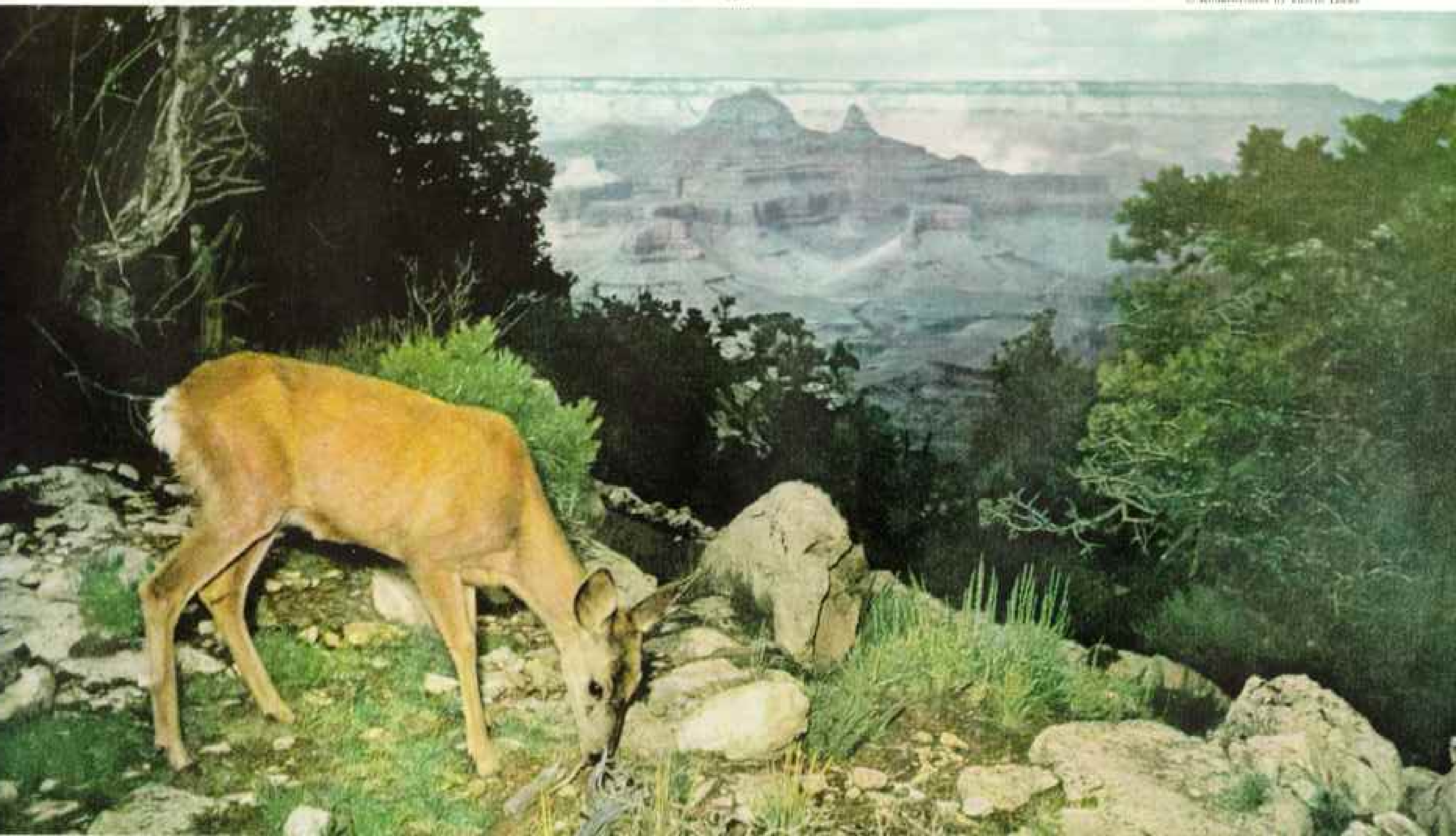
From the loftier north side watchers can see the headlights of cars 50 miles away. Here the Colorado is thoroughly hidden. The canyon to the right belongs to a tributary, Bright Angel Creek.

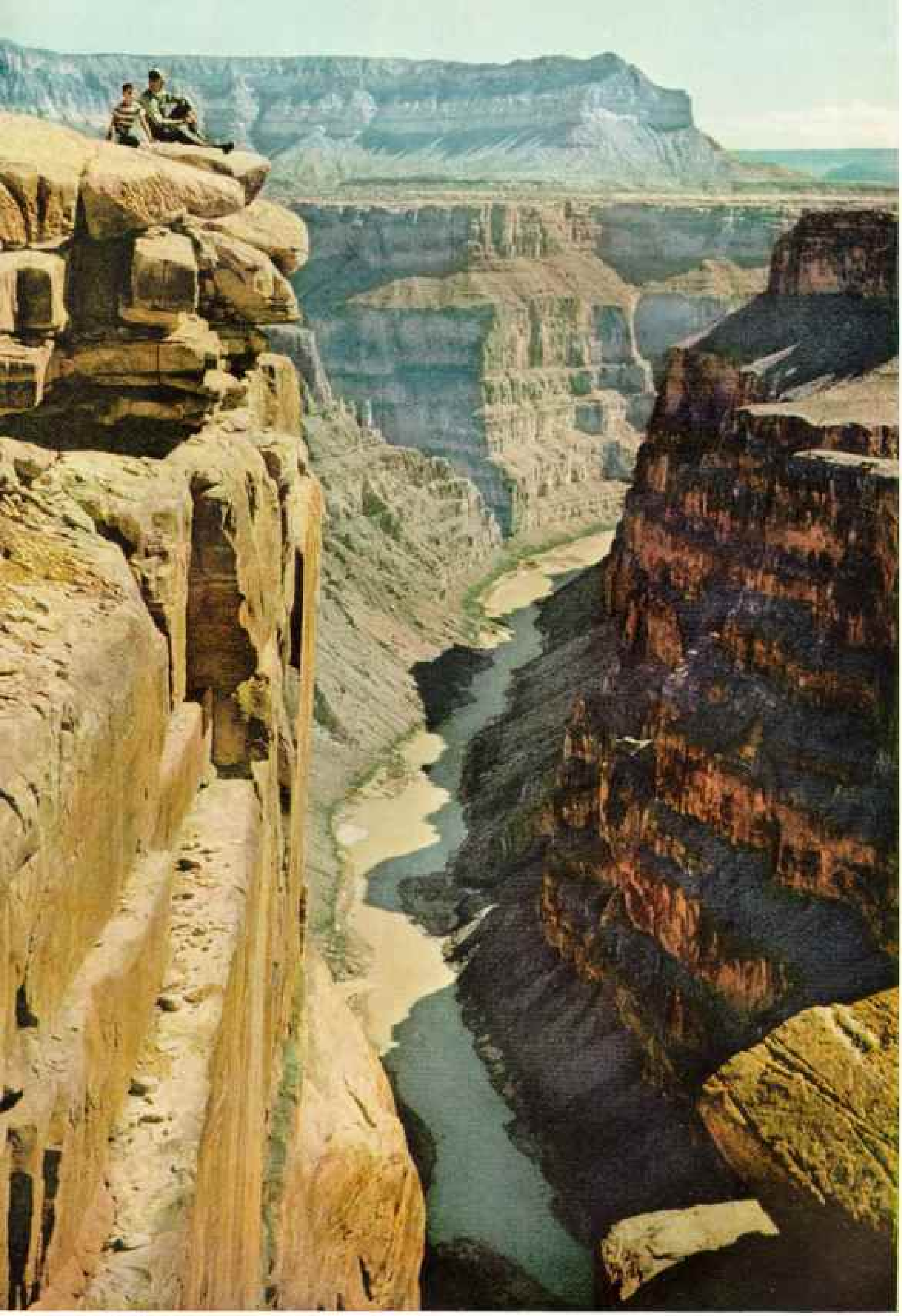
↑ Quaking Aspens, First Trees to Come Back After Fire, Cover a Burn on the North Rim

Gunther Castle, Colter Butte, and Aisap Butte rise on the left. Flat-topped Siegfried Pyre dominates the right in this autumnal scene.

↓ A Mule Deer, One Nervous Eye on the Camera, Browses on the South Rim

Deer sometimes cause traffic jams on park roads. "Don't feed them," cautions the author, "for they can inflict injury with sharp feet."





Koilachrome by Justin Locke

Toroweap Overlook (Foreground) Crowns a Cliff Rising 2,802 Feet Above the Colorado

At this distance from its source the creek has picked up so much mineral content that it appears a beautiful blue-green, and the pools beneath Havasu and Mooney Falls look as if Nature had poured bluing into her rinse water. From this color the tribe takes its name—Havasupai, the Blue-green Water People.

A double quonset hut, whose sections were flown in by helicopter and reassembled, serves as the Episcopal chapel. Laetitia Viele, formerly of Buffalo, New York, is the fieldworker in charge.

"Transportation from Hilltop is so costly," Miss Viele said, "that I had to pay $77 to bring in my gas refrigerator; but, no matter what the price, the machine has done wonders for my morale. Ice cream made in the freezing chest has solved the problem of getting boys and girls to attend choir practice."

Medicine Man Helps Missionary

As the village's volunteer nurse, Miss Viele has a rival but not an enemy in the medicine man, who shakes rattles to treat the sick.

"But he's sensible; he cooperates when it's necessary," she said. "Once I gave sulfa tablets to a seriously ill patient to be taken every four hours. Would you believe it! The medicine man lent the patient his watch so she could time the dose."

Havasu boys consider it a privilege to drive the village tractor. Gift of an implement company, the machine was disassembled and packed in. Now it does nearly all the plowing once performed by horses.

Mrs. Marian Collins, wife of the resident Indian agent, conducts sewing classes.

"We have 15 women taking lessons," she said, "but only a few can meet at the same time because we have no more than four machines. Right now the girls are getting ready for our spring style show."

Women love to play cards in the heat of the afternoon, and so do the men if they are not occupied in the sweat baths.

The Havasupai sweat lodge is a low conical hut set partly in, partly out of the ground. Fire-hot stones carried into the lodge and doused with cold water give rise to clouds of choking steam.

Douglas W. Schwartz, a young archeologist digging into the ruins near Supai, describes the Indian sweat lodge as hotter than the Turkish bath.

"I shall never forget my first bath," he said. "About the time I thought I couldn't stand the steam any more, the Indians started singing, and then I learned they had to sing three more songs before it was polite to leave. About halfway through each song they poured more water on the rocks. I thought the ordeal would never end. To get a gasp of fresh air, I put my head against the ground.

"When I finally escaped from the hut, I felt so parboiled I could have stuck a fork in myself. As I lay panting, others went into the lodge. When they emerged, my Indian companion said, 'Let's go in again.' Not until then did I learn that I faced three more sessions of four songs each."

Grand Canyon has not given up all its secrets and mysteries. To this day new wonders are being discovered.

I recall Barry M. Goldwater's having asked me, "Louie, do you know anything about a natural stone bridge in Nankoweap Canyon below Point Imperial?"

As a United States Senator from Arizona, Mr. Goldwater has a special interest in Grand Canyon, the outstanding wonder in his State. Having flown over Nankoweap Canyon several times, the Senator told me, he felt sure he had sighted such a bridge.

I had to confess I had never heard of the phenomenon, nor did our records report one. Very few persons have ventured into wild Nankoweap Canyon since Major Powell's party surveyed the North Rim basin in the latter part of the 19th century.

Exploration by Helicopter

To satisfy his curiosity, Senator Goldwater last October 30 made a helicopter landing in the basin, together with his pilot, Bob Gilbreath. A 6-hour hike covering four rugged miles took them to a soaring natural bridge. Carved out of the Redwall limestone by a fork of Nankoweap Creek, the bridge appeared to be 200 feet high and fully as wide (page 618).

"I sat there and wondered," the Senator said, "whether any other white man had gazed upon the sight from so close a vantage point. . . .

"In the distance, a dry waterfall towered above the creek's dusty stream bed."

What a picture that waterfall must present in spring when snow waters are cascading hundreds of feet! Imagine the rainbow spray that smothers the red stone arch at high noon!

Kodachrome by Luis Marden, National Geographic Staff

Medieval Bruges, Heart of Flanders, Flies Heraldic Banners on Festive Days

Founded more than 1,000 years ago, the city remains a moated museum piece of the Middle Ages. Its 700-year-old Belfry rises on the right (page 652). Buses run along abandoned trolley tracks on Steenstraat.

Bruges, the City the Sea Forgot

Belgium's Chief Port and World-trade Center in Medieval Days Relives Its Past in Brilliant, Reverent Pageantry

By Luis Marden

Foreign Editorial Staff, National Geographic Magazine

With Illustrations from Photographs by the Author

THE SEA gives and the sea takes away. Five centuries ago ships brought goods from all the known world to the busy docks of Bruges on the flat Flanders plain. The bourse of the canal-girt Venice of the North set the exchange for all Europe.

Then sand choked the city off from the sea, and ships and the world abandoned Bruges to dreams of past glory (map, page 634).

But what Bruges lost in trade the world gained in art. For the receding tide of commerce left the somnolent city to grow old gracefully among its canals; today Bruges remains a nearly perfect example of the medieval city in architecture and atmosphere.

Night Reveals City at Its Best

I am glad that I first saw Bruges by night. As I walked through the sleeping town, my footsteps echoed in the quiet, narrow streets. The greenish-yellow light of gas lamps gleamed on the stone pavements, but as I approached the canals the street lamps were dark and the serrated gables of the old houses rose black against the amber sky glow of the illuminated canals.

When I turned the last darkened street corner and came out on the quays, I saw a fantastic sight. In the glassy black water of the canal, spires and towers and gables hung upside down in perfect amber-and-blue reflection. House windows along the canal reflected the soft light in glistening rectangles, and weeping willows trailing their long fronds in the canal drew wavering lines of light on the water. In the background rose the dimly lighted tower of the Belfry (page 652).

Each summer and autumn the principal buildings and the canals of Bruges are illuminated from nightfall until midnight. The engineers have done a masterly job of painting with light in two colors only: the amber of sodium vapor and the bluish-white of mercury, which sometimes photographs green.

Along the canals glided sight-seeing boats with noiseless underwater exhausts. The boatmen's voices, explaining the sights, echoed from the stone arch of a bridge, one of 82 that span the city's canals.

Across one end of the lagoon called the Lake of Love, a multiarched bridge, lighted in amber, hung like a golden caterpillar over the still water and touched legs with its inverted counterpart below.

When I tried later to make time exposures of the night illumination, the boats made photography difficult. If one passed while the shutter was open, it left a blur of light on the film, and the reflections of the lighted buildings would break up in its agitated wake.

I had to wait until the boats stopped running, a little before midnight. But at 12, firemen on bicycles rode round the canals and turned off the lights. So I usually had about 15 minutes in which to make pictures—but first I had to wait until the disturbance left by the craft had died down and the reflections were motionless again.

Once I waited a long time, my camera on a tripod, until the reflections stopped trembling, then opened the shutter. When the exposure was nearly complete, a swan glided out of the shadows of the bridge, pushing a bow wave that formed a glassy rope of orange light round its breast.

Swans Linked with History

Swans have swum on the canals of Bruges since 1488. That was the year the townspeople finally lost patience with Pieter Langhals, a cruel henchman of Maximilian of Austria, and, after a short trial, tortured and beheaded him in the town square. Legend has it that when Maximilian later returned to power, he ordered the people to atone for the crime by keeping "long-necks" (*langhals*) on city canals at public expense forever.

To this day, the bakers of Bruges prepare loaves each day for the town swans. City firemen pedal round and feed the birds, which bear the city's mark on their beaks (pages 632 and 650).

↑ Towered Donkey Gate Flanks Bruges's Medieval Moat

This gate, one of four still standing beside the canal, earned its name when donkeys used to enter it with produce on their backs. It is often called Ostend Gate, for it spans a highway leading to that port.

Donkey Gate has survived six and a half centuries and two world wars.

The fisherman angles for gudgeon, a small member of the carp family. Swans bear the city's mark on their bills (page 650).

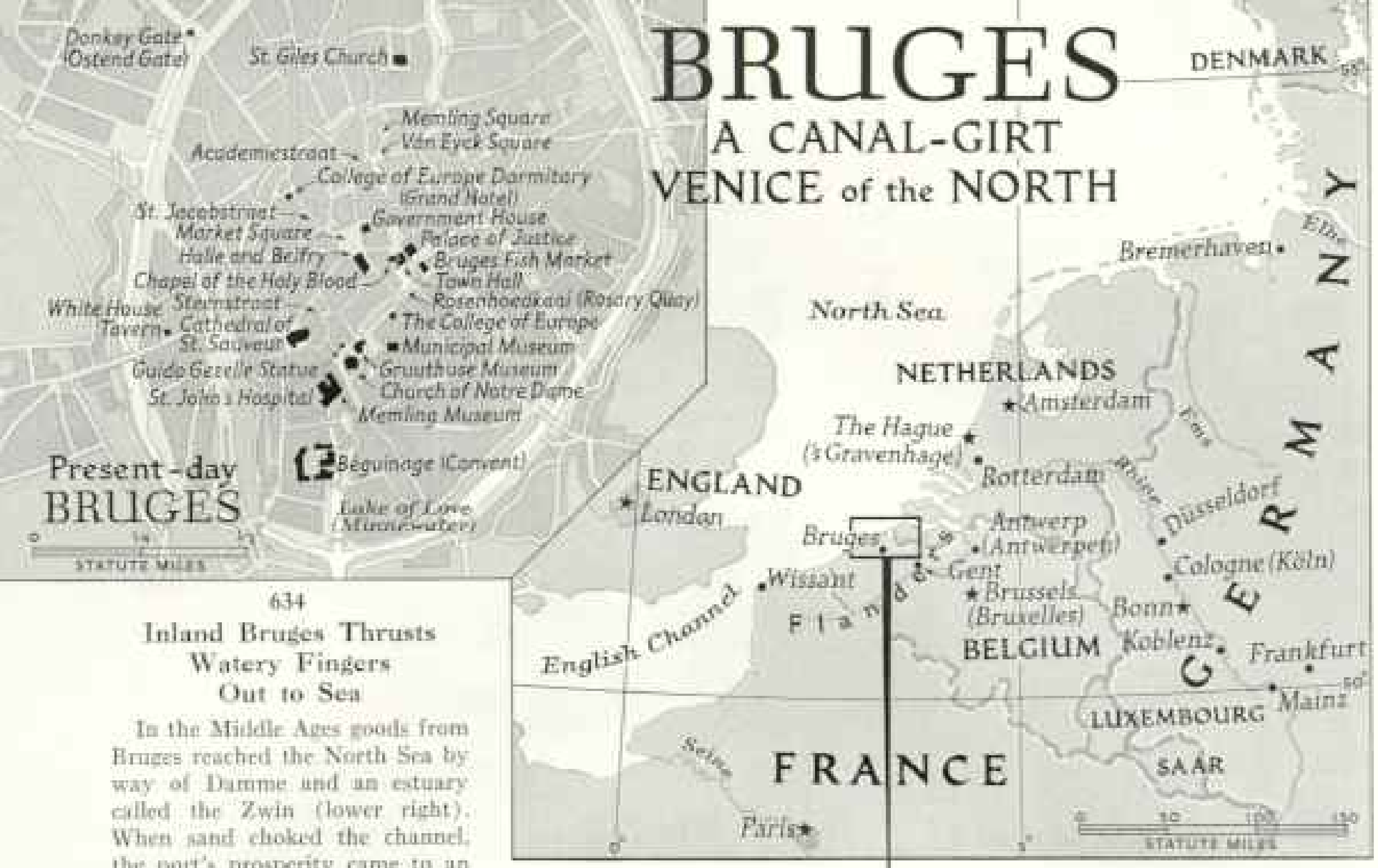
Giants Prepare to Go on Parade →

These hollow titans outside White House Tavern are worn by ordinary men who watch their step through peepholes. Their job is to march in a procession announcing a neighborhood fair. One giantess wears Bruges's classic feminine costume with lace cap (page 631).

Cyclists await the go signal from a traffic light on the striped pole. They represent the thousands who pedal through the city gates each summer week end for holidays at North Sea resorts 8 to 10 miles away.

BRUGES

A CANAL-GIRT VENICE of the NORTH



634
Inland Bruges Thrusts Watery Fingers Out to Sea

In the Middle Ages goods from Bruges reached the North Sea by way of Damme and an estuary called the Zwin (lower right). When sand choked the channel, the port's prosperity came to an end. By digging canals to Ostend (1622-65) and Zeebrugge (1896-1907), modern Bruges re-established its connection with salt water (page 642).

One day I climbed the 365 steps to the top of the Belfry of Bruges, then clambered up a ladder to beams where hung the bells of the tower's carillon. Below me a party of British tourists clattered up the stairs. Above the chatter I heard a clipped, cultivated voice ask, "What exactly is it a belfry *of*?"

A good question. For Bruges's beautiful bell tower, which stands in the Market Square, rises from no church or town hall. It was begun in 1281, on the ruins of an older tower destroyed by fire, to house the charters that granted independence and privileges to the city. In an alcove halfway up the tower the documents were kept in strongboxes behind double wrought-iron gates (page 655). Cities of the Middle Ages jealously guarded their privileges and autonomy and felt strongly their individuality as city-states.

At the Belfry's base, the Halle served as a warehouse to store the cargoes of ships, which could sail right up to the square. The Belfry stands on piles sunk into the stream bed; with the weight of years the tower has leaned slightly from the perpendicular.

The tower housed a great bell that rang to warn the town of danger or on occasions of great rejoicing. Watchmen kept vigil on the high battlements for the approach of enemies or outbreaks of fire.

Kodachromes by Luis Marden, National Geographic Staff

Little Bear (Inset) Is the First Citizen of Gabled, Tile-roofed Bruges

Legend says the first Count of Flanders found a white bear in the field that became Bruges. Today the bear shares the city's coat of arms with a lion. This figure stands in a niche on Academiestraat.

In the 18th century the Belfry acquired a carillon of 47 bells. Every quarter hour the tower clock sets in motion a huge drum studded with hundreds of metal pins. The studs trip wires as they turn and play a Flemish folk tune on the bells, in the fashion of a tremendous Swiss music box (below).

Belgium Says It with Bells

But the carillon rings most melodiously when played from a keyboard by the city carillonneur, who gives concerts four times a week from June to September (opposite). Then people sit at cafe tables on terraces round the Market Square to listen to the bells, which many call the sweetest in all Belgium. The ringing notes vibrate from the dark column of the Belfry like sound waves emanating from a giant tuning fork.*

The clear, simple melodies of Flemish tunes seem written to be played on bells. To please visitors from the New World, the carillonneur sometimes plays tunes like "Home on the Range" and "Old Folks at Home." To my ear, the bells seem to protest at such times, as if forced to speak in alien accents.

The bells of Bruges always reminded me of another sphere in which Belgians excel: the making of fine glass. The clear note a thin goblet of Belgian crystal makes when struck sounds like an attenuated echo of the treble bells of Belgium's carillons.

In Bruges bells are always ringing somewhere. The city seems at times to be all sounding metal, running the gamut from a deep, vibrant booming to pure liquid notes that strike like a joyous exclamation.

> Through the balmy air of night
> How they ring out with delight!

wrote Poe, but there was a deep-voiced bell in Bruges that I did not hear with delight.

* See "Singing Towers of Holland and Belgium," by William Gorham Rice, National Geographic Magazine, March, 1925.

637

Bulletin de Segmaco, Fils Inc.

Bells of Bruges Respond to the Touch of Both a Master and a Robot

The 47 bells of the carillon play part of a composition every quarter hour and sound the full arrangement on the hour. For automatic operation, pins in the giant music box trip wires leading to hammers on the bells (above). The brass drum contains 30,000 holes, weighs 20,000 pounds, and rotates by clockwork. Every two years the chimes are changed. Here a carillonneur alters the melody by placing the pins according to a musical score.

Politics on occasion have influenced the bells. In 1794 the city put "God Save the King" on the drum to please the British. But when French Revolutionaries entered Bruges on June 23 of that year the pins were hastily removed.

Another carillonneur practices Bach. To swing the tongues, he strikes the peglike keys with a leather-guarded fist and pushes the pedals. Carillonneurs need agility and strength. In hot weather they sometimes strip to shirtsleeves and end performances bathed in perspiration.

Lightning followed by flames destroyed the original carillon in 1741. It was this fire, the third in course of time, that Longfellow mentioned in the verse:

In the market-place of Bruges stands the belfry old and brown;
Thrice consumed and thrice rebuilded, still it watches o'er the town.
As the summer morn was breaking, on that lofty tower I stood,
And the world threw off its darkness, like the weeds of widowhood.

New bells were installed in 1745–48.

Kodachrome by Luis Marden, National Geographic Staff

The Fried-potato Wagon Is to Flanders What the Hot-dog Stand Is to America

French fried potatoes are a national favorite. Restaurants serve them with every meal; no one need ask. These children in Bruges's Market Square buy their *frites* in paper cones.

That was the one in the church tower next to my hotel. Beginning every morning before 7, it shook the windows for 20 minutes.

Seen from the top of the Belfry, Bruges unfolds like the famous 16th-century map of the city by Gerards. The streets, marked by rows of gables, wander toward the perimeter of the oval-shaped city, and canal waters catch the light among the dark brick buildings. Quadrangles of green mark churchyards and convents, and the outer canal encircles the city with a liquid band.

Beyond, the flat plain of Flanders, its towns and cities marked by spires, looks as two-dimensional from this height as the landscape in an old Flemish tapestry. Ship canals to Ostend and Zeebrugge, grooves filled with light, run to the horizon.

The heart of Bruges beats in the Belfry, and the heart of Flanders as well. For at one time the name Flanders meant Bruges and its environs alone. The city still is the polestar of the Flemings, and it is more common there to hear and see the Flemish name of Brugge than the French equivalent.

Even today, nearly 700 years after its building, the Belfry of Bruges dominates the city. When I flew in a small airplane over the tiled roofs, the Belfry rose up over the curving streets and threads of water like the gnomon of a sundial, its straight black shadow lying across the red roofs as if to mark the years that pass with gentle touch over the old town.

Largest Ships Once Called

From the air I looked out over the flat, fertile plain to the North Sea, 9 miles away. In the 5th century all this part of the coast lay beneath the sea. When the sea receded, it left many creeks, arms, and estuaries. Into the head of the largest, the Zwin, emptied a small stream flowing from Bruges. The Zwin, nearly 4 miles wide at its mouth, enabled the largest ocean-going vessels to sail right up to the city gates.

But the small stream (today lost in the canals) brought very little current into the head of the Zwin, and, as the years passed, sand began to close the upper end of the sea arm. Deep-draft vessels could then go no farther than Damme, 3 miles from Bruges. There they transferred their cargoes to barges that sailed to the foot of the Belfry to unload merchandise into the Cloth Hall warehouse, under the bell tower.

By the end of the 14th century Bruges was at the height of its wealth and splendor as a world-trade center, and its outer port of Damme sprouted a forest of masts. Ships flying the flags of many lands brought all manner of goods. Warehouses were filled with silk, cloth of gold, spices, drugs, cotton, pearls, fruits, precious metals, leather, lumber, amber, furs, oil, gold ingots, and wines. Extremely important was the wine trade with France, which also sent paper, salt, oil, and hemp.

Bruges re-exported all these, as well as dried and salted fish, arms, butter, beer, and animals such as bears, parrots, lions, and monkeys, but, most of all, the famed Flemish cloth, woven in Flanders of English wool.

Bruges attracted merchants from all over the known world. The powerful Hanseatic League held strong interests there, and 15 nations had consulates in the city, which grew to 35,000 inhabitants.

Dante Wrote of Early Canals

A canal lock with gates had been built in Damme as early as the 12th century, and so famous did the region become for its canals and sluiceways that Dante wrote of it in Canto XV of his *Inferno*. Speaking of the Seventh Circle of Hell, he said the bank on which he walked between the crimson river and the desert of burning sand held back the waters:

"As the Flemings between Wissant and Bruges, dreading the flood that rushes toward them, make their bulwark to repel the sea."

At Damme was born, according to legend, Till Eulenspiegel, the medieval jokester. He and his companion, Lamme Goedzak, were a sort of Teutonic Quixote and Sancho Panza, though Eulenspiegel, far from being an idealistic dreamer, hoodwinked and badgered innkeepers, priests, and princes.

Under the Dukes of Burgundy Bruges acquired a court surpassed by few in the world in splendor. Painters, sculptors, and goldsmiths, always sensitive to a large court with its rich patrons, flocked to the city.

So splendidly attired were the women of Bruges that when Queen Jeanne of France came to the city, she looked at the mass of women turned out in her honor and said bitterly: "I thought that I alone was queen, but here I see hundreds of them around me."

William Caxton lived in Bruges as a merchant for some 35 years and learned the printing trade either there or at Cologne. Later he returned to England to set up that

↑ **Striped Awnings Overhang Sidewalk Cafes in the Market Square**

Emblems perch atop many of these 17th-century buildings. A golden basket identifies the Panier d'Or. Taverne Royale and Restaurant Central have wrought-iron finials. Crow-stepped gables are characteristic of Low Country architecture.

Most of the automobiles come from France, Italy, England, or West Germany, but the limousine on the left is American. A robust Brabantine draft horse, a Belgian specialty, draws the rubber-tired dray.

→ Baby rides the rumble seat on mamma's bicycle.

↓ Boys carry a model ship at the blessing of the fishing fleet in Zeebrugge.

country's first printing press, at Westminster.

In the house of a family named Van der Buerze merchants met to effect exchange transactions. One theory is that the French form of the family name, Bourse, was the origin of the term as a synonym for money exchange.

But inexorably the sandbanks advanced. The Zwin had become a pilot's nightmare, and its last practicable port was Sluis, in what is today the Netherlands. In time that port had to be abandoned, too, after the first ship had run aground there in the middle of the 15th century.

Three centuries of prosperity were drawing to a close for Bruges, and ships and merchants began to move to Antwerp, where a big harbor presented no shipping obstacles.

But the people of Bruges did not give up without a struggle. They built locks and dug canals to try to fight the advancing sand. In 1546 a Flemish painter, Lanceloot Blondeel, put forth a plan so daring that the conservative merchants, taken aback, voted it down. Yet the scheme would have been the salvation of Bruges had it been carried out in time.

Blondeel proposed to abandon the attempts to flush the sand out of the Zwin. He wanted to cut a canal straight across country to the North Sea, to emerge on the coast between Knokke and Heist. Three hundred and fifty years later this was finally done, and Bruges had an outlet to the sea at Zeebrugge, scene of a famous World War I battle (page 653 and map, page 634).

City Houses Art Treasures

Despite the wars and revolutions that swept over Bruges, the city was such an incredibly rich treasure house of art that enough remained to dazzle travelers of succeeding centuries.

Masterpieces of painting hang in the Municipal Museum, in St. John's Hospital (page 646), and in churches and private houses. Curiously, of the most famous Flemish painters at Bruges, none is known to have been born there. But Jan van Eyck, Memling, Van der Weyden, Hugo van der Goes, and many others born elsewhere came to Bruges.

It was the custom of the Flemish burghers to commission a painting of a holy subject and to have themselves included as one of the figures of the composition. A famous portrait of a donor appears in the painting by Jan van Eyck commissioned by Canon Joris van der Paele in 1436. At the right of the Virgin and Child kneels the canon, whose fat and flabby face, with its double chin and network of corded veins and wrinkles, is depicted with marvelous realism.

Not long ago a physician examined the portrait of the canon. He said he was certain that the man had been nearsighted and "did himself rather too well," as the English used to say of gouty country squires.

Later research has revealed that one of the canon's greatest household expenditures was for enormous quantities of Burgundy, and that he did indeed indulge in good living. That the doctor's diagnosis across five centuries was correct was a tribute not only to the medical man's skillful professional eye but also to the fidelity of the painter's portrait.

Squares Named for Artists

The Brugeois love of painting and literature is evident in the public monuments of the city. Both Memling and Van Eyck have squares named for them, with statues (opposite), and another famous statue is of Guido Gezelle, best loved of Flemish poets. It was refreshing to find a city where all the monuments were not to military men.

Though both Flemish and French are official languages in Belgium, one hears far more Flemish spoken in Bruges than French. In modern Belgium the old domain is divided into the provinces of West and East Flanders, with Bruges as capital of the former.

Most Flemings speak French as well as Flemish, but few French-speaking Walloons have a command of the Flemish tongue.

Flemish is written the same as Dutch, though the two languages are pronounced somewhat differently. An English- or German-speaking person can sometimes pick up words or the general drift of Flemish, and it is not very difficult for such people to read simple public signs.

Flemish has a rapid, businesslike, and virile sound, and I like to hear it spoken, particularly in some dark-paneled cafe where solid-looking citizens sit over mugs of beer, looking like subjects Peter Paul Rubens might have painted. As a matter of fact, Rubens used to frequent a Bruges cafe that still stands, and it looks like a Rubens cafe.

Almost every schoolboy knows the lines of Caesar's *Gallic War* which state that all Gaul is divided into three parts and those which

Kodachrome by Luis Marden, National Geographic Staff

Old Master Jan van Eyck Broods Over Bruges, Cradle of Flemish Painting

A Dutch artist paints the statue of the famous Fleming. His watchers are dressed for an outing. One girl wears the white-dotted red handkerchief seen on so many Flemish children.

describe the people of these regions, saying: "Of all . . . the Belgae are the bravest." But he probably does not remember that the Romans also noted that the Belgians were hospitable and drank beer. Tacitus wrote: "For drink they use the liquid distilled from barley or wheat, after fermentation has given it a certain resemblance to wine."

Pieter Bruegel's lusty canvases, such as "The Wedding Feast," do not depict scenes of a long-dead era. Except for costumes and setting, such groups could be painted today from real life, because the Flemings now as then are lovers of good food, good drink, and a hearty good time. But, most of all, the people of Flanders love beer.

Giant Horses Pull Drays

Beer flows more readily than water in Bruges; the meandering canals move much more slowly than the spouting amber streams of a thousand taps. There is dark beer, light beer, golden beer, ruby-red beer, blond beer; rye beer, wheat beer, barley beer; beer of 4-, 8-, and even 12-percent alcoholic content. Burghers drink it in the morning, at midday, and in the evening, consuming about 30 gallons per person a year, nearly three times the amount drunk by the Germans.

Belgian brewers' drays, loaded with fat barrels, are drawn by handsome, gigantic Brabantine horses, which are among the world's finest draft animals. Drays and horses rumbling and rattling over the paving stones remind the American of early Baltimore or New York.

The Brugeois—father, mother, and the children—love to sit at cafe tables (outside on the terrace in fine weather). There are nearly 500 cafes in Bruges, from small, narrow hideaways with four tables to big, elaborate cafes with 100 tables, equipment for various games, and chess players deliberating over boards in the corner.

What do the Belgians eat with their beer? Fried potatoes. Since my visit to Belgium, French fried potatoes have become Belgian fried potatoes for me (page 638). I found I had not really tasted fried potatoes until I went to Belgium. At restaurants in Bruges you are not asked if you want them; they come automatically with every meal. Strangers sometimes ask for potatoes, and the waiter says, a bit impatiently:

"Yes, yes, but what would you like for vegetables?"

But they must be "northerlings." I thought my good friend Rafael Dusauchoit was being overly technical when he looked at some fried potatoes and said, "Won't do; they're southerlings," but within a week or so, under Raf's guidance, I could tell the difference easily.

Northerlings come from the flat polders north of the Bruges-Ostend Canal. This heavy black soil was once drowned under the sea, and it produces rich, yellow potatoes. South of the canal the soil is sandier and the tubers paler.

Whenever I ate fried potatoes in a restaurant, the waiter would carry off the platter as soon as the potatoes began to cool and bring in a platterful so hot I could hardly touch them. He did this two or three times during the meal.

Although Belgians love their beer, they are also devoted to the choicest French wines.

"It is our custom," a Brugeois friend told me, "to lay down wines on the birth of a son, for use when the boy comes of age."

When I dined at the homes of old Bruges families, servants served everything but the wines. This the master of the house did himself, rising to pour for each guest. In the absence of the father, this duty devolves upon the eldest son.

Wines Hidden from Invaders

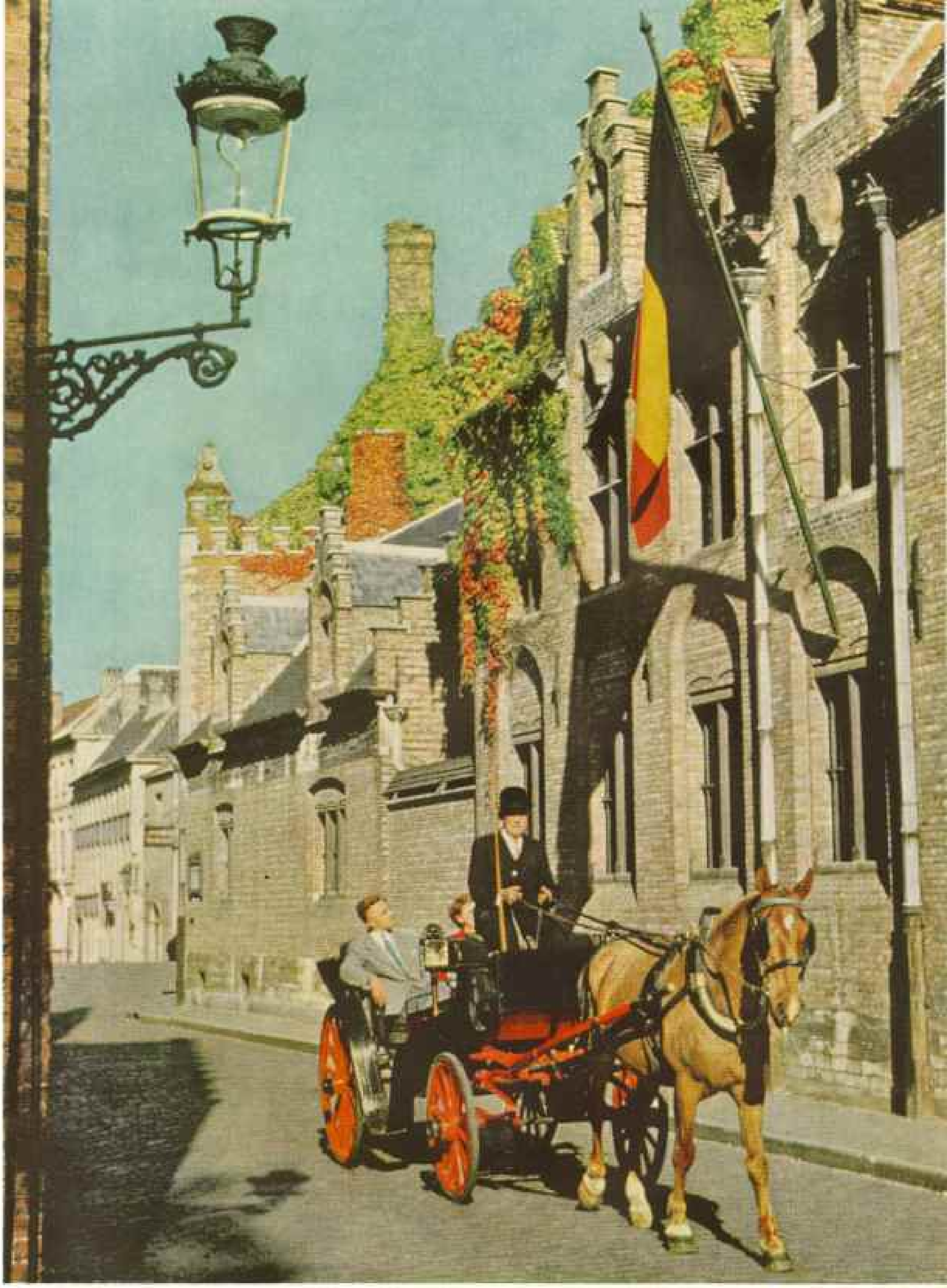
The Grand Hotel was an elegantly old-fashioned hostelry on St. Jacobstraat. Built in 1600, the house acquired Grecian caryatids and a curving Empire staircase for the coming of the first Napoleon. I lived in a high-ceilinged, large-windowed room in which the poet Longfellow, a friend of the late proprietor's grandfather, had stayed.

Madame van den Berghe, white-haired chatelaine, told me how twice, in two wars, German Army officers had taken over the hostelry. Twice she had had an alcove of the wine cellar hurriedly walled up by masons, while the tramp of boots sounded on the stones outside.

Both times, from 1914 to 1918 and through the lean years of World War II occupation, the interlopers were unaware that the rarest vintages, such as a priceless Romanée 1900, had been hidden from them.

Bruges la Morte is far from being dead. The city wears an engaging air that combines medieval tranquillity and present-day bustle and industry. Belgians are hard workers, and though the Brugeois love their spotlessly

(Continued on page 653)



Kodachrome by Luis Marden, National Geographic Staff

Stone-block Streets Still Echo the Clip-clop of Carriage Horses

Ivy climbs the gables of the Gruuthuse Museum, and Belgium's flag flies from the mast. Old-fashioned gas lamps (left) survive along most streets despite the encroachment of electric lights.

The Art Museum of St. John's Hospital Houses Only Six Paintings, but All Are Masterpieces by Hans Memling

This triptych, the museum's showpiece, depicts the Mystical Marriage of St. Catherine in the center. The right-hand panel shows the Vision of the Apocalypse. On the left, Salome receives the head of John the Baptist from the executioner.

A Stained-glass Maker Works with Living Light →

Belgians excel in the manufacture of colored glass for stained-glass windows. Craftsmen, like the 13th-century masters, work from black-and-white cartoons copied in larger size from the artist's water-color sketch.

Here artist-craftsman Michel Martens assembles cutout pieces of glass in his studio to test their effect. He next paints in details, such as human features; pieces thus embellished are then fired in a kiln. Finally the glass bits are fastened with lead.

← Lacemakers Start Their Training Early

Handmade bobbin lace, a Belgian specialty, reaches its highest development in Flanders. Flemish painters portrayed the beauty of Bruges lace, which is made of linen thread from Flemish flax.

Some laceworkers, like these girls in a convent school, are no more than 6 or 7 years; others have turned 80. They all fix pins in a paper pattern mounted on a cushion; then, working with all fingers, they interweave threads among the pins. At a distance the clicking of shifting bobbins sounds like twittering birds.

↑ Modern Crossbowmen of a Medieval Society Shoot Artificial Birds on a Lofty Mast →

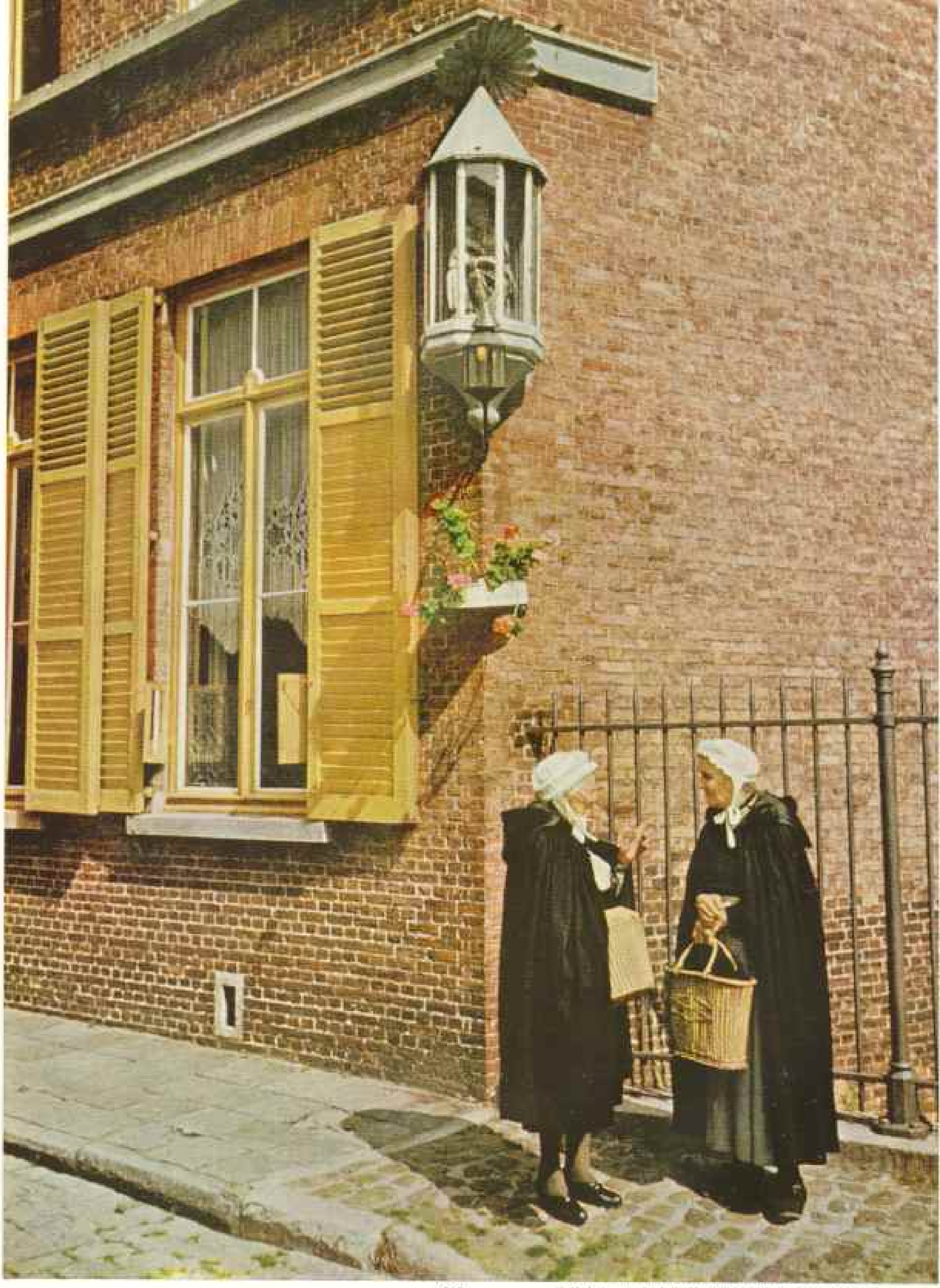
Bruges's Royal and Princely Guild of St. George was founded more than 700 years ago. Its first Golden Book of members bears the signatures of Mary of Burgundy, Charles II, Charles the Bold, Maximilian of Austria, and Philip the Good. Another old archery society, St. Sebastian's, uses the longbow. Queens Victoria and Elizabeth II have been enrolled as honorary members. When Charles II was an exile in Flanders, he took part in many shoots at St. Sebastian's.

→ Page 649. To cock the powerful crossbow, archers use a long metal lever and hook. They take aim with short feathered bolts. Feathered targets are attached by pulling the hinged mast down to ground level. Originally "birds" were fixed to stationary vanes of windmills, possibly the origin of the vertical shoot.

650

Swans Have Furrowed the Waters of Bruges's Canals Almost Five Centuries

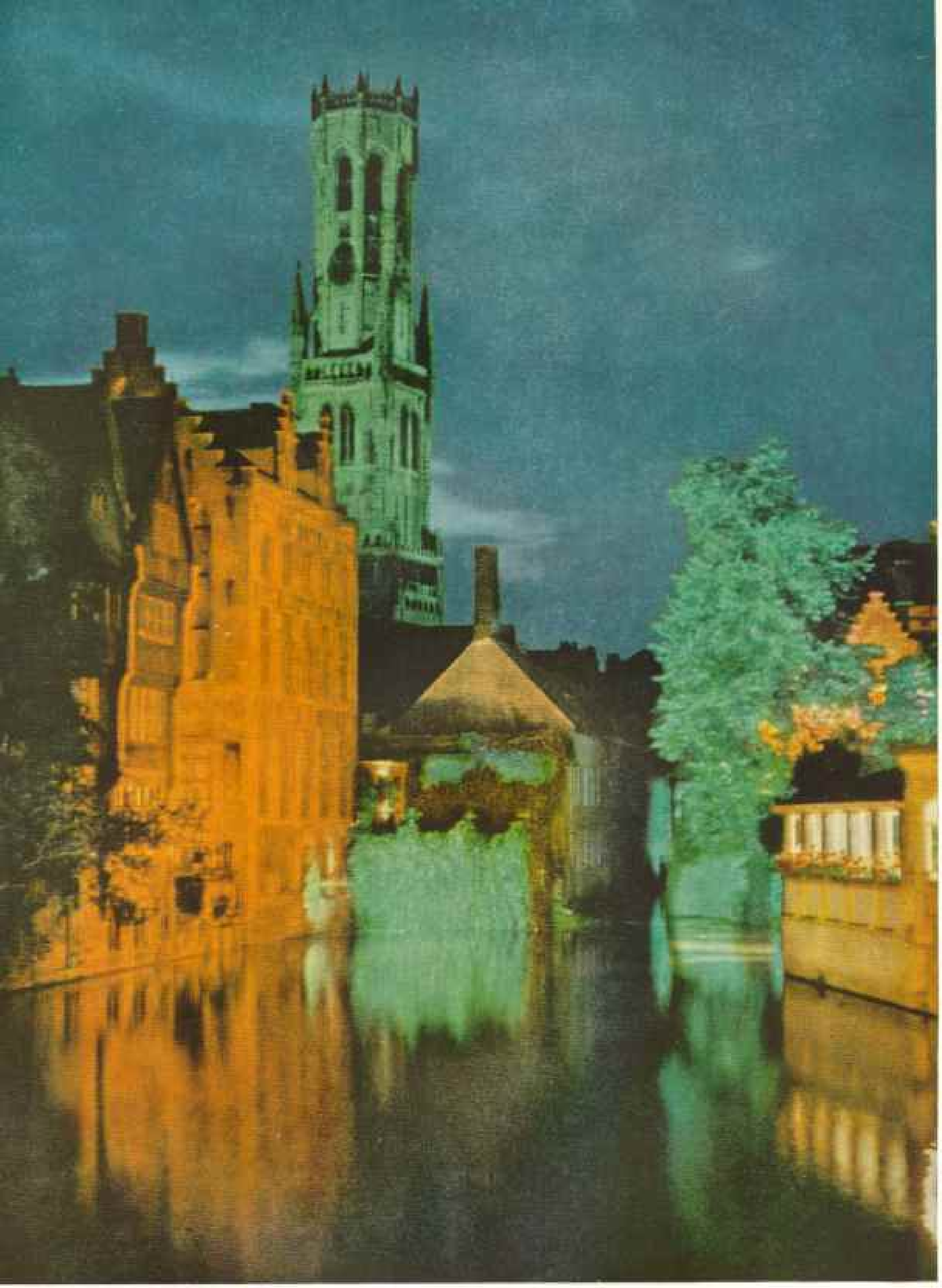
In 1488 townspeople executed a tyrannous official named Langhals (long-neck). Tradition says Emperor Maximilian condemned them to keep the long-neck birds at public expense forever. They have been doing it ever since.



651 © Kodachromes by Lula Marden, National Geographic Staff

Grannies' After-shopping Gossip Goes Unheard but Not Unseen

These lace caps and black cloaks have passed out of vogue. A perpetual light burns beneath the house-corner shrine to the Virgin. Window shutters carry "spies," hinged mirrors that enable the housewife to watch passers-by.



Kodachrome by Luis Marden, National Geographic Staff

Painted with Light, Belfry and Gables Stand Out Against an El Greco Sky

Rozenhoedkaai (Rosary Quay) at twilight offers the city's most famous view. Like many old buildings and canals, it is illuminated each summer from dusk to midnight. The Belfry was built long ago to house city charters.

kept city's past so much that not the slightest change in house design may be made without permission of the authorities, they move with the times in business and manufacture.

Among the many horticulturists round about Bruges there is one who, with hundreds of glasshouses, is one of the largest growers of greenhouse plants in the world. Here I saw species of orchids that I had often photographed in their native Brazil, Venezuela, Colombia, and in Central America, brought by selective breeding to such perfection as they seldom attain in the wild state. By crossing, some plants had become the parents of new and striking hybrids—some beautiful, but others, to me, rather monstrous in their deformation of the original simple flower outline.

Old and New in Industry

In quiet squares old ladies still sit at their door fronts making lace. Their lace caps bend over little cushioned stands over which the hardwood bobbins fly with a clicking and chirping like a flock of sparrows.

Yet on the Market Square stands a tool shop with the biggest collection of machinists' and craftsmen's tools I have ever seen displayed for sale in one place. There were caliper rules, micrometers, gauges, wrenches, and pliers; pincers, hammers, and forceps for every kind of craft—silversmiths', goldsmiths', watchmakers'—reminiscent of the old guilds that once flourished here.

In the suburbs stained-glass artists and craftsmen cut pieces of imprisoned light and fit them together with the same tools and in the same manner as their 13th-century predecessors (page 647).

A few blocks away one of the world's largest car foundries turns out railway carriages and tramcars for the world. At Zeebrugge I watched 30-odd green coaches made by this factory being loaded aboard ship for Iran. Tramcars of Brussels and many other European cities come from the city of Bruges.

The port of Zeebrugge (Sea-Bruges) stands as the perfect example of Flemish industry and persistence. For 400 years the Brugeois doggedly carried on the fight to become a great seaport again, and in 1907 the plan of the painter Lanceloot Blondeel, too imaginative and grand for his time, finally was realized.

At a point on the coast between Blankenberge and Heist engineers built a long, curving mole that thrust its arm one and a half miles into the sea, to hold off that archenemy that had nearly choked Bruges to death—the sand. A 26-foot-deep ship canal was cut through the 7½ miles to Bruges, terminating there in big basins to accommodate large vessels.

Shortly after completion of the harbor works, World War I broke out. When the Germans overran Belgium, they quickly saw the advantages of Zeebrugge as a port from which their submarines and destroyers, safely based upstream in Bruges, could harry Allied shipping. At Bruges they built covered concrete pens that by the war's end could house 30 U-boats.

To bottle up this hornets' nest, the British made their famous raid in the early morning of April 23, 1918. They succeeded in sinking blockships at the mouth of the canal, while men on other ships "stormed the mole at Zeebrugge" to write an undying chapter in the annals of valor in war.

At the end of the war the retreating Germans blew up the mole and port works. Rebuilt, the port saw a moderate movement of ships, though then, as centuries before, it faced difficult competition with near-by Antwerp.

When the Germans occupied Zeebrugge the second time, they pulled down the monument to the 1918 raid. Allied bombings and German demolition again left the port a jumble of ruins, but once again Flemish hard work and perseverance rebuilt the port in record time.*

In a restaurant on the mole at Zeebrugge I was introduced to a dish nearly everyone eats along this coast: cold boiled prawns. North Sea draggers, bringing in catches, heave to off the mole to boil the prawns on board. Though smaller than some New World shrimp, North Sea prawns are exceedingly savory.

How to Eat Mussels

Mussels and fried potatoes are another classic dish on the Flemish coast. The blue-black bivalves, which grow on breakwaters and pilings along this coast, are steamed in a pot with sliced onions, celery, bay leaves, and black pepper. The steaming mussels are eaten with—needless to say—a platter of fried potatoes and rye bread and butter, washed down with dry Belgian beer.

The initiated, scorning forks and spoons, always eat mussels directly from the half shell, then use the empty shell to scoop up the rich broth. The good people on the mole brought bowl after bowl of mussels and potatoes dur-

* See "Belgium Comes Back," by Harvey Klemmer, National Geographic Magazine, May, 1948.

ing the meal, so that one always had hot food.

In Flanders one's host, whether in a restaurant or private house, is likely to feel offended if the guest does not eat a little more than he can possibly hold.

Unfortunately, my good friends on the mole, like so many thousands of others in Belgium, England, and particularly the Netherlands, suffered in the hurricane and flood tides of February, 1953.* Raging seas badly damaged their restaurant and hurled huge steel gasoline tanks beside it 60 feet up the mole.

New College of Europe

Just as the commerce and industry of Bruges continue today, so the cultural life of the city maintains a vigorous growth. The Brugeois are justly proud of a new center of higher learning, and a hope for the future of united Europe, that has made Bruges its seat: the College of Europe.

A poster issued by the college, printed in French and English, says:

"Europe to live and recover needs: young intellectuals, to study objectively European problems: experts, political, technical, and administrative, with a truly European outlook. For those two ends the College of Europe has been created. It is concerned with young people who have completed their university studies; wish to complete their education in a wider and more international way; would like to live for a year amongst colleagues of many different nationalities and beliefs; who wish, at Bruges and in their later careers, to serve the cause of the free world and United Europe."

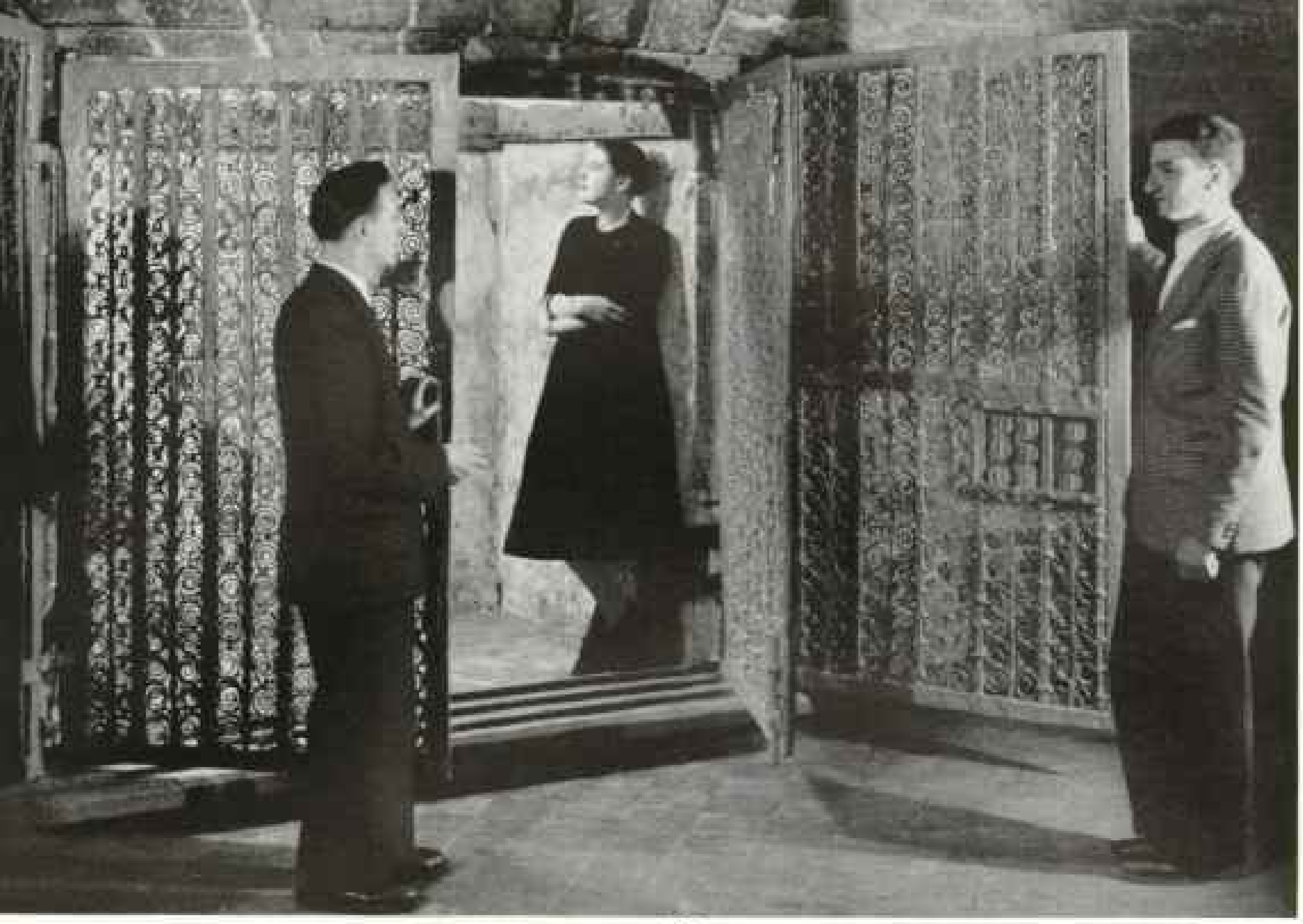
The college teaches history, geography, economics, sociology, European institutions, administrative sciences, and international, comparative, and constitutional law. The faculty includes men of nearly all European nationalities, and Americans have also served.

The idea of the college originated in 1948, following a Congress of Europe held at The Hague. A Franciscan monk from Bruges said: "Let's have it at Bruges, because that city lies at the geographical center of Western Europe. Also, Bruges does not have one of the big national languages or cultures that would impose itself on the school."

* See "Helping Holland Rebuild Her Land," by Gilbert M. Grosvenor and Charles Neave, NATIONAL GEOGRAPHIC MAGAZINE, September, 1954.

A Liquid Lens Focuses Light on a Lacemaker's Flying Fingers

In fine weather Bruges lacemakers prefer to work by daylight, sitting in their doorways. In winter or at night they use this old-fashioned device. The flask of water spotlights the kerosene lamp's rays on the bobbins. Modern lighting, despite its other advantages, does not give the same soft but brilliant effect



655 B. Bryan

Centuries-old Wrought-iron Doors Guard Alcoves of the Strong Room in the Belfry

Here medieval Bruges's charters of independence were stored. Today they are kept in the city records office. Never attached to a church or town hall, the tower was built expressly to house these documents (page 634). In the days when Bruges was still a great port, ships sailed directly to the Belfry's foot.

The Rector, Prof. Henri Brugmans, who is a Netherlander, said to me:

"When students first come here, each sees Europe through his national spectacles. The first few classes are usually polite and formal, but then reserve breaks down, and they begin to ask delicate questions, of the kind that have been causing international rows for years."

Students take two or three field trips a year. One trip was to hydroelectric installations in France, Switzerland, and Italy, to study power plants with a view to their best utilization for power distribution if there were no national boundaries.

One day I visited the Bruges Fish Market, which is in a square with open-sided, roofed-over stalls around the four sides. I was photographing men unloading boxes of rays, whelks, prawns, lobsters, and sole.

Some of the men wore small gold earrings, which helped, so they said, to maintain their keen eyesight. A man who wore wooden shoes to keep his feet dry on the stones, which were constantly flushed with water, and who carried a big coalfish (like a cod) by the tail, rushed up to ask if I was with the National Geographic Society. When I said yes, he shifted the fish to his left hand, wiped his right on his jeans and thrust it out, saying in English:

"Glad to meet you; I'm a member."

That same day I had talked with the burgomaster of Bruges and with the director of a local bank, who were both members. Such incidents brought home to me the fact that there are more members of the National Geographic Society in little Belgium than in any other country of continental Europe. In 1954 there were 8,375.

City's Most Precious Relic

The Belgians are an extremely devout people. Religious feeling is particularly strong in Flanders, and nowhere more marked than in Bruges. For the pious burghers of Bruges the greatest event in the long history of their city occurred 800 years ago when, in 1150, the Count of Flanders returned from the Second Crusade.

In the Count's train rode a chaplain who carried a gold-mounted crystal tube containing the most precious relic ever to come out of the Holy Land. Tradition says it was the actual blood of Christ, collected on Golgotha

by Joseph of Arimathea. Grateful to the Count for his efforts on the Crusade, the King of Jerusalem had presented him with the relic.

For more than eight centuries the Holy Blood has been preserved in its chapel, except in time of war or revolution when some trusted citizen took the relic home to hide it in the walls or other safe place until the return of peace (page 662).

Once a year the Holy Blood is carried in solemn procession round the city. The procession, which goes back to the 14th century, includes prelates and civic leaders and allegorical groups in medieval magnificence.

In 1938 there was presented for the first time, on the Market Square of Bruges, the Play of the Holy Blood, or *Sanguis Christi*. Father Jozef Boon wrote the play, a dramatic pageant which begins with the death of Christ, re-enacts the bringing of the Holy Blood to Bruges, and traces the city's trials and triumphs through the Middle Ages and up to the time of the French Revolution.

So successful were the seven performances of 1938 that the town council voted to repeat the performances in 1939, on the eve of war.

More than 100,000 spectators witnessed each prewar series, and in 1947 the play was resumed, to be repeated from then on at five-year intervals.

Play Has Cast of 2,500

I saw the performances of August, 1952. I can only say that I was overwhelmed by the spectacle. The play, which is given in Flemish, takes place at night on a huge stage at the base of the Belfry. Two thousand five hundred citizens take part, either in the pageant itself or as part of the 150-piece orchestra and choir of 500 voices.

The burghers who participated received no pay. They were firemen, teachers, accountants, bakers, shopgirls, carpenters, housewives. The youngest player was 5½; the oldest 78. One man's seven sons and daughters appeared with him.

But the chief actor in the Play of the Holy Blood is the Belfry itself. One journalist wrote that the tower "wept, lamented, wailed, rejoiced, and mourned." The play, intensely moving in its own right, would lose much of its force without the grim symbol of the tower against the night sky, alternately dark and forbidding and then shining with light and promise.

I sat with 10,000 others on benches set up in the square. The deep-toned triumph bell of the tower had rung for half an hour, then fallen silent. On the stroke of 9, a mighty voice issuing from the darkened shaft of the tower cried thunderously:

"People of God, peace be unto all of you . . . now the Play of the Holy Blood begins."

From the Belfry sounded three slow beats of the great bell, then from the topmost turret came the blare of trumpets, attenuated to thin and silvery melody in the night air. The play had begun.

Scene Painted in Light

As the imperious opening notes of the specially written symphonic score of M. Arthur Meulemans were played by the orchestra, the gigantic stage began to fill with colored light, and angels filed in and massed on the stage, on the battlements, and in every opening of the old tower.

From a raised control chamber in the center of the square the stage director and producer, M. Anton van de Velde, painted the scene with light. His hands played on the giant rheostats and switches as on the keyboard of an oversized organ. The colors grew more intense, changed, and blended, recalling the Belgian genius with stained glass as they took on the vibrant hues of cathedral windows in warm reds, rich blues, amber, and green.

The first part of the play showed the mob of Jews harangued by their leader, and the pitch of emotion rose until the mob broke away from the stage and ran, a thousand strong, to pound on the doors of the government palace.

It is this flow of movement, with groups coming and going from side streets, appearing at one side or even behind the spectators, in the authentic settings of many of the later events, that gives the play such evocative power and realism.

Suddenly, spotlighted on the balcony overhead, Pontius Pilate appeared, laurel-wreathed and disdainful, to call down to the mob:

"What must I do with your Jesus of Nazareth?"

"Crucify Him! Crucify Him!" The shouts rose to a roar.

A piercing note of horns, and there appeared in the spotlight beside Pilate, pale and still, the figure of Jesus, crowned with thorns and with His hands tied before Him. The mob

(Continued on page 665)

Kodachrome by Luis Marden, National Geographic Staff

The Belfry, Heart of Bruges, Summons Burghers to the Play of the Holy Blood

Every five years the city presents the Sanguis Christi, a pageant celebrating the arrival in 1150 of a vial said to contain blood taken from Christ on Golgotha. The play was first presented in 1938; the next series of performances will take place in 1957. Here the Lion of Flanders undulates on a 50-foot banner hanging from the tower above Crusaders who have brought the relic from the Holy Land.

← Sorrowing Christians Follow Christ on His Way to Calvary

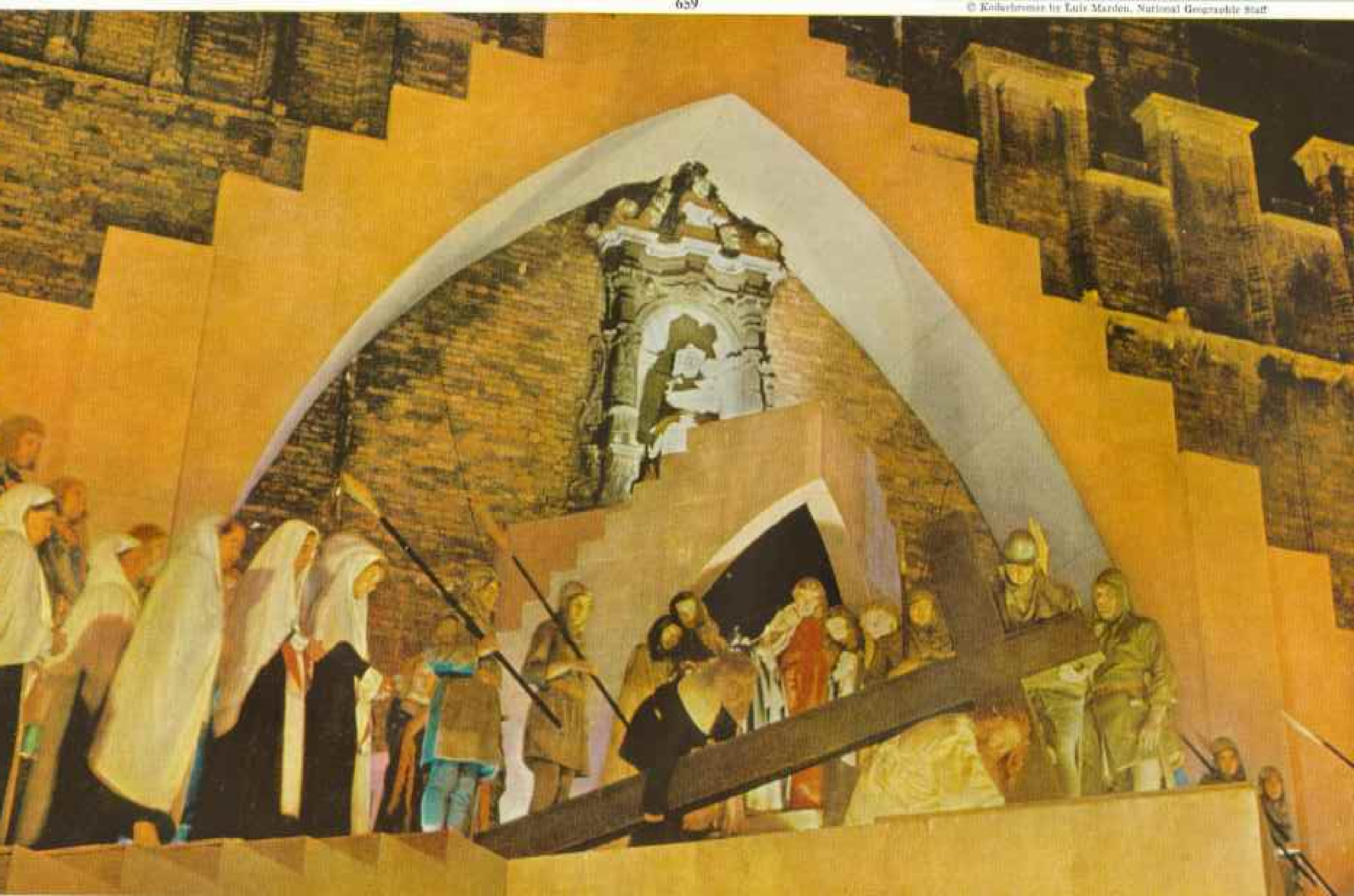
Bruges performs its Holy Blood play during a three-week period.

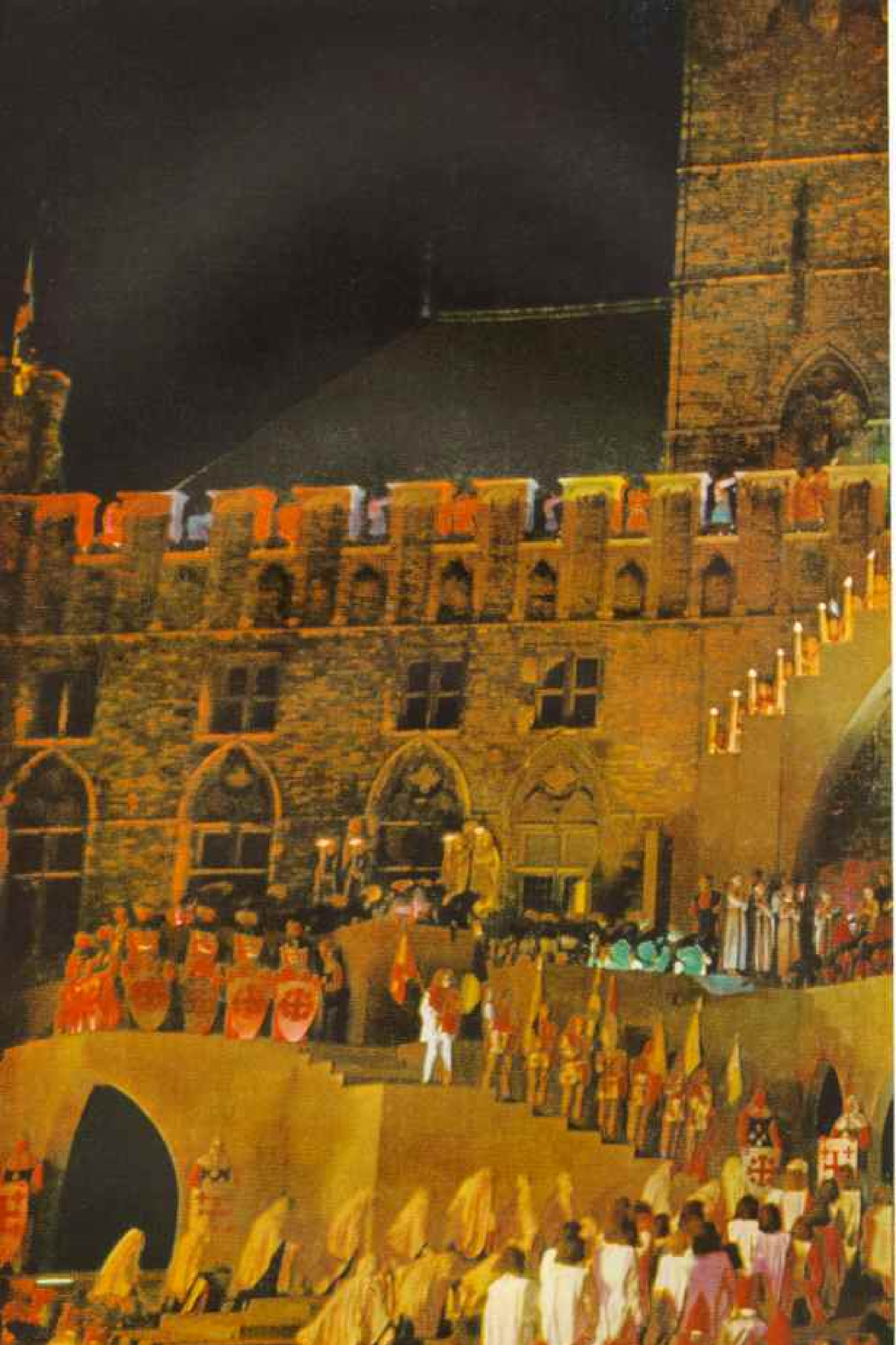
Lower panel: Torch-bearing pages light the way into the city for the Count of Flanders and his Crusaders, who return with the Holy Blood of Christ, gift of the King of Jerusalem.

Jesus Struggles with His Cross

Opposite page: A white spotlight bathes a stone statue of the Virgin and Child, part of the medieval Belfry's façade. Bruges's beloved little bear, symbol of the city, stands just below the upper arch.

Next two pages: The play's grand finale glows like a Flemish primitive painting. Clad in lace mantle, the Virgin stands in the central spotlight beneath the arch, having saved the city from complete destruction by French Revolutionists. Burghers and men-at-arms portray Bruges's medieval glory. The great triumph bell beats in the tower.





Bruges's Precious Relic Is Displayed for the People's Veneration

Chained to the priest, the crystal tube is revered as containing blood of Jesus which Joseph of Arimathea collected on Golgotha. Each Friday the faithful file past this dais in the Chapel of the Holy Blood. As each worshiper kneels and kisses the tube, the priest wipes the crystal with a cloth.

A member of the Noble Brotherhood of the Holy Blood appears in ceremonial robe on the left. A policeman (right) stands guard whenever the relic is removed from its vault; his presence symbolizes the fact that the Holy Blood belongs to the city, not to the clergy.

Once a year, on the first Monday after May 2, the Holy Blood is carried in procession through the streets. In times of war, revolution, or riot the relic has been entrusted to a zealous burgher for walling up in his house. Chosen guardians faithfully kept Bruges's secret during two German occupations.

Diederik of Alsace, the Count of Flanders, hung the vial around the neck of his chaplain, who never took it off, night or day, until their return to Bruges from Jerusalem in April, 1150.

Sisters of St. Benedict Dress Figurines of the Holy Blood Play

These nuns work in the Béguinage, a Bruges convent established seven centuries ago for lay women. The original *béguines* retired to a quiet life of good works, meditation, and prayer. Their place in the old buildings has been taken by these Sisters of St. Benedict, who wear the béguines' old coif and habit. So tranquil is the convent's inner green quadrangle that it has been called the City of Peace.

Skilled needlewomen, the sisters prepare stylized figures showing scenes from the Bruges pageant. This group represents the moment on the Via Dolorosa when Veronica wiped Christ's face with her kerchief. To announce the play's presentation in 1952, the figurines were exhibited in Belgian Tourist Offices across Europe and in the Americas.

Written by Father Jozef Boon, the play is performed by 2,500 townspeople. It is given in Flemish.

breathed a long "Ah!" and fell back. To me it was one of the most impressive moments of the play: the mounting fury and tumult, the clashing of brass and drums, then the sudden recoil and hush as the wan, silent figure appeared.

Soon the mob redoubled its shouts, "Death! Death! Blood! Blood!" and the prisoner was led away.

As the procession to Calvary filed across the stage (pages 658 and 659), the music and gigantic chorus sounded a tragic and somber mood, and the scene was bathed in dark-red and blue light.

When Christ and His followers departed, the stage filled with the faithful; angels appeared on the battlements and turrets of the Belfry, their garments flickering in the wind and the orange light like flames; and when Christ met His death the chorus and orchestra swelled in a great diapason.

The Belfry shone with light, and Joseph of Arimathea mounted the steps to the foot of the 30-foot crucifix and raised the Grail to catch the blood of Christ. So ended the first part of the Play of the Holy Blood.

Immediately the second part, a picture of medieval Bruges at the apogee of her splendor, followed. The trumpets sounded, and the stage and tower filled with mailed knights who stood with red-crossed shields in pools of blood-red light.

Watchmen manned the lookout towers on the Belfry as a swelling chorus sang.

"Flanders, my country, arise! Bruges, wake up and live again!" and an enormous golden banner bearing the black-and-red rampant Flemish lion was slowly hoisted up the front of the Belfry (page 657).

The applause was deafening, for, though people come from all over the world to see the play, there was a great mass of patriotic Flemings in the audience. Watchmen went through the ritual cries of closing the gates of the city for the night, and the citizens knelt for their evening prayer, when suddenly a watchman shouted the traditional warning, "*Brugge, waak op!*" (Bruges, wake up!)

Other watchmen called down to the fearful populace that an army was approaching the city, but soon the fear turned to joy as the cry went round, "It is the Count of Flanders who returns from the Crusades with the men of Bruges!"

From behind the audience in the great square horsemen clattered over the stones, armor glittering and pennons fluttering from lances. Amid the golden flourish of trumpets, Dieterik of Alsace rode in with the chaplain beside him carrying the precious cylinder of the Holy Blood. So came the Sanguis Christi to Bruges in the year 1150.

As the burgomaster received the Count, the people roared a welcome and the stage filled to a glorious apotheosis as the music rose. The scene grew dazzling with light, movement, and color as the people waved flags and shouted. Still more horsemen, two by two, cantered into the square; pages on foot carried flaring torches. The whole tableau became suffused with light, ringing bells, and joyous singing, and took on the glowing colors of a living Flemish primitive.

City Rises from Destruction

The final portion of the play began with the stage and tower in darkness, relieved by rays of livid green light that picked out tattered black banners. The scene was laid many years later, and again the watchmen cried out, this time in horror. For the French Revolutionists were approaching, and the sacred relic must be hidden. The mob rushed in, waving banners and spears, disheveled women began to dance the carmagnole, and smoking red flares broke out all over the tower. As cannon boomed and rockets hissed and flew, Bruges was burning (opposite).

Having sacked the city, the rebels departed, and amidst the chaos the Virgin Mary appeared and called on the people of Bruges to rally and begin anew (page 660). The play ended on a note of triumph, with the stage filling with nearly 2,000 brilliantly lighted figures, and the great triumph bell beating in the night.

When the Brugeois speak of the play, they speak with the voice of the clerk who presented an allegorical play in Brussels centuries ago. He said, "We do it from love."

Page 664

← **Flames Flare from the Belfry as Revolutionaries Pillage Bruges**

Torches of French looters form a streak of flame (lower right) in this time exposure, and red fire bursts from the watch towers and octagonal lantern. Seen under the smaller arch at lower center, the Virgin makes an appearance to save the city from total destruction. When she has driven off the raiders, the stage fills with players, ending the pageant (page 660).

Kodachrome by Luis Marden, National Geographic Staff

Arizona's Operation Beaver Lift

The Hard-working Beaver, Sometimes a Pest, Turns His Engineering Talents to the Conservation of Soil and Water

By Willis Peterson

HIGH in Arizona's rugged Mogollon Rim country, a sharpness in the air forecast autumn snows and the end of outdoor activity. Each day the mountains shrugged off coats of morning frost with increasing difficulty.

Construction gangs working on a dam in the valley below raced against winter's deadline. Some felled trees. Others dug a canal to float logs to the main camp. Divers, highly skilled, fitted timbers into a stream-bed foundation, filling the chinks with mud and stone.

No painted sign advertised the fact that this dam was being built by small brown animals under auspices of the Arizona Game and Fish Commission. Yet the beavers, the tireless engineers of the Mogollon Rim, were working for State conservation officials as surely as if they had been on the payroll.

Beavers Moved to New Homes

These particular beavers were brought to Arizona uplands by the State's wildlife commission in an animal transplant spurred by the demands of irate farmers in the valleys.

Farmers have sometimes had harsh things to say about *Castor canadensis*, the beaver. The animal will dam an irrigation ditch as quickly as a stream, and he is fully capable of chopping down half a dozen young fruit trees in a single night. For cut he will, and build he must.

His inroads on irrigation ditches could hardly be felt more severely than in water-scarce Arizona. Almost all of the State's fields of alfalfa, citrus, cotton, and wheat owe their existence to irrigation.

Once the chubby rodent finds a suitable spot on an irrigation ditch, he sets up housekeeping with a tenacity that defies ax and dynamite alike. Only death can stop his building.

Rather than risk open warfare by farmers against law-protected beaver, Arizona officials decided to put Castor and his clan to work on man's side rather than against him. The plan called for relocation of "nuisance" beavers in remote wilderness areas, where the animal's engineering talents would create dams to conserve water instead of blocking irrigation ditches and destroying orchards.

Thus began Arizona's Operation Beaver Lift, executed in the field by Howard Borneman, a veteran wildlife worker.

My wife and I met "Barney" Borneman by chance while photographing wildlife in the foothills of Arizona's White Mountains. We found him in the process of trapping a nuisance beaver, the first step in Operation Beaver Lift.

He used a simple trap that seemed to be little more than two hinged wire baskets. When sprung, the halves snap together, enclosing the animal without harming him (page 672).

As bait, Barney offered tempting aspen bark slivers, a favorite food of the beaver family. Then, tearing a hole in a near-by beaver dam, he placed the trap at the break, about eight inches deep in the water.

"Put it any deeper and the beaver'll drown," he explained.

When the beaver sees the water level dropping in the tunnels to his lodge, Barney continued, he explores until he finds the break in the dam. As he begins repairs, his hind foot usually springs the trap.

Ear Tags Trace Migrations

Barney tags each captive by crimping a small metal disk into one ear. A number on the disk identifies the beaver, and a check of the records reveals his length, width of tail, length of hind foot, date and place of capture, and release area.

Once tagged, beavers are ready for relocation. If they should ever be caught again, the record would supply useful information such as age, growth, and extent of wandering.

During the last 10 years Arizona authorities have relocated more than 500 beavers, especially in the central and southeastern parts of the State. Officials express enthusiastic approval of the results.

In the wild Mogollon Rim country, for example, the animals have not only survived but prospered. Where seeps trickled in springtime, beaver dams now store water. Where

667 Warren E. Garst, Walt Disney Productions

Like a Boy Caught in a Cookie Jar, a Beaver Stands Wide-eyed with Alarm

Handlike forepaws rank with long sharp teeth as the rodent's main tools. Using them, the animal pushes, pulls, digs, and scratches. Here water mats the coarse guard hairs.

topsoil washed away during heavy rains, lush meadows now grow. Where grass previously was parched by midsummer, the water table has risen and keeps the sod wet. Where wildlife and livestock once watered at stagnant pools, they now drink from natural streams.

To see how all this works, my wife and I went on our first beaver lift high into the pine- and spruce-clad White Mountains.

State conservation officials had selected five pairs of full-grown beavers to establish a new colony. The animals weighed 35 to 40 pounds apiece and measured a little over two and a half feet long. Often individuals weigh rather more—40 to 50 pounds.

Nothing Dull About Beaver Teeth

On one of the creatures Barney showed us a beaver's most important equipment: four orange incisors about an inch long, so prominent that they seem to be his only teeth, although he does have grinding molars farther back (page 675).

Constant gnawing wears away the soft dentine at the back of each incisor faster than the hard enamel in front, thus keeping the teeth sharp and chisel-shaped.

These large front teeth made my wife wary of petting the beaver until Barney put her fears to rest. The animals are usually gentle toward humans, he assured us, and even if handled are likely to use flailing tails rather than teeth in self-defense.

Barney dropped the emigrants into gunny sacks well soaked with water. The bundles squirmed crazily at our feet as the trapper loaded the pack horses. The loosely woven sacks permitted easy breathing and reasonable comfort but presented a difficult surface for gnawing teeth.

Bill Slaughter, who operates a cattle ranch near the proposed "plant," furnished horses, pack sacks, and bedrolls for the trip. He had more than a casual interest in the project, since his cattle graze along the trickling rivulet that would house the colonists (page 672).

"In time," said Slaughter, "I hope these beavers will turn that trickle into a watering place for my livestock."

The lift was not a long one, but difficult terrain often slowed our progress. The trail at times followed 60-degree slopes and dipped into deep gullies.

Spread out beneath us like silver coins on a green rug glistened strings of beaver ponds, outposts of conservation. Aspen groves quivered white and green at the water's edge, promising many a good meal for our bark-loving passengers.

On the trail each horse carried five beavers. At intervals Barney halted the pack train to pour water over the sacks.

"Beavers have a lot of fat under their heavy fur, and it's hard for them to stay cool," explained the trapper. "Besides, you've got to keep a beaver's hind feet wet. Otherwise the webbed tissue between the toes gets dry and chapped."

Nine miles into the mountains, we reached a tiny stream that crept through a small flat. Stands of aspen and other deciduous growth choked the margins of the rocky stream bed. Barney's sigh of satisfaction told us that this was the end of the trail for our 10 passengers.

Now Borneman applied a little wildlife psychology. He and Slaughter cut a pile of brush and threw it alongside the stream. Then they released the beavers, confused and exhausted from their long ride, and the rodents scrambled for the protection of the brush. The shelter would suggest a new home to them (page 673).

So the colony was off to a good start.

When we returned a week later, the new settlers had already begun construction, and small saplings lay about as if to be measured for cutting.

Forests Bombed with Beavers

The Arizona game authorities did not originate this idea of "planting" beavers for conservation purposes. A generation ago Federal conservation agencies began transporting beavers from one stream to another with beneficial results. Following this lead, a number of States experimented with the idea in the 1930's and 1940's.

Idaho gave the plan a new twist in 1948: its State Department of Fish and Game literally bombed the forests with beavers. Trappers caught nuisance beavers; then pilots experienced in dropping fire-fighting "smoke jumpers" into the deep woods went into action. They parachuted the animals in specially constructed boxes into mountain meadows far from civilization and near suitable streams. The boxes broke open when they hit, and the beavers, with nothing injured but their dignity, soon started work on their own conservation projects.

(Continued on page 677)

Ektachrome by Willis Peterson

Beaver's Paddlelike Tail Serves as a Rudder Afloat, a Dining Stool Ashore

Vegetarians, beavers prefer the soft bark of aspens, willows, and cottonwoods, but they also feast on aquatic plants. This peeled trunk may be chopped into portable lengths for dam construction. When the beaver smacks its tail *ker-slap!* on quiet waters, companions heed the danger signal and dive to safety.

← Anybody Home? Heaped Boughs Mask Beavers' Snug Lodge

To create year-round ponds, the beaver dams streams. Deep pools serve the rodent as shelter from enemies, a means of floating lumber, and a hiding place for winter's food supply.

Dam-deepened water moats this newly built lodge at Gentry Spring in the Mogollon Mesa country of central Arizona. Underwater entrances lead to cavelike quarters just above water level. Weathered sticks top the mud roof. The author and his wife find no door or window; chinks in the dome ventilate the abode.

Page 670: Clumsy on land, the beaver moves gracefully in water. Nose and ear valves close when it submerges. The animal can stay down 15 minutes.

↓ Danger threatens; *Castor canadensis* heads pondward.

672

♠ Bewildered but Unhurt, a Young Captive Cowers in Its Wire Trap

Beaver-built dams often destroy farmers' irrigation ditches in populous areas. To solve the problem, Arizona, like some other States, transplants beavers to remote regions where their ponds check erosion and provide water and lush pasturage for livestock.

Howard Borneman, working for the Arizona Game and Fish Commission, live-traps with this wire-mesh device. He baits the open box with aspen slivers and leaves it in shallow water. A triggered spring entraps the beaver without injury.

←Rancher Bill Slaughter (left) helps Mr. Borneman bag a beaver for the horseback journey to a spot high in the White Mountains.

Freed Prisoners → Go Exploring

When the beavers dam this trickling stream, rancher Slaughter's cattle will drink from a clear cold pond even in summer droughts. Piled brush helps the animals start work.

Nature's Lumberjack Sinks Chisel Teeth into a Juicy Aspen

Circling the tree, the beaver notches a wide band about the trunk. Then, with wrenching bites, it tapers the bole to a point; the tree snaps. Gravity, not the beaver, directs the fall. On smaller trees the logger completes his cutting on one side. The animal usually works alone, but two may collaborate on a large tree.

675

↑ Frenzied Digging Bares Grass Roots

Leaves, roots, and tough grasses bind the mud in beaver dams and lodges. The animal trowels materials into place with forepaws and nose. Coarse guard hairs emerging from this beaver's dark-brown inner fur lend a cinnamon hue to its coat.

↓ Orange Incisors Hew Trees with Ease

A beaver must gnaw, else ever-growing teeth prop its mouth open. Lower incisors cut while uppers guide and hold the wood (opposite page). Webbed hind feet (left) make the rodent an expert swimmer; the broad flat tail acts as scull and rudder.

↑ Gentle Caress Melts a Beaver Kit's Fear

Lustrous beaver fur lured men into the remote corners of America. Trappers, exploring distant wildernesses, opened rich lands for farmers and miners. Dealers in pelts amassed fortunes. Mercilessly hunted, the beaver neared extinction. Laws finally stopped overtrapping, and today the animal is making a comeback.

The mild-mannered creature makes a gentle pet. It seldom unsheathes its long teeth in captivity; it could, if so inclined, take off a man's finger. Pencil-pointed logs above attest to its carving ability. Roberta Peterson strokes the wild kit's chin.

← Small Eyes See Little

Keen smell and hearing compensate for poor sight. Mr. Borneman holds a 2-month-old beaver; it will weigh 40 to 50 pounds at maturity.

Kodachromes by Willis Peterson

The beaver, North America's largest rodent, swarmed in streams almost everywhere on the continent when white men first came. The colonists were oblivious of the animal's virtues as a conservationist, since conservation was hardly a problem then. But they speedily discovered that he was valuable for other reasons.

Woodsmen thought him a weather prophet extraordinary. Medicinally, the settlers credited him with fabulous cures. Castoreum, a secretion of the perineal glands, was an early American cure-all for every ailment from colic to sciatica. One writer enthusiastically endorsed the substance for deafness, pleurisy, and apoplexy, and asserted that it would strengthen the sight and stop hiccoughs.

Another favorite remedy called for powdered beaver teeth to be taken in soup. For treating epilepsy, a night's snooze on Castor's furry pelt was considered excellent.

This sleek fur coat, so lavishly bestowed by Nature, almost caused the beaver's undoing, as a look into history discloses.

Beaver fur appears dark to pale brown in color (page 675). Closer examination shows that the color is provided by the long, coarse guard hairs which cover and protect the short, dense, and silky underfur for which the skins are valued. When the beaver comes out of the water, it wipes and combs itself dry with remarkable combing claws on the two inner toes of each hind foot. This redistributes the oil and makes the fur waterproof again.

Pelts Served as Currency

Man quickly found that he, too, could make good use of this beautiful and practical fur. The demand for beaver pelts, especially for export to Europe's hatmakers, sent the trappers and mountain men ranging across the continent far in advance of the settlers. More than any other animal in North America, the beaver changed the course of history.

Beaver pelts became a widely recognized standard of exchange. In the 1780's, 12 skins bought a four-foot gun. Six furs bought a red Hudson's Bay Company blanket. These blankets are still measured and marked with reference to beaver pelts: a "3½-point" blanket, single-bed size, is as large as three big beaver skins and one small one. In more recent times the "points" have come to be a symbol of quality as well as a standard of size.

Fur cargoes from Canada and the American Colonies, turning overnight into fortunes of glittering louis and golden guineas, were contributing causes of the French and Indian War fought by England and France.

Later, in the 1780's, John Jacob Astor put a small sum into fur commerce. After half a century he withdrew, a millionaire, only one of many whose fortunes were founded on the fur of the beaver.

The fickleness of fashion alone saved the beaver from extermination. About 1840 silk hats moved ahead of beaver in popularity. As the demand for Castor's hide fell, so did the price of pelts, and trappers no longer found the beaver so profitable a quarry.

Nature's Balance Restored

Gradually Nature's balance was restored, and the beaver began to gain in numbers again. Protective laws were put on the books wherever the rodent lived.

To anyone who has studied the animal's construction works, the trite phrase "busy as a beaver" is an understatement. As a woodcutter, hauler, architect, and mason, he has no four-footed peer.

In many cases the beaver builds his house, or lodge, out in the pond created by his dam. On the proposed site he gathers sticks and brush and forms them into a rough circular platform reaching a few inches above the water's surface. Stones, boughs, and slender poles, generously chinked with mud, form walls and roof, a cone-shaped structure three or four feet high. Encircled by water, it is in effect a crude moated castle (page 670).

Passageways, made by gnawing and adjusting the sticks, all lead downward. Thus the beaver has to dive under water to leave or enter his home, but this is hardly an inconvenience for the amphibious creature; rather it is protection from land-bound enemies.

Father and mother rear a family usually in the same house every year. Each summer more mud and sticks are added until the lodge becomes a mansion in proportion, as much as seven feet high and 25 to 35 feet across at the water level.

I never tire of watching Castor carry supplies to repair his home. Clasping a double armful of mud, leaves, and grass, and steadying himself with his enormously useful flat tail, he waddles upright over the incline to the top of his mud and stick hut. Using nose and forepaws as trowels, he pushes and pats the mortar into place.

To protect his home from high water or

Hungry Beaver Hunts Food in the Snow

When mountain streams freeze and snow blankets the land, the beaver relies on an underwater storage chest for his meals. Branches and tender twigs anchored on a pond bottom in autumn usually fulfill his needs until spring arrives. Passageways leading down from the lodge permit daily dives to the food cache. The beaver keeps dam and water level high, and the pond seldom freezes solid.

In some parts of the country beavers begin storing food as early as August. But sometimes low water or harassing enemies cause delays and an early winter closes in before supplies are adequate. Then the creatures may forage in the deep snow.

←With earth buried deep, the beaver climbs snowbanks to gnaw limbs. Trees felled six to eight feet above ground level attest to his winter activities.

A heavy coat keeps the rodent warm even in the coldest weather. Snow-caked back and tail serve as camouflage.

Warren E. Rupst,
Walt Disney Productions

flash floods, this hydraulic expert often builds a flood-diversion dam. When angry water hits the supplementary dam, it fans out, losing its force. I have sometimes found three of these loosely knit structures before coming upon the builder's home dam with its backed-up water surrounding the lodge.

Beavers living on larger and swifter water courses burrow in the banks. Their tunnels begin under water, then turn upward to a hollowed-out nest above the waterline. Air vents are camouflaged with brush. The bank beaver, once thought to be a different species, merely exploits his environment.

Though Castor is primarily a nocturnal creature, you can find him abroad in the daytime puttering around his cone-shaped house, if you have patience.

On one such occasion I was lying in wait with telephoto camera, 50 or 60 feet from the lodge. Presently two brown noses broke the water and a pair of young beavers, or kits, clambered onto the brushy roof.

As with all young creatures, their desire for play overcame their sense of caution. In mock battle they charged each other, whacking tails on the mud-covered sticks. Grasping with handlike forepaws, they wrestled, tumbling over and over. Between half nelsons they took time out to scratch themselves. Then, slipping into the water, they dived under natural hazards to play tag; now and again smacking the water surface in their exuberance.

Fathers-to-be Take Leave

In my fascination I completely forgot the camera. It was just as well, because the mother had lumbered out of the water to watch her charges. The sound of the shutter would surely have alarmed her and sent all three scooting for safety.

Mamma studied her youngsters while sampling a leftover from last night's dinner, methodically knifing bark from a leafy aspen limb. Soon the romping children grew tired and joined her. Sitting on haunches, they nibbled daintily as they held the succulent bark in their tiny hands.

Beaver kits, normally one to four in a litter, are born usually during April and May. During this time the male discovers that his presence is unwelcome and takes a leave of absence. The young, open-eyed at birth, begin to accompany their mother into the water by the second or third week.

Even at an early age they primp for long periods, as if greatly concerned over the state of their glossy fur. With the specialized double claws on their hind feet they comb themselves over and over.

Thus engaged, they sit upright on their tails but not without much swaying and tilting. I have been highly amused watching the little fellows wash their faces, tending so seriously to their toilet that they lost balance and toppled headlong.

Food Stored Against the Winter

Because beavers do not hibernate, all members of the colony work together gathering winter food supplies. They wedge short tree limbs in the muddy bottom, weighting them down with mud and stones. This fresh food locker can be reached at any time, even though the pond's surface freezes over.

If the beaver runs short of food, he must break a hole through the ice and look for a suitable tree. A gnawed aspen stump high above ground level is evidence of a snowbank sawhorse and testimony to a long, hard winter.

Imagine this floundering figure lurching through snow, tugging his newly cut limb with his teeth. At best he can only waddle laboriously over the bare ground. Only an emergency would take him out when the earth is buried deep in drifts.

In water, however, the beaver is hard to beat. Nose valves shut automatically when he submerges. Oversized lungs permit him to stay under sometimes for as long as 10 or 15 minutes, to the discouragement of wolverine, coyote, lynx, and bear.

Away from the safety of his pond, the beaver becomes wary, as we can tell from the logging trails he builds. These direct routes, graded and smoothed, provide for quick getaway should danger threaten, and they make it easy to pull logs to his wood yard.

Not satisfied with building roadways, Castor digs canals as well. His waterways connect one pond with another for social calls and for floating logs. If the grade is level, he will at times excavate a ditch 300 feet long or even longer.

In the logging area he becomes a gourmet, choosing only trees with the best bark. Bracing himself on hind legs and tail, he grasps the sapling with his forepaws and cuts a notch at body height with his lower incisors. Lowering his head, he chisels a similar notch four to six inches below. One sharp twist and he

National Geographic Photographer J. Baylor Roberts

Eager Beaver! A Lost Kit Takes Nourishment from a Louisiana Game Warden

Frightened, the beaver cries out like a child. This pet won the hearts of conservationists at Camp Salmen.

tears away bark and wood between the cuts. Soon the ground is littered with chips.

The animal lumberjack usually cuts a small tree through from one side; a larger trunk may be circled or cut on two sides (page 674). When the trunk begins to creak, he rushes to safety.

Despite popular notions, he cannot control the direction of a tree's fall, and sometimes the hapless creature is trapped by his own handiwork.

When beaver young are two or three months old, the whole family usually goes up and down its stream on a junket which may last three or four weeks. If the aspen supply is giving out at home, Castor may find another spot more to his liking, and the group will start work on a new dam and lodge.

Back at the old home place the dam, no longer repaired, will gradually give way. The pond will vanish, but on the acres it covered black silt will burst into a rich carpet of grass. In time the forest will creep in again to replace the aspen and willow on which the beavers fed.

When spring comes, the new dam will conserve the rains that precede the dry season. Trout may prosper in the new pond and waterfowl breed in new nesting sites. Fur bearers such as muskrats, mink, and raccoons will flourish in an improved habitat.

As spring wears into summer, the impounded water will quench the thirst of stock and wildlife alike and give farmers who were once beaver foes a much needed supply for their irrigation ditches.

Some ranchers, conservationists, road builders, and others criticize this picture of the beaver's work as being too bright, for his presence still creates problems. Nearly all, however, agree that under proper control he can do far more good than harm.

As Barney Berneman puts it, "The Arizona game department relocates many forms of wildlife, but beavers are the only ones that return work for our efforts."

One Hundred Hours Beneath the Chesapeake

Aquascope Explorers Bring Back Remarkable Photographs in Color from the Murky Depths of the Bay

By Gilbert C. Klingel

With Illustrations by National Geographic Photographer Willard R. Culver

WITH an ear-splitting clang the hatch of our steel diving chamber was banged shut above us and clamped tight. Then, with a noisy grinding of chains, we were lowered into Chesapeake Bay.

For a moment we could hear water sloshing over the top of our strangely shaped "Aquascope" and could see the world cleft in twain as we slid beneath the waves.

Suddenly all was quiet in the narrow chamber. Sound as well as sight of the upper world had vanished. The vibrating hum of the air compressor on the barge above ceased and was replaced by the steady, barely audible hiss of the air pumped to us.

Into the Silent, Teeming Depths

Suspended in a green haze, we were on our way to the bottom. Our purpose was to study at close range and to photograph, in color, the creatures that live in swarming millions in the Bay's depths. The expedition was the result of the pooling of my previous undersea experience and the resources and ideas of the National Geographic Society.

With National Geographic photographer Willard R. Culver, I lay on a foam-rubber mattress and gazed through a Plexiglas window at the little-known world before us (page 687).

There had been no hint that August afternoon of the undersea hurricane we were about to witness. A daylong calm had lain over the waters, and, except for a gentle roll coming in from the Atlantic beyond distant Capes Charles and Henry, the Bay was like a mirror.

The only visible movement as we descended was a gentle gliding motion, the slow slipping by of small bubbles and bits of floating matter. The tide had just turned and was starting in.

We were several miles out from shore, just beyond the outer end of the long sandy bar that projects into the Chesapeake north of Wolf Trap Light, between the mouths of the Piankatank and York Rivers (map, page 683).

The bar is a favorite resort of fishermen, a place where we expected to find abundant marine life—schools of bluefish and croakers, sharks, porgies, and sea trout.

On our way down we watched wave-focused shafts of yellow light piercing the liquid fog in long, quivering fingers, wavering uncertainly and then disappearing, only to be replaced momentarily by others. In a few seconds they faded softly away, and our window showed uniform green.

About 20 feet down we entered a layer even denser than the green surface water. Innumerable bits of minute suspended matter began flowing by our window. When we turned on our lights, the particles resembled snowflakes which, inexplicably, had fallen beneath the sea. In steady streams they drifted by, obscuring our vision and restricting our sight to a few inches.

We did not know it then, but in 20 minutes we were to be in the grip of an underwater hurricane, a deep-sea storm the equal of any blizzard I have seen in the air above.

We landed gently on the bottom at 35 feet. A cloud of brownish-yellow sand erupted before the window, then slowly settled or drifted away. The Bay floor, swept clean of all growth, looked as if it had been scoured by a giant brush.

Deep-sea Storm Buffets Aquascope

The storm began slowly. At first we noticed that the "snowflakes" were drifting more swiftly, beginning to twist and eddy more violently, and that the loose sand was starting to move, the small grains first, then the big. A large black sea bass came from somewhere behind us, slithered with vibrating fins close to the bottom, nosed along the lower edge of the window, then disappeared. We noted that it was struggling to maintain its course.

Soon we saw larger objects going by. Rolled-up balls of marine vegetation torn from its roots, mangled and twisted sponges, and tufts of red and purple algae went rolling over and over, bounding like tumbleweed on a wind-swept prairie. Then the bottom itself

682

Night Shrouds Chesapeake Bay, but Aquascope's Work Goes On

Beneath these black waters, two men in a strange diving chamber, the Aquascope, explore the mysteries of life in the Bay (page 687). Aquascope's mother craft is this pontoon barge, with its welter of rigging and gear. Her surface crew tends generator and air pump, and with steel cable and winch controls the chamber's descent to depths of 100 feet.

Nocturnal excursions find the underwater world alive with many forms of life that hide by day. Light flares beneath the barge pontoon as Aquascope fires its cameras and high-speed lamps.

began to break loose. Bursts of sand and shells were blasted away and poured into the murky distance in gyrating clouds.

Soon the whole space before our eyes became a gray blur, a turbid blast of driving particles of sand and white flakes, a veritable underwater sandstorm. We felt as if there should be a screaming or howling of wind instead of the uncanny quiet.

When the 3,000-pound Aquascope began to quiver, we knew it was time to surface. We left the bottom in a queer sliding motion and then swung free in a wide arc on the end of our cable. The blast turned us half over, and for a brief time we thought we were going upside down.

Cameras and lenses slithered about inside or piled up around our arms and legs. We braced ourselves and hung on while the deck crew reeled us in. Nor did we come right side up until we were close to the surface.

To our surprise, when we broke through the silvery film, the Bay was still like a sheet of glass; only a few moving bubbles and the thrumming of the anchor line gave any hint of the underwater storm.

Such deepwater storms occur daily. Twice in every 24 hours a great surge of ocean water enters the Chesapeake's mouth, and twice the accumulated flood pours out to sea again. Down in the unseen depths, broad streams wind through sinuous channels and flood the obscured bottom with a briny deluge.

Two-way Undersea Rivers

These oceanic currents are like undersea rivers, but they are rivers without visible borders except for the dark slopes of their channels. They melt imperceptibly into other oceanic streams, joining them for a while, or they may divide and separate in mid-flow. In places they move parallel, over or under each other, or even in opposite directions.

But whatever their course, the currents all come in long, wide-curving ribbons from the slopes of the Continental Shelf, pushed onward by the tremendous pressures of the moon-urged tides. They act in concert with

the abyssal turbulence created by the warm northward-advancing Gulf Stream lying only a few miles to the east and by the waning force of the cold southward-flowing Labrador Current, many miles to the north.

These hidden streams, daily reversing their direction with the tides, flowing rapidly or creepingly, break into a thousand segments as they penetrate the long reaches of the Chesapeake.

There they are mixed with a new flood of fresh water from the mountains and fields of the Virginias, Maryland, and Pennsylvania, which finds its way to the long, winding river valleys and thence to the sea.

Both floods mix and combine their massive burdens of organic life, dissolved chemicals, and nutrient materials. Within the sheltering arms of the land, in a region which is part sea and yet part of the continent, are provided the conditions and the food for a swarming marine fauna.

Yet, although an arm of the Chesapeake nourished the first permanent English settlement in North America, the depths of its waters are almost as little known today to the average American as they were in the time of the Jamestown colonists. Most of the life of the Bay has been classified, and in many areas the waters have been charted and their chemistry investigated, but few persons have penetrated the green depths.

The very life which makes the Bay such a storehouse of food helps to conceal it. Every square inch of water contains hundreds, even thousands, of micro-organisms, such as diatoms and other minute algae, foraminifers, and protozoans. Though most of the water's turbidity is caused by fine suspended silt, the abundance of microscopic life also clouds the water; every object is softened, dimmed, or obscured by the mass of the tiny bodies; they filter out the light and hide the strange world in which they live.

Numerous photographs in black and white and in color have been made in tropical seas where the water is crystal clear, and many have been published in the National Geographic Magazine; but there have been few underwater portrayals of North Atlantic marine life.

Unusual Submarine Portraits

The accompanying portraits, a partial record of fewer than 30 days of operations in the field, represent the accumulation of approximately 100 hours beneath the Bay.

There were three prerequisites for success: (1) that the Aquascope personnel be able to remain on the sea floor for long periods if necessary, in reasonable comfort, breathing air under normal surface pressure, free from cold and from stinging jellyfish, unmolested by the sweep of currents and tides; (2) that they

Salt and Fresh Water Meet in the Chesapeake, Drowned Valley of the Susquehanna River

Tidal currents merge with the outpourings of hundreds of rivers, creeks, and branches in this vast tidewater region, largest in the United States. Here mingle oyster dredgers and trawler fleets, skipjacks and cabin cruisers, merchant ships, and gray vessels from the mighty naval base at Norfolk.

Beneath the busy surface exists an even busier world of swarming marine life rarely seen by man.

be able to bring cameras within a few inches of the bottom, where most of the Bay life has its being; and (5) that there be available under finger-tip control an array of powerful high-speed lights capable of creating instantly any desired lighting condition.

The Aquascope resembles a large misshapen yellow steel lobster (page 686). Its body and tail accommodate the two observers and an intricate maze of relays and condensers, tubes and switches. On each side are steel and Plexiglas "claws," which house a battery of four lights. Two additional lights are mounted from an overhead telescopic "antenna," which can be extended or retracted from inside.

The chamber was lowered and raised by a chain hoist and cable winch operated by the surface crew on a steel pontoon barge. A 25-horsepower outboard motor moved the barge and the Aquascope it carried.

Compared with most other deep-sea rigs, the Aquascope is comfortable. There is no danger of the "bends," for there is no pressure.

Cold is no problem, either, even in icy bottom currents; instead, we found that excessive warmth bothered us more and often forced us to descend clad only in bathing trunks.

Most of our dives lasted two to three hours; one extended nearly five. The time possible beneath the sea is limited only by the patience of the deck crew.

The Aquascope, of course, has its limitations. It restricted our depth to 100 feet, but for our particular work this was not important, for we always observed more life and more activity in relatively shallow water.

Undersea Night Life Active

We wished also to be able to study the life of the Bay after dark. Night beneath the sea is a time of great activity, one that reaches a double climax in the hours just after sunset and again just before dawn.

As an aid in focusing our speed lights and attracting nocturnal forms, we were equipped also with a series of small battery-powered lights that could be brightened or dimmed at will so they would not frighten away light-wary species. Many nocturnal animals are highly sensitive to light, and we found we could control the movement of certain types by changing light intensity. Some species could be shuttled back and forth across our window by alternately brightening or dimming the lamps on either side.

Gwynn Island, Virginia, was chosen as the principal base of operations because of its proximity to the ocean and because in a limited area it offers marine conditions varying from deep water to shallow tidal flats.

In the strait of Milford Haven between island and mainland lies a peaceful region of water, grassy areas teeming with crabs and other small life, and coves and creeks. It is replete with oyster bars and stretches of shifting sand and soft mud, each with its peculiar life and special ecological conditions.

One end of Milford Haven opens on the Piankatank River, a beautiful unspoiled estuary; the other, at the Hole in the Wall, a series of sandy bars and shallow shifting channels, a feeding ground for porpoises and a passageway for fish and other organisms migrating to and from the Bay.

Dance of the Anemones

We soon learned, however, that incessant movement is the key to life beneath the Bay. Even on the shallow tidal flats the eelgrass waves continually when submerged, first in one direction, then the opposite, posturing perpetually back and forth as if in a ballet.

In the deeper waters the finger sponges quiver constantly or vibrate as the water passes through their orange or scarlet branches. Tentacles of anemones sway and dance (page 690); fish rock back and forth singly and in masses. Prawns cling with transparent claws to the weed and algae, and even crabs at times seek shelter and bury themselves in the sand.

In fact, whole legions of animals have gone underground to escape predators or to hide and trap their prey, and the Bay's floor is literally full of holes. The owners, an assortment of worms, small fishes, and crustaceans, continually blow out clouds of fine silt, which give the effect of small volcanoes erupting.

The constant stirring up of suspended silt and the settling of micro-material from the waters above make necessary a never-ending house cleaning. Except in swift channels, everything is sprinkled with fine powder; it clings to the vegetation, fills holes and crevices, quickly covers the shells of oysters and crabs, and smothers all but the most active organisms. The slightest movement stirs it up; tiny minnows create clouds with the action of their tails; a walking crab can leave a trail like skywriting for yards, and an active

(Continued on page 693)

685

Delicate Sea Nettle Wears Lacy Ruffles; It Stings with Poison-laden Tentacles

At times ghostly *Dactylometra* infests Chesapeake Bay's turbid waters in vast swarms. Swimmers hate this jellyfish: its slightest touch burns flesh, and extensive stinging can cause severe illness. Tentacles, up to a yard or more long, trail gracefully except when retracted from danger (right). Some nettles are white, lacking this reddish hue.

Underwater scenes in this series were photographed from the Aquascope in Chesapeake Bay.

Kodachrome by National Geographic Photographer Willard R. Culver

The Aquascope, Resting on Its Barge, Heads for Adventure in Chesapeake Bay

Many divers and many cameras have explored the crystal waters of the Tropics, but the cold and gloomy depths of northern seas have yielded their secrets to few men.

One of these men is Gilbert Klingel, Baltimore metallurgist who pursues natural history, boatbuilding, and writing by avocation. With financial and technical support from the National Geographic Society, he built the Aquascope from which life in the murky Chesapeake could be photographed.

Here the specially constructed pontoon barge carries the ton-and-a-half Aquascope and crew past Gwynn Island in Virginia. ↓ Amid a rattle of chains the Aquascope submerges, ballasted by 400 pounds of steel. A 25-horsepower outboard motor beyond Bill Nahm's shoulder drives the barge at a speed of five knots.

686

Caged in Steel and Plastic, Author and Photographer Prepare for Descent

Page 687: Behind this inch-and-a-half-thick window, Klingel and National Geographic photographer Willard R. Culver recline on foam rubber. A pump on the barge supplies dehumidified air under normal pressure; telephones ensure easy communication with the surface crew.

When curious creatures approach bait tied to the chamber's lower edge, a flick of the control panel selects powerful high-speed lights on wings (left and right) and telescopic boom (above). These flash when the camera shutter is tripped.

Culver faced overwhelming difficulties because of silt clouds and a seasonal "living soup" of micro-organisms. Yet he captured a remarkable record of Chesapeake marine life in its natural habitat.

Kodachromes by National Geographic Photographers Willard R. Culver (above) and Richard H. Stewart

As Ugly as Its Name, a Toadfish Glowers from Its Hiding Place Beneath Finger Sponges

Legions of sponges flourish in the Bay, clinging to rock and sand, to oyster clumps and wharves, to the bottoms of boats and even the backs of turtles. Some of these primitive animals penetrate shell, rock, or wood.

Many Bay sponges are little more than soft brown blobs. But the finger sponges scattered over large areas flash vivid color through the somber submarine world. Their spreading branches provide favorite haunts for hunters, such as this toadfish lying in ambush.

Wrinkled brown skin, face lappets, and chin barbels effectively camouflage the grotesque toad against the silt and rocks of the sea bottom.

For all his lack of beauty, the male toadfish has a highly developed paternal instinct and zealously guards his mate's eggs against intruders.

Inquisitive Toadfish Check on the Aquascope

"Of all the fish we met," says the author, "toadfish were the most curious and fearless. Often they came swimming out of the haze, propped their chins against the window, and stared at us as we worked switches and cameras. Curiosity abated, they crawled under the window ledge and went to sleep."

➔At 25 feet, this specimen cruises above an oyster bed.

➔Only five feet from the surface, a toadfish moves in a fog of silt and millions of tiny drifting plants and animals. A flash of white shows savage jaws. Eelgrass and algae (right) shelter a cluster of sea squirts.

A Voracious Appetite Lurks Inside Pale, Translucent Anemones

↑Sponges, algae, and anemones form an eerie flower garden, nearly smothering the up-ended oysters on which they make their homes.

Delicate colors and petallike tentacles suggest the flowers of the land, but sea anemones are animals nonetheless. Unlike their relatives, the jellyfish, they do not float free but cling tight to any anchorage.

←Anemones, never still, spend their hours twitching and quivering as if afflicted with St. Vitus's dance. Small creatures brushing against the seemingly innocent tentacles are paralyzed by minute poisonous barbs, then drawn remorselessly into the animal's waiting mouth.

Sea Bass and Sponge ➔ Make a Study in Ebony and Fire

Black sea bass frequenting the Bay's rocky areas showed remarkable manners, each fish waiting patiently for its predecessor to finish before attacking the Aquascope's proffered bait.

Fish looming in the background suggests the disappearing Cheshire cat.

➧ Eels showed no consideration for one another as they tore at the bait. Greedy and quarrelsome, they often fought, churning up the bottom.

An oyster drill (lower center) crawls up the Aquascope's window. This snail, bane of the oyster's life, bores through the hardest shell to feed on the flesh.

Kodachromes by National Geographic Photographer Willard R. Culver

Sand Perch and Crab Wander Through an Oyster Bed

On hard surfaces the oyster grows at any angle, but where it may be overwhelmed by silt the mollusk stands upright so its valves can open freely.

Blue Crab, Itself a Favorite of Gourmets, Banquets on a Fish Head

Once at rest on the bottom, the Aquascope was ignored by many of the Bay's inhabitants. This 7-inch crab with stalked eyes seems oblivious of observers.

fish can create a small explosion which takes minutes to clear away.

Although the Bay's waters are somber and even drab at times, the subdued tones heighten, by contrast, the brilliant colors of some fishes and of the sponges and algae.

This was particularly true of the finger sponges, which carpeted certain areas in flame-hued masses. They grew commonly on soft bottoms of gray mud, and the delicate tracery of their vividly colored branches was accentuated and brought into high relief by their dull backgrounds.

Toadfish Lurk Under Sponges

Finger sponges were the favorite lurking places of toadfish, those grotesque creatures that abound in all parts of the Bay, and there were few sponges that did not have toads under their bodies (page 688).

Ugly to a degree shared by few other fish, with enormous mouths, rows of needle-sharp teeth, and an assortment of queer face lappets and chin barbels, toadfish are generally hated by fishermen. Their bite and spines can be dangerous, and they show a savage disposition when hooked. In addition, they have no commercial value.

But their ugliness masks a surprising efficiency, and their strange appearance aids them in acquiring food and avoiding enemies. Toadfish do not waste energy pursuing prey, but rest comfortably half-buried in the silt, looking like the bottom itself, until some luckless victim passes close.

Then their lethargy is instantly thrown aside. There is a sudden snap of a yawning mouth, and the prey is no more.

Not all of the Chesapeake is sand and soft ooze; nor is the bottom a level plain. In places long lines of tilted rocks protrude from the floor and create a strangely weird landscape of jagged hills and valleys. These rocks are festooned with delicate algae, highly colored encrusting sponges, and a fretwork of lacy bryozoans. Some seem to sparkle with hundreds of small white crystals. But on close scrutiny the crystals are seen to be not mineral but the delicate tentacles of small burrowing worms that inhabit the rocks in hundreds.

Beneath the rocks are innumerable cavities, and there are ledges and narrow, winding, shadowy canyons and gullies. These hidden places are home for animals which we seldom saw elsewhere. Black sea bass had taken possession; their gliding forms were always present.

These bass were an interesting demonstration of protective coloration. Close to our windows, their bodies appeared a beautiful gun-metal black, and their eyes shone deep, iridescent blue. This is the way they appear in open air on the deck of fishing boats. So pronounced is their hue that no alteration in color seemed possible; yet we were to learn that a distance of only two or three feet so altered their appearance that they were nearly indistinguishable from their surroundings.

As they melted into the background, they changed from black to a strongly striped mottled brown, then to tan, and finally to soft yellow green. Reflection from a sponge sometimes caused their blue eyes to photograph orange (page 691).

The ability to blend into the underseascape was shared by many different fish. Even those with highly contrasting markings, like the spadefish we found living in the rock valleys, faded easily away and merged into the green blankness (page 694).

Spadefish are beautifully streamlined and arrayed in mixed silver and iridescent gold, with four or five vivid black zebralike vertical stripes. Yet, as they retreated, the stripes paled quickly to gray, from gray to green, and finally to the soft light which is of the water itself. The reflection of the lighter scales persisted long after the seemingly stronger black had disappeared.

Fish That Resemble Gnomes

Not one Chesapeake fisherman in a hundred has heard of horned blennies, much less caught one; nor would he quite believe what he had seen if he did. The blennies are among the most remarkable of all the Bay's fishes and among the most successful. They are odd-looking in the extreme, and, although only three or four inches in length, they make up for their small size by a host of special abilities and attributes. The rock valleys were their special domain.

A blenny close up looks like nothing so much as a gnome or troll which has acquired fins and taken up an underwater existence. Its face is that of an old man, gnarled and wrinkled, with protruding brow; its eyes are peculiarly human, and they stare with a strangely fixed look. But there the resemblance ceases, for protruding from the upper margin of each eye is a sharp-pronged

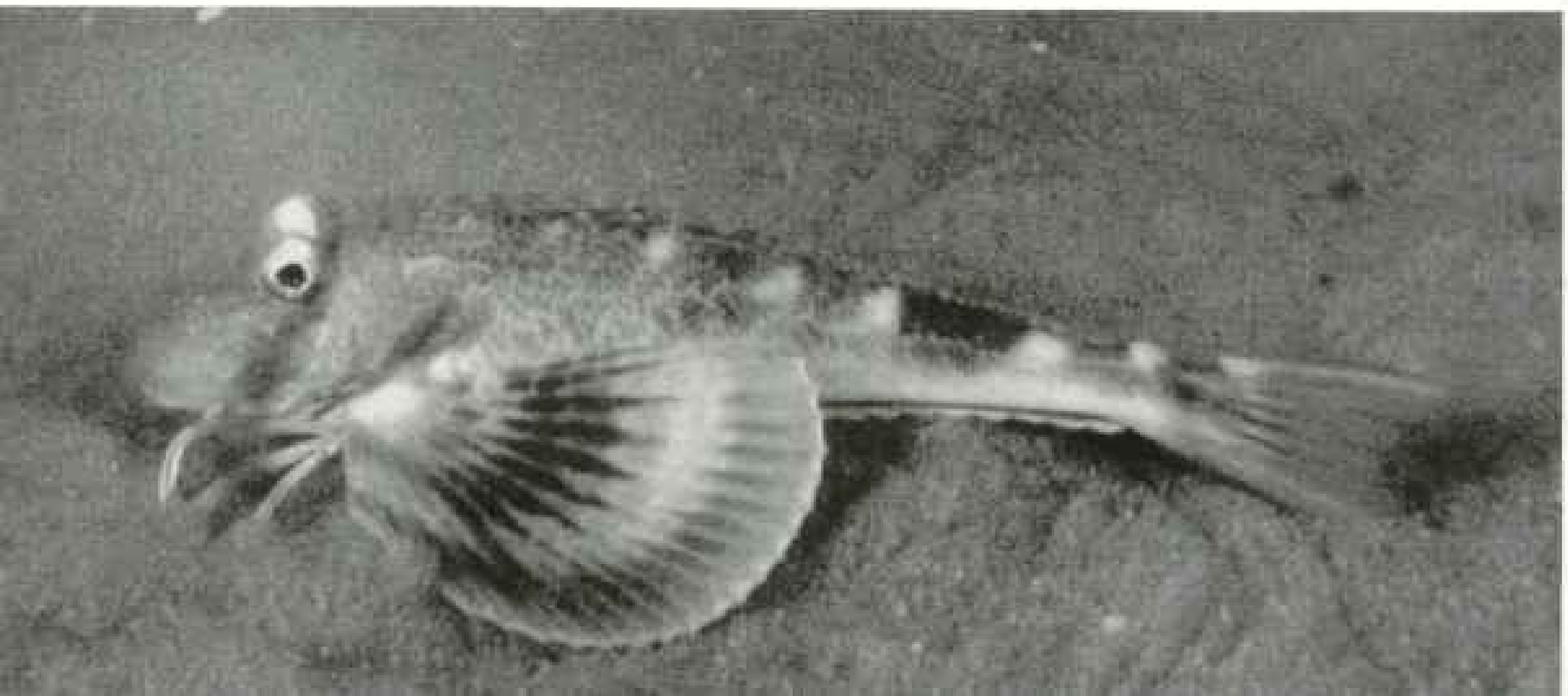
Fore and Aft: Spadefish Resembles His Tropical Cousin, the Angelfish

"antler," or branched tentacle, like those of young deer. Unlike deer antlers, however, the "horns" are flexible and may be bent easily in any direction. They function as sensory organs and not as weapons (next page).

As if these peculiarities were not enough, the blennies have taken to hopping as a means of getting about, although they can swim quite well if they wish to. They skitter about the bottom like grasshoppers.

Although the rocks they inhabit are the dwelling places of larger and hungrier fishes ready to gobble up helpless blennies on sight, they do very well indeed. Nearly every

The Sea Robin, a Clumsy Swimmer, Walks and Digs with Pectoral Fin Rays



blenny owns a castle to which it retires when danger threatens. Their fortresses are the center of their activities, and their territories are jealously guarded against invasion. More than once we saw them sally forth and chase away large black sea bass.

Their homes are only vertical empty oyster shells, but they provide every protection a blenny can possibly need. Inside is a silken-smooth nacre-lined cell, and the walls are stout. Outside and all around are fields of succulent algae on which to browse, hordes of luscious crustaceans for dinner, and a never-failing tide to bring a fresh supply.

The most rewarding hours were those of darkness, and nearly half our submarine excursions were made at night. Then we saw forms hidden during the day and beheld the nocturnal pageantry which is such an important part of the deep-sea scene. For night is the time of activity for many species, when they come forth to feed and to go about their mysterious errands. Night is the time of the worms, of the flounders and eels, of the half-beaks, and of the sharp-toothed needlefish. It is also the time when the crabs leave their hiding places and prowl in search of food.

No two evenings were quite alike. One of the most memorable was the night of the flounders, when for hours we were the focus of attention for these strange flattened fishes.

We had landed in an open glade of golden sand in the midst of a forest of waving weed. On one side a steep sand slope rose surfaceward and melted into the blackness above. Ahead our lights created long cones of radiance, which were accentuated by the gloom and by the millions of motes of microscopic living matter that were already beginning to concentrate in the beams.

For a second we were alone; then our lights began to perform their customary magic. A veritable blizzard of small iridescent pink fish burst into the cones of light and went wild with activity. Their diminutive forms hurtled back and forth across the beams in a sort of frenzy.

Pink Fish Dash in All Directions

Although their tiny bodies were so closely packed as barely to permit passage and were hurtling in every direction, we never once saw them collide. So fast were they going and so incessant was their movement that we were unable to identify them. Culver took a picture of their massed bodies, but when our eyes had recovered from the high-speed lamps they were nearly all gone, frightened away by the sudden blinding flash.

Our dimmer bait lights, however, were sheer fascination for a host of other small beings. Dozens of spiraling red nereid worms raced in and out of the light. Their bodies were decorated with numerous featherlike appendages, and they seemed to vibrate as they darted through the water. Their energy was incredible, and they hurried about as if impelled by invisible electric currents.

Glass prawns, so transparent that one could see their insides working, hung motionless in

Horned Blenny Peers from Its Fortress, an Oyster Shell

The blenny raises its family in the shell of a dead oyster. Flexible "antlers," a kind of tentacle, help detect passing crustaceans which the miniature fish seizes in lightning dashes from cover. Although blennies can swim, they normally jump about the bottom like grasshoppers (page 693).

midwater. Innumerable isopods and copepods and other small crustaceans jerked spasmodically back and forth, tracing erratic trails in the beams. Countless larval fish, all eyes and stomachs, hovered in the weaving mixture and gobbled crustaceans smaller than themselves.

Grotesque Feast of the Crustaceans

Their hunger seemed insatiable, but it was nothing to that of the crabs. By dozens these long-legged blue and green crustaceans came stealing out of the weed aisles, creeping sideways across the sand and up to the bait at our windows. They tore and shredded the tender flesh with their claws, cut it into ribbons, and shoved it into their mouths, where it was ground into shreds (page 692).

It was a grotesque scene. The lights cast long, crooked shadows and accentuated every detail of their circling pointed bodies—the cold, glistening, stalked eyes, the sharp claws poised for offense or defense. It was every crab for itself, and they were quarrelsome. While the bait lasted, they fought and tore and worried, struggling for each scrap, menacing one another with their claws.

The scent of their feasting must have drifted on the tide, for long after the last morsel was gone they kept coming, searching with small quivering antennae for the source.

Flounders Lie in Ambush

With the stragglers came the first flounders. At surprising speeds they glided in, with fluttering fins a foot or so above the sand, sliding in long graceful curves into the circle of radiance. Then they suddenly banked, slowed slightly, and dived at a low angle into the bottom. When they hit, a small eruption of sand concealed them for a moment; when it cleared, they could hardly be seen. Only their eyes, mounted and swiveled on low turrets, provided any hint of their presence; their bodies blended perfectly with the bottom.

They were nemesis for smaller fish crowded under the lights, and they stationed themselves where activity was greatest. We saw their eyes follow some intended victim, watching and waiting for the right moment. Then they would burst from concealment, seize their prey, circle the lights, and glide in again to dive into the ground and wait once more.

The Chesapeake contains jellyfish in such incredible numbers that at times they can be reckoned in the billions. Most of them are so diaphanous and frail as to be barely distinguishable, and one can swim through their packed bodies without being aware of them. Some are poisonous, others harmless. Some are exceedingly small, others big. The larger ones may be strikingly colored and may trail yard-long streamers of stinging tentacles.

Yet, though we saw them at times in the hundreds, we found photographing them one of our more difficult assignments. And for an unexpected reason.

Jellyfish are supposed to be helpless and to have little control over their movements. Like other plankton, they drift freely about as winds and tides dictate. More than 90 percent water, their anatomy and sensory organs are primitive. Only by the slow pulsations of their umbrellas or the vibrating action of minute cilia can they achieve independent action. Yet, for all these handicaps, we found to our surprise that we could never successfully and deliberately approach them with the Aquascope.

Creatures of Another World

When we were as far as 20 feet away, the jellies somehow sensed our coming and maneuvered themselves out of reach. Only by hanging still as they passed were we able to obtain their portraits (page 685).

We were to learn that in other ways, too, they are not so helpless as generally thought. They seem to have a rudimentary ability to band together and maintain nearness to one another. Almost always they came in groups, often only a few individuals but at times many hundreds.

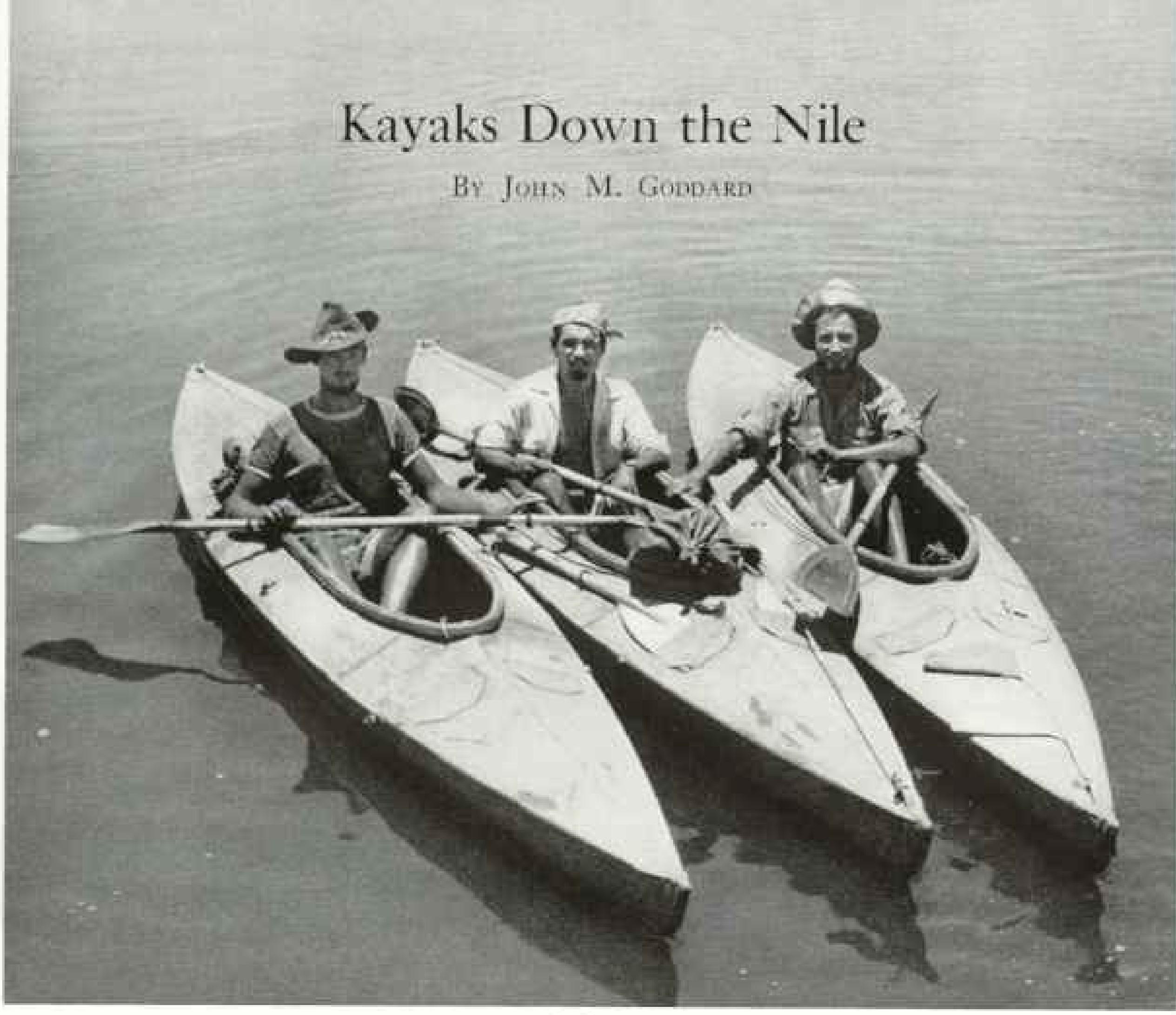
It is an enthralling and slightly weird spectacle to witness one of these swarms beneath the sea moving en masse with the tides, to see their fragile pulsing bodies and the yards of translucent stinging tentacles. More than any other creatures, they seem to belong to another world.

They are part of the boundless ocean and convey the sense and feel of the sea. The sea is their substance and from the open water they draw nourishment and all their needs.

And when in the course of time they have performed the strange and mysterious functions for which they were designed and have accomplished whatever obscure purposes they were made for, they dissolve and quickly become sea again, merge with the ocean that gave them birth, become one with the flowing tide that is at once their life, their support, and the means of their destruction.

Kayaks Down the Nile

By John M. Goddard



BUBBLING up at our feet in 10 tiny springs, the Nile, longest river in the world, leaped to life from its southernmost source and ran down a grassy hillside. With two French friends I stood 6,700 feet above sea level in the central African highlands of Ruanda Urundi, watching the trickle that stretches itself out at last to 4,100 miles.

My companions, Jean Laporte and André Davy, and I clambered up a 10-foot pyramid erected in 1938 by a German explorer, Dr. Burkhart Waldecker, to honor all who had sought the Nile's source (page 699).

For this splashing brooklet and for us who had jeeped, hiked, and bushwhacked to find it, a turbulent tomorrow lay in store. Torn to froth in rapids and flayed by rain, wind, and parching heat, the swelling stream was to be our unpredictable host as we paddled and portaged cockleshell kayaks from source to mouth, a distance equal to that from my home in Los Angeles, California, to the shores of eastern Greenland.

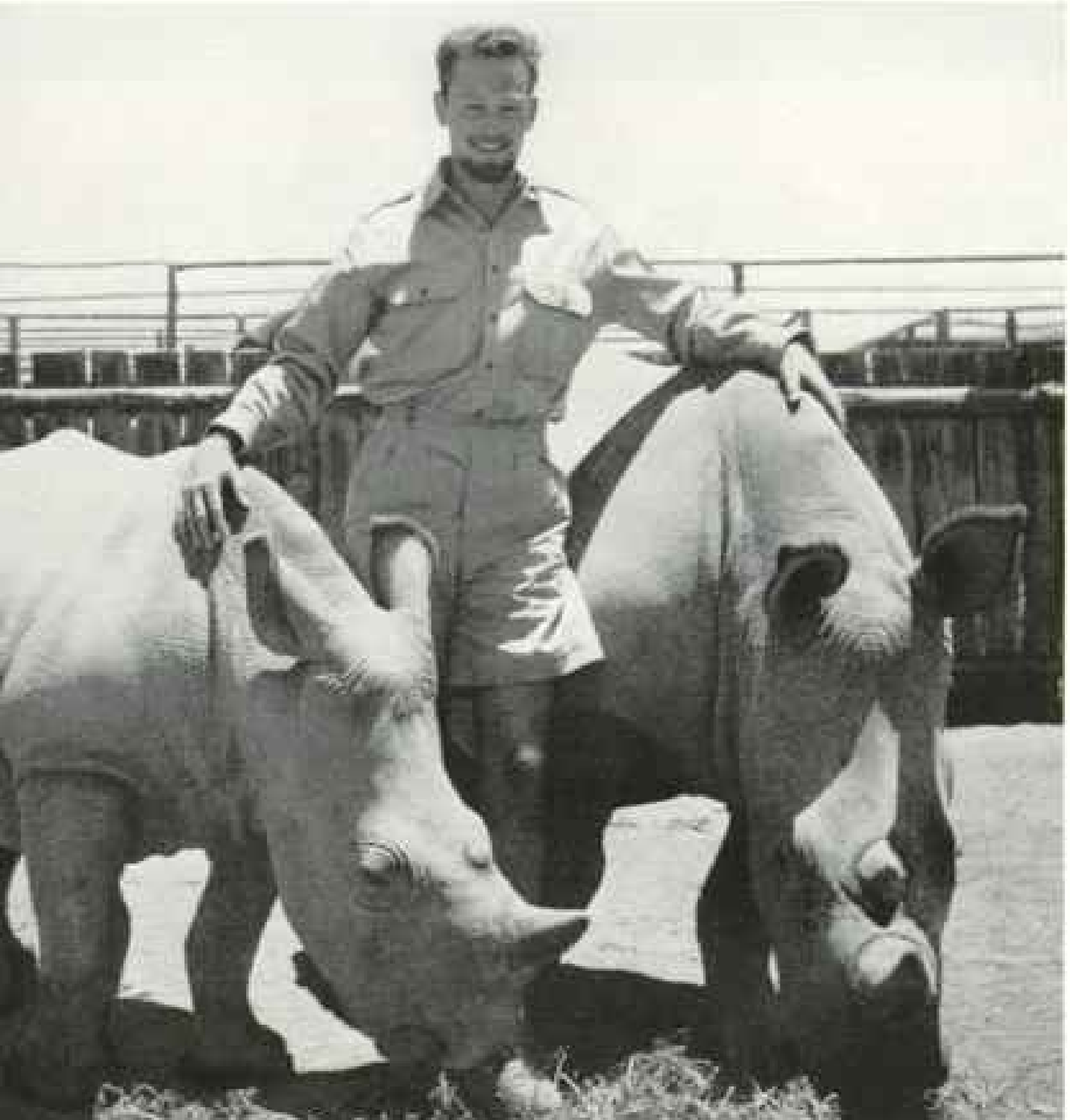
There, that November day on a windy hill 4° south of the Equator, began the realization of a dream that had haunted me for 15 years—the dream of exploring the river of the Pharaohs, of Cleopatra, Kitchener, and Speke (map, page 700).

I was drawn by the lure of this great stream that blends the unfenced zoos of Africa's upland plains with the ancient cultures of Egypt and the Mediterranean, compounding history and natural history unmatched on this globe.

For thousands of years the Nile has challenged explorers, historians, and scientists. I think it is not too extreme to say that the Nile has influenced, somehow, every person living in our Western World today.*

Near-disaster struck at the very start of our journey. Bedded down at our first campsite near Kakitumba on the Kagera (page

* See "Safari from Congo to Cairo," by Elsie May Bell Grosvenor, National Geographic Magazine, December, 1954.



↑Camped in Mid-Africa, Explorers Make Ready to Run the Fabled Nile

Belgian officials called it "triple suicide by kayak" when John Goddard, Jean Laporte, and André Davy, newly arrived in Ruanda Urundi, announced plans to paddle the length of the Nile.

On embarkation eve the expedition bedded down by the Kagera River, headstream of the Nile. Barking baboons, screaming hyenas, and snorting hippos made sleep impossible. Disaster struck quickly the next day. Boiling rapids capsized one boat, smashed another, and forced a two-week delay. John M. Goddard

←Petting Wild Rhinos, Author Wins a Wager

In jest, the custodian of this Kenya animal compound bet Mr. Goddard he could not stroke these rare white rhinos, newly captured in the Sudan.

Seconds later the larger beast attacked the keeper, injuring him slightly.

John M. Goddard

Davy Perches Atop a Cement Pyramid

Where southern headwaters of the Nile run off Mogarua in Urundi, a German explorer in 1938 erected this 10-foot marker in memory of those who had sought the Nile's source. Urundi official Jacques Lamy stands behind André Davy.

Nile Headwaters Leap to Life in the African Highlands

Mystery shrouded the Nile's source for thousands of years. Many explorers failed to find its origin.

In 1862 a British traveler, John Speke, reached Ripon Falls, outlet for Lake Victoria. He pronounced it the Nile's fountainhead, and the world long accepted his belief.

Today the 500-mile-long Kagera River system, rising in hills southwest of Lake Victoria, is recognized as the Nile's true headstream.

Ten tiny springs spawning the Kagera meet on Mogarua's slopes to form this narrow waterfall, the first on the Nile.

Downstream, where the river widens and surges eastward, the adventurers launched their kayaks. For author Goddard, a student of anthropology at the University of Southern California, this remarkable journey was the realization of a 15-year dream.

Jacques Lamy

Omdurman
Khartoum North
Khartoum
White Nile Dam
(Jebel Auliya Dam)
K a s -
s a l a
Wad Medani
Gedaref
Ed Dueim
Sennar Dam
El Obeid
Kosti
El Jebelein
Er Renk
Nuba Mts.
4144
S U D A N
Lake No
Kodok (Fashoda)
Malakal
Bahr el Ghazal
Tonga
Sobat
S u d d
U p p e r
N i l e
Gambela
Ayod
Gila
Baro
Bahr el Zeraf
Bahr el Jebel
Pibor Post
Bor
Bahr el Ghazal
E T H I O P I A
Mongalla
E q u a t o r i a
Juba
Nimule
Albert Nile
Aswa
Rhino Camp
Arua
Pakwach
Murchison Falls
Victoria Nile
Butiaba
Masindi Port
Lake Kyoga
Mt. Elgon
14178
Irumu
Lake Albert
2030
U G A N D A
Namasagali
Victoria Nile
Kitale
Eldoret
Owen Falls Dam
Kampala
Jinja
Entebbe
Equator
Kisumu
125 miles to Nairobi
Lake Victoria
3720
Kabalo
Kindu
Lualaba
Kakitumba
Bukavu
Mweru
Musoma
Lake Kivu
RUANDA
URUNDI
T A N G A N Y I K A
Speke Gulf
Mwanza
K E N Y A
B E L G I A N
C O N G O
Rwindi
Katonga
Lake Edward
2952
Start of Author's Nile descent
Bigiria
Lake Tanganyika
Mediter-
ranean
Rashid
(Rosetta)
Dumyat
(Damietta)
Alexandria
Baguriya Canal
Tanta
El Mansura
Port Said
Minuf
Zagazig
El Giza
Cairo
Suez
Pyramids of Giza
Saqqara
El Faiyum
Beni Suef
Sinai
Gulf of Suez
Gulf of Aqaba
El Minya
Bandit attack
Dairut
Asyut
E G Y P T
Red
Sea
Bur Safaga
Sohag
Qena
El Karnak
Thebes
Luxor
El Kharga
Temple of Edfu
Kom Ombo
Aswan
1st Cataract
Aswan Dam
Island of Philae
Temple of Sebua
Abu Simbel
2nd Cataract
Wadi Halfa
N u b i a n
D e s e r t
Gold mine in ancient quarry
Delgo
3rd Cataract
Geddi
Abu Hamed
S U D A N
4th Cataract
Merowe
5th Cataract
Napata
Korti
Author encountered violent sandstorm
Berber
Atbara
Ed Damer
Kabushiya
Meroe
6th Cataract
Shendi
Naga
Gez Regeb
Omdurman
Khartoum North
Khartoum
White Nile Dam
Cairo
ASIA
Sahara
Dakar
AFRICA
Area of large map
Nairobi
Cape Town
0
1000
STATUTE MILES
0
100
200
STATUTE MILES
© National Geographic Map
Drawn by Douglas A. Strobel and Victor J. Kelley

← **The Nile Flows 4,100 Miles to the Sea**

Unlike other great tropical rivers, the Nile courses south to north. Spanning jungle, swamp, and desert, it drains more than 1,119,000 square miles of northeast Africa. The Goddard party, paddling 15-foot kayaks and portaging where necessary, followed the stream from Urundi, where it rises, to Rosetta (Rashid), Egypt, where it empties into the Mediterranean.

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698), the Nile's turbulent headstream, we spent a sleepless night listening to the hiss and boil of the river, the thunderous snorts of hippos, the scolding bark of baboons, the whirring and chirping of myriad insects. At intervals a hornbill screeched or a hyena loosed its maniac cry.

We recalled the words of the district commissioner who had driven us from the Kagera's source to our embarkation point.

Officials Take Gloomy View

"You chaps are committing triple suicide by kayak," he said. He was one of several officials to voice such a view.

Shortly after dawn Jean and André shoved off in their heavily loaded kayaks while I, on the bank, filmed the scene with a motion-picture camera. By the time I climbed into my boat, the swift current had swept my friends out of sight downstream.

Hurrying to catch up, I was startled when a huge bull hippopotamus erupted from the water. The monster splashed, sneezed, and snorted like a fairy-tale dragon, forcing me to swerve. With enormous jaws agape he plunged after me, but I pulled away.

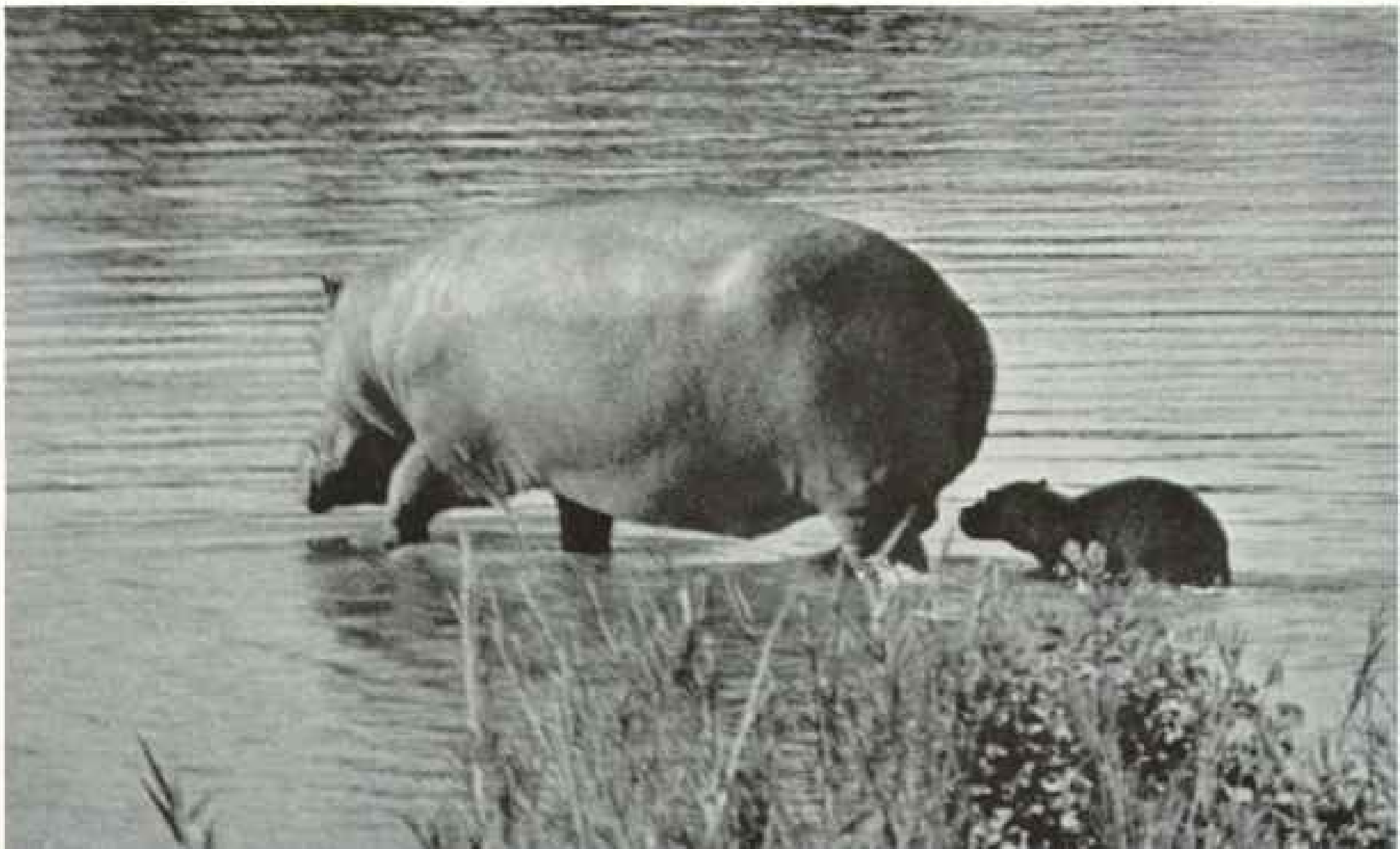
701 Kay Beebe

↑ **Curious but Cautious, a Vain Baboon Admires His Mirrored Image**

A biscuit and an hour's coaxing tempted this baboon from the near-by jungle. Normally ferocious, he ate from the author's hand.

↓ **Baby Hippo Stays Close to Mother**

"I once thought of hippos as harmless, amiable creatures," says the author, "but I changed my mind on the Nile. Attacking without apparent provocation, they charged us in the water." This pair was photographed by Quentin Keynes in the Belgian Congo.



When I caught up with my companions at the brink of white water, André shouted that he had already counted 112 hippos.*

Jean was a skilled paddler, with many years of experience on French rivers. André and I did our best to follow in his wake and imitate his white-water technique, but our deeply loaded boats were hard to maneuver.

Below the rapids I took the lead. The boiling current gave us no chance to check our headlong descent. Suddenly the river seemed to disappear behind a screen of foliage.

Snagged Kayak Swamped

Fighting to control my skittish boat, I could see that rank vegetation intertwined two small islands. Either I must attempt the vine-choked channel between the islands or dodge to the right on the chance of finding open water. In a split-second decision I headed for the channel ahead, leaving the right-hand passage open for my companions.

I had barely flattened myself in the kayak when submerged roots snagged the prow of my boat. Instantly the torrent filled and engulfed it. I was dragged along upside down, my legs caught in the lashings which secured the duffel bags. I was drowning, and I knew it.

Then my rifle fell loose and struck me full in the face, momentarily stunning me. As my senses returned, I gave one mighty heave in a desperate summoning of strength. Blessedly, I wrenched free of my deathtrap and fought to the surface.

Through the fast water I worked my way to the right bank and pulled myself ashore. As I lay panting and nauseated, I wondered about the others. Was our trip ended before it was even well begun? Suddenly I heard a voice asking if I was all right. It was Jean.

* See "Roaming Africa's Unfenced Zoos," by W. Robert Moore, National Geographic Magazine, March, 1950.

Lake Victoria Fishermen Cast Off in Hand-sewn Boats but Unmended Shorts

Hilly, tree-covered islands dot the immense lake, head reservoir of the White Nile. New Owen Falls Dam (opposite) will raise the lake's level three feet during the next 25 years. Violent storms, rising suddenly, may capsize these light craft, spilling men into crocodile-infested waters.

W. Robert Moore, National Geographic Staff

George Rodger, Magnum

Each Second Thousands of Gallons of Water Gush from Mighty Owen Falls Dam

Kayak voyagers, portaging around this section of the river, watched construction gangs at work. Queen Elizabeth opened the $61,600,000 project in April, 1954. Harnessing the Nile, it feeds power to Uganda industries, helps irrigate Egypt and the Sudan. Sluices spout water 100 feet out to avoid erosion of the riverbed.

I answered him and asked, "Where is André?"

Jean held up a sodden hat and one water-soaked bag. It was the only evidence of our friend's fate. We shouted and searched for more than an hour, but to no avail. André had vanished.

Wrecked and Marooned, but Alive!

Jean and I salvaged my kayak; then he wandered off into the brush as I sat morosely slapping at tsetse flies. Suddenly, with a whoop of joy, Jean bounded into view, yelling the happy news that he had found André!

Our lost companion had been hidden from us because he had cracked up at a blind spot, where the right bank formed a horseshoe curve. He was still marooned on a mass of rock in a welter of white water.

Yelling over the rapids' roar, we worked André almost to shore with a long rope, when his boat, its back broken, folded. He was spilled out but grabbed the rope. I held fast while Jean helped André from the water.

After a few minutes' rest, we wrestled baggage and battered kayak to dry land through papyrus twice as tall as a man. Biting insects nearly drove us crazy as we wallowed through knee-deep muck. Leeches clung in clusters to our legs.

"I know now what they mean when they say Africa 'gets under your skin!'" I commented.

704 John M. Goddard

Dense Papyrus Walling the Nile Defies Landing

"Often we paddled till long after midnight, seeking an opening," recalls the author. "The sharp marsh grass slashed our bodies; fierce mosquitoes and tsetse flies stung like fire; crocodiles slithered underfoot." Here curious Madi tribesmen paddle shoreward to inspect kayaks and crew.

Light, resilient kayaks, usually associated with arctic waters, presented a strange sight on the tropical Nile. Canvas and rubber cover the ash framework. Cockpit measures 17 inches wide and 40 inches long. Each boat carried 200 pounds in addition to the occupant.

Wearily we trudged downstream to make camp and take stock. Fortunately we had salvaged most of our equipment, though loss of our heavy weapons handicapped us severely in subsequent food hunting.

My movie camera and its five lenses had been thoroughly soaked and 500 feet of exposed film ruined.

While my partners waited two weeks in Kampala, metropolis of Uganda, I made the long, tedious journey to Nairobi, Kenya, to have the photographic gear restored to working condition.

Reunited, we explored for two days the grassy shores of Lake Victoria, gazing out over a body of water 26,640 square miles in area, more than one and a half times as large as Switzerland, a lake so vast it actually has a tide.

The natives have a novel explanation of this tide: They say it is caused by hippos coming out at night to feed. Movements of the lake's multitude of crocodiles are apparently so irregular as not to affect the water level.

From Jinja, where the Nile proper is born in the lake's coiling overflow, we hiked downriver.

Where Three Feet Is a Mighty Figure

At Owen Falls, just downstream from a steel rail-and-highway bridge that spans the river, we inspected the beginnings of a great hydroelectric development here in the depths of darkest Africa (page 703).

Since our visit this dam has been completed and the first generators installed. Twenty-five hundred feet long and 85 feet high, the concrete barrier has now obliterated both Ripon and Owen Falls.

To ensure even power flow and maximum water storage for irrigation of new farmlands far downstream in Egypt, the dam will raise the level of Lake Victoria three feet. While this may not seem an impressive figure, it will mean (because of Lake Victoria's vast area) an added accumulation of billions of gallons. Water impounded here will help prevent another "seven lean years" in Egypt, in case of a rainfall deficiency at the river's source.

Generators here will produce 150,000 kilowatts of power at a cost of just two-tenths cent a kilowatt.

"If additional dams and power stations were

built," said the young engineer who guided us around the site, "the first 80 miles of the Nile could produce more electricity than all Britain consumes. By providing power to mines and mills that would draw on abundant local raw materials, this low-cost electricity might revolutionize the whole of East Africa." *

Next day a narrow-gauge train carried us 50 miles from Jinja to Namasagali, bypassing the unnavigable chutes and rapids in the reach immediately north of Lake Victoria.

Camped on an Old Stern-wheeler

At Namasagali we took up brief residence on an old disused stern-wheeler. In near-by Banyoro fishing camps we attempted—futilely—to hire natives and a dugout to accompany us in our two intact kayaks to Masindi Port, 100 miles downstream. The Banyoro were much too busy fishing to take time off for a pleasure trip.

For André's smashed kayak we had ordered a new framework from Paris, to be delivered to us at Juba, a month's travel ahead.

On the third day the European port captain appeared with two grinning Jaluo natives who were willing to accompany us in their big dugout—for an exorbitant price (page 706). After much palaver in Swahili, we settled on a recompense of two khaki shirts, a two-cell flashlight, and 35 shillings ($4.90) cash.

Oumu and Gabrini, our new recruits, we immediately dubbed the "Gold Dust Twins."

Gradually the river's current slackened as we approached Lake Kyoga, a shallow, spreading body of swampy water where, for 60 miles, channels filter through masses of lily pads and lake weed. For hours we heaved and shoved with our paddles, fighting for every forward boat length through the plant-choked water. Finally we reached more open water; it was like lifting an airplane clear of the runway.

The twins and I had been manning the dugout. Now André spelled me, and I swept ahead in my little chip of a kayak. Suddenly I experienced an overwhelming sense of physical insignificance. I was alone in a vast, trackless swamp with the sweeping immensity of sky overhead. Only the phantom whisper of the wind and the occasional haunting cry of an ibis broke the eerie stillness.

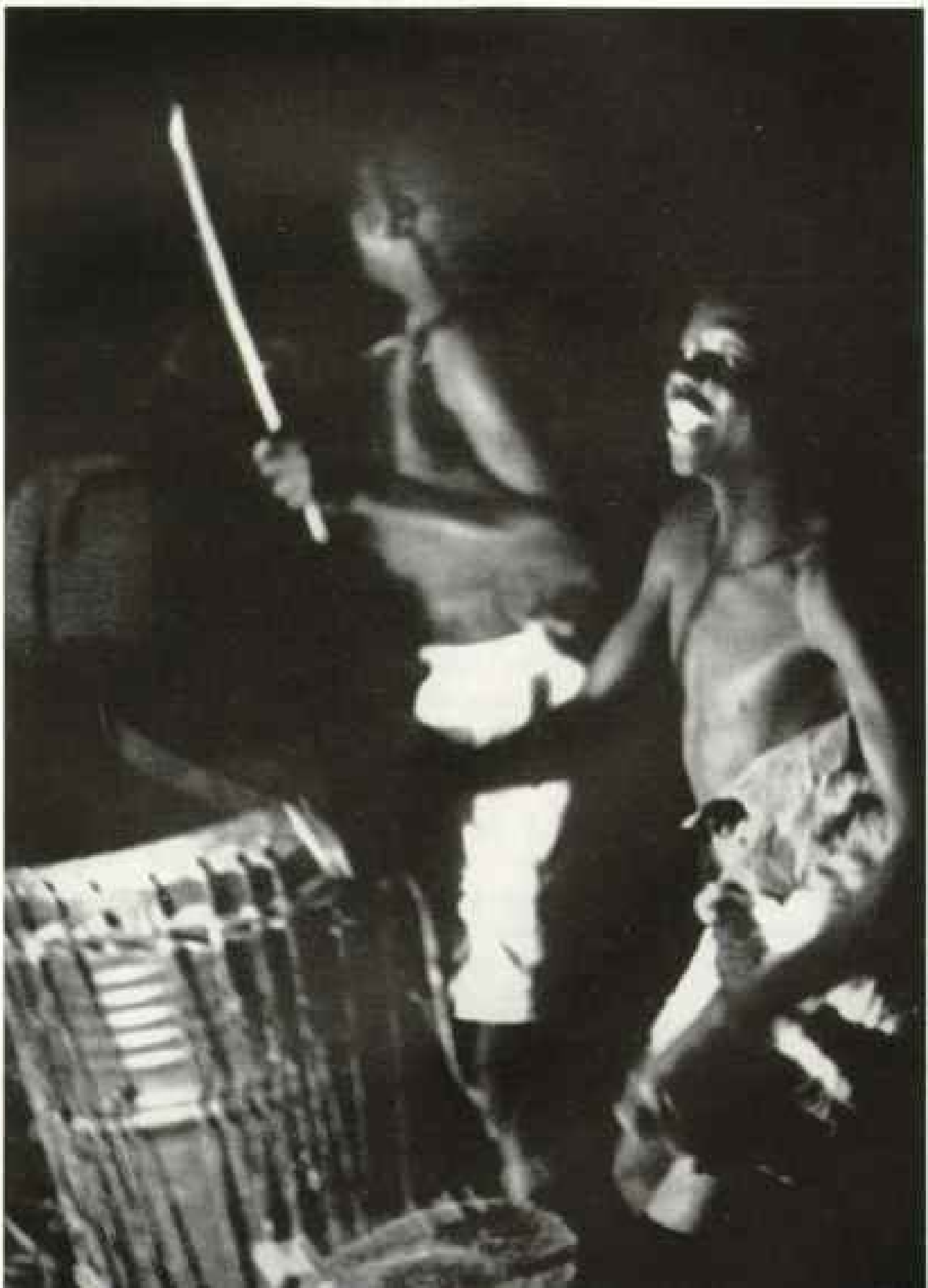
It took us four days to reach Masindi Port. For one stretch of 27 hours we were trapped on the water, unable to break through the

* See "Britain Tackles the East African Bush," by W. Robert Moore, NATIONAL GEOGRAPHIC MAGAZINE, March, 1950.

Drums Throb, Bonfires Blaze: Africa Dances

Booming tom-toms of dancing Alur tribesmen fill the hot nights along the Albert Nile. Oil-drum instruments are heated to increase resonance.

Jean Laguerre



André Davy, His Kayak Smashed, Rides Swampy Lake Kyoga in a Hollowed Tree Trunk

Africans shared the expedition's adventurous spirit. For two khaki shirts, a two-cell flashlight, and $4.90 these Jaluo tribesmen paddled with the party 100 miles down the upper Nile; neither had previously ventured one-fifth as far. Capricious winds made the crude sail useless. A double-bladed aluminum paddle (foreground) flashes from the author's kayak.

papyrus swamp to dry land. Our legs grew numb from inactivity.

As we groped through the moonless night, we blundered into a herd of hippos. In the dark, it was an unnerving experience. Several of the big river horses came plunging and snorting after us, separating us temporarily.

We came upon several Banyoro fishing camps on Lake Kyoga. Huts of woven papyrus stood about an open fire pit overhung with a platform for smoking the fish which are so important in the tribal diet.

The fishermen greeted us cordially and invited us to dinner. We would have said a polite goodbye and kept on paddling had we guessed what the *pièce de résistance* would be. Fat roasted locusts! We gingerly tasted some well-cooked specimens and found them surprisingly palatable.

These people used grass baskets to scoop up gnats that swarmed in such clouds that we had to breathe through handkerchiefs. Pressed into little cakes, the gnats are dried and eaten. Termites, frightened out of their nests by pounding and then popped into boiling water, are another favorite food.

All of us learned not to examine menus critically, but just to be grateful for what was available.

We arrived at Masindi Port exhausted from paddling against the wind, our constant foe throughout the trip. Prevailing from the north, it sprang upon us every dawn, developing in strength as the day progressed. It would have been much easier to hoist a sail and journey up the Nile from the Mediterranean.

A little paddle-wheel steamer took Oumu and Gabrini and their dugout back to Namasagali, thus saving them the long sail home. We watched our Gold Dust Twins go with regret, realizing that we were unlikely ever to see them again.

To avoid impassable rapids below Masindi Port, we drove by truck directly to Lake Albert. The English explorer, Sir Samuel Baker, discovered this great Nile feeder in 1864.

Traversing undulating bush country, we choked and gasped from the acrid smoke of a thousand fires. Natives set them to destroy the vermin and to clear off the tinder-dry vegetation so their cattle may enjoy fresh green fodder after the rains begin.

Step-down to Torrid Tropics

After a spine-jolting drive we emerged on an escarpment with the broad waters of Lake Albert agleam 1,000 feet below. In the distance loomed mountains that form the watershed between the Nile and Congo basins.

The heat intensified as we dropped off the escarpment. At Lake Victoria we had enjoyed an altitude of more than 3,700 feet; at Lake Albert we descended to 2,030.

707

Elephants Graze Beside Lake Albert

"The elephant stands 11 feet tall, weighs up to 6 tons, and is the most powerful land animal in the world; yet he subsists entirely on bark, leaves, grass, fruit, and roots," observes the author. "His intelligence, character, and personality make him the true king of beasts."

Cape buffaloes, waterbucks, wart hogs, and impalas also abound on these papyrus-lined banks. Birds riding aboard the elephants feed on insects flushed from the brush.

John M. Goddard

At Butiaba, the lake's chief port, we established headquarters aboard another old lake steamer.

A British hydrographic engineer took us aboard his launch for an observation trip to Murchison Falls, on the Victoria Nile 25 miles east of Lake Albert.

Bound upstream for a change, we chugged mile after mile past herds of hippos lolling in the shallows.

Sand bars, dark with the bodies of dozing crocodiles, came alive when the ugly reptiles, alarmed by our approach, splashed into the water and swam toward us in a hissing, slithering mass.

Both banks swarmed with elephants, waterbucks, wart hogs, and baboons. A pair of wary Cape buffaloes, startled by our huffing engine, left their watering place and loped off.

Cape buffaloes are Africa's most deadly and vindictive animals. Wounded, they have been known to ambush hunters. Not content with killing their victims, they trample them with ax-sharp hoofs. They are noted for their even disposition—always mad!

From a landing below Murchison Falls I pushed off alone in my kayak and paddled farther upstream against a powerful current flecked with bubbly gobs of foam. When I could no longer make headway, I hauled out and climbed a steep, wooded cliff, emerging directly above the falls.

There before me surged fabulous Murchison Falls, the only major waterfall along the whole length of the Victoria Nile (opposite).

Churned to froth in rock-studded rapids above, the seething current plunges into a cleft, at one point only 19 feet across. Through this rift, with an ominous booming that throbs through air and earth, the Nile drops 120 feet.

As I paddled back to the launch through the shadowy twilight, a troop of baboons barked at me, an elephant trumpeted, monkeys chattered and screamed, crocs hissed, and hippos grunted.

It was near Murchison Falls that the American novelist Ernest Hemingway and his wife survived two airplane crack-ups within two days, early in 1954.

Nile Steamer Picks Up a Hitchhiker

Back at Lake Albert our host detoured to drop off his "crazy" passengers on the eastern shore.

By great good luck we caught sight of a steamer northward-bound from Butiaba. I paddled out, flagged the ship, and persuaded the captain to carry André, his wrecked boat, and most of our equipment as far as Pakwach, 35 miles down the Albert Nile.

Along the Albert Nile the river margins were grassy, with

King-size Teeth Spike the Crocodile's Powerful Jaws

One huge reptile, leaping from the riverbank, missed the author by inches. "I think it was nearly as frightened as I was," he recalls. Here he wears the skull of a 13½-foot specimen which he shot with a borrowed gun—and finds his head a perfect bite-size.

Jean Laporte

parklike groves of trees. Wooded hills occasionally lifted in the background. The Nile flowed calm and slow.

Jean and I stopped at native villages on the western banks and on the unpeopled eastern shore to photograph elephants (page 707).

One huge tusker objected. He lashed the air with his trunk, enormous ears flapping angrily. Finally he charged me. I turned and ran, flinging my kayak into the river a scant few seconds before Jumbo thundered to the water's edge (page 712).

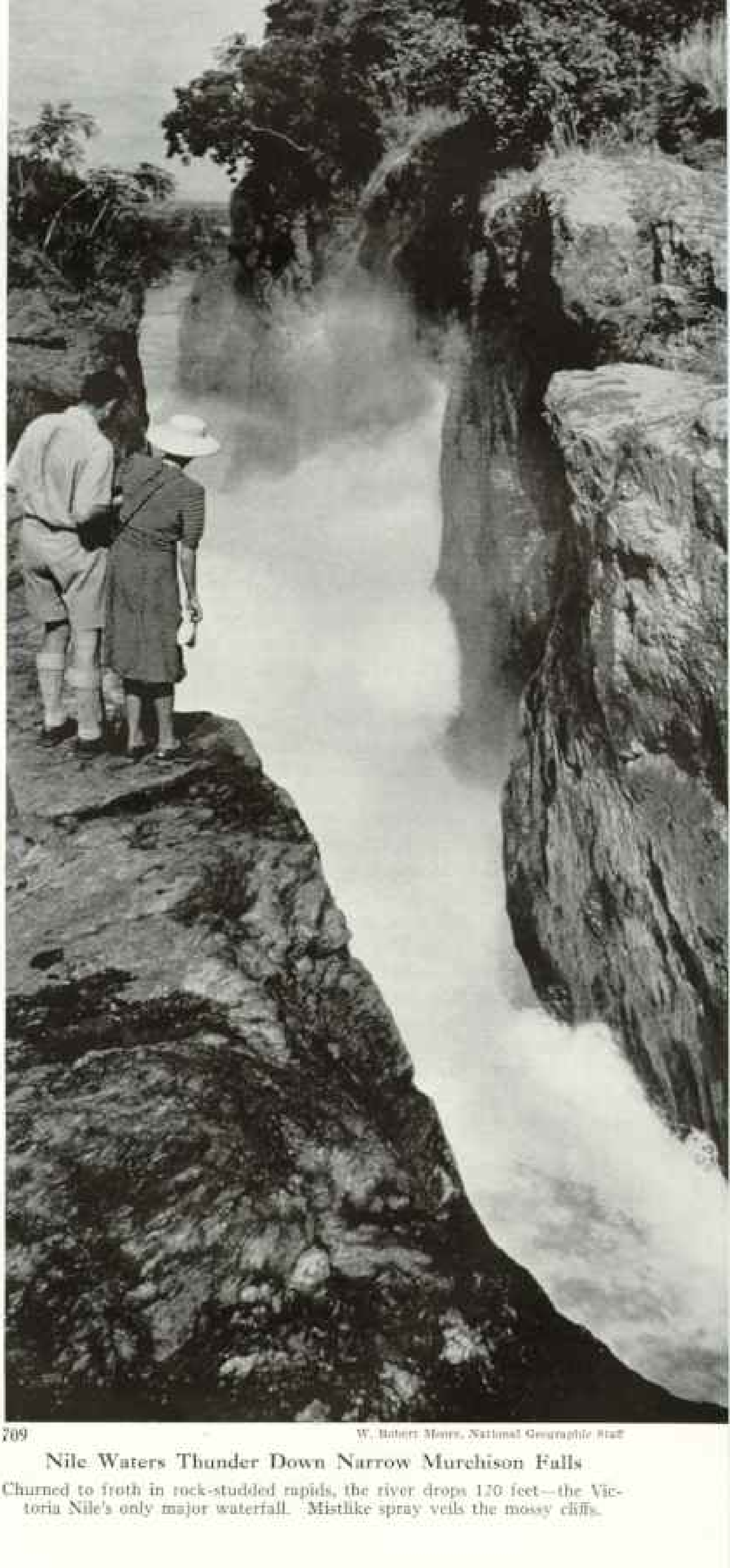
Drums Boom as Africa Dances

At Pakwach two husky Madi boatmen agreed to accompany us with their dugout as far as Nimule, on the Sudanese frontier 125 miles distant. We bought rice, eggs, bananas, and chickens, then set out again, Jean and I in the kayaks and André paddling the dugout with Okelo and Oliyo.

Sleeping that night in our tent on a grassy knoll, we were awakened by the deep throb of drums. We got up and followed a trail to a small Madi village. There all the natives were leaping and cavorting in time to cacophonous music put out by three drummers and a cymbalist.

Our arrival cut short the festivities. The Swahili greeting, "*Jambo, sana, habari,*" seemed to put the men at ease, but scared women and children edged away as we approached.

After a brief palaver



709 W. Robert Moore, National Geographic Staff

Nile Waters Thunder Down Narrow Murchison Falls

Churned to froth in rock-studded rapids, the river drops 120 feet—the Victoria Nile's only major waterfall. Mistlike spray veils the mossy cliffs.

719 John M. Goddard

Excited Young Alur Dash into Lake Albert to Greet the Kayak Caravan

"They swarmed over our boats, inspecting us and our equipment in the minutest detail," says the author. "Some had never seen a white man; many had never spoken to one. They are probably still talking about the unprecedented visit of the mysterious strangers who paddled down the Nile."

the natives, convinced we were not hostile, resumed their frenzied antics. The drummers took turns heating their instruments over a fire to make them more resonant.

The men danced grotesquely around the four musicmakers, their oiled, naked bodies gleaming in the moonlight. Women stood just outside the circle, jigging in time to the drums. From time to time they uttered piercing shrieks.

The night was half gone when we got back to our sleeping bags. In the morning we shook scorpions and centipedes out of trousers and shoes and took up the paddles again.

The day before Christmas we reached Rhino Camp, chief trading center of the Albert Nile. Here turbaned Moslems in small stalls were bargaining with Africans representing every tribe within 100 miles.

Christmas and a Hippo Hunt

Prospects for a merry Christmas took a bright turn when we encountered a hospitable young Persian, Ali Khalfan, a merchant from Arua, 40 miles to the west. At the Khalfan home we sat down to a Christmas dinner table loaded with spicy delicacies—wheat chapatties, wild rice with kebab, and stewed fish, the repast topped off with fruit pudding and lemonade in tall glasses.

A few mornings later, once more afloat, we joined a group of natives in a hippo hunt. Armed only with spears, these people kill the animals for their meat—which we, too, found delicious—and feel the prize well worth the risk.

We watched them spear a hippo in the river, then wait patiently for the beast to surface. The animal will finally have to come to the top; so the hunters follow its underwater movements with a wood float. The final round is bloody and violent, followed by grunting and excited shouting as dozens of natives drag the monster to the beach. Men may have been wounded or killed in the tussle, but the tribesmen still hold a victory feast, gorging on the fresh-killed hippo meat.

After a week's travel on the serene Albert Nile, we reached the borders of the Sudan at Nimule. Behind a deserted customs shed stood a scattering of native huts.

Here was the unpretentious gateway to the Sudan, a hodgepodge of races, cultures, languages, and religions. The Sudan comprises nearly 1,000,000 square miles, an area one-third that of the United States, yet its population is only 8,820,000, about the same as Ohio's.*

The Negroid people of the south have no stable government, no currency, little commerce, no writing, no wheeled transport, few tools. They go about stark naked or clad in bark cloth and animal skins. Yet we found them among the happiest people we have ever met.

* See "South in the Sudan," by Harry Hoogstraal, NATIONAL GEOGRAPHIC MAGAZINE, February, 1953.

From Nimule to Juba, a stretch of 125 miles, the Nile is a shallow, rapids-ridden torrent. Rather than risk our thin-skinned kayaks in the interminable white water, we decided to span this reach on foot, trekking along the banks.

African Chief Provides Bearers

A few miles north of Nimule we called on Chief Zelindo, ruler of the Madi tribe. A tall, handsome African, he bore himself with the dignity of a Roman senator. We watched him accept tributes of cotton and ivory from his people. For this occasion he wore not feathers and beads but a neat khaki uniform. At our request, the chief provided three strapping youths to transport our supplies.

Jean Laporte, stricken suddenly with fever and too weak to travel on foot, proceeded to Juba in a government lorry with our disassembled kayaks and other equipment.

According to an ancient Egyptian proverb, he who once drinks the water of the Nile, though he may travel to the ends of the earth, will one day return to drink of it again.

For Jean Laporte this prophecy was unhappily fulfilled. Jean went back to Africa to make a color movie and to navigate the Nimule-Juba stretch he had missed before. With him went an ethnologist, Jacques Blein.

They launched their kayaks in the rough stretch north of Lake Victoria, which we had bypassed. Eight miles below Ripon Falls both craft capsized in rapids and Blein was lost.

André and I passed a memorable week tramping along the Bahr el Jebel (Arabic for "mountain river"), as the Nile is called in the southern Sudan. Our three porters followed at our heels, loads balanced on their heads. We followed game trails, often through 10-foot-high elephant grass.

Our only weapon was a .22-caliber rifle. I was all too conscious of the rifle's inadequacy, but it was a great comfort to our boys, who

The Camera, Mystifying but Fascinating, Wins Many Friends in Africa

The Sudanese Shilluk, once warlike, now hunt hippos with spears and stage boisterous moon dances to work off aggressive energy. Gray wood ash and blue beads make up their costume. These youngsters peer into the camera's view finder; to look down and yet see straight out amazed them.

Jean Laporte

believed it could kill anything from a mouse to an elephant.

Our safari took us through a beautiful, unspoiled land abounding in animal and bird life. Africa's crowned crane was a common but ever-captivating sight. The region was thinly populated with small Madi and Bari villages.

We intruded upon one dozing Bari community during siesta hour. Our hearty salutations startled men napping in the shade of their mushroom-shaped huts. They took one look at the sunburned strangers and lurched indoors. Children playing near by fled in tears or ran to their mothers. Excited goats, dogs, and chickens added to the commotion.

Once the novelty of our visits wore off, however, the natives accepted us warmly (pages 710, 711). Even when short of food, they always had plenty to share with us. They sensed our dependence on them and never let us down.

We saw herds of impalas, waterbucks, and antelopes as we hiked along. Our porters were perplexed at my passing up this luscious game. It was impossible to make them understand that my gun was too light for such hunting.

One morning I made them joyously happy, and provided us all with a feast, when I shot a big wart hog. He charged me after I shot him, and I had to finish off the 200-pound creature with a big rock.

Our boys were jubilant. Their faith in the little .22 was vindicated. They plucked bristles from the boar's back to weave into good-luck charms. Then, during a day-long orgy of feasting, they put away 10 and 12 pounds of meat per man.

During the night a herd of elephants browsed near the camp, knocking over trees and thoroughly scaring André and me. Our native boys were not worried; they knew we had a weapon.

Close Call with Deadly Snake

The next day, as I sleepily led the way over a game trail, I was jolted wide-awake by the sight of a fat puff adder sliding across the path. Another two feet and I would have trod on the deadly reptile.

In a Madi village I came upon two girls bathing in a pool and lifted my movie camera, half expecting them to beat a giggling retreat. But they just smiled demurely and went on with their ablutions.

Interspersed among the Madi huts were little granaries for storing cotton, durra, and peanuts, chief wealth of the tribe. With flat stones the women were grinding durra flour. Primitive as they are, in our terms, the Madi people use a mold fungus akin to penicillin. They put yeasty water in jugs, and as the mold forms skim it off and spread it on cuts and other wounds.

On the eighth day from Nimule we stumbled into Juba looking like what we were, jungle refugees.

712

An Enraged Elephant Routs the Author

Ashore, Mr. Goddard attempted to make camera close-ups of this bull. Suddenly it charged. With the angry beast almost atop him, the author ran to the river, leaped in his kayak, and paddled furiously. Thwarted, the tusker returned to high land (page 709). This picture was enlarged from a 16-mm. motion-picture frame.

Jean Laporte

John M. Goddard

Spear Poised, a Madi Fisherman Hunts Dinner in the Turbulent Fola Rapids

Nile perch may weigh 200 pounds. These rapids, stretching between Nimule and Juba in the southern Sudan, forced the party to trek 125 miles along the banks (page 711). Tepeelike Madi huts crowd an island clearing.

We were feverish with malaria, and our bare legs were raw from the lacerations of thorns and saw grass. For eight days malaria kept us flat on our backs and miserable.

After this siege we reconstructed André's kayak with new parts air-mailed to us from Paris and covered the 120 miles between Juba and Bor in just three days.

We passed through the Sudan during the dry season. Every night the sky glowed with fires set by the tribes.

One night a rush of animals forewarned us of fire's approach. Suddenly the flames leaped upon us, moving as fast as a man can walk. We snatched up our belongings and ran for the nearest exit—the river.

The district commissioner at Bor read us a telegram from the governor of his province forbidding us to travel by kayak through the perilous sudd country. It was claimed that there was too much danger of our becoming lost in the swampy wilderness of floating vegetation which covers thousands of square miles between Bor and Lake No.

Sudd, a floating mass of marsh grass and papyrus cut loose by action of wind and water, has trapped many a Nile navigator.

We traveled through the sudd as far as Tonga on a paddle-wheel steamer with a keen-eyed Sudanese pilot. But first we waited 11 days at Bor for the ship to be dragged off a sand bar near Mongalla.

Dinka People Move with Herds

The delay gave us a chance to become acquainted with the tall, slender Dinka people who live in and around Bor. There are three great Nilotic tribes in the Negro-dominated southern Sudan, the Dinka, the Nuer, and the Shilluk, all very tall, dark people (pages 714 and 715).

A proud, pastoral, cattle-raising people, the Dinka move about with their herds in response to changing conditions of flood and drought. As with the other Nilotic peoples, their wealth is measured in cattle and goats.

Inflation, we were told, had hit the Nilotic tribes. A reasonably sound wife cost about

Jogging Dinka Pace Slow Nile Boats →

Pastoral tribes of long-limbed, narrow-headed Negroids move about with their herds in the swamps and savannas of southern Sudan. Nilotes measure wealth in cattle; their cows buy a bride or pay for a crime. Lithe Dinkas are among earth's tallest people.

Hoyningen-Huene, Mark Star

↓ Hooking one leg in the crook of the other, a Nuer "stork man of the Nile" leans on his spear; tribesmen find the pose relaxing (page 717). Gourd-shaped club serves as a weapon; switch beats off flies.

Three Lions

40 head of cattle, with perhaps a few goats and chickens thrown in. The prewar price was only half this.

At Lake No, where the river becomes the White Nile (El Bahr el Abyad: "white river"), the enfeebled stream was revived by the Bahr el Ghazal, its largest west-bank tributary. Our little steamer, the *Rejaf*, took three days to twist through the immense marshlands to Tonga. At every turn the ship brushed the sedgy banks.

Sudd Traps Hapless Ship

In 1936 a steamer came to a dead end after following a false channel through the sudd for 20 miles. When the captain attempted to retrace his route, he found that the sudd had closed in behind his ship and trapped him. Before help arrived, he and 22 of his passengers starved to death.

The *Rejaf's* captain told us of the British Jonglei Canal project, a plan to cut a 200-mile channel through the sudd along the Bahr ez Zeraf, right-bank branch of the Nile. Thus a large part of the Nile's flow could escape the spongy swamps which now absorb half its volume.

Each day we docked briefly at Nuer villages to replenish fuel wood and take on cargoes of dried hides. A swamp-dwelling, cattle-raising people, the Nuer think white men are silly to wear clothing in the burning

African heat. For most of them the fashion is stark nudity.

Rarely do the Nuer kill their cattle, and then only for ritualistic practices. Occasionally, however, they tap the jugular vein of a cow, draw off some blood, and mix it with milk. We sampled this nutritious beverage: its taste brought shudders of nausea.

The Nuer are stork men of the Nile. We watched groups of long-legged dandies, each more than six feet tall, strut down to the landing: spears and clubs balanced on their shoulders. They were quite naked except for a cosmetic layer of gray wood ash and a few strands of blue beads around their waists.

Clamped in a Strong Grip, a Reluctant Bari Boy Enters the Crocodile-haunted Nile

In shallow water the parent will teach a young son the art of spear-fishing. Hollow log container slung over the shoulder functions as creel, chair, and headrest. Empty gourds will be filled with river water.

John M. Goddard

↑Gen. Charles George Gordon Rides a Bronze Camel in Khartoum, Shady Sudan Capital

A flotilla of dignitaries and reporters met the kayak expedition in midstream at Khartoum, city of stately government buildings and wide, tree-lined avenues.

After logging 2,275 miles on the Nile, the author and his companions spent 10 days in the capital, basking in civilization's comfort.

Here, in 1885, the courageous but ill-fated "Chinese" Gordon fell under the spears of the dervishes, fanatic followers of a religious leader (opposite page).

← "We Feast Tonight!"

Severely limited supplies and lack of heavy hunting guns kept the explorers hungry. Here the author, smiling at the prospect of his first square meal in three days, holds a fat Egyptian goose, which he shot with a .22 rifle.

River tribes cheerfully shared their food. Fish was the staple native diet, but occasional feasts featured such fare as roasted locusts and boiled termites.

Jean Laporte

Julie M. Archbold

Gleaming Tomb of the Mahdi Rises Like an Inverted Goblet Above Omdurman

The Mahdi, an ascetic who claimed descent from Mohammed, died in 1885, five months after his armies had overrun the entire Sudan. When Anglo-Egyptian troops captured Omdurman in 1898, they destroyed the tomb and scattered its contents, lest the spot again become a symbol of fanaticism and rebellion. But one of the Mahdi's sons built this new shrine, a virtual reproduction of the original tomb.

They stopped beside the river as if at a signal, and in perfect unison each man lifted one leg and rested it in the crook of the other. Apparently quite relaxed in this position, they stood like so many featherless shore birds (page 714).

Four genial Scottish Catholic priests gave us shelter at Tonga, where they maintain a mission and school for the Shilluk people. A handsome stock, the Shilluk have a more comprehensive social organization than the other Nilotes; they alone are united under the rule of one king.

After a restful night in the fathers' thatched guesthouse, we spent a day touring near-by villages where Shilluk women were weaving fish traps from marsh grass.

The Shilluk men, dusty white from the wood ash they rub all over their bodies, looked like visitors from another world. A glimpse through our camera view finders won their friendship. Unable to grow beards, they were fascinated by ours, especially my bushy red growth. Obviously, only magic powers could produce hair of such a hue.

"They don't know what hair-raising adventures we've gone through to grow these beards," quipped André.

The Shilluk yield grudgingly to civilization's restraints. Occasionally they still vent their warlike spirits on neighboring tribes.

Taut Nerves Relax in Moon Dance

But they have other outlets for their energies, too. We watched a crowd of Shilluk men, fortified with native beer, pace strenuously through their moon dance. They were caked with red ocher and clad in their best leopard skins. Tall hairdos had been neatly set with dung.

As we admired the performers' enthusiasm, Jean commented, "This is just what I need during the long, raw Parisian winter—a good knockdown, drag-out moon dance. I can't

George Rodger, Magnum 718

imagine a neurosis or hypertension surviving such a shaking up."

We bought food at Malakal, seat of government for the Upper Nile Province. Forty miles downstream we landed at Kodok, a small district headquarters once known as Fashoda. Here in 1898, after a grueling march across the Congo basin, a French army officer, Maj. Jean Baptiste Marchand, led a French bid for the upper Nile.

Britain Balked France in Sudan

The news of Marchand's intrusion sent General Kitchener, fresh from his victory over the Mahdi's army at Khartoum, racing upstream with Scottish and Sudanese troops. Backed by this formidable escort, Kitchener informed Marchand that his claim

was invalid, thus ending the so-called "Fashoda Incident."

In the 500 miles below Malakal the Nile drops a mere 30 feet. With no appreciable aid, therefore, from current and with head winds a daily curse, it took us a month of sweaty paddling to reach Khartoum.

Landscape and people changed. The country grew ever more barren, the climate hotter and drier.

Gradually the Black Sudan fell behind and we plunged deeper into the Moslem Sudan, land of sand, camels, and white-robed men who pray five times a day toward Mecca. At the last Nilotic village, Er Renk, we bought rice and eggs from bearded Arab merchants. At their sides stood lanky Dinka wives.

Into the Arab World

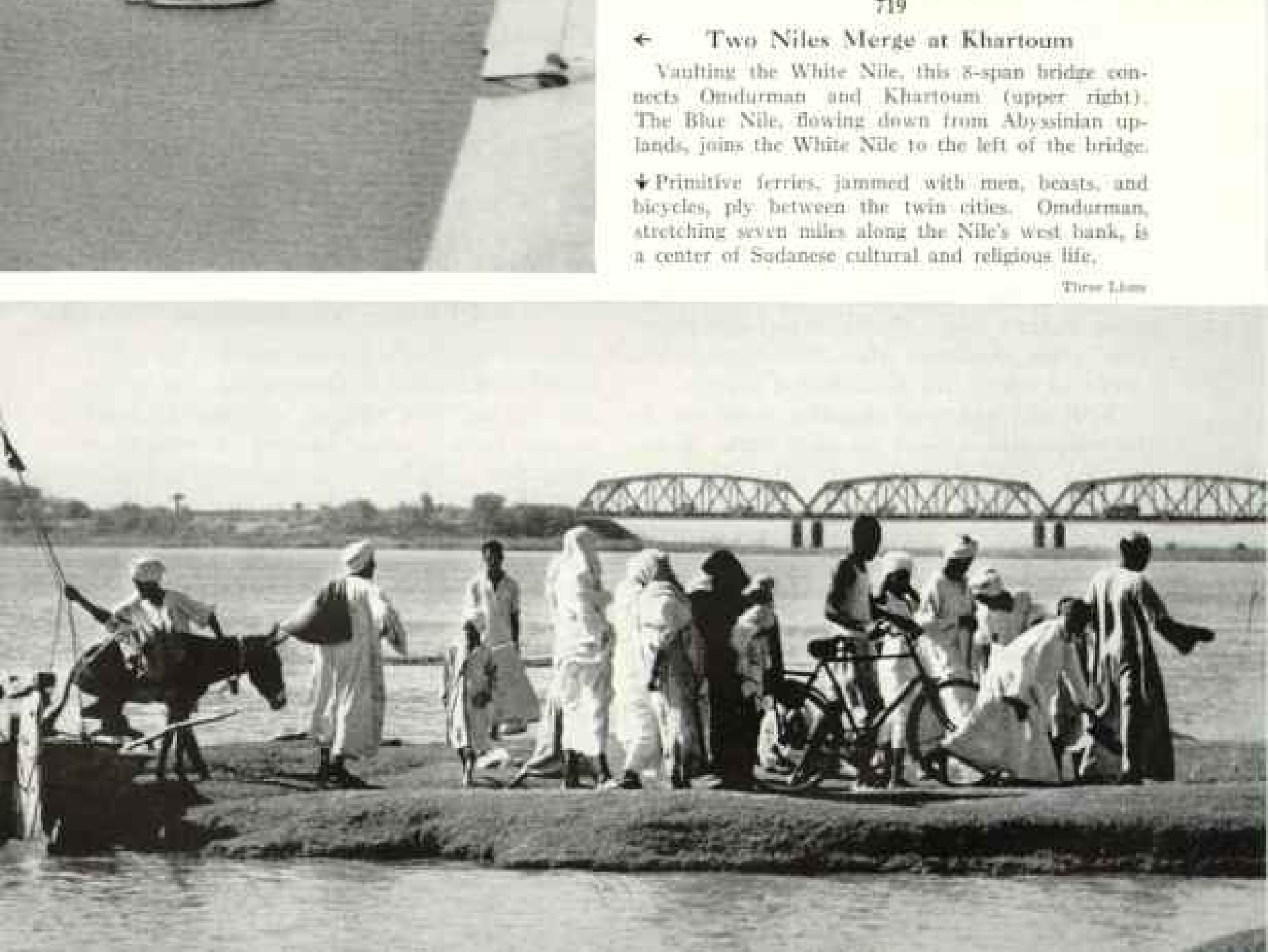
The transition was complete at El Jebelein, our first Arab town. There brown-skinned people dressed in turbans and flowing, wrapperlike galabiehs strode sandy alleys between homes and shops built of mud-brick reinforced with camel dung and straw. Now we had to learn Arabic, language of the Sudan and Egypt.

Game vanished, to be replaced in interest

← **Two Niles Merge at Khartoum**

Vaulting the White Nile, this 8-span bridge connects Omdurman and Khartoum (upper right). The Blue Nile, flowing down from Abyssinian uplands, joins the White Nile to the left of the bridge.

↓ Primitive ferries, jammed with men, beasts, and bicycles, ply between the twin cities. Omdurman, stretching seven miles along the Nile's west bank, is a center of Sudanese cultural and religious life.



On a Swimming Tour of Submerged Philae Island, the Author Explores a Shrine

Impounded waters at Aswan Dam drown the island where ancients worshiped the goddess Isis. Diving with face mask and fins, Mr. Goddard swam among once-magnificent ruins now coated with moss.

by bird life in marvelous variety and profusion. Orange-billed skimmers scooped up minnows from the river surface. On the reedy banks gleamed regal white ibis. Bald-pated marabou storks, four feet tall, strutted like pompous men, snipe and sandpipers squabbling at their feet. Flocks of teal and Egyptian geese darkened the sand bars, while overhead soared the space-loving osprey.

Both heat and wind abated at sundown; so we frequently stroked on after dark. When paddles dragged with our exhaustion, we looked for a soft sandbank or for the campfires of Sudanese fishermen. These beacons guided us to a welcome unfailingly hospitable.

The 1,400-foot, nine-span railway bridge we passed under near Kosti was the first we had seen since leaving Owen Falls, more than 1,500 miles behind us. The bridge guard casually glanced at us, turned away, and then leaped to the rail to stare. Those weren't crocodiles—they were boats, driven by men who dipped long, stiff arms in the water!

At Ed Dueim we watched toiling natives load barges with bales of cotton from El Gezira, a vast flat area between the White and Blue Niles. Here 1,000,000 irrigated acres produce extra-long-staple cotton, among the finest grown.

Chief Offers Wife for Kayak

As we approached each village, the chief would be informed of our coming. He would put on his best turban and march down to the water's edge, heading a welcoming delegation. My kayak so fascinated one chief that he couldn't wait for a demonstration; he jumped in and paddled around in a circle backward. He thought so highly of the boat that he wanted to trade me one of his four wives for it.

Our kayaks were the smallest craft, we were told, ever to pass through the 16,400-foot White Nile Dam, 30 miles south of Khartoum. The structure was completed by the British in 1937; its backed-up waters and those behind the Sennar Dam on the Blue Nile irrigate Egypt.

Arabs who cranked open the giant lock gates laughed heartily at a situation they found ludicrous, for our kayaks were lost in the immensity of the structure.

On March 17, four and a half months after leaving the Nile's source, we arrived at Khartoum, capital of the Sudan (page 716). Here, we were just past our halfway mark. We had logged 2,275 miles down the Nile.

A sizable flotilla bearing reporters and dignitaries met us at the confluence of El Bahr el Abyad and El Bahr el Azraq, the White and Blue Niles. Along the clear, dark waters of the Blue Nile they escorted us to a landing and official welcome in front of the Grand Hotel.

Privately, a high-ranking officer strongly advised us to quit while we were ahead.

"I apologize for doubting that you would get this far," he said. "But I urge you to end your voyage here. You will never survive the descent through the cataracts."

We spent 10 days in Khartoum. After five months of primitive living, it renewed our spirits and bodies to bask briefly in the comforts of civilization.

Across the White Nile we toured Omdurman, a sprawling city built of Nile mud. Its population of 130,400 is nearly twice that of the capital it faces.

In Omdurman we were impressed by the gleaming mausoleum of the Mahdi, shaped like an inverted goblet (page 717).

Into the Sixth Cataract

Too soon, it seemed, we had to embark again. Forty-five miles below Khartoum the Nile swirled us through an eight-mile-long chasm bordered by steep hills of basalt and granite. Here the river deepens and narrows to less than 100 yards.

This was the mild Sixth Cataract. Actually it is the first of the famous cataracts reached as one descends the river; geographers who numbered them traveled upstream from the mouth.

Here we enjoyed some of the loveliest landscapes of the Nile. Fertile green banks

Flowing Through Philae's Stately Ruins, the Nile Hides Secrets of a Mysterious Cult

The island's very earth was considered holy. In chambers like this swarmed Greek and Roman pilgrims, come to offer sacrifices to Isis. Carved cross (above kayak) attests to later Christian services.

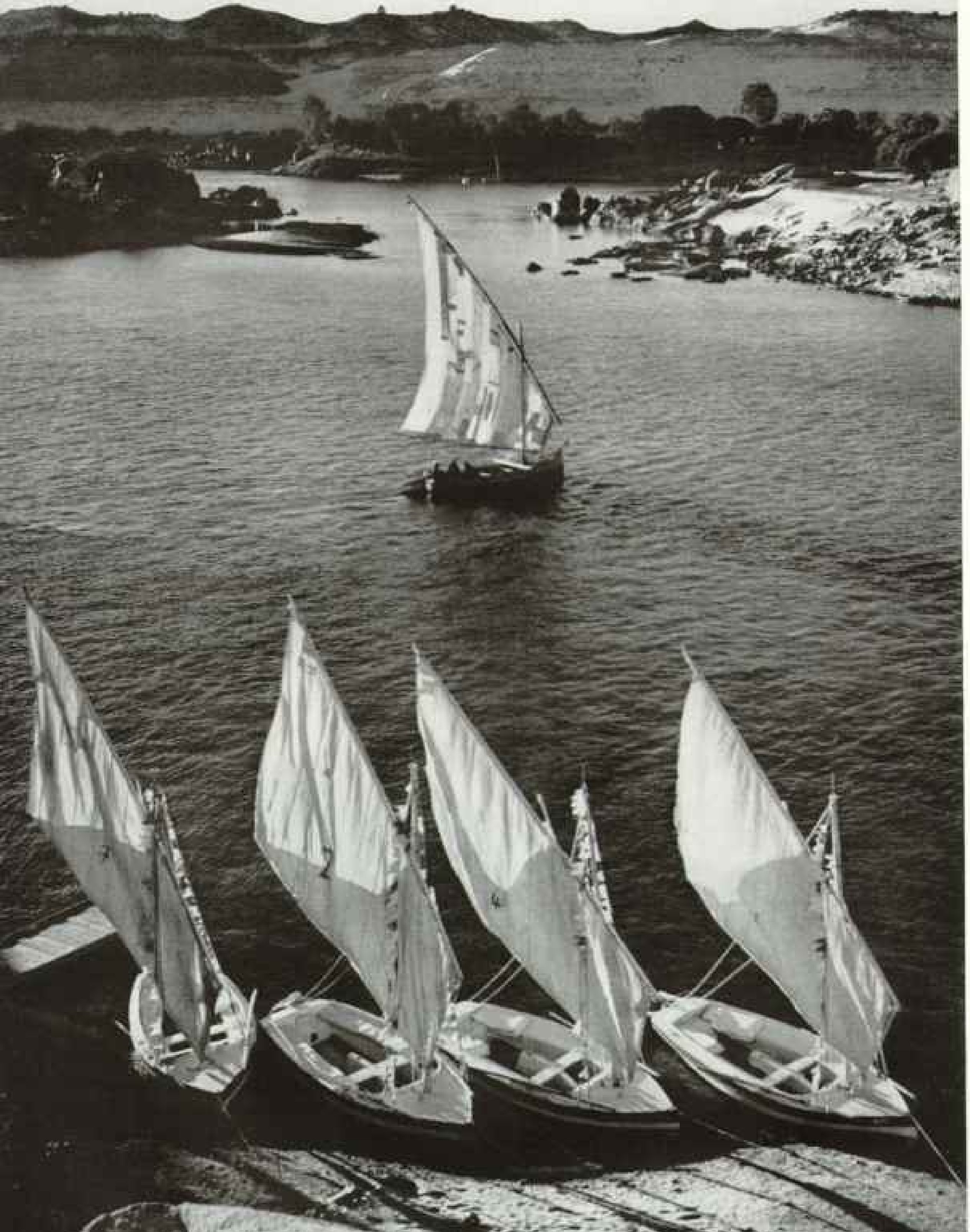


Fig. 1a.

White-sailed Felucca Taxis Fleck Waters Where Ancient Barges Loaded Aswan Granite

In near-by quarries slaves of the Pharaohs hewed and shaped monoliths and statues for Nile temples. Here, at the First Cataract, Mr. Goddard watched Egyptian archeologists unearth a 4,000-year-old tomb.

climbed to groves of date palms and irrigated gardens. White sand beaches fringed granite islets covered with luxuriant grass and shrubs. Beyond the narrow river strip, however, stretched the endless blazing desert.

We reprovisioned at Shendi on the right bank, a quiet town of cubical mud dwellings and shops. Far out in the desert beyond, we visited at Naga our first ancient ruins, several small temples built 2,000 years ago.

Dinner in a Bedouin Hut

Near the antiquities we watched Bedouins filling their water bags. They drove bantam donkeys back and forth to draw up the precious liquid from a deep well. Robust, handsome folk they are, despite austere lives that are an unending round of torrid days, chilling nights, suffocating sandstorms, and perpetual thirst.

One old chief invited us to his hut for a meal. We sat around a common pot, dipping bread in sour camel's milk.

Near Kabushiya we stopped to explore the 2,000-year-old ruins of the once-great city of Meroe, ancient southern capital of Ethiopian kings and later of the influential Meroitic kingdom. It was at one time seat of the proud queens called Candace, one of whom fought the Romans valorously until overwhelmed by their armies under Petronius, about 20 B.C.

Three weeks of rigorous paddling brought us to Atbara, a tidy town of tree-lined streets, bright gardens, and attractive residences. Here the Nile receives from the east its last tributary, the Atbara.

At our next major check point, Berber, we spread sleeping bags on a sand bar near the boat landing. During the evening the wind grew suddenly violent. By midnight a howling sandstorm was blasting us. Through the long dark hours the *haboob* held us captive, curled up like caterpillars in our nylon cocoons. We kicked and squirmed to keep from being buried alive by drifting sands.

Wind's Whimsey Complicates Search

By dawn the gale had abated. We prepared to paddle to a more sheltered spot. To our horror we discovered that two of our kayaks, André's and mine, with most of our equipment in them, had been swept away when the sandy shore they rested on was undermined by pounding waves.

After a 5-hour search we found the boats, intact and undamaged. Mystifying was their location—André's craft half a mile upstream, resting on the west bank, mine a mile downstream on the eastern shore.

The riverscapes between Khartoum and the Egyptian border reminded me of the Colorado River country of Utah. Great knobby masses of colored porphyry, gneiss, and basalt crowded in upon the Nile. Where the rock transgressed the river itself, raging cataracts imperiled us. Thirty-one of these treacherous rapids stud the river between Khartoum and Wadi Halfa, subjecting us to nearly 1,000 miles of hazard.

We emerged unscathed from the boulder-strewn Fifth Cataract. But in chutes just south of Abu Hamed, where the Nile begins its sweeping detour to the southwest, we ripped holes in the rubberized skin of our kayaks. It was a relatively simple job to vulcanize these rents—assuming that one got the boat to shore!

We were never sure what danger lurked around the next bend. Once committed to a rapid, there was no turning back. Our open cockpits were so low that water nearly swamped us in every turbulent stretch, such as the steep Fourth Cataract.

Cautiously we threaded the serpentine Third Cataract where the river is bracketed by bleak hills of golden and rosy rock.

Ancient Zoo in Stone

The chief of Geddi, a tiny village south of Delgo, escorted us to ancient rock paintings and carvings in the hills above the Nile. The petroglyphs varied widely in age and subject, the oldest dating possibly from the time when the northern Sudan and Egypt were less arid and inhabited by animals now found only in the south. The solid rock was etched with crude figures of lions, giraffes, antelopes, and buffaloes.

In the same area we found names and writings in Greek, adorned with small crosses and other symbols, as well as carvings of warriors locked in combat. These probably date from the early Christians in the area.

A day's paddle from Delgo we stopped to visit a gold mine operated by the only two foreigners living between Atbara and Wadi Halfa, Paddy Bishop, a lean, 28-year-old Irishman, and Oscar Durham, an Englishman.

The two men extract gold from tailings of an ancient Egyptian mine, still laced with precious metal left from the crude, inefficient

A Mile and a Quarter of Granite Dams the Nile at Aswan

U. S. Air Force

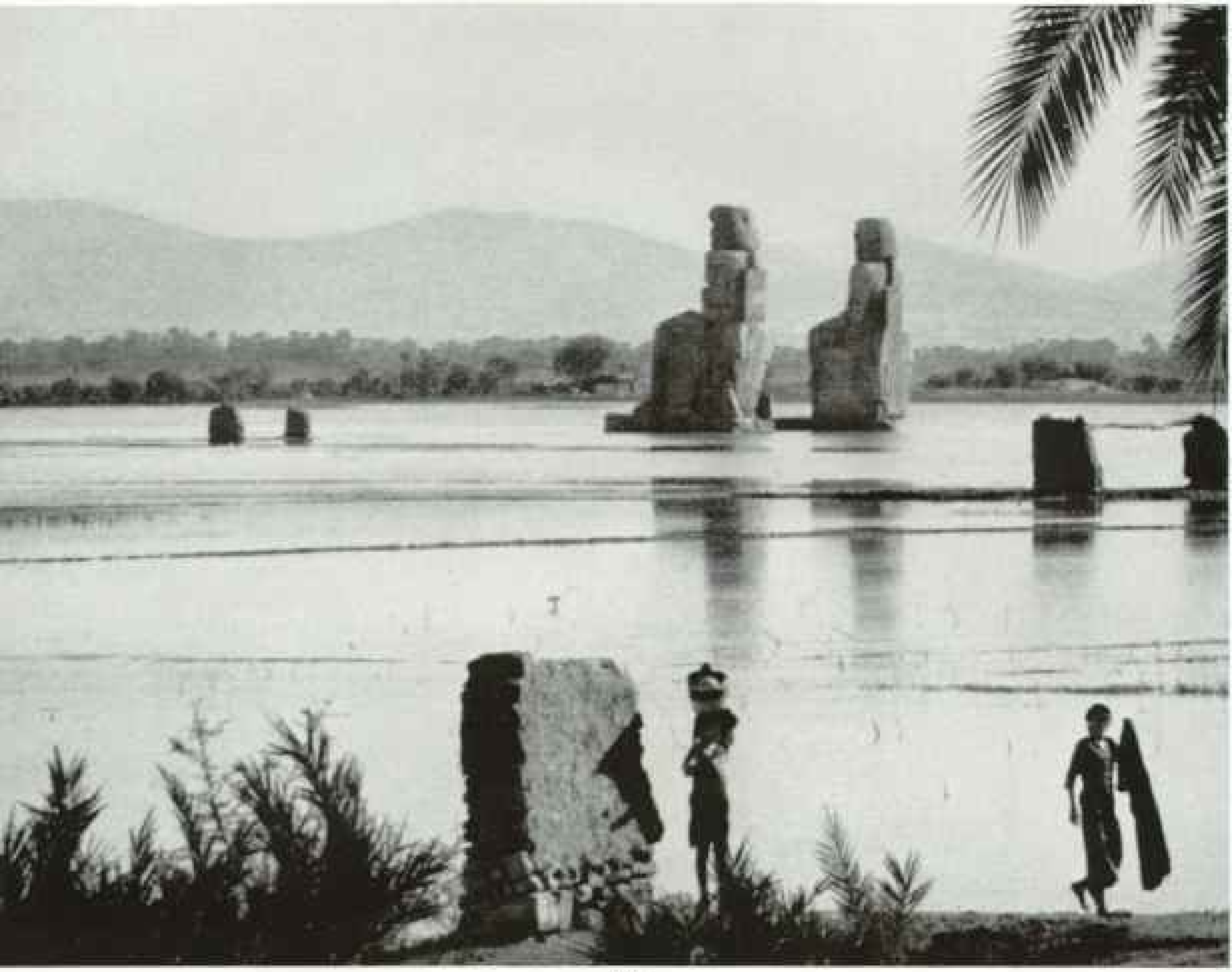
method of excavating ore in Pharaonic times.

Heat and hunger became almost unbearable as we neared the Egyptian-Sudanese border. From dawn to dusk, stroking down the pale-green Nile, we sweltered under the savage African sun. Glaring water and shimmering sand redoubled the impact of the searing rays. At times the heat seemed to have physical consistency, like a fiery fog.

Around midday, with the temperature at 125° or higher in the shade, it was painful even to breathe. Craving for water became almost an obsession. Fortunately the source of supply was as close as the reach of a cupped hand. Twelve quarts a day per man was average, and no beverage ever tasted so delicious.

Food, too, was a crucial problem in this dead land of sand and rock, where the natives barely eke out a livelihood. The ducks and geese we occasionally shot tided us over many a period of near-starvation. And once I found telltale tracks that led me to a clutch of turtle eggs buried in the sand.

"Ah, ping-pong balls!" André exclaimed. After we ate them he said, "Yes, ping-pong balls," but not joking now.



726

Coptic Christian Villagers Rejoice as a Life-giving Flood Blankets the Fertile Plain of Thebes.

Villagers, accepting our arrival as decreed by Allah, cheerfully shared with us their meager diet of *kisra* (wheat cakes), rice, *rayib* (curdled goat's milk), *melukhiya* (a greasy, spinachlike vegetable), and dates.

In the rapids we had the Nile almost to ourselves. Only occasionally did we see Bedouins, statue-still on the high banks, following our progress with undeviating—and probably unbelieving—stares.

Once, unhappy about the look of a wild stretch of rapids ahead, I managed to haul out on a rocky islet in the midst of tumbling,

roaring water. Jean, however, swept past and over a cascade. Capsized and thrown out, he was battered on the rocks and nearly drowned. Ribs of his kayak cracked.

In the awesome Second Cataract, where the Nile fingers its way through a labyrinth of channels between grotesque masses of rock,

727 Henri Cartier-Bresson, Magnum

Rising Nile Waters Lap the Colossi of Memnon

an ugly chute forced us to make a portage of 100 yards.

Swimmer Serves as Pilot

Near the foot of the Second Cataract we came to a rapid where every channel seemed to disappear among the rocks. Standing at the river edge trying to pick a route, we heard a voice and turned to see a barrel-chested Arab astride a donkey. We returned his greeting and explained our predicament.

Before our amazed eyes, the stranger stripped off his turban, waved for us to follow, and dived into the swirling water. Through tortuous, racing channels he swam ahead of us and greeted us with a broad grin when we won safely through.

I never looked back to see if our benefactor's donkey was swimming down the stream behind us.

Six and a half months after our departure we entered Egypt, the "narrow kingdom," sixth Nile basin country that we touched. Three-fourths of the great river lay behind us.

From the border to Aswan we passed through desolate, infertile Lower Nubia. Gradually the Nile loses identity as a river, swelling out behind Aswan Dam to form the world's longest man-made reservoir, a lake that reaches 230 miles south.

Among Ancient Splendors

At Abu Simbil we stood in awe before one of Egypt's most magnificent antiquities, the cliff temple of Rameses II. Of four seated statues of the king, each 65 feet high and carved out of the living rock, three remain in place. An earthquake apparently tumbled the fourth.

Rameses reigned for 67 years (1298-1232 B.C.). Under this vainglorious but successful monarch Egypt reached new heights of splendor. Rameses kept architects and sculptors busy erecting statues and temples to his glory.

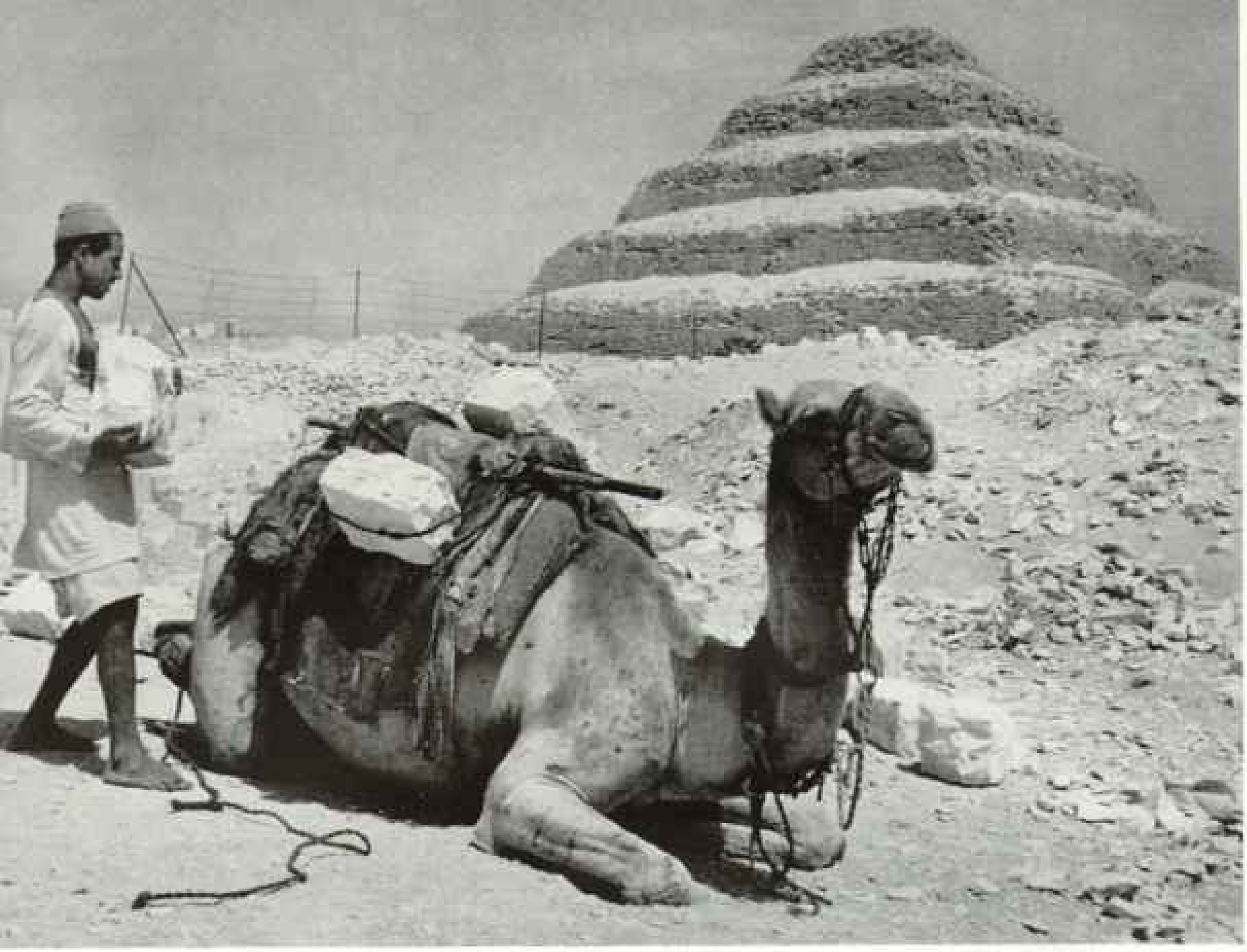
Above Aswan we paddled through colonnades and courtyards of the flooded buildings on the submerged island of Philae.

The partly drowned Temple of Isis made a fine diving platform. Crocodiles are rare this far north; so I donned swim fins and face mask and plunged down through green water to examine slime-coated columns and inscriptions of this superb temple, built more than 30 lifetimes ago (pages 720 and 721).

Egypt's greatest modern wonder, the Aswan Dam, came next on our crowded itinerary. The water it has stored and meted out has proved more valuable to Egypt's millions than all the pyramids and temples ever built (page 724).

Local laborers built the dam under British supervision between 1898 and 1902. They used 1,000,000 tons of granite from the same quarry that furnished masonry for ancient temples.

Portaging around the dam, we dodged through the First Cataract and entered the land of the fellahin, the agrarian peasant of Egypt. From this point to the Nile Delta only the banks of the river, to a depth of



Crumbling Limestone Makes Treacherous Climbing on Egypt's Earliest Pyramid

This 195-foot step pyramid at Saqqara houses King Djoser's 5,000-year-old tomb. Workers clearing a path load a hardy camel; Egypt's versatile beast of burden also plows the fellahin's fields and turns irrigation wheels.

about 10 miles back from the shores, are settled and cultivated.*

Egypt, of course, is mostly uninhabitable desert. Its borders enclose a land area equal to Texas and New Mexico combined. Yet it squeezes a population of 22,221,000, two and a half times that of Texas, into 3 percent of this space. This cultivable fraction is a slender oasis with a total area of about 13,500 square miles—a little larger than the Netherlands. The average farm has half an acre of land.

Small wonder that the Nile is so anxiously studied and watched over, with $1,000,000 spent each year on hydrological research alone, as the river's flow becomes a more and more critical fact to the expanding population it supports.

Once a year the Nile overflows its banks, spreading a thin layer of alluvial soil over its flood plain to revivify the tired, intensely cultivated land (page 726). This soil, most of it transported from the highlands of Ethiopia, accumulates at the rate of about 4 inches every century. Egyptian farmland, therefore, now stands 7 feet higher than in Cleopatra's time, and 20 to 30 feet above the level in the days when the pyramids were built.

Village life in modern Egypt preserves in all essentials the features of rural life in ancient Egypt. Even the people's stature, build, and coloring mirror the appearance of the subjects of Pharaoh.†

Incriminating Skull

Four miles below Aswan Dam we took photographs of the newly excavated tomb of an Egyptian general of the Old Kingdom. A skull one of the archeologists gave me for a souvenir later got me in trouble when a curious policeman spotted it in my kayak and was positive he had caught a murderer red-handed!

* See "By Felucca Down the Nile," by Willard Price, National Geographic Magazine, April, 1940.

† See "Daily Life in Ancient Egypt," by William C. Hayes, National Geographic Magazine, October, 1941.

729 National Geographic Photographer B. Anthony Stewart

High-masted Feluccas, Laden with Golden Grain, Line the Cairo Waterfront

Lateen sails furl tightly against bamboo spars. In ships like these, 30 river pirates attacked the kayaks (page 730). Pyramids of Giza, southwest of Cairo, rise above distant palms.

Almost every day we broke off paddling to visit the marvelous monuments of Egypt's glorious past: the Ptolemaic Temple of Kom Ombo; the Temple of Edfu, with its enormous twin pylons, towers 110 feet high.

On the Plain of Thebes we saw remains of the richest city of ancient Egypt. Here was the capital of the Pharaohs during the New Empire period, when Egypt's political power and culture reached their zenith of influence and splendor.

Valley of the Tombs of the Kings

On the east bank lie El Karnak and modern Luxor, the latter with its stupendous Temple of Amun. The west bank today is one broad necropolis, guarded by the Colossi of Memnon, two immense portrait statues of Amenhotep III, each 65 feet high (page 726). Beyond, to the west, lies the fantastic Valley of the Tombs of the Kings.

Before passing through the Asyut Barrage, we stopped at the American United Presbyterian Mission Hospital and Leper Clinic in Asyut. The hospital is a well-equipped institution, staffed by 20 skilled American and Egyptian doctors and nurses who minister to as many as 8,000 patients a year.

Across the river we called on the "Nile Mother," Lillian Trasher, a 66-year-old American from Jacksonville, Florida, who for 40 years has been "Mamma" to thousands of Egypt's orphaned and deserted waifs.

As we stroked along through a lonely region near Dairut, we were jumped by Arab river pirates. Attempting to intercept us, the desperadoes, about 30 in number, attacked in five high-masted feluccas, shouting and brandishing rifles as they raced toward us.

Luckily the Nile was nearly 1,000 yards wide, giving us ample room for evasive action. We paddled furiously, finally outdistancing our pursuers, who probably planned to rob us.

As we started to breathe more easily, bullets began whizzing past as the pirates blasted away with rifles. Fortunately wind and waves kept our kayaks bobbing like corks, making us awkward targets even for the best marksman.

730

Spangled Beauties Sway to the Rhythm of Muted Flutes

Superb muscle coordination in their dancing makes these young twins famous throughout the Near East.

The author watched them perform at a Cairo reception. To him they confided a cherished ambition: to appear in a Hollywood Technicolor movie with dancing star Gene Kelly.

"They would be a smashing success," Mr. Goddard predicts.

John M. Goddard

Jean Laporte

After Nine Arduous Months and a Million Paddle Strokes, Boatmen Near the Sea

Political unrest seethed in Egypt during the explorers' visit. Hysterical fellahin in the Delta, mistaking the camera-laden trio for spies, attacked from the riverbank. Egyptian policemen, mounted on handsome Arabian stallions, provided an armed escort during the last 100 miles (page 732).

Two weeks later we reached Cairo. Our report of the pirate attack brought prompt action. A posse of 200 Egyptian soldiers took off in pursuit of the outlaws, who surrendered after a brief skirmish and were imprisoned.

Voyagers Feted in Cairo

We lingered in Egypt's cosmopolitan capital, feted like celebrities by a host of new friends who had been following our progress. I had the privilege of attending the annual Fourth of July garden party given for Americans in Egypt by Ambassador Jefferson Caffery.

Of course, we drove southwest from Cairo to visit what are perhaps the most famous of all antiquities, the Pyramids of Giza, Egypt's trademark.

With Jean at my side, I fulfilled a boyhood ambition by climbing to the top of the Great Pyramid of Khufu, built of 2,300,000 limestone blocks, each weighing two-and-a-half tons.

From the Great Pyramid our gaze swept postcard Egypt—the shimmering yellow desert, the green valley of the Nile, the Sphinx, and the Step Pyramid of King Djoser at Saqqara, Egypt's oldest pyramid (page 728).

At the Pyramids I boarded a sour-looking "ship of the desert." After nine months of paddling down the Nile, it took a camel ride to make me green around the gills!

In buoyant spirits we stroked away from Cairo, escorted by racing shells from the Royal Rowing Club. With only 120 miles to go, we felt our journey was as good as finished. We should have remembered that the only predictable thing about the Nile is its unpredictability.

Into the Delta Country

Twenty miles downstream we detoured down the Baguriya Canal, one of the network of waterways through the flat Delta country, where Egypt grows two-thirds of her cotton.

Gliding along the village-fringed canal, we were able to look over the back fence at the

life and customs of the people, often without their even being aware of our passing.

When they did spot us, the villagers displayed great agitation. Women washing clothes or filling jars at the water's edge scattered in alarm. Swarms of men and boys noisily paced us along the banks.

But when we paused to photograph graceful feluccas, we were totally unprepared for the riotous events which followed.

Attacked by a Mob

A mob of hysterical fellahin surged to the banks. Anticipating trouble, we paddled away, whereupon the overwrought natives pelted us with clods of dry mud.

"I think they don't like us," André said.

In fear for our lives, we surrendered. Some members of the crowd, even after our capitulation, kept striking us with sticks and clods until restrained by their companions.

Upon landing, we were quickly surrounded by 300 jostling, spitting, vilifying natives. Our passports, which we held up as identification, were knocked from our hands.

It seemed we might be killed on the spot. But at last three gafirs (village policemen) edged their way through the throng and, heeding our demands, led us to the dwelling of the village chief. Completely bewildered, this official ordered his gafirs to lock us up until he could get the help of a police lieutenant from a neighboring town.

Along a dusty alleyway we were hustled to a dungeon, where for five hours we picked lice and fleas from our clothing.

The police lieutenant, equally perplexed, loaded us into his pickup truck and drove to the town of Minuf to refer our case to the commandant of police.

Fortunately the commandant could speak English and, as he put it, had "followed the expedition with envy from the beginning." Apologizing for the attack, which he attributed to a spy scare, he promised that he would personally take steps to protect us from any further unfriendly demonstrations.

Next morning the commandant drove us back to the canal, informing us on the way that the five districts around Minuf comprised one of the most densely populated regions in the world. We found two guards watching over our boats and a subdued citizenry lining the shores.

As we shoved off, three husky soldiers garbed in khaki and wearing red tarbooshes, rifles slung across their backs, appeared on the bank. Each was mounted on a handsome Arabian stallion (page 731).

Here was an escort to protect us—compliments of the commandant. They followed us along the shore, and every few hours a fresh trio would take over the job. These alert patrols watched over us all the way to the Mediterranean.

After traveling 8,000 miles through the remote regions of Africa, virtually unarmed and on our own, we found it laughable to need an armed guard on our passage through this civilized portion of the route.

Nine arduous months after embarking on our "impossible" expedition we reached Rosetta (Rashid), where during flood season Nile water pours into the Mediterranean. In times of low water a barrage holds back the river for use in irrigation.

We had arrived at the goal that had seemed at times unattainable. Each of us had dipped a million paddle strokes since our start on the Kagera.

Mayor Surprised and Relieved

The mayor of Rosetta, who had been advised that we were on the way, welcomed us with exclamations of relief.

"I didn't think you would make it!" he said.

"Well," I replied, "four can do anything—if one of them is God."

Weeks later, back in Los Angeles, I counted up the practical results of our venture. André and Jean had collected valuable information in their respective fields, geology and entomology, which they turned over to French scientific institutions. And I had gathered material which should help me earn a Ph.D. degree in anthropology at the University of Southern California.

To the Adventurers Club of Los Angeles I returned its faded flag, which I had carried to the summits of Matterhorn and Popocatepetl before journeying by kayak and portage from headsprings to mouth of the Queen of Rivers.

Notice of change of address for your National Geographic Magazine *should be received in the offices of the National Geographic Society by the first of the month to affect the following month's issue. For instance, if you desire the address changed for your July number, The Society should be notified of your new address not later than June first. Please give BOTH your OLD and NEW addresses, including your postal-zone number.*

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In addition to the editorial and photographic surveys constantly being made, The Society has sponsored more than 100 scientific expeditions, some of which required years of field work to achieve their objectives.

The Society's notable expeditions have pushed back the historic horizons of the southwestern United States to a period nearly eight centuries before Columbus. By dating the ruins of vast communal dwellings in that region, The Society's researches solved secrets that had puzzled historians for 300 years.

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On November 11, 1935, the stratosphere flight of the world's largest balloon, *Explorer II*, sponsored by The Society and the U. S. Army Air Corps, reached a world-record altitude of 72,395 feet. Capts. Albert W. Stevens and Orvil A. Anderson took aloft a ton of scientific instruments and obtained results of extraordinary value.

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In 1948 The Society sent seven expeditions to study the sun's eclipse on a 5,320-mile arc from Burma to the Aleutians.

A Greek cargo ship sunk in the Mediterranean 2,200 years ago was found in 1952 and is being excavated by the National Geographic Society-Calypso Marine Archeological Expedition led by Capt. J.-Y. Cousteau of the French Navy.

The National Geographic Society and the Royal Ontario Museum in 1951 explored and measured newly found Chubb meteor crater, 11,500 feet in diameter, in northern Quebec.

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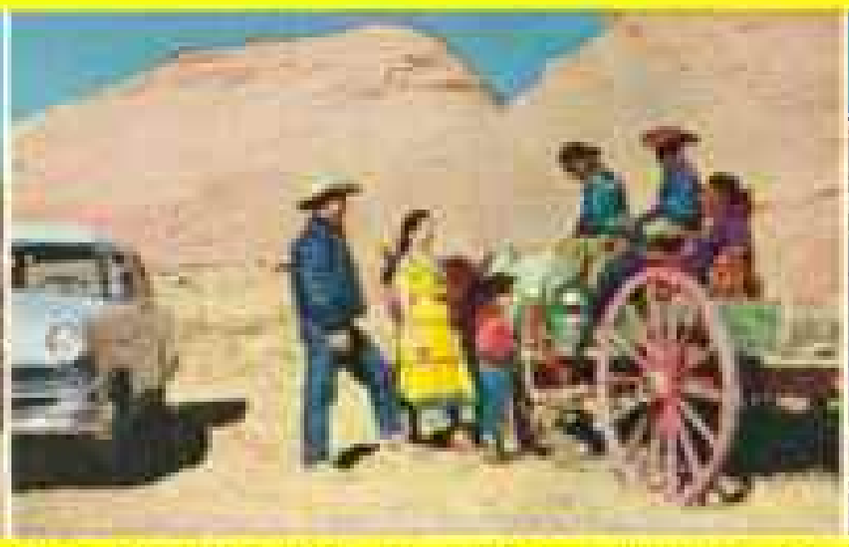
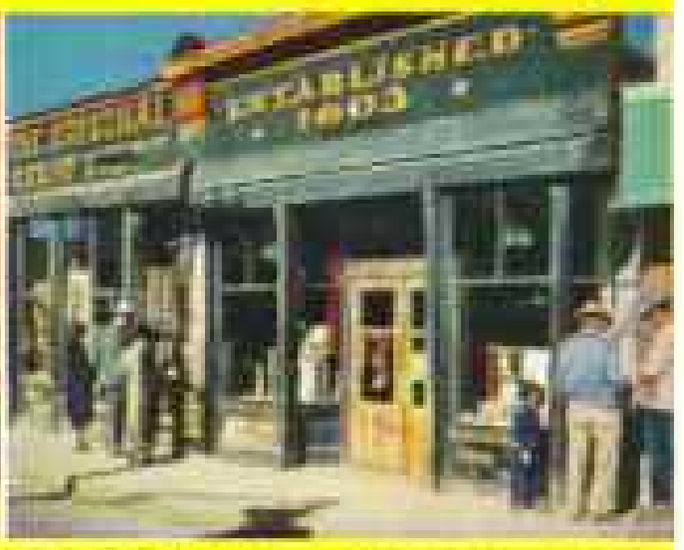


See Navaho Indians driving wagons on side roads near main highways. Watch them weaving rugs, making jewelry.



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The newest, and only sub-tropical National Park in the United States, the Everglades is, in a sense, the most American of all, for it is primarily a *refuge*. Here, the once-hunted egret and other spectacular bird species live unmolested; even the alligator is an honored guest. Nowhere else in America will you see such large congregations of birds and such unusual plant life as in this Florida wonderland that belongs to you. It has been said that each of the 28 National Parks has a special lesson for those who look for it. The Everglades makes you know what it is to be free.

A Salute to the National Audubon Society

Sinclair salutes the membership of the National Audubon Society for 50 years of outstanding accomplishment in the conservation of America's wildlife, plants, soil and water.

The Society, which has headquarters at 1130 Fifth Avenue, New York City, was a major force in the establishment of Everglades National Park and conducts Wildlife Tours there today.

Perhaps the brightest feather in its cap was the saving of the egret. Years ago, when fashion decreed that every lady wear a feather on her hat, thousands of egrets were slaughtered for their plumage. The Society roused public opinion against the fashion. The plumed hat became a badge of shame and its sale eventually prohibited by law.

As a result of the Audubon Society's efforts, the egret was saved from extinction to become a symbol of the Society's many achievements in conservation.

MOTORISTS – if you would like to visit the National Parks by car, the Sinclair Tour Bureau will help you plan your trip. Write: Sinclair Oil Corporation, Sinclair Oil Building, 600 Fifth Ave., N.Y. 20, N.Y.

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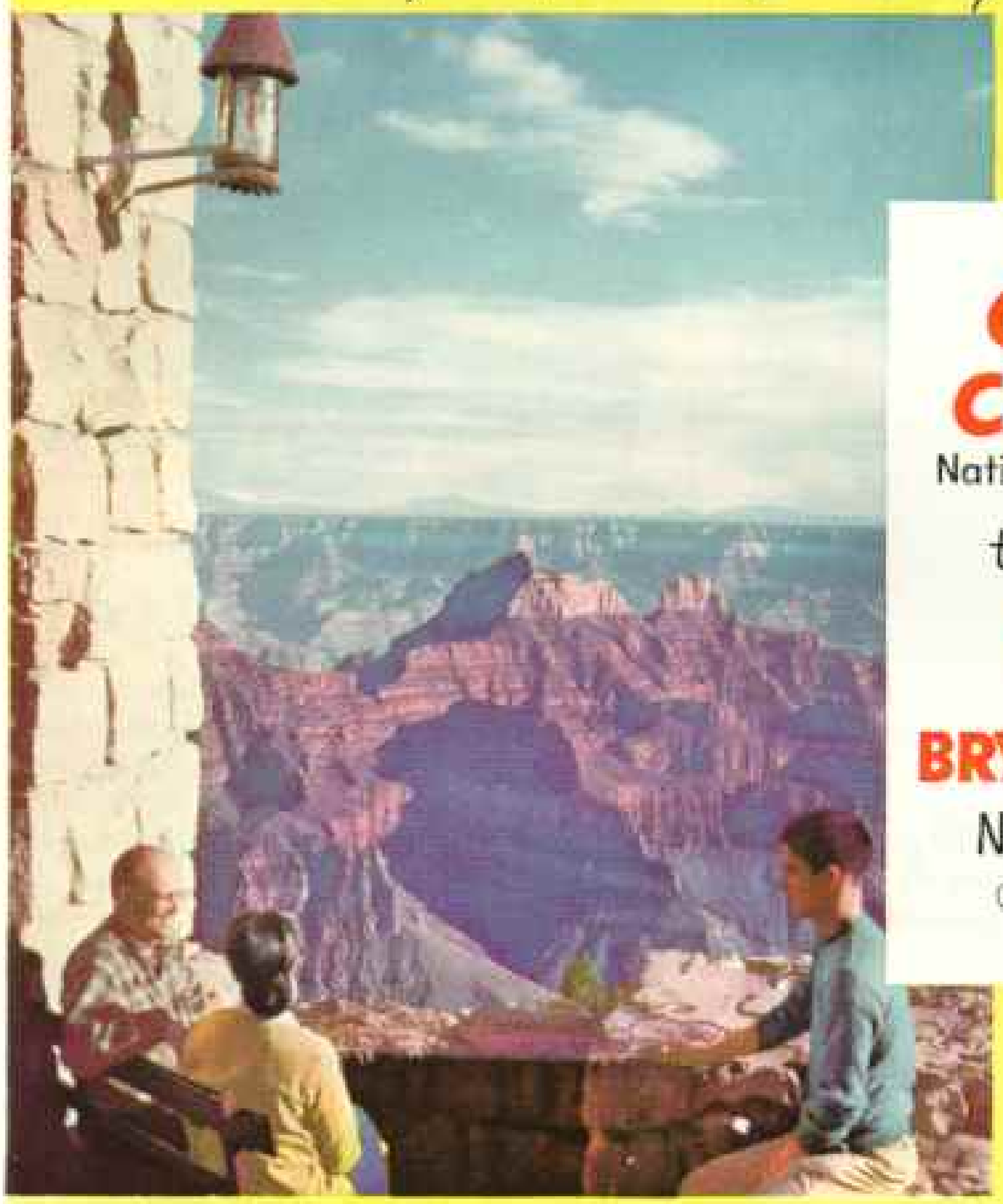

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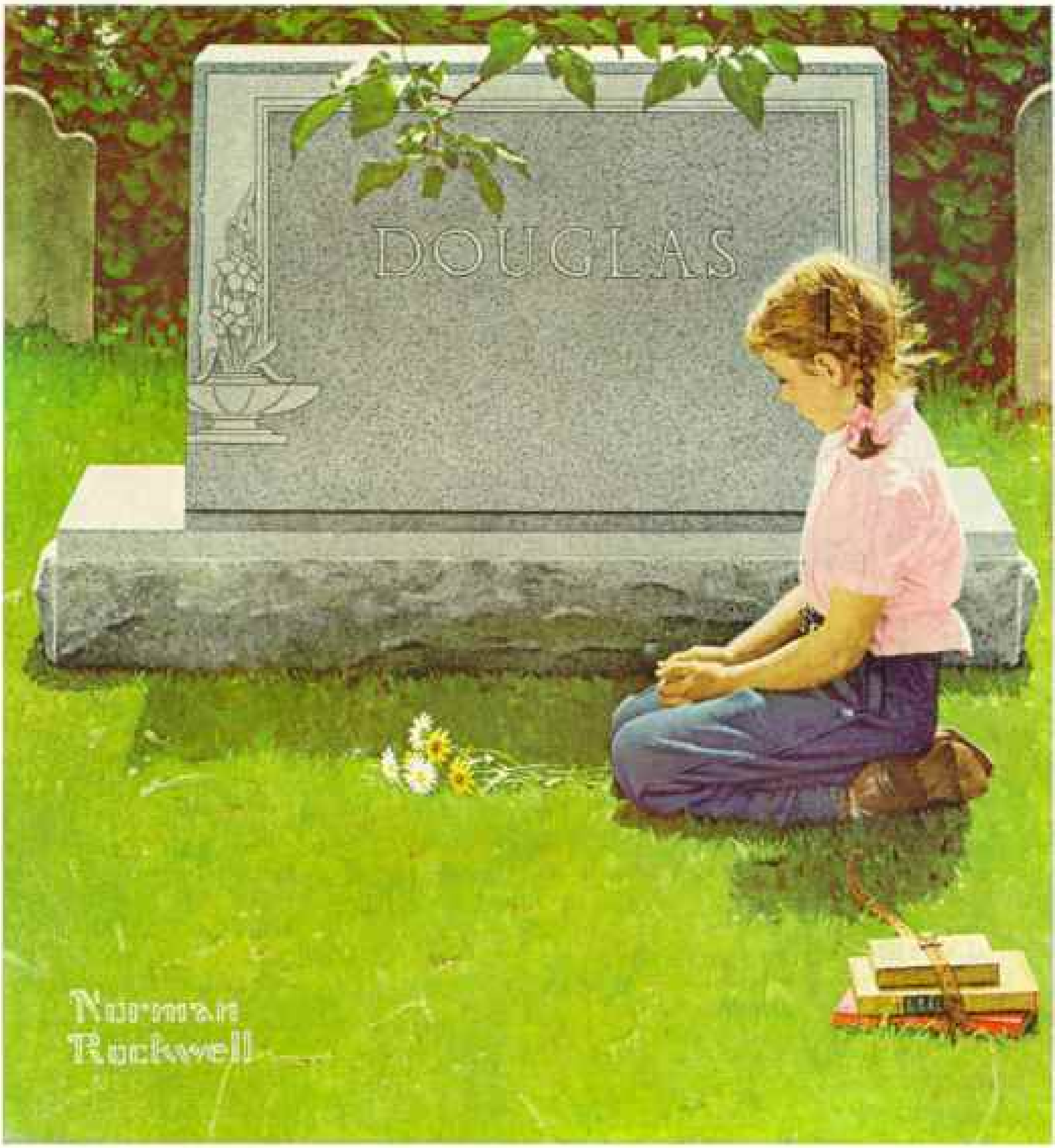

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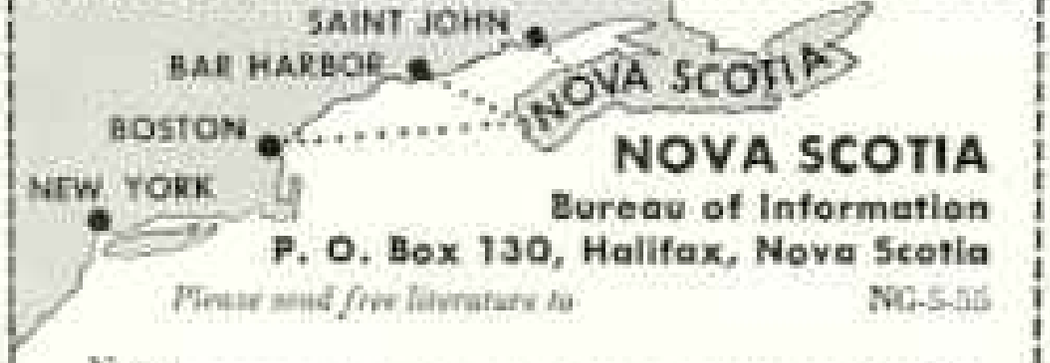

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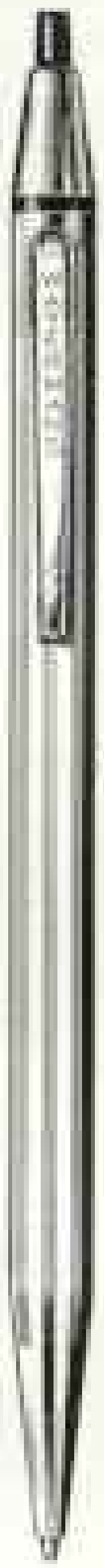

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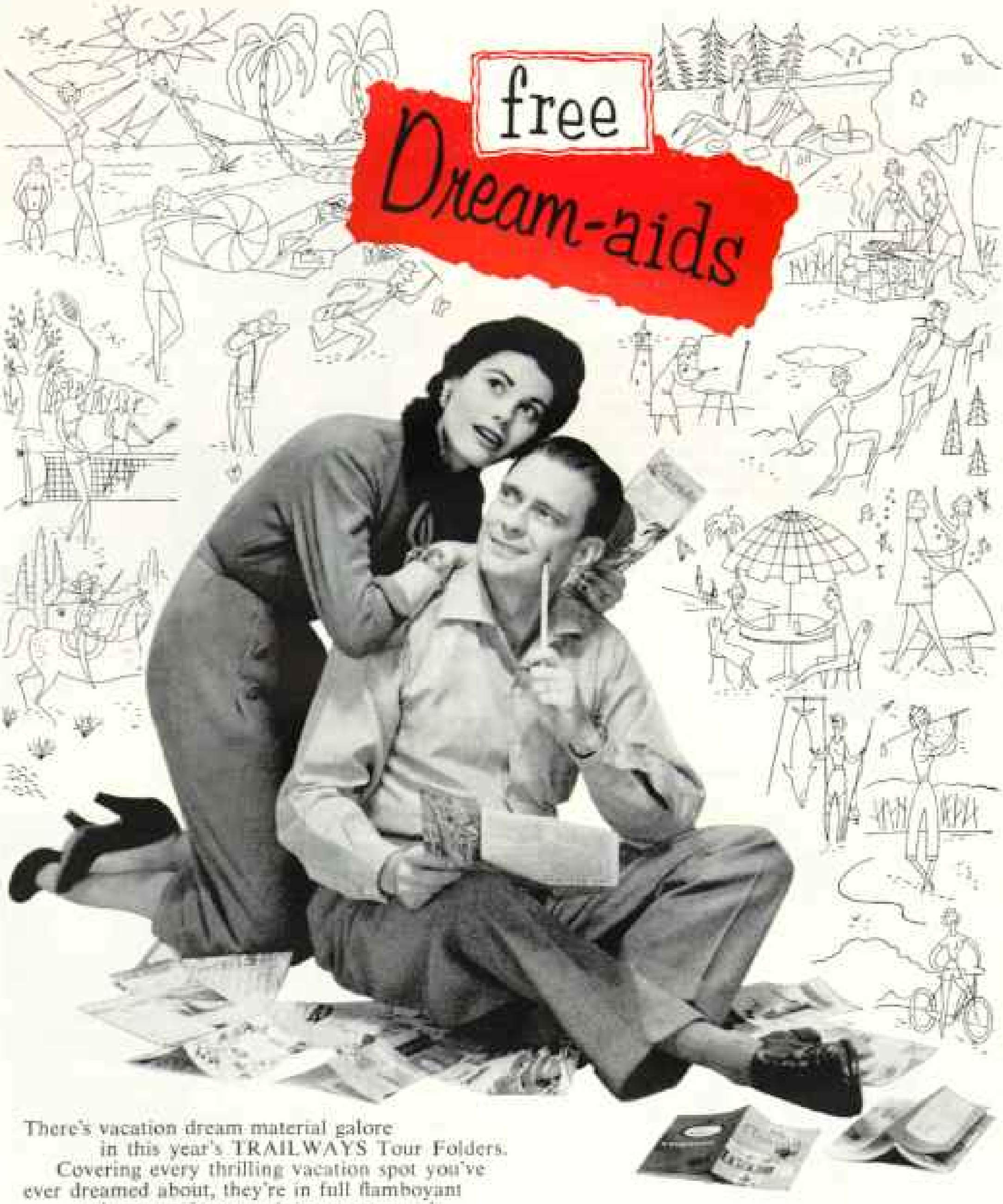

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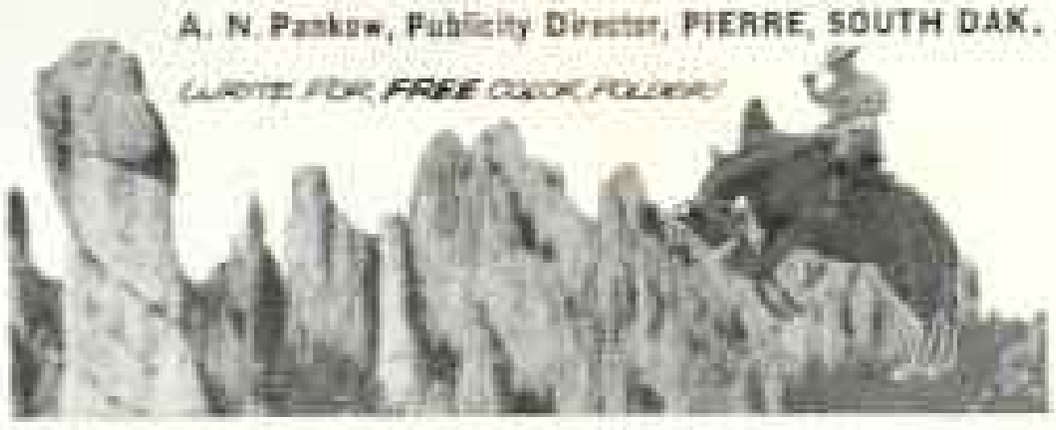

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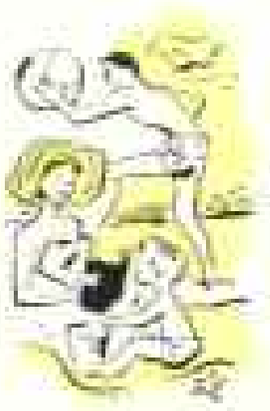

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The Canadian

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ENJOY REFRESHMENTS in the smart Mural Lounge under a mural painted for Canadian Pacific by one of Canada's great artists.

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Make reservations now! Wide choice of accommodations! See your local agent or Canadian Pacific, in principal cities in U. S. and Canada.

Look at the car–and you know the man likes action

Nowadays, you can tell the *man* by the *car* he keeps.

Obviously, the car you see here belongs to a person who likes to go places. And he likes to get there with a minimum of effort and a maximum of pleasure.

We had such a man in mind when the design of this 1955 Lincoln began. And we gave our designers and engineers a goal that we believe has been achieved.

The aim was this: to build a fine car with *action* to surpass any other car—with beauty to match the tastes of Americans on the move who demand the finest.

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Here is a new combination of utter smoothness with ultra quick acceleration. No jerk, no lag—just one unbroken sweep of power from zero to superhighway speed limits.

If you want a car with performance far ahead of its time—a car with beauty that speaks for itself and says so much about your own good taste—the new 1955 Lincoln is for you.

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LINCOLN

for modern living
for magnificent driving

"I saw few die of hunger...
of eating, a hundred thousand"

Benj. Franklin

POOR RICHARD'S ALMANACK—1738

Benjamin Franklin's observation that he saw more people die from eating than from starvation is certainly pertinent today. For, if you weigh more than you should, the chances are better than 9 out of 10 that your extra pounds have accumulated because of overeating.

When you store up weight, you are also likely to store up future troubles. These could include diabetes, gall bladder and kidney disorders, heart disease or high blood pressure . . . to mention a few.

In fact, studies show that the death rate from all causes is 22 percent higher for people who are from 5 to 14 percent overweight than for people of normal weight. Among people who are 25 percent overweight, mortality is about 75 percent higher.

If you are overweight, why delay the obvious advantages of reducing? Before you start to reduce, however, there are some pitfalls you will want to know about and avoid.

First are the drastic dietary fads which usually limit you to a few foods, and second is the indiscriminate use of so-called "reducing pills." Only when overweight is accompanied by a serious disease may quick reducing be desirable.

The safe and sane diet is the one that reduces you *slowly* . . . two to three pounds per week . . . and that *permanently* keeps you at your best weight. In fact, throughout adult life it is a good rule to keep your weight at slightly below the level that is normal for your age and body build, or bone structure.

It is always wise to let your doctor decide what you should weigh and, equally important, let him plan your reducing diet. He will see to it that your meals are properly balanced, especially in protein, vitamin and mineral content.

Do not expect too much too soon when you start dieting. It took a long time to acquire those surplus pounds . . . and it will take time to lose them. If you want to keep check on your progress, weigh yourself weekly, rather than day to day. If you stick to your diet, your weekly weighings will eventually show how much you are losing in weight.

Once your weight is down, try to avoid any return to your old ways of overeating . . . and gaining. For *permanent* weight control usually brings a rich reward—*better health and added years in which to enjoy it.*

This is the kind of fun you have

Every evening's a gay occasion on a festive Moormack Cruise. The soft night air and bright tropical stars lure you on deck to watch, or join a swimming party in the lighted pool. While your Cruise Liner sails the smoothest of all seas, a 6-piece orchestra invites you to drop by and dance.

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When you give Sheaffer's, you give more than a helping hand for career years. You give your *approval* in the highest degree. And you fulfill the long-ago promise that nothing but the best would ever do.

Fills the modern way
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Sentinel ensemble illustrated, $27.50

Sheaffer's Snorkel pens from $8.75...other Sheaffer pens from just $3.75

Sheaffer's
new Snorkel pen

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. . . the Cine-Kodak K-100 Camera

If you want beautiful 16mm. color movies with unusual corner-to-corner definition and over-all color purity, *this is your camera.* Glance over this partial list of features, if you will. See if there are any you'd willingly be without . . .

Loads easily and quickly—takes 100-foot rolls, single- or double-perforated, color or black-and-white.

Longer shooting—up to 40 feet of film without rewinding! Your choice of 5 speeds from 16 (standard) to 64 (slow motion) frames per second. Unique spring-motor dial tells how many feet can be run without rewinding. Standard film-footage indicator, too.

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3-way exposure lever—"half-down" for steady shooting; "full-down" for self movies; "up" for single-frame shots.

Special effects—spring-motor drive . . . hand crank . . . back winding . . . electric-motor shaft . . . permit a wide variety of exposure effects. Yet no camera is *easier* to use than the basic K-100.

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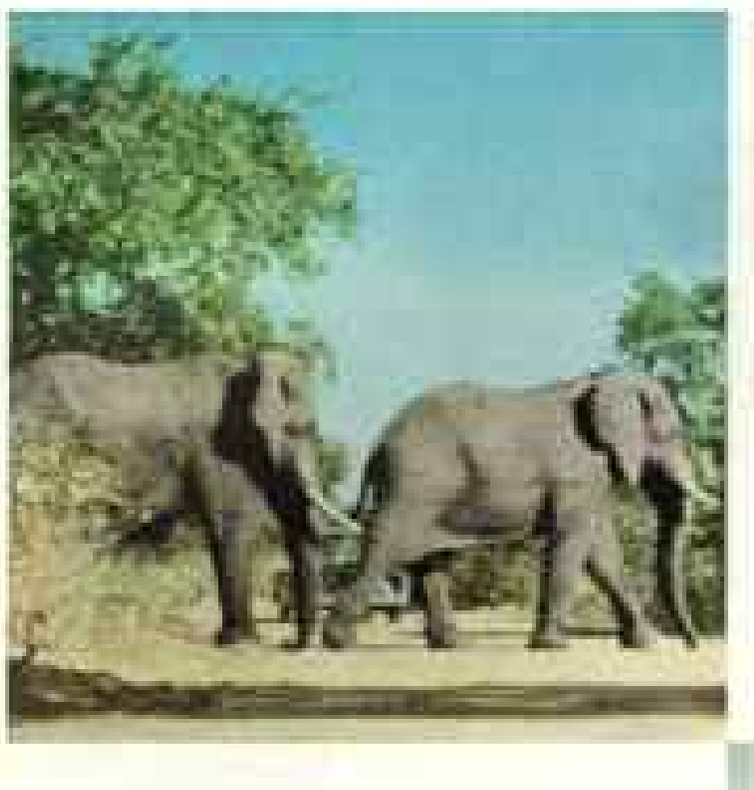

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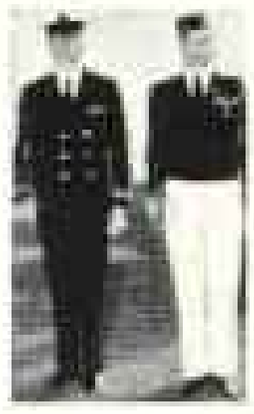

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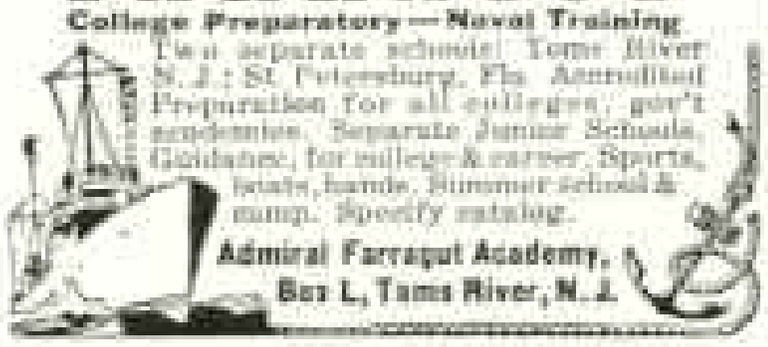

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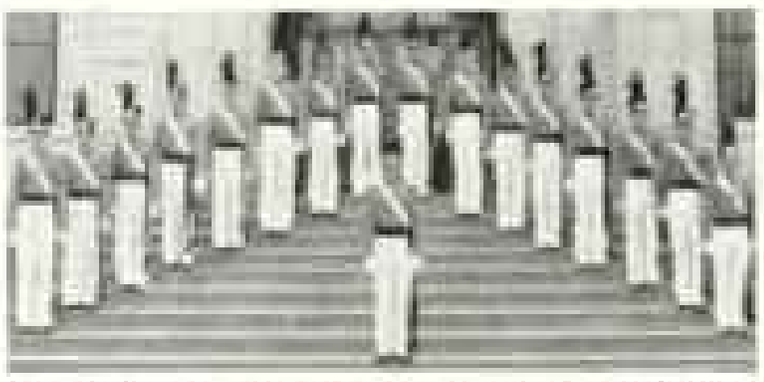

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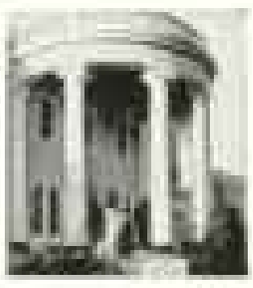

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IN THE

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* *The Membership Dues, Which Are for the Calendar Year, Include Subscription to the National Geographic Magazine*

To the Secretary, National Geographic Society,
Sixteenth and M Streets Northwest, Washington 6, D. C.: *1955*

I nominate .....
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(This information is important for the records)

Address .....
FIRST ADDRESS OF NOMINEE

..... *for membership in The Society.*

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5-55

"Not a man in sight..."

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