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THE NATIONAL GEOGRAPHIC MAGAZINE

AUGUST, 1959

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At work on cameras that will dive deeper into the sea's mysterious abyss than instruments have ever gone before, Dr. Harold E. Edgerton tries out a new model in—of all places—a college swimming pool. Eventually the cameras and their high-speed flash lights will dangle at the end of a seven-mile cable as Dr. Edgerton strives to give NATIONAL GEOGRAPHIC readers a glimpse of one of earth's last frontiers—the bottom of the 36,000-foot Mariana Trench.

Here Dr. Edgerton tests the underwater definition of his new stereoscopic deep-sea camera. It then successfully withstood a pressure of 8 tons per square inch—the maximum found in the sea—in a 16-inch naval projectile pumped full of water.

"It's the best use I know for a 16-inch shell," says Dr. Edgerton, Professor of Electrical Measurements at the Massachusetts Institute of Technology and 1952 winner of the National Geographic Society's Franklin L. Burr Prize for his invention of the high-speed flash.

The Society's Research Committee, in supporting this exciting project, has teamed Dr. Edgerton with the noted French marine explorer Capt. Jacques-Yves Cousteau, of National Geographic-*Calypso* Expedition fame. To Cousteau's divers he is known affectionately as "Papa Flash."

Not everyone can be a Cousteau or an Edgerton, but members of the National Geographic Society share their experiences and—through their dues—make possible such work.

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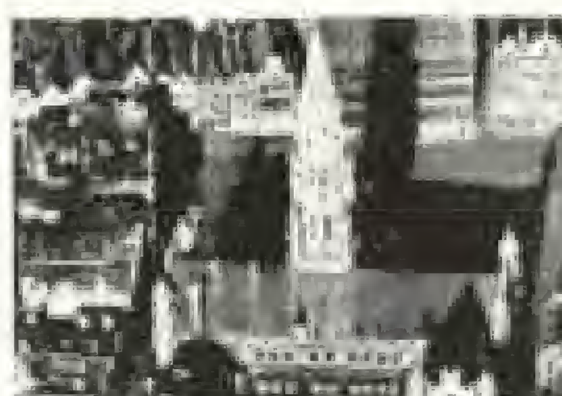

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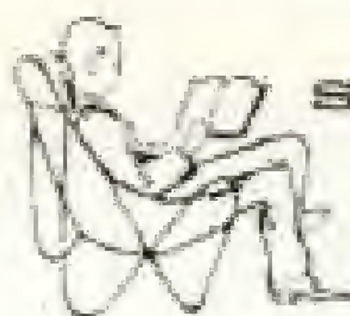

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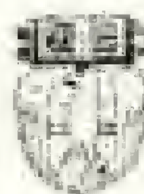

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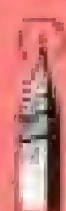
Insurance  Company

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VOL. CXVI, No. 2 WASHINGTON AUGUST, 1959

Giant Sequoias Draw Millions to California Parks

Visiting earth's largest living things a century after their discovery, a former park ranger roams the high meadows and jumbled crags of Kings Canyon and Sequoia National Parks

By JOHN MICHAEL KAUFFMANN

National Park Service

Illustrations by National Geographic Photographer B. ANTHONY STEWART

THE HIGHWAY WRITHED and coiled up the ramparts of the Sierra Nevada. Behind, drenched in June sunshine, lay California's San Joaquin Valley; ahead beckoned the hazy, tumbled ridges of Sequoia National Park.

With my car in second gear, I patiently swung around each hairpin turn as I drove up toward the Giant Forest. Other cars, crawling cautiously below me, seemed toylike and remote. Beyond and far below I caught glimpses of the brawling Kaweah River. On the canyon walls yuccas were in flower. "Candles of Our Lord," the Spaniards called them. Buckeyes thrust forth ivory blossoms. Far away, at the head of the valley, snow clung to the peaks of the Great Western Divide.

Up this canyon, a century before, Indians led a rancher along dim, twisting trails to see an incredible wonder—the giant sequoia trees, largest of living things. I marveled at the feat of highway engineering that now permits more than a million visitors each year to drive these heights (map, page 152).

Four Guardsmen Flank Road

The air cooled deliciously as I climbed. Here sugar pine, white fir, and dogwood cloaked the mountainsides; more than a mile high, I had reached a zone of plant life approximating that of southern Canada. I rounded a bend and caught my breath in elation. Before me stood the Guardsmen: four sequoias flanking the roadway like the pillars of a city gate (page 151).

I was back in the Giant Forest once again.

As a United States park ranger, I had worked among the giant sequoias and in the rugged wilderness of their Sierra Nevada setting. I knew how much their lives—both imperiled and saved in their latest of many centuries—mean in beauty and inspiration.

Now, as a camera-carrying visitor, I was returning for a summer to see and learn more about two national parks whose boundaries encompass not only the world's most spectacular trees, but the deepest canyon and the highest mountain in the 48 contiguous States.

Sequoia trunks, their cinnamon-red bark bright wherever sunlight played, rose massively amid the green. I parked to rest after the tortuous drive and walked over to a group of the trees. The driver of a passing auto grinned at me and called: "You look just like a midget!"

He was right. In the Giant Forest we humans are all Gullivers in a Brobdingnagian world.

At Giant Forest Village I found the Sentinel Tree watching over hundreds of other recently arrived Gullivers buying film and camping supplies (page 178). This community center serves several thousand visitors, who hike the trails, camp in the groves, or relax in rustic cabins. The scurry of sightseeing does not disrupt the village's serenity, however. "Relax, youngsters," the old trees seem to say. "Your lives are short enough. Enjoy them!"

Heeding that advice, I selected a campsite where the sunset filtered through the boughs, and raised my tent snugly between two sequoia trunks. No sooner had I unpacked my gear than the official campground welcoming committee arrived: inquisitive robin, bump-

Shafts of Light and Coils of Smoke Say It's Breakfast Time in Giant Forest

Twin national parks, Sequoia and Kings Canyon, climb from the foothills above central California's San Joaquin Valley to the 14,000-foot crest of the Sierra Nevada. Within their 1,300 square miles of wilderness they protect thousands of ancient Big Trees, the fabulous *Sequoia gigantea*, natives of mile- to mile-and-a-half-high benches and slopes.

Author Kauffmann, now a member of the National Park Service's headquarters staff, served a season in these parks as a ranger. He found them to be three worlds: silent forests, savage canyons, and wind-swept granite peaks culminating in Mount Whitney (page 187).

Here sequoias already full-grown when Julius Caesar ruled Rome rise like pillars within a cathedral. Camper's incense, the aroma of bacon and coffee, drifts through Firwood campground in Sequoia National Park.

KODACHROME © NATIONAL GEOGRAPHIC SOCIETY

tious chipmunk, and truculent jay, panhandlers all.

The blue-fronted jay hopped onto my picnic table, scolding for food. I was about to oblige when—*crash!*—bombs seemed to be falling. Loosened by the wind, foot-long sugar-pine cones thumped down upon the campground. Boys from a neighboring tent ran over to retrieve them and scampered away with arms full.

At suppertime the forest filled with the fragrance of wood smoke. A dusk breeze carried the laughter of children and the faint notes of a guitar. Lanterns danced along the paths as families gathered around their evening fires.

Prowling Bears Upset Trash Cans

Seldom are families or friends united more closely than when they sit about a campfire. Here in the Giant Forest were scores of camps, many only a few yards apart. Yet around the primeval comfort of a fire each group felt private and secure.

Crash! This time it was no pine cone. I recognized the nightly bear raid—what rangers call the "Trash Can Symphony." Giant Forest's bears were busy tipping over the receptacles to see what tidbits humans had left. A mother bear and her cub shuffled by within a few feet of me. I knew they would not harm me if I did not molest or feed them; so I settled back against a tree to read by lantern light. I was never sure thereafter, however, who might be looking over my shoulder.

Later that night I was awakened by the sound of galloping paws, of a great body passing overhead, and of tearing canvas. I gazed up at stars. I had pitched my tent in Bear Alley, and Bruin, frightened away from a midnight snack, had taken his accustomed escape route. Next day I moved what remained of the tent to a safer site.

A coyote chorus was my dawn alarm clock, and a delegation of deer trotted by to make sure I was making the most of the morning. Fresh campfire smoke diffused the sunbeams and bore the aroma of frying bacon and bubbling coffee (page 148).

Down at the Information Center a camper asked where he might see Mount Whitney, highest peak in the United States until Alaska became a State.

"Over on the east side of the Sierra you can see it from the road," replied Park Ranger Carl Kronberg, "but from here you'll have to hike to Alta Peak. That's nine miles, and I'm afraid there's still snow on the trail."

The man laughed. "I'm from Florida. I like to *see* snow, not walk through it!"

I, too, decided to acclimate myself gently to Sierra altitudes and a summer of wilderness hiking. What better way than first to walk the beautiful trails that wind through the Giant Forest?

I faced a familiar problem. Should I see the biggest tree right away or build up to it by first inspecting other notable specimens of *Sequoia gigantea?* Like most visitors, I joined the stream of human ants circling the General Sherman, most massive of living things and one of the oldest (page 167).

I wondered how many tons of tree towered here, high as the Capitol dome in Washington, D. C. Some say 2,000, with enough wood to build 40 five-room houses. If it were tunneled like the Wawona Tree in Yosemite National Park, not one but three cars abreast might drive through it, for the trunk is as wide as a city street.

House-sized Trunk Awes Visitors

It is this trunk, nearly 37 feet in diameter at the base and tapering only slightly for half its 272-foot height, that gives the General Sherman the title of biggest. Other giant sequoias have slightly larger bases; their relatives the coast redwoods grow considerably taller, but for all-around bulk the General Sherman is champion.

"I feel so . . . infinitesimal," murmured a young woman as she gazed upward.

"I feel like a youngster," replied a white-haired grandmother with a twinkle.

The tree is so well-proportioned and so surrounded by other giants that many visitors do not realize its size. "It takes more than a quick look," said John Sinclair, the ranger on duty at the General Sherman. "People who

Towering Sentries in Cinnamon-red Coats Guard the Road to Sequoia Park

Most visitors using the park's south entrance catch their first close-up of the giants when the twisting, climbing road from Visalia divides here at the four Guardsmen. Thriving clumps of baby sequoias are 12 to 15 years old; they prove the great redwood forest eternal. Tall white firs, as at left, commonly associate with sequoias.

KODACHROME © NATIONAL GEOGRAPHIC SOCIETY

KINGS CANYON
NATIONAL PARK
SEQUOIA
NATIONAL PARK
Florence Lake
Blaney Meadows
South Fork San Joaquin R.
John Muir Trail
Evolution Valley
Lake Sabrina
Evolution Lake
Mt. Darwin
South Lake
Little Pete Meadow
Wanda Lake
Muir Pass
Le Conte Canyon
Bishop Pass
Black Giant
Dusy Basin
Palisade Glacier
Grouse Meadows
John Muir Trail
Devils Crags
Mather Pass
N. Fork Kings R.
Burnt Mountain
Middle Fork Kings River
Simpson Meadow
Taboose Pass
Mt. Pinchot
Aberdeen
Los Angeles Aqueduct
Owens River
Lake of the Fallen Moon
Spanish Mountain
Granite Pass
Sawmill Pass
Granite Basin
Kings River
South Fork Kings River
CEDAR GROVE AREA
Independence
Converse Basin
General Grant Tree
GENERAL GRANT GROVE
Sawed Tree
(Part of Kings Canyon N.P.)
Kings Canyon
Copper Creek Area
Kearsarge Pass
John Muir Trail
Scaffold Meadow
Mt. Brewer
Roaring River Ranger Station
Deadman Canyon
Junction Peak
Great Western Divide
Generals Highway
General Sherman Tree
Congress Group
Lodgepole Campground
Tokopah Valley
Tableland
Mt. Barnard
Tulainyo Lake
Alta Peak
Mt. Russell
Mt. Whitney
GIANT FOREST
Giant Forest Village
Tharps Rock
Mt. Stewart
Hamilton Lakes
Tharps Cabin
Bearpaw Meadow
High Sierra Trail
Moro Rock
Sugarbowl Dome
Whitney Pass
Marble Fork Kaweah R.
Mt. Kaweah
Middle Fork Kaweah
Mt. Langley
Ash Mountain Park Headquarters
Redwood Meadow
Big Arroyo
Mt. Guyot
Castle Rocks
Mt. Eisen
Paradise Peak
Army Pass
Kaweah
Hammond
Paradise Ridge
Atwell Grove
Silver City
Mineral King
E. Fork
Kaweah River
Three Rivers
Kern Canyon
Great Western Divide
Window Cliffs
Hockett Meadow
S. Fork Kaweah R.
Kern Peak
Sierra Nevada
STATUTE MILES
Ranger Station
Sacramento
NEVADA
San Francisco
YOSEMITE NATIONAL PARK
White Mts.
KINGS CANYON
SEQUOIA
Owens Valley
San Joaquin Valley
Visalia
CALIFORNIA
Pacific Ocean
Los Angeles
STATUTE MILES

stay awhile and gaze and think grow more wondering by the minute. 'Thirty-seven feet!' they say to themselves. 'Why, that's wider than my house!'

"The same is true of the tree's age. When I told one woman that we thought it was about 3,500 years old, she wept. 'I'm sorry,' she said, 'but when you think about all the things that tree has known and faced. . . .' "

I, too, felt this impact of the ages. "It is as if in these trees the flow of years were held in eddies," John Merriam once wrote of it, "and one could see together past and present. The element of time pervades the forest with an influence more subtle than light, but that to the mind is not less real." *

Egypt was conquering an empire when the Sherman sprouted. The tree was a thriving adult when Greece flowered into its Golden Age. And on a winter's night when a great star blazed over Bethlehem, this tree stood straight and tall, already more than 1,500 years old.

Ice Age Doomed Most Sequoias

The sequoias now growing in the Giant Forest are living links with ancient history, but sequoias as a race carry us back to the age of dinosaurs.

Born in the Mesozoic era, more than a hundred million years ago, the *Sequoia* genus, fossils indicate, flourished throughout earth's Northern Hemisphere. The Ice Age wiped out most of them.

Sequoia gigantea, a native of the Sierra Nevada, survived in high basins that were sheltered from the glaciers. Its more widespread cousin, *Sequoia sempervirens*—the everliving sequoia—remained only along the mild shores of California and southern Oregon. In the mid-1940's *Metasequoia glyptostroboides*, the "dawn redwood," hitherto known only in fossil form, was found still growing in China.

Recently the giant sequoias surrendered their title as earth's oldest known living things to the gnarled bristlecone pines—one of them 4,600 years old—in California's White Mountains to the north.† But these rival patriarchs' centuries may be numbered; the Big Trees may yet have a longer life span.

"We can't prove it, because no one has ever found a giant sequoia dying of old age," Chief Park Naturalist Robert Rose told me as we gazed at the General Sherman's towering bulk. "The trunks you see on the ground fell because of calamity, not age. Who knows but what the oldest standing trees are growing yet!"

Because of their great size they grow slowly now, but the General Sherman and its cohorts still thrive and put forth seed. I found their will to live even more wonderful than their size or age.

In the Giant Forest stand trees that have been burned to blackened hulks. Yet, with a slim ribbon of sapwood remaining, they live proudly on, healing their frightful wounds. Lumbermen who felled sequoias sometimes found ancient fire scars deep within the trunks, hidden by new growth. Even a woodman's saw failed to kill one sequoia. The Sawed Tree near General Grant Grove was cut nearly through, but did not fall. Now it has healed over the saw cut.

I saw more of this amazing vitality on the daily nature walk from the Sherman Tree through the Congress Group. Here two magnificent stands of sequoias honor the U. S. Senate and House of Representatives, which passed the legislation establishing Kings Canyon and Sequoia National Parks (page 182). Near the Congress Group stands the President Tree, rivaling the General Sherman in size.

"The bark of the giant sequoia is one of the tree's secrets of survival," Ranger-Naturalist Jack Hickey told us. "It's sometimes as much as two feet thick. Only the hottest, longest fires can penetrate it."

Room in Tree Created by Fire

At a campfire talk later I watched Jack apply a propane torch to a chunk of the spongy, fibrous bark. A total of more than an hour of such demonstrations at a temperature twice as hot as the average forest fire had burned out only a small cavity.

Nearly every large sequoia bears scars of the fires of past centuries. Some were merely singed; the armor of others had been pierced by infernos of forest debris. Subsequent fires ate into the heartwood. At the Room Tree we found the entire center of the trunk hollowed by fire, but new growth was enclosing it. Children crawled through the Room Tree's doorway to explore, or climbed up to peep through its window (page 160).

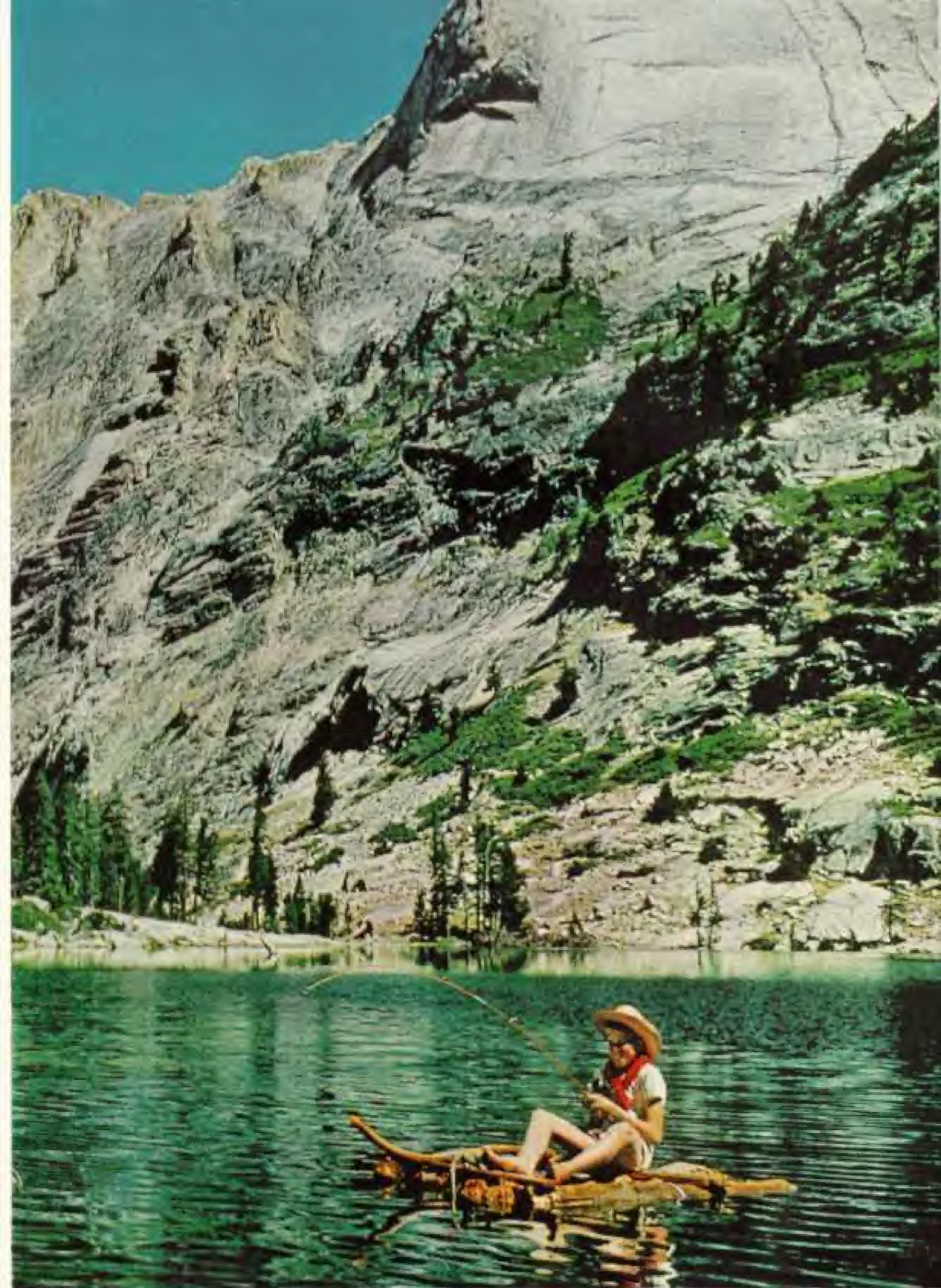
"Gee, I've never been *inside* a tree before," laughed one boy.

* *The Living Past*, by John C. Merriam, copyright © Charles Scribner's Sons, New York, 1930.

† See "Bristlecone Pine, Oldest Known Living Thing," by Edmund Schulman, NATIONAL GEOGRAPHIC, March, 1958.

Boy Scouts Cultivate a Tan on the Sun Deck of the Sierra

Treeless 2,000-foot ramparts of granite show this camp lies in high-basin country, world of the golden eagle and fighting trout. This largest of



KODACHROME BY JOHN E. KAUFFMANN © NATIONAL GEOGRAPHIC SOCIETY

three glacier-carved Hamilton Lakes sparkles beneath the Great Western Divide.

To reach camp, the Boy Scout troop hiked two days from the highway. "We have no formal program here," its leader told Mr. Kauffmann. "We just let nature entertain the boys."

College girls who spend their vacations working at Giant Forest Lodge named their quarters for Elvis Presley's first hit song.

Cabin Guests Top Off the Day with Campfire Song and Story

As leaping flames hold back the night, lodge hostess Mora Brown calls for amateur talent. "Once," says the author, "she landed the world's worst folk singer—me!"

"I'll bet a bear sleeps in here in the winter," whispered his brother.

Another of the sequoia's defenses, contained in the heartwood as well as the bark, is tannin. This chemical helps the tree resist blight and insect attacks, as well as rot. Sequoia logs that have lain in the forest for centuries are still sound.

Erosion and gravity are the tree's most dangerous nonhuman enemies. Since it has no taproot, a sequoia balances on a broad platform of shallower roots. If erosion upsets its equilibrium, it may topple while still in its prime (page 170).

The tranquil trees cast their spell, and although I was full of curiosity and questions, Ranger Sinclair and I frequently fell silent as we walked. So when a torrent of invective suddenly poured upon us from a near-by tree, we almost jumped from the trail. A flick of a bushy tail revealed a Douglas squirrel, giving us a first-class cussing out.

The Douglas is the champion harvester of sequoia cones. Deftly he cuts them off, then hurries down to retrieve them—often to find

that a golden-mantled ground squirrel has beaten him to it. The Hatfields and McCoys had nothing on these feuding families.

I picked up one of the hard egg-sized cones that littered the trail. Its seeds resembled flakes of rolled oats, each slim, dark kernel enveloped in a golden membrane that formed a pair of wings. It takes some 5,000 of these seeds to make an ounce. The largest lives in the world come in small packages!

Unlike the coast redwood, which can sprout from stumps or burls, the giant sequoia grows only from seed. Few of this prolific tree's seeds are fertile, and those that do germinate must have mineral soil and ample sun and moisture. Even then the seedling must survive the first year's hazards of drought and insect or animal appetite before its worst dangers are over.

Today thousands of the giants-to-be flourish in the parks, ensuring the future of the groves. Bushy, spire-crowned, and lacking the thick, reddish bark of their parents, they are often mistaken for other species. But their sharp awl-like needles, overlapping along the twigs, identify them as children of *Sequoia gigantea* (page 151).

This spiny foliage also distinguishes them from their flat-needled coastal cousins. Both species of sequoia are often called redwoods for the rosy color of their freshly cut wood. Foresters, however, usually restrict this term to the coast redwood, used extensively for lumber. The larger variety is called by its translated scientific name: giant sequoia. The noted naturalist John Muir called it simply the Big Tree.

Sequoia. The name, I reflected, is as

Hikers Cool Off Indian Style in Kaweah River's Torrent

Uncontaminated streams rise from park snows and forests. These youngsters hiked from Lodgepole Camp along the Kaweah's Marble Fork to Tokopah Falls.

KODACHROMES © NATIONAL GEOGRAPHIC SOCIETY

Rose-hued and yellow monkeyflowers brighten mountain slopes. Pussypaws have tonguelike leaves and long-stemmed blossoms. More than 1,000 plants bloom in the two parks.

Snow plant, spring's flaming harbinger, pushes up through centuries of forest duff. This saprophyte, a consumer of dead tissue, often appears to shine with its own built-in light.

American as the tree that bears it. At the Chief Sequoyah, one of the patriarchs of Giant Forest, we learned something about the half-breed Cherokee Indian in whose honor the redwood tribe was named. Unschooled, surrounded by barbarity, Sequoyah, like his namesake tree, had an unquenchable will to rise above adversity. He became respected as craftsman and tribal representative. And in 1821 he completed the first alphabet ever devised for an Indian tongue.

Austrian botanist Stephan Endlicher named the coast redwood in Sequoyah's honor. When the Big Tree was found to be of the same genus, it too took the name. The spelling of Sequoyah was altered to conform with the Latin used by science.

Giant Trees Impress Even the Blind

My walk to the Congress Group was the first of many I was to take in the Giant Forest. I traversed nearly every trail; yet the trees seemed always to call me back with John Muir's invitation: "Come to the woods, for here is rest."

Once a blind man came to the Giant Forest. His son led him along the forest paths, and as the boy described the trees, the man raised his sightless eyes and smiled, sensing their courage and serenity.

I was profoundly thankful for all my senses when walking in the Giant Forest. From a rustic seat in the House Group one can view sequoia boles and boughs as if gazing into the vaults of some great, green cathedral. Here nature has surpassed by far the massiveness of Durham, the grace of Chartres. Light streams through high branches and with its play turns the ridged and twisted bark into Gothic carving. Here the reverence of ages slips into one's soul.

The sunset hour is perhaps the most beautiful in the Giant Forest. The long light reddens sequoia trunks until they glow in the dark spaces of the groves. In the summer it purples the carpet of blooming lupine. Shadows lean across the forest. Then the birds begin to sing, flute answering tiny flute in trilling antiphony. It is elfin music sung to giants.

One cannot walk far in Sequoia and Kings Canyon National Parks without coming upon one of the many emerald meadows for which they are famed. Crescent Meadow in the Giant Forest has been called the "Gem of the Sierra." When I saw it, it was a jewel box of wild flowers. Sierra shooting stars showered the meadow with lavender. Later it would be white with Queen Anne's lace, then gold with senecio.

From a meadow bank children watched tiny trout that idled in the stream. Grown-ups were listening to Dr. Robert Rhodes of the West Coast Nature School. Eagerly cramming notebooks with the names of flowers and trees, some seemed bewildered. Dr. Rhodes was sympathetic.

"You are learning as adults," he said, "things that a generation ago on the frontier you would have learned automatically as children."

Far up the meadow, oblivious of humans, a California mule deer browsed. Fumbling excitedly with lens and light meter, I crept close for a photograph. Now to make the buck raise his antlered head. "Look pretty for the camera," I teased. The deer ate on, unconcerned. I whistled, shouted, and waved my arms, to no avail. Only after I had shifted my tripod out of position did he condescend to lift his nose a few inches above the grass and eye me sourly. As I struggled for a shot he turned and stalked away in search of privacy.

Log Housed Forest's Discoverer

Beside another meadow not far from Crescent stands one of the world's most unusual log cabins. Perhaps one should say that it lies rather than stands, for it is made of just a single log, an enormous hollow sequoia. Completed by a gable end, door, window, and chimney, this snug cabin was the summer home of Hale D. Tharp, who discovered the Giant Forest a century ago (page 180).

Tharp had befriended Yokuts Indians living near his Kaweah Valley ranch. In turn, they urged him to come with them to see a forest where they "walked in silence" among trees that a score of Indians could scarcely surround. In the summer of 1858 Tharp went, becoming the first white man to gaze upon the largest grove of the largest trees in the world.

He went again in 1860, and for 30 years thereafter used the area as summer range for his stock. Here in 1875 Tharp met and entertained John Muir, who named the grove.

Alone as usual, Muir was exploring the Sierra wilderness he so loved, learning its secrets and its beauties and writing about them with passionate understanding. Muir

KODACHROMES BY NATIONAL GEOGRAPHIC PHOTOGRAPHER B. ANTHONY STEWART (RIGHT) AND JOHN E. FLETCHER © N.G.S.

Fire-scarred Giants Refuse to Die

Only repeated major fires can pierce nonresinous sequoia bark, which is sometimes two feet thick. Charred, the tree grows a new hide. This wound's curling lips show *gigantea's* healing power. Except in rare cases, only falls kill the sequoias (page 170). But thin-skinned young sequoias fall easy prey to flames.

Flame-hollowed Room Tree will keep its cavity but heal its "window," from which these boys are seen, and its "door" (upper left), which admitted them.

Fire wounds mark most sequoias; some scars appear even more ghastly than this 65-foot cleft.

called Tharp's log a "noble den . . . likely to outlast the most durable stone castle, and commanding views of garden and grove grander far than the richest king ever enjoyed."

The two mountain men talked long about the trees, even as lumbermen's saws were biting into sequoia wood not many miles away. Thousands of sequoias were felled, their ponderous trunks often splintering and left as waste.

Stumps Remain from Growth of Ages

Converse Basin, near the borders of Kings Canyon National Park, is a giants' graveyard of stumps—all that remains of a sequoia stand once rivaling the Giant Forest.

When the Giant Forest itself was threatened, such sights aroused the national conscience. It found voice in men like publisher George W. Stewart of Visalia, California; Gustavus Eisen of the California Academy of Science; and, of course, Muir.

In 1890 Sequoia was established as our second national park, 18 years after Yellowstone. A week later the General Grant Grove near by was given national park status.

Still the Giant Forest was not safe. Private land holdings within the park included some of the finest sequoia stands, and over the years timber values rose temptingly. To preserve these trees, the Department of the Interior obtained an appropriation of $50,000 for land purchase. The amount needed, however, was $70,000.

It was a reasonable price, but could the additional $20,000 be raised in time? The Congress was swamped with preadjournment business, and options on the land had nearly expired. Would it be in order to appeal to the National Geographic Society, whose members from every State were so deeply interested in the preservation of America's natural treasures?

It was. The Society's Board of Managers, appreciating the emergency, acted promptly to appropriate the needed sum. This grant, presented in 1916, was the first of nearly $100,000 given by The Society and individual members for such purchases. The Giant Forest was saved intact.*

"This act on the part of your Society I know will meet with the highest commendation from its great membership," Secretary of the Interior Franklin K. Lane wrote Dr. Gilbert Grosvenor, then The Society's Director and Editor and now Chairman of its Board of Trustees, "because thereby you render to the Government of the United States and to all of its people a lasting service and in a sense create a monument to the honor of your Society itself.

"The trees which your money, together with that appropriated by Congress, enables us to purchase are . . . the original pioneers. To have them fall before the ax of the woodman would have been a lasting crime," Secretary Lane concluded, "reflecting seriously upon the people of our country."

In 1926 Sequoia National Park was more than doubled in size and now comprises 604 square miles. In 1940 an equally spectacular 710 square miles, adjoining Sequoia on the north and including the General Grant Grove, was established as its twin—Kings Canyon National Park.

General Grant Tree Honors War Dead

Next to the Giant Forest, Grant Grove is the best known and most accessible of the parks' 24 groves of *Sequoia gigantea*. The General Grant Tree, which is second in size to the General Sherman and thought by many to be even more impressive, is widely known as the Nation's Christmas Tree (opposite), at which Yuletide observances are held. In addition, it has been designated by Congress as a national shrine honoring America's war dead.

Western azalea blossoms brightened the grove when I first visited the General Grant Tree. Near it lay the Fallen Monarch, a hollow sequoia log used as a stable in days when Army cavalrymen patrolled the park (page 176). Beside it towered the General Lee. As he had to many a Union general, the Virginian seemed to be in two places at once. Had I not seen a magnificent General Lee

(Continued on page 171)

* See "Saving Earth's Oldest Living Things," by Andrew H. Brown, National Geographic, May, 1951.

Battle-worn General Grant Ranks Second in Command, Army of the Sequoia

Only the Sherman Tree (page 167), largest of earth's living things, outstrips General Grant in size; both may be 35 centuries old. Pride of Kings Canyon Park, the great tree serves by act of Congress as a national shrine to all United States war dead.

KODACHROMES BY NATIONAL GEOGRAPHIC PHOTOGRAPHER B. ANTHONY STEWART © N.G.S.

Telephone Repairmen in Yellow Hard Hats Ride Trail Across a Roadless Wilderness;

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Majestic Mount Eisen and the Great Western Divide Loom Beyond Sugarbowl Dome

Time Stands Still in a Slab of History

Tags on this Giant Forest cross section mark growth rings formed when Rome fell, Mohammed was born, and swords flashed in the Crusades. Smokey the Bear pleads for caution with fire.

Given 3,496 years more, this infant sequoia could become another General Sherman (opposite). It sprang from a quarter-inch-long seed.

If General Sherman grew at the base of 167-foot Niagara Falls, it would rise 105 feet above the crest. The major limb on the right has more girth than most trees.

A Wary Doe Bounds into Camera Range on the High Sierra Trail

Stalking a Sierra grouse and her brood one July evening, photographer Stewart heard a bear snort in the thicket above the trail. Seconds later the frightened mule deer flashed out of the woods.

Mount Stewart's granite peak (center) dominates the rugged Great Western Divide in this view east from Bearpaw Meadow tent camp (page 184). The mountain's name honors Col. George W. Stewart of Visalia, who played a part in the movement that led in 1890 to the founding of Sequoia National Park.

Clinging to the canyon wall, the trail dips and crosses the Kaweah River's Middle Fork, then passes Hamilton Lakes and Kaweah Gap on its way to the scenic Kern River Canyon.

Fir and buckbrush clothe the slopes. Sequoia, however, could live at Bearpaw's altitude, 7,700 feet.

KODACHROME © NATIONAL GEOGRAPHIC SOCIETY

Tree in the Giant Forest? Yes, I had. Generals Sherman and Grant both are challenged by a stalwart Confederate rival.

Many visitors in Grant Grove paused to admire the stately California Tree. To a mountain chickadee family, however, the awesome trunk was merely home. The busy parent birds darted in and out of a nest hole that a woodpecker had drilled in the thick bark, striving endlessly to satisfy the hunger clamoring within.

High Country Beckons Hikers

Beyond the sequoias of the General Grant Grove and the Giant Forest looms the majestic backdrop of the Great Western Divide (page 164). From Moro Rock, a massive granite dome rising 4,000 feet above the Middle Fork of the Kaweah, I first viewed these peaks in panorama.

It is a sight well worth the climb up 456 dizzying steps from the Giant Forest. On crisp mornings, when a warming sun makes lizards scurry, the divide sparkles against the sky. As dusk creeps through the hills and white-throated swifts dive through darkening space, the sunset gilds the mountain crowns. Then moonlight frosts them, and rivers mutter in the stillness.

Many trails lead into this hinterland to form a network of more than 900 miles. From Moro Rock the mountains beckoned, reminding me that in sequoia country each road's end is only the beginning. Like thousands of others each year who are enthralled by this challenge, I soon was digging through my duffel for hiking gear.

My first hike was only a morning's walk, but the two miles of trail up Tokopah Valley reveal all the elements of Sierra grandeur. The Watchtower soars 2,000 feet above the Kaweah River's tumbling Marble Fork. Tokopah Falls seems to draw its water from rock-rimmed sky.

As I neared the cataract, a stocky little athlete in gray eyed me from a river rock. Bobbing up and down, he seemed to be doing calisthenics, interspersing them with daredevil plunges into the current. Then in a burst of flight he dodged down the stream.

No renewed acquaintance could have delighted me more. The water ouzel, or dipper, Muir's "hummingbird of blooming waters," was welcoming me again into the wilderness. I had met him before, by a Rocky Mountain tarn, had heard his torrent of melody flowing down Olympic rivers. Once beside a Black Hills cataract I had found his spray-splashed nest of living moss.

This water-loving bird symbolizes to me all that is clean and brave and joyous in life. Through the West, from Mexico to Alaska, the dipper lives only where pure waters flow. He feeds fearlessly in foaming rapids and, through storm and cold, sings the year round.

"Climb the mountains and get their good tidings!" I had followed paths that led to snow-fed lakes. Now Alta Peak, rising northeast of the Giant Forest, 11,211 feet above sea level, seemed to echo John Muir's exhortation. The snows were mostly melted now; so friend Frank Netzer and I shouldered knapsacks one morning for a camping expedition up the mountain.

Leaving the sequoia groves, we plunged into red-fir forest. Beyond Panther Gap, Tharp's Rock thrust up over Mehrten Meadow like a granite fist. Above a timber line of twisted foxtail pines we panted onto Alta's snow-splotched summit.

Young Mountains Shed an Older Shell

We gazed upon an endless world of mountains. From north to south the Great Western Divide sawed its way across the sky. Eastward, beyond, loomed higher peaks. One far summit, we knew, must be Whitney (page 187). How old these ranges looked, motionless under the drifting clouds.

Yet a geologist would call them young. They have the sharp edges of youth still upon them, and they were made by motion. Once they were molten, welling up under rocks that were laid down beneath an ancient sea. The region rose and tilted in successive stages. Overlying rocks—the old mountains—wore away, and only their roots remain. The exposed granite core, freshly carved by rivers of water, ice, and wind, now forms the Sierra Nevada—the Snowy Range.

Imagine the Crash That Shook the Forest When Contorted Roots Let Go!

Lacking taproot anchors, giant sequoias balance on platforms of shallow feed roots reaching out a hundred feet or more. When ground erodes or softens, they lean and eventually fall, sometimes on windless nights. Rangers miles away have heard the boom. Dead at last, the tannin-filled trunks resist rot and insects for centuries.

KODACHROME BY JOHN M. KAUFFMANN © NATIONAL GEOGRAPHIC SOCIETY

Dainty stars of gilia, or mustang clover, carpet high slopes. Judy Raah holds the cone of a Jeffrey pine.

Staghorn lichen gilds the trunks of pines and firs, neighbors of the sequoias in Giant Forest. Lupine spikes the sun-dappled ground with shafts of blue.

Golden-throated gilia petals unfold late in June.

Since most of the snow melts away in summer, Muir, I thought, had a better name for these mountains: the Range of Light. Dawn turns its peaks into pinnacles of pearl. The midday sun shimmers across the pale rocks with blinding intensity. The light mellows as afternoon wanes, and at sunset the cliffs blaze with alpenglow (page 185). As we broiled steaks back at our Mehrten Meadow camp that evening, Tharp's Rock gleamed like a gigantic lump of gold.

Frank and I were off to the mountains soon again. This time we joined Park Service friends on a "Ranger's Holiday": a three-day, 40-mile hike. The first mile confirmed the reputed ground-covering abilities of Park Ranger Carl Kronberg and Ranger-Naturalist Don Newman. Gasping, we watched them forge steadily up the trail. We found an ally in Ranger Bill Crumpacker, however.

"I hope," he remarked as he leaned against a rock, "that 'Giant-Step' and 'Scamper-Toes' have a pleasant trip of it."

The nicknames found their mark. Carl and Don grinned and slowed their pace. Our rest signal thereafter was "Let's study nature." We studied nature often.

Tableland Slopes Ever Upward

Our first objective was the Tableland, dividing the Kaweah and Kings River watersheds. On this 11,000-foot-high desert of granite men feel as insignificant as insects—and perhaps a bit closer to God because of it.

A dragon-headed crag scowled down at us as we toiled up bench after bench, past pools of snow water, toward the height. Let no one ever say that the Tableland is flat. Convinced that each domed horizon was our last, we reached it only to find another crest ahead. Our hopes came true with a suddenness that made us gulp. Before us, a glacier-dredged canyon yawned so deep that the stream watering its meadows seemed but a silver thread in a ribbon of green.

Here stretched our route, we thought, and sat down with tired relief. Carl and Bill, however, seemed puzzled. They consulted map and compass. "Wrong canyon," they announced.

We had veered too far north, but a short walk eastward put us back on course. Another canyon opened, and below us a tarn gleamed with the blue-green color of a tourmaline. We clambered down into Deadman Canyon.

We felt more dead than alive ourselves as we trudged past the lonely grave of sheepherder Alfred Moniere, whose fatal illness there in 1875 gave the canyon its somber name. Six miles beyond, we reached our destination—the Roaring River Ranger Station at Scaffold Meadow. The proximity of two such names as Deadman Canyon and Scaffold Meadow has given rise to tales of murder and frontier justice. Actually the scaffold referred to was an old food cache built high out of animals' reach.

On the Trail with Fox and Emma

Sequoia and Kings Canyon National Parks are so large that one can hike for days within the span of a single watershed. My trips were completing a first acquaintance, at least with the parts that lie west of the Great Western Divide.

While I was serving as a seasonal park ranger the summer before, Fox, Emma, and I had traveled Sequoia's southern reaches. Fox was my big red horse, a faithful civil servant. Emma, the dear old harridan, was my white mule.

Together we covered the Hockett Meadow country, a region of timbered ridges and broad meadowlands. Here deer feed constantly in early summer and frost sparkles on the grass. Over Paradise Ridge, north of Atwell Grove, we patrolled the trails to Redwood Meadow. There sequoia giants brood over the ranger cabin, and night descends on an owl's wing.

But now I wanted to explore the High Sierra Trail, high road to Hamilton Lakes, to Kaweah Gap and beyond, down Big Arroyo toward the mile-deep canyon of the Kern. One morning I set out afoot.

I added my tracks to many others—those of birds and bears, squirrels and lizards, deer, horses, and men. A mountain quail scurried down the trail whistling to her chicks. From a fir grove around the bend a doe watched me, her long ears twitching. Suddenly she bounced away a few paces; then stopped to watch again.

I saw the cause of her concern. Her half-grown fawn, frightened yet curious at this strange creature with a pack on his back, needed parental instructions. "Don't worry," I called. "I won't hurt your baby!"

On such hikes through the parks I often found myself talking to the birds and animals I met. Call it mountain fever if you like; but these encounters were so pleasantly mat-

Campers' Moving Day: Fun for the Family, Work for the Burros

Last year 34,000 persons packed into the Sequoia-Kings Canyon back country, making it the most visited wilderness in the National Park System.

Veteran backpacker Jean-Louis Jacot of Montrose, California, graduated to burro packing three years ago when his family joined him on the high trails.

"Burros are gentle, friendly, and the best of company," he says. "Anybody can handle them. But each winter I forget the diamond hitch, the best one for tying on packs."

At right, father refreshes his memory from the Sierra Club's *Going Light—with backpack or burro.* Mrs. Jacot holds the book. Yvonne and Billy form the audience.

KODACHROMES BY NATIONAL GEOGRAPHIC PHOTOGRAPHER B. ANTHONY STEWART © N. G. S.

Fallen Monarch Died Centuries Ago; Its Bones Endure

In 1869 a Sierra pioneer lived in this fire-hollowed giant. Tradition says the tree later became a saloon. Cavalry patrols in the 1890's used it as a stable. The tough trunk, a feature of General Grant Grove in the Kings Canyon National Park area, may last centuries more. General Lee Tree stands at right.

A Grove Says Thanks to Those Who Saved It

Lumbermen made small profit turning unwieldy, brittle Big Trees into shingles and grapevine stakes. They nevertheless acquired parts of Giant Forest.

Beginning in 1916, the National Geographic Society raised $100,000 to help the National Park Service buy sequoia groves before cutting could begin.

Today State and Federal ownership protects some 90 percent of all remaining groves.

ter-of-fact that it seemed completely natural.

Wherever the trail swung around an open, rocky mountain spur, blooming yarrow drenched the slopes with gold. Scores of wildflower species spangled stream banks. Yellow mimulus monkey faces crowded among the lavender Chinese houses of collinsia. Columbine added pastel orange; Indian paintbrush, a fiery red. Among them stood rein-orchis spires of frail white blossoms.

Slowly the divide grew closer as I trudged along. Nine miles, ten miles, eleven miles—at last I caught a glimpse of yellow canvas through the trees. Bearpaw Meadow camp, perched on the edge of a canyon at the base of the divide, offered back-country hospitality. Idris and Opal Hall, the camp hosts, welcomed me in to dinner, and then and there I learned that all I had heard was true: Mrs. Hall serves the finest meals in the Sierra Nevada. I'd walk eleven miles for her cooking any day.

"You should see the faces of the backpackers who eat here after living on dried foods for a few weeks," laughed Idris as I sighed in ecstasy over baked ham and pie. "Then, when they find the shower. . . ."

"*Shower!*"

Sentinel Tree Looks Down on the Motor Age, a Moment in Its Existence

Where Indians once walked in silence, vacationists now buy souvenirs, meals, gasoline, and haircuts in Giant Forest Village on the Generals Highway (next page).

KODACHROME © NATIONAL GEOGRAPHIC SOCIETY

GIANT FOREST MARKET

"Sure—there's plenty of hot water if you'd like to scrub up before bedtime."

Beyond Bearpaw the High Sierra Trail clings to the face of a precipice and crosses the brink of a waterfall before reaching the biggest of the three Hamilton Lakes. I arrived there just as the morning sun was silvering the Angel's Wings, 2,000-foot cliffs that hover above the water.

Hummingbird Guards a Mighty Realm

As I sat on a glacier-polished rock, scanning this enormous amphitheater, a tiny form flitted boldly before my eyes, then hung motionless on invisibly beating wings as if to challenge me. A calliope hummingbird, one of the smallest of warm-blooded creatures, was guardian of these vast spaces. It was a paradox to ponder: this mite of life pulsing in such a chasm of the earth.

Hamilton Lake is a popular camping spot. Cheerful shouts led me to the camp of Boy Scout Troop 373 of Sierra Madre, California (page 154).

"We have no formal program here," said leader George Black, who has brought Scouts to the lake for 10 summers. "We just let nature inspire the boys. Some want to fish; others hike. Some spend all their time right here by the creek, fascinated by the wildlife they see."

At another campsite I met Tony Bertsch, a Los Angeles house painter for 10 months of the year and for the other two a solitary Sierra backpacker. Hiking in the mountains without a companion is not recommended by the Park Service, but Tony is a veteran in the wilderness.

"One day in 1930 I drove my Model-T Ford up to Glacier Point in Yosemite and got a look at all that wonderful wilderness," he told me. "I just wrapped a coffee pot and some food in an old comforter and started walking.

"I've been hiking in the Sierra every year since. There's adventure in being alone and dependent on only yourself. There's adventure, too, in being under the sky and the stars at night, and in knowing the plants and trees. At first I scarcely knew a pine from an oak."

B. ANTHONY STEWART

Tony's words made me long to push deeper into the Sierra fastness—to "Go and look behind the Ranges," as Rudyard Kipling put it. One day my chance came. "How'd you like to come along on a back-country inspection trip?" asked District Ranger Bill Briggle, under whom I had worked the year before.

Rangers Patrol Rugged Back Country

As back-country coordinator for Sequoia and Kings Canyon National Parks, Bill has under his care more than half a million acres of America's finest scenery. When snows melt, Bill's team of rangers rides over the passes to man a network of wilderness stations and patrol hundreds of miles of trail until winter storms close the mountains again.

Bill told me we would head into Evolution Valley in the northernmost part of Kings Canyon National Park, then climb over Muir Pass and down into the heart of the Kings River country. At Florence Lake, Raymond, dean of the park pack mules, sighed stoically at our pile of duffel. Bill's horse, Trixie, made friends with Beauty, the mountain-wise mare I had rented for the trip. We were not to see a road again during our five-day, 90-mile trip; yet we would cover only a fraction of Bill's district.

Beyond Blaney Meadows we swung onto the John Muir Trail. The most famous in the Sierra, it begins in Yosemite and follows

Giant Forest's Discoverer Lived in This Hollow Tree

Indians led Hale D. Tharp to the grove in 1858. For 30 years he summered his cattle in verdant meadows and lived in his fire-tunneled log with its shanty foyer (page 159). John Muir, wandering naturalist of the Sierra, called Tharp's home a "noble den."

A few years ago vandals destroyed the name and discovery date that Tharp carved on the log

J. R. WEBER

Mother raccoon teaches her baby to burglarize a ranger's cabin.

Park raccoons, deer, and bear tame readily, but mountain lions, wildcats, and bighorn sheep shun mankind and keep to the wilds

the mountain chain south for more than 200 miles. We were welcomed to the Evolution country by a thundering waterfall and a shout from Park Ranger John Kline, who had ridden down trail to meet us.

As we neared his tiny cabin, heads popped out of the doorway: first John's wife, Kathaleen; then their pink-cheeked daughters, Kathy and Mary Margaret. A moment later Ronald Kline and his pal Gene Fleming raced up from the meadow to help us unpack Raymond. Grins broadened when such delicacies as fresh meat came to light.

Many travelers praised the inspiring example of this ranger's family, self-reliant and thriving in a wilderness valley 14 miles from the nearest road. That evening, as we consumed a record number of Kathaleen's hot biscuits, we heard their summer's adventures.

Animals Play Part in Daily Life

It was a story of hiking to trout-filled lakes, of swimming in cold, clean water and sleeping the crisp nights through under stars. There were animal friends to tell of, too: Crunchy the chipmunk, Black Bart the outlaw junco, and Hester and Chester and Bernadine, the ground squirrel babies. Ron had fish stories we could believe.

Next morning our horses' hoofs crunched through hoarfrost as Bill, John, and I followed the wan meadows up toward Evolution Lake. Valley and lake were named for the famous doctrine of Charles Darwin.

But evolution has a sound and sense to it that could apply to all the High Sierra country. Heaved up in eons past, then scoured and plucked and polished in the geologic yesterday of glacial times, it is primeval country as yet unprepared for puny man.

Like actors entering stage before their cue, we found ourselves in an earlier act of nature's grand drama. Glacial remnants still clung to a far mountainside; vegetation struggled for survival, while snow clouds and a chill breeze reminded us that at 10,000 feet summer is a fleeting thing.

We felt strangely exhilarated in this world of rock and snow. John Muir could have told us why. "There is a love of wild nature in everybody," he wrote, "an ancient mother-love ever showing itself whether recognized or no, and however covered by cares and duties."

More than 30,000 people a year can testify to the truth of his words. That is the estimated number who, afoot or on horseback, visit the back-country regions of Sequoia and Kings Canyon National Parks each summer.

No comparable wilderness can match for visitors' use this High Sierra district of the twin parks, for it is a convenient wilderness, close to one of the Nation's largest and fastest growing population centers.*

During my trip with Bill, we encountered scores of outdoorsmen—and women—of all ages (page 175). Some families included campers so young that they were carried papoose-fashion; one pigtailed six-year-old strode proudly down the trail carrying her own hefty little knapsack.

There were Scouts, too, and rock climbers and fishermen. At Wanda Lake an angler showed me a sight I longed to have caught myself: six freshly landed golden trout. These are the most sublime of fish, the Sierra's own native glory. Long ago the waters must have trapped the reflections of a sunset and transformed them into living things.

Rugged Pass Challenges Visitors

On the bleak 12,000-foot summit of Muir Pass we paused at a stone shelter hut where more than a hundred persons had registered during the previous week. We did not linger, however; snow flurries spat down on us, and we began the descent into Le Conte Canyon.

This was stupendous country, incredible country, where superlatives seemed weak and inadequate. Hour after hour our horses picked their way down the rocks and snow, slipping, hopping into the abyss. A wind ruffled the sapphire surface of Helen Lake. Clouds scudded over the Black Giant. Then we plunged downward again.

Finally the descent eased. Pine groves and meadow patches gentled the landscape. Streams muted their roaring to a trailside

* See "New Rush to Golden California," by George W. Long, and other California articles in the NATIONAL GEOGRAPHIC, June, 1954.

Silent Senators Rise in Majesty from Sierra Snows

Two stands of exceptionally fine trees make up the Senate and House groups. The President Tree, in lonely splendor, keeps vigil near by. A wide-angle camera lens brought lofty branches into the picture, but perspective made the ramrod-straight boles appear to lean. Sequoia's distinctive awl-like needles stay on branches all year.

KODACHROME © NATIONAL GEOGRAPHIC SOCIETY

chuckle. When we unpacked and pitched camp at Little Pete Meadow that evening, Raymond and the horses rolled on the ground in tired delight. Our campfire sent its sparks to join shy stars. Sleep came quickly to the tinkle of horse bells.

Next day our inspection tour turned from the canyon up toward Dusy Basin and Bishop Pass, one of nine such gateways through the High Sierra crest into the twin parks. Many of them permit horsemen and hikers to climb from Owens Valley roads into the back country in a matter of hours.

Park Service Handles Difficult Job

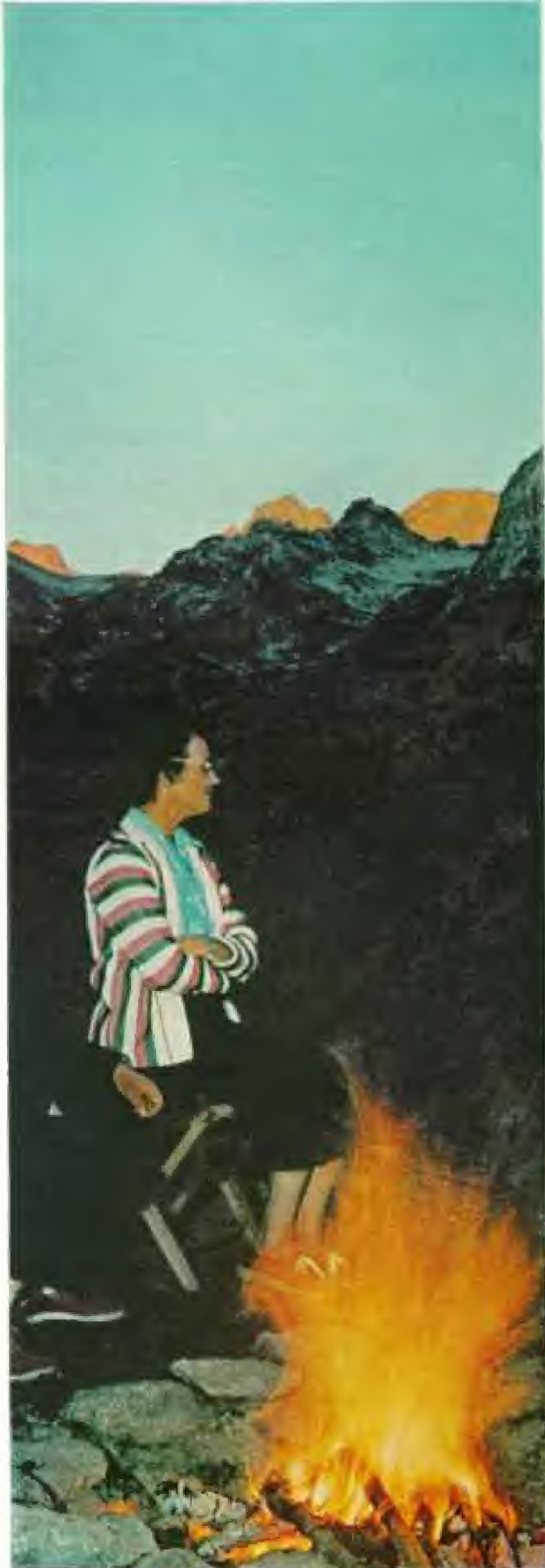
Complex protection problems confront rangers in an area where so many people can drop in for a visit, yet where only about 15 acres in every square mile of the high country afford campsites or pasturage. How to keep the meadows blooming and yet feed the horses? How to keep the lakes pristine and yet provide for hundreds to camp by them?

As Bill talked with passing packers or with campers searching for wood, I remembered how difficult is the task which America has set for its Park Service: to preserve the often fragile beauty yet provide for its enjoyment by a growing Nation increasingly enthusiastic about its out of doors.

I had hoped to mount the pass, to stand astride California's rooftree. A storm massed above Dusy Basin, however. The naked rocks darkened, and wisps of heather shivered in the wind. We retreated from these heights down the switchbacks to the shelter of forest and the meadow grass.

At Grouse Meadows we parted company with John Kline, who returned to his ranger station and family, while Bill and I headed down the Middle Fork of the Kings River toward Simpson Meadow. Far below us the river boiled among the rocks. Above the canyon rim we glimpsed the fierce jaggedness of the Devils Crags. As usual, a forest of pine and fir heralded our approach to meadowland, but many of these trees were fire-blackened corpses. Because of a careless camper, we rode through acre upon acre of desolation.

Simpson Meadow, however, was lush and green, and Park Ranger Bill Martine and Fire Control Aid Jeff Williams served us a hearty supper at their tent headquarters there. As dusk approached, Bill handed me his fly rod: "Here, you'd better catch us all some breakfast." In less than an hour I had my limit of brilliant rainbow trout.



Dancing Flames Warm Campers at Bearpaw;

KODACHROME BY JOHN E. FLETCHER © NATIONAL GEOGRAPHIC SOCIETY

Alpenglow and Full Moon Bathe the Roof of California at Twilight

Although frequented by fishermen, the Simpson Meadow country is not now traveled as much as are the higher regions along the Muir Trail. But in old times? Jeff showed me potholes in the bedrock where Indian squaws ground meal. Their crude stone pestles were still in place.

Flakes of obsidian—black volcanic glass—chipped off by some Indian arrow maker lay scattered near by. That obsidian, found east of the Sierra, had been traded across the ranges.

Only 23 miles of trail now lay between us and the road end at Copper Creek, six miles east of Cedar Grove in Kings Canyon. But what a 23 miles! All morning the trail climbed a mountain's shoulders. To our right we caught sight of the park's most poetically named body of water, the Lake of the Fallen Moon.

North America's Deepest Canyon

Higher, just under the divide, meadows provided pasturage for our stock while we ate a streamside lunch. Atop Granite Pass we first saw the Kings Canyon panorama of peaks and gorges, and beyond Granite Basin we started down.

It took all afternoon—5,000 feet down, down, down into the canyon formed by the South Fork of Kings River.

In some places Kings Canyon plunges more than 8,000 feet from mountaintop to riverbed. So measured, it ranks as the deepest in North America.

At last shiny specks of color below us marked the road-end parking area, where we hoped someone would meet us. We hardly expected that it would be the Chief Park Ranger himself. After his more than 30 years in the parks, however, Irvin Kerr knew that when men come out of the back country, they appreciate a helpful welcome at the home corral.

Bill gave Irv the details of our trip. Then the chief turned to me.

"We'll be needing a seasonal ranger to help out during the fall," he said. "Got your uniform with you?"

"It just so happens. . . ." I grinned, and before long I was wearing the familiar forest-green outfit and Stetson hat.

There are only some 400 career park rangers, men who have dedicated their lives to safeguarding 24,000,000 of America's most beautiful acres and all who enjoy them.*

About 600 seasonal rangers lend a hand during times of heavy vacation travel. Teachers or graduate students, many of them, they come from all over the United States to spend a part of each year helping to preserve our natural and historical heritage. I was glad to be one of them again.

Also helping the career employees are crews of hard-muscled youngsters uniformed in boots and jeans. They fight fires and forest blights, build trails, man lookout posts, and aid in search and rescue missions.

I shall not forget a time spent with two teen-age crewmen high on the canyon wall below Castle Rocks in Sequoia Park. Hour after hour we hacked at bronze-limbed manzanita while smoke billowed and flames flared. Between watches on the fire line that night I learned that a ranger's hat does not make a very good pillow.

It wasn't much of a fire, really—just a patch of smoldering brush. But for us it was a taste, at least, of the ceaseless fight that guards our country's park and forest reservations. Sometimes it is a hard fight but always a rewarding one. Sometimes it is fought by fire crews to save a forest; sometimes it is accomplished by citizens like the National Geographic Society members who helped to save the sequoias.

"Does Smokey Live Here?"

I shall always remember a small boy who ran up to me one day in a park campground. "Hi, Mr. Ranger," he greeted me excitedly. "Have you seen Smokey the Bear? Does Smokey live in these woods?"

I thought of all that is symbolized by that hearty cartoon figure that children love (page 166). It stands not only for the work of State and Federal services, but for a national foresight that has set aside preserves such as Sequoia and Kings Canyon National Parks for little boys of the future to enjoy.

"Yes, son, Smokey lives here," I replied.

* See "Heritage of Beauty and History," by Conrad L. Wirth, National Geographic, May, 1958.

Tulainyo, the Continent's Highest Lake, Fills a Glacier-scooped Bowl

In the 50 States, only Alaska's highest mountains top 14,495-foot Whitney (left). Between Whitney and Tulainyo, still ice-choked in midsummer, stands Mount Russell 14,190 feet high. Lacking an outlet, the lake drains by seepage.

INSIDE THE WORLD OF THE Honeybee

By TREAT DAVIDSON

With photographs by the author

THE PORTULACAS were in full bloom in my garden in Warren, Pennsylvania. The bees, quick to take advantage of a bumper pollen crop, shuttled regularly between flower and hive.

Idly I watched one, gilded with pollen dust, landing on a portulaca (right). A pollen sac bulged on its rear leg.

How remarkable, I thought, that bees provide an efficient delivery service between blossoms, so that plants may receive pollen, become fertile, and bear fruit. But this little visitor had no interest in the pollinization of plants. Any service to nature as a Cupid for flowers was purely coincidental. Her sole mission was to gather pollen to be mixed with honey, producing beebread for feeding larvae.

As I watched the laden worker beelining for home, I found myself wishing I could follow her, peer into her dark hive, and record with a camera the highly developed life inside.

My interest in the fascinating life of the honeybee (*Apis mellifera*) turned into an absorbing photographic project when the technical staff of the National Geographic Society lent me a special camera and I installed observation hives in my studio. Glass walls made it possible for me to look into many of the cells.

Each hive rested on a pivot. By turning the hive, I could keep an eye on anything of interest on either side. To reduce the chances

of being stung, I cut an entrance for the bees through the studio wall directly into the hives.

My Italian bees, ordered from a Georgia breeder, arrived in a screened wooden box. To quiet them, I painted sugar syrup on the screens and let them take all they wanted. The queen had traveled in a separate little cage, which I placed in the hive.

When I shook the worker bees out of the package near the hive entrance, they were too lethargic to fly or sting. They immediately walked in, following the scent of the queen. When all were inside, I put the hive on its stand in the studio. To make the bees feel at home, I had already hung up strips of comb from another hive. Bees will adopt strange larvae and care for them as their own.

Hive's Morale Depends on Queen

By next morning the workers had neatly fastened this comb to the hive's glass sides. They were cleaning up to their immaculate standard, dancing in front of the entrance, and flying around near by to establish their new location. I installed a sugar-syrup feeder at one end of the hive and released the queen from her cage.

The queen heading each colony is constantly surrounded by a retinue anxious to serve her in every way. Each time she pauses for a rest, her attendants close in to caress, feed, and clean her (page 194). Many workers try to touch her with antennae, as if to seek reassurance of her presence. Loss of a queen is communicated through the hive, probably by touch, fanning, or odor recognition.

On her mating flight the queen receives millions of microscopic, threadlike spermatozoa from a drone bee. She retains them in a special sac, the spermatheca, to fertilize all eggs that will develop into female bees. But the eggs which develop into the male, or drone, bees she does not impregnate. Such eggs can even be laid by queens that have never mated.

This puzzling matter was studied and disputed for years until scientists generally accepted the fact that the drone has no father.

Investigating the number of mating flights a queen makes, Canadian scientists daubed hundreds of virgin queens with nail polish containing radioactive zirconium. On leaving and then entering the hive, the queens passed over a Geiger counter—recording an average of seven mating flights each. A queen's tolerance for radioactive materials, incidentally, proved to be many times that of man.

Normally all the queen does is lay eggs. In spring and summer when the colony must be built up and kept at maximum strength, she lays about 1,500 a day. In her lifetime she can produce more than a million.

Small brood cells, averaging five to the inch, are for rearing workers, while less numerous but larger cells, about four to an inch, are for drones. The queen inspects each cell, turns, backs in, and sticks the egg to the cell bottom. There it stands upright (page 200).

In three days the egg falls over and hatches into a small, white larva which is promptly surrounded with food by the watchful nurse bees. For the first two or three days they supply each tiny cell with royal jelly—a highly concentrated food secreted by glands in their heads. From then on the worker larvae receive beebread—a mixture of pollen and honey.

If a queen should be lost, the workers try to replace her. They enlarge several cells containing fertilized eggs or newly hatched larvae, and feed the larvae royal jelly throughout their growth. But no queen will develop if the larvae are more than three days old. Then the bees may become listless, or may stimulate workers into laying by feeding them royal jelly. But, since their eggs are unfertilized, laying workers can produce only drones.

The experienced beekeeper looks out for such trouble. If he cannot obtain a new queen quickly, he takes a queen cell or brood comb with eggs and young larvae from another hive. In either case the workers enthusiastically return to their jobs.

Rulers Stage a Royal Battle

Though the workers start several queen cells, nature normally decrees that there shall be but one queen to a colony. The first queen to emerge tears the remaining queen cells open and destroys her helpless rivals. If several emerge at once, they fight it out.

To record such a royal battle, I placed two mature queens alone in a small glass cage. They began to fight at once (page 195).

Closely entwined, they flashed their curved stingers and strained to deliver a fatal stab. After 10 minutes of exertion, they disengaged for a two-minute rest in opposite corners before resuming battle.

When the fourth round started, one queen was obviously weakened. She soon expired after repeated stings. The victor walked away, paused, shivered, and also fell dead.

Pipelike Tongue Buried in the Feast, a Winged Diner Sucks Syrup from a Dish

To take the extraordinary photographs on these pages, the author (below) peered for two years into the hive life of the honeybee. His equipment: 120,000 bees in three glass-encased hives and a high-speed camera provided by the National Geographic Society. The worker bee above, shown eight times life size, dives into a lunch of sugared water, the author's bait. She shows the versatile seven-pronged mouth that can knead wax, rake up pollen, or draw nectar from a blossom (page 205).

Ranks of Hives in a Georgia Pine Forest Shelter Bees for the Mail-order Trade

Because this encounter took place under artificial conditions, I checked its validity by introducing a queen marked with a spot of blue paint into an observation hive. In less than a minute of fighting the stranger seemed to be losing.

Thereupon both queens were closely surrounded, or "balled," by workers. When the ball dissolved, the resident queen calmly resumed her duties, and workers carried her dead rival out of the hive.

Sometimes workers dissatisfied with their queen will ball her suddenly, pull off her wings and legs, and sting and suffocate her.

Keeping track of the queen is one of the beekeeper's most time-consuming tasks. Occasionally he must completely dismantle a large hive and examine all brood frames to find a queen that should be replaced because of injury or age.

Experienced apiarists know at a glance the temper of their charges, but only rarely have I found any working their hives without veil. They will do so only to demonstrate their skill. Even with the best protection, it is disconcerting to have a cloud of bees buzz around your head and obscure your vision. To avoid this, the most common of all tranquilizers for bees is smoke.

Blown into the hive entrance, a judicious amount of smoke will calm the most vicious swarm. Subsequent puffs while the hives are disassembled will keep them quiet as work progresses.

The standard smoker today is a metal fire pot with a bottom draft applied by a bellows. Improvised smoke making can backfire, as was discovered by a gardener in our neighborhood after a swarm—possibly deserters from this photographic project—took up quarters in a wall of the house. To smoke them out, he made a wad of a Sunday newspaper, placed

Unveiled Keeper Inspects Queen Cells; His Smoke Pot Spouts a Tranquilizing Cloud

it against the wall, added oily rags, and applied a match.

Luckily the fire department responded promptly. Damage was limited to $7,500. The bees were gone.

The safest smoker now available is an aerosol hive bomb that refutes the adage about smoke and fire. Filled with liquid hardwood smoke derivatives, it puffs nicely when the nozzle is pressed.

A still newer discovery is that bees in a hive will stop motionless in their tracks as long as they are exposed to high-intensity sound waves, most notably those at frequencies between 600 and 800 cycles per second. That's the pitch of the notes an octave and a half above middle C on the piano keyboard.

According to researchers at the Pennsylvania State University, such sound waves from a loud-speaker placed about a yard from the hive affect the bees' highly sensitive vibration receptors. They carry these in their legs.

Among the social insects, honeybees occupy a higher place than bumblebees, their larger, noisier, and hairier relatives. Bumblebees also collect pollen, and nectar to turn into honey. But they never store as much of it or build elaborate combs. Thus a bumblebee colony dies out at the end of the season and only a fertilized queen survives by hibernation to start a new colony in the spring. All by herself the bumblebee queen must then seek out a spot for her nest—preferably some moss-lined hollow deep in the ground, such as the abandoned nest of a field mouse. There she builds a wax cell for her first eggs, and incubates them. While brooding, she lives on her own store of honey; she also feeds this to her young.

The more distantly related wasps and hornets rarely make honey. They consume nectar directly from flowers. For their larvae,

Worker and Slim Queen Flank a Bulky Drone

Tens of thousands of workers, all sterile females, dominate the hive. Drones, the queens' ponderous mates, usually number hundreds. Queens, the solitary egg layers, rule one to a colony. The author daubed blue lacquer on this queen to identify her in the teeming hive.

Courtiers in striped livery attend their queen with feelers aimed like the antennas of a TV set. Zealous bodyguards, they caress their sovereign so devotedly they rub her thorax bare of fuzz.

Death Calls a Draw in a Royal Battle

Docile toward their subjects, queens attack one another with murderous hatred. These two contestants writhe and grapple, each straining to drive a sting between the plates of her opponent's armor. After repeated jabs, the queen at lower left rolls over and dies. The exhausted victor succumbed seconds later.

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Guard Unceremoniously Bounces a Murdered Drone from the Hive

Playboys of the bee world, drones live a life of carefree luxury. Though unequipped to make honey, to build comb, or even to defend the colony, the pompous males swagger about the hive, bullying their smaller sisters and demanding service. The workers submit, pampering and grooming the drones for the queen's mating flight.

But a terrible justice descends on the luckless wastrels after their queen has mated. Nipped, abused, and starved by their former nursemaids, the terrified drones flee the colony or cower in corners where they are killed. A worker hustles this carcass from the hive.

the social wasps catch caterpillars and other insects, helpfully pre-chewing the meat for their young.

Far more consequential than honey making is the pollination of plants and here, too, the honeybee surpasses her relatives. Usually she seeks out just one variety of pollen on each collecting trip and just one kind of nectar to turn into honey. This methodical way of working makes her uniquely useful to agriculture.

Orchard Owners Rent Bee Colonies

Many insects carry pollen, but they often traipse from flower to flower indiscriminately, and all the pollen that doesn't reach a plant of its own kind goes to waste. No wonder orchard owners each spring rent 8,000 honeybee colonies in New York State alone to assure the largest possible crop of apples.*

Like human beings, bees seem most contented when they are busy. On warm, balmy days when there is a good flow of nectar, they are most tractable. They start early, work late, attend to their business, and avoid trouble. About the only thing they are likely to resent is interference. Anything that blocks their flight by getting in front of their hive is apt to be stung.

Bees become ill tempered if the flow of nectar stops. The buckwheat plant yields heavily in the morning and when it slackens later in the day, the bees get cross. A rainstorm has the same effect.

Bees really go berserk when their honey is scarce and someone leaves a full comb exposed in the apiary. As soon as scout bees discover this treasure, look out! Quickly the comb seethes with thousands of fighting bees, and the ground is littered with the dead.

Thus frenzied bees on the warpath rob each other's hives and sting every living thing they can find. But workers usually preserve stinging for defense; an attack kills the bee unless she can withdraw her stinger, which she cannot do from human flesh (page 198).

No matter what the day-to-day mood of the worker bees, sooner or later they are sure to dispose of the drones. But first, for a few months each season, these male bees are tolerated in a monarchy of females, even though their usefulness is limited. The drone has no glands to produce royal jelly or wax. His tongue is unsuited for gathering nectar. There are no pollen baskets on his legs. He doesn't even have a sting, although he buzzes so loudly when disturbed that to the uninitiated he ap-

* See "Man's Winged Ally, the Busy Honeybee," by James I. Hambleton, NATIONAL GEOGRAPHIC, April, 1935.

pears the most frightening of bees. The drone's only purpose is fertilizing the queen to produce future generations of workers.

Bees left to follow their inclinations when building combs will make about a fifth of the cells large enough for drones. They store winter supplies in them, but in spring they are emptied and cleaned and the queen gradually fills them with unfertilized eggs to build up the drone population.

About 24 days later the young drones start the first and only work most of them will ever do: they cut their way out of their cells, just as a chicken leaves its shell (page 201).

Wet and bedraggled, the drones totter around on uncertain legs until they are fed by a worker or discover an open cell with honey. From then on they are swashbuckling parasites in the hive, blundering out only on sunny days to join young workers on practice flights or to take a sun bath.

As a drone acquires strength and flying skill, he may cruise far above the trees, hoping to find a queen on her mating flight. His appetite whetted by the fresh air, he soon returns to the hive to eat and rest until the next fine day.

Drones pay no attention to a queen in the hive, but when she spirals aloft on a mating flight, every drone in the vicinity takes off at top speed with a determined buzz. Here again is demonstrated nature's favoring of the fittest for reproduction, because only a strong, fast drone can overtake the queen. After mating, this drone—the only one among thousands to accomplish his mission in life—drops with the queen and dies.

Thoughtful apiculturists believe that the superfluity of drones insures the queen's safe return to her hive. A few bees high in the sky might quickly be consumed by birds or dragonflies. With a large entourage of expendable drones, the queen increases her chances of escaping a thousandfold.

Drones' Days of Comfort End

As the active season ends, the workers conclude that the indolent drones are no longer useful and should be eliminated. Gradually the atmosphere in the hive changes. The workers neglect their tasks.

The drones, threatened by the workers, at first seem surprised. Then their pomposity disappears and they merely slink around. Some rush outdoors and soon die of cold or starvation, because the guards permit no return. Others huddle in corners until they starve or are forced out to die. Drone eggs and larvae are torn from their cells, and normal routine returns only after the massacre.

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Unsheathing Her Sting, an Angry Bee Launches a Suicide Attack

Sinking her poisoned stiletto into human flesh costs the honeybee her life. Gripping with tiny claws, she lowers her abdomen, thrusts in her slender tail lance, and then pulls away. The sting, studded with microscopic barbs, stays fast in the victim and the tug disembowels the bee.

This remarkable photograph shows a worker, her sting embedded in the author's hand, in the act of ripping free. The sting exacts fiery vengeance for her death.

A living hypodermic, the barbed sting carries its own powerful injection mechanism. Twenty minutes after penetration, muscles torn from the bee's body still pulse. They drive the sting deeper and deeper and inject poison as potent, drop for drop, as rattlesnake venom. Clear poison sac and brownish muscles show plainly in this view, magnified 25 times.

My neighbor David J. Johnson stopped in one day when cold drizzle had checked the flow of nectar from the fruit blossoms. This had so infuriated his own bees that he was awaiting better weather for apiary work. Dave mentioned that he didn't mind getting stung in the hand, and so the idea for a picture was born.

Because it is difficult to take pictures while wearing a veil and gloves, I took off one glove as Dave caught the first bee with one hand. He put it on his other hand a few inches from the camera, but it promptly flew away. He pinched, patted, and abused bees for an hour or so. None showed any inclination to attack his proffered hand, but two jabbed stingers into *my* wrist.

Bee Stings the Camera's Bellows

As I adjusted the camera, I noticed a sting embedded in its bellows. Examination through a glass disclosed that the muscles that pump away for several minutes after being detached from the bee were still operating to sink the sting deeper and inject more venom.

After this vivid demonstration of a bee's aversion to photographers and cameras, I knew I would have no difficulty in recording a similar performance on film. I just had to stand and take it (opposite page).

It is often written that bees care little for the lame, halt, and blind among them. But my many hours of observation and photography incline me to a contrary view.

In the hive they continually pass food to the queen, to their larvae, and to each other. A bit of food given to a starving colony is at once widely distributed. If no more food is available, the bees starve together—though the queen, being favored, will be the last to succumb.

Stray bees in the studio fly toward the light. When stopped by the closed window they buzz up and down the pane until exhausted, then drop to the sill and die. As I brushed them off one morning, a bee flew in the open door, lit near the still forms, and began examining one with her antennae. The newcomer then unfolded her tongue and placed a drop of nectar in the other's mouth.

To my amazement, the "dead" bee began to twitch, was fed again, and was helped to its feet by the good Samaritan. These kindly ministrations continued until the resuscitated bee flew away apparently as good as new.

To determine whether this unsuspected phase of bee behavior was accidental, other bees were paralyzed with cold and then placed on a rock in a sunny spot. The first bee to revive always began to look after the others. Only after all had revived did they finally depart, one or two at a time, and return to their normal activities.

All honeybees are similar structurally, but only the sexually undeveloped female workers show maternal instincts. They build the nest cells, incubate the eggs, and feed and care for the young.

The first three weeks of a worker's life are devoted to duties in and around the hive. After emerging from her cell, she spends several days licking brood cells clean to receive the queen's eggs. Then she feeds larvae for about eight days. After that she may pack pollen into combs; make wax and build combs (page 208); take nectar from field bees and concentrate and store it; clean refuse from the hive; or guard the entrance against robber bees or other enemies. Finally she graduates to field work herself.

Bees collecting pollen or nectar may visit a single blossom or several thousand for a full load, depending on weather and seasonal conditions. The number of daily trips also varies, but collectors frequently average 10 flights on good days. Pollen gatherers usually make more trips because pollen is easier to gather. One observer watched a bee bring in 47 pollen loads in a single day.

Siesta Follows Nectar Hunt

Each worker has two stomachs. The first is the bee's personal stomach. The second, or honey sac, stores the nectar as she gathers it from the flowers. When she returns to the hive, she regurgitates the nectar and then eats a bit of honey and takes a brief rest. At other times she is immediately refueled by a house bee and promptly sails away to collect another cargo.

How fast can a bee fly? Between 10 and 15 miles per hour, experts find.

One especially inquisitive observer, Dr. Brian Hocking of Alberta, Canada, built a "flight mill" to gauge the speed and mileage of insects which were cemented to the tip of a delicate revolving arm.

From his measurements he figured that a gallon of nectar could provide enough energy for a bee to cruise 4 million miles at 7 m.p.h.

The life span of the workers in the busy

(*Continued on page 211*)

Brood Cells Give a Hive the Look of a Punchboard

Methodical honeybees divide the hive into nurseries and warehouses; thus a beekeeper can draw off honey without disturbing the young. This hatchery shows open cells containing white larvae, and brown, capped chambers holding the older pupae. Darker honey cells and orange-colored pollen cells on the fringes of the nest provide ready food for the brood and for worker bees running their endless nursing service. During spring and summer a thrifty colony may produce 1,500 bees a day.

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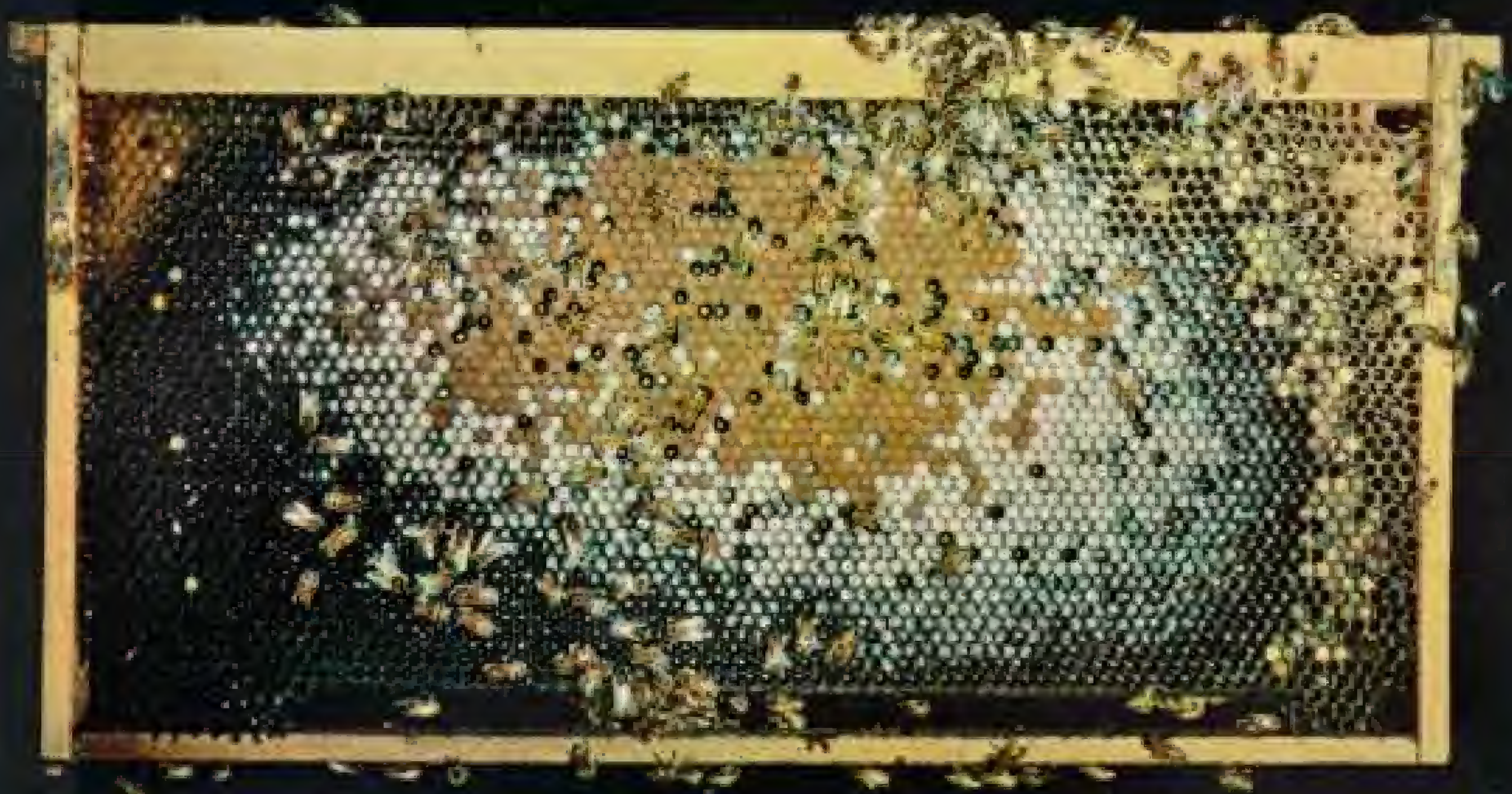
Wax Chambers Imprison a Glistening Brood

Bedded down in narrow cells, bees complete the miracle of metamorphosis in two or three weeks. These photographs show workers in stages of transformation from slender egg at bottom of left cell in top photo, through larvae of varying ages (directly above) to pupae (top photo, center and right).

During egg and larval stages, nurse bees leave the cells open, feeding royal jelly, pollen, and honey to the young. As larvae turn to pupae, the nurses seal the cells and entomb the inmates, which emerge as gleaming adults.

A seconds-old drone cuts through the wax and gazes on the adult world with compound eyes. Wings fan themselves dry. Then, waving sensitive antennae armed with smelling knobs, the drone searches for his first meal of honey.



Anesthetizing a hive, Dave Johnson, the author's neighbor, shields his head with a helmet and veil but relies on a smoke pot to protect his hands. Beekeepers, though developing partial immunity to the poison through countless stings, seldom leave their faces uncovered. Enraged bees can penetrate a felt hat or canvas glove. One apiarist who got venom in his eye described it as a mixture of "cayenne pepper, onion juice, and horse-radish." Men with weak hearts or allergies have died of a single sting.

Antennae wagging, two workers meet beside empty honey cells. A load of nectar swells the abdomen of the insect at left, weighting it nearly to the floor. Tail held high indicates the other worker has emptied her honey sac into the common store.

Passing nectar from mouth to mouth, the three bees at lower right begin the conversion to honey. Swallowing, then regurgitating, they concentrate the fluid. Other workers, their heads thrust into cells, store the food for ripening.

ALL KODACHROMES BY TREAT DAVIDSON © NATIONAL GEOGRAPHIC SOCIETY

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Hovering Like a Helicopter, a Foraging Bee Braces for a Landing

Workers earn collecting assignments after an apprenticeship as cell cleaners, brood nurses, comb builders, and guards. To obtain a tiny load of nectar, a bee visits hundreds of flowers. She may contribute half a teaspoonful of honey in an industrious four- to eight-week lifetime. This bee buzzes a stand of blue bugle.

A seeming monster, dramatically magnified 32 times, unfolds a trunklike proboscis to prospect for clover nectar. Outer parts of the mouth protrude from the tongue, suggesting a snail's horns. Millions of bristly hairs, some even jutting from the eyes, adapt the insect to pollen collecting (next two pages).

Another forager probes a thistle, whose petals almost camouflage her tongue.

Pollen Harvesters' Jeweled Cargoes

Young bees live largely on pollen, the reproductive spores of flowers. Flights of workers gather the fragrant dust, add honey for preservative, and store the mixture—called beebread—against famine. The workers above, hind legs laden with booty, drop the multicolored harvest into chambers interspersed with honey cells.

Close-up of a forager's leg (left) shows the "basket," a bristle-edged cargo hold.

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Turn Drab Comb into a Gay Mosaic

Well-stocked baskets (right) burden a worker poised for take-off. On each trip she carries a supply of honey from the hive, mixes it with pollen, and tamps the sticky mass into tight balls.

Aerodynamic marvels, honeybees put man-made carriers to shame. An efficient airplane carries a quarter of its weight as cargo; a honeybee airlifts payloads weighing almost as much as she does.

Flakes of wax like fish scales ooze between the segments of a worker's abdomen. She scrapes off the substance with her legs, chews it into soft pellets, and fashions exquisite cells (below).

A Horde of Winged Masons Festoons a Hive in the Making

Honeybees, master architects and engineers, secrete their own building material. To stimulate wax glands, younger bees that have not yet become foragers gorge on honey, then lock claws and hang in living curtains. Their body temperatures rise as digestion takes place, and after several hours the wax begins to flow from pockets on their abdomens (above).

Walls of wax average only 1/350 inch thick. Inspired mathematicians, bees utilize the hexagonal cell, which fits snugly against its neighbors on all sides, combining structural strength and maximum capacity.

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Dance of plenty, performed by a pollen-laden bee (left, center), lures a circle of excited workers. Speed and pattern of her steps, according to Austrian scientist Karl von Frisch, reveal the location of a new find. Without further guidance, the audience buzzes unerringly to the bonanza.

Living air conditioners ventilate their home by furious fanning of wings. Bees maintain brood temperature at 93-95° F. On hot days they spread water over the combs to cool them by evaporation; in winter they mass atop the cells. Death occurs if the cluster drops below 28° F.

season is about four to eight weeks. They literally wear themselves out. Their delicate wings gradually break away and become smaller and smaller, until they can no longer carry the bee and her heavy load back to the hive.

Workers hatched late in the season, which have done little or no field work, become the mainstay of colonies wintering in cold climates. They may live six months or longer.

Returning Worker Goes into Dance

When a worker bee returns to the hive loaded with nectar or pollen, she cavorts excitedly in small circles to attract attention. The pattern and duration of these dances vary, and the dancer occasionally stops to give out samples of nectar. The spectators continually touch her with their antennae, their organs of smell (opposite).

This curious behavior has prompted much speculation. Some qualified observers think the dancer simply shepherds the bees directly to the find. Others, notably the distinguished Austrian scientist Karl von Frisch, believe that the bees' "joy dance" itself conveys precise information about how far away the flowers are, and in what direction.

To test von Frisch's principal conclusions, I set up two glass dishes during a dearth of nectar, about 20 feet apart and some 50 feet from an observation hive. One held rich sugar syrup flavored with vanilla extract. The other bait was similar but unflavored.

Scout bees discovered both dishes simultaneously and began filling up. The scout imbibing flavored syrup was marked with a dot of red fingernail polish.

Within a minute the marked scout ascended in a widening spiral to orient herself and sailed for home. At the hive she rushed past the guards and transferred her cargo to waiting house bees. After turning several energetic circles in various spots on the comb she hurried out for another load.

On the return trip she was joined by another bee, which was also marked. Soon both were dancing in the hive. This procedure continued in geometric progression until the comb twinkled with marked bees dancing madly. The supply of vanilla syrup was exhausted before less than half the unflavored syrup was carried to the hive.

Since it seemed impossible to follow the dance patterns accurately in the turmoil of the hive, moving pictures were made for leisurely study. These seemed to confirm further some of von Frisch's explanations.

Nevertheless, our own experiment proved more perplexing than enlightening. Was the marked bees' enthusiasm an optical illusion, due to their brilliant red markings? Or was it caused by the vanilla's high alcohol content?

Worker bees use a marking system of their own to indicate a rich food source, reports Dr. von Frisch. The bee's abdomen contains a scent organ in a skin pocket lined with glands. Returning to a particularly attractive flower, the bee opens this scent organ as it alights, applying a scent pleasing to other bees. "It seems to carry the meaning 'come here, this way!' " von Frisch says.

To verify this assumption, he placed two dishes with sugar water far apart. He allowed a dozen bees to sample one dish and another dozen to sample the other. At one feeding place, however, he applied a bit of shellac to each arriving bee, closing the pocket where the scent gland lies. Both groups danced vigorously in the hives. But the bees unable to mark their find with scent attracted only a tenth as many newcomers as the others who were using their scent organs as usual.

Rich Food Produces Faster Wiggle

Recently one of von Frisch's German pupils, Dr. Wolfgang Steche, affixed small magnets to the bees' abdomens and, recording the rate and intensity of movement on an oscillograph, found that the richer the nectar the bees found, the more furiously they wiggled during their dance. The total number of wiggling motions gave a clue to the distance of the nectar find. For instance, wiggling of 1.2 seconds duration indicated 3,000 feet.

Steche built a bee of wood and perfumed it with lavender. Then he stuck it into a hive on a wire and wiggled it by moving the wire which was attached to an oscillator. The bees responded to Steche's messages and flew straight to lavender-flavored syrup he had placed at various distances from the hive.

Because bees can regulate hive temperature and humidity to their liking, they have wider adaptability to climate and environment than other insects. These ancient users of air conditioning tighten their clusters and increase their activity to generate heat, or loosen them and fan their wings to ventilate (pages 209 and opposite). When outside heat is excessive, they bring in water to evaporate and cool.

Fur-coated thief, a Florida black bear, braves fury on the wing to plunder a hive.

Mail-clad killer, a praying mantis, lunches leisurely on a hapless worker. Stings bounce off the mantis's plated shell.

Certain wasps puncture bees to drain their honey sac of nectar. Bee lice, a species of fly, hoodwink honeybees into disgorging their hard-earned treasure by tapping them on the lips in the manner of workers signaling for transfer of a load of nectar (page 203).

In cold weather, when the temperature in the observation hives drops to 57° or less, the bees form a cluster over the combs. The inner bees eat and generate enough heat through metabolic processes to keep the outer bees at least at 45°. If they are colder than that, they cannot move and soon die. Careful observers detect a gradual interchange between the cool outer insulating layer and the warmer inner bees. Thus many have equal chance to eat and warm themselves.

Each Comb a Small Miracle

In this highly organized society each bee contributes something, but no single bee completes anything. The efficiency with which the insects build honeycombs is one of the marvels of creation. Bees fabricate almost a square foot of comb from only three ounces of wax. This light structure will store about 90 ounces of honey or provide cradles for 6,000 baby bees.

In an emergency, each worker can perform the task of any other worker. Bees with a queen can neither be frightened nor discouraged. If a storm or some other calamity should almost wipe out a prosperous colony, and only a queen and handful of workers are left, the survivors will promptly start all over, and frequently they succeed.

The enemies that prey on individual bees are certain dragonflies (or "bee hawks"), spiders, mice, toads, and birds. Wax moths and ants cause trouble in the apiary. And the praying mantis will devour every bee it can catch (opposite).

From a normal 50,000-bee hive, about a thousand workers may disappear each day. Probably half are eaten by their foes.

Still another threat to the tranquillity of the bee is man—the bee hunter, not out to kill but to bring home the honey.

One day my brother Sydney telephoned from Maine that his neighbors the Packard brothers, Burton and Marlborough, were enthusiastic bee hunters and making ready for an expedition. We were invited to join.

Bee hunting in that rugged and heavily timbered country is strenuous sport. With few farms and no apiaries in the vicinity, bee trees are few. To find one, the Packards used a triangulation system, with the bees supplying the angles.

First Burton put sugar syrup flavored with anise on a platform in his camp garden. When the first bee to find the bait had filled up and made a beeline for home, Marlborough noted the time and line of flight on a geodetic map.

In 25 minutes the bee was back, accompanied by a friend. From this the Packards guessed that the colony must be about two miles away. They checked and rechecked their calculations as more and more bees arrived. Then we captured several and put them into a cigar box which had a cork-plugged hole through the top. We drove the captives two miles on a convenient road, releasing them one at a time and marking their line of flight on our map. The lines of flight intersected at a point near Ragged Mountain.

After an exhilarating climb through the quiet woods—as we went we released more bees to guide us—we at last discovered the well-concealed entrance to their home. The opening was about 35 feet up in an otherwise sound white ash that measured more than two feet in diameter at its base.

Fortunately the tree stood near a lake, so that next morning we had no trouble bringing in some necessary equipment: a power saw, axes, ropes, and smokers.

As the tree cracked to the ground, the shock of the fall seemed to paralyze the bees. Few hovered around the entrance, but Sydney lighted the smoker anyway. He had carelessly put on shorts and was in no mood to take chances.

We chopped off some interfering limbs, and a cut below the entrance soon exposed a six-foot-long hollow with our reward: two pails of honeycomb of excellent quality.

"Since it's early in the season," said Marlborough, "the bees will have plenty of time to replenish their store for the winter. I heard of a bee hunter who once got 97 pounds of honey from a single colony."

Busy Life Continues in Studio Hives

Meanwhile my observation hives back home had remained undisturbed for three weeks. When I returned I found the bees were occupying as much comb as they could completely cover and maintain at a constant temperature of 93° to 95° F. At this level the wax is ductile, eggs hatch, larvae thrive, and the pupae develop rapidly.

All the observation hives were prospering beyond expectation because their supplementary supply of sugar syrup enabled them to increase their stores regardless of the weather.

While these bees were busily increasing their brood and collecting provisions, hives of other

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Swarming Bees Drape an Apple Tree; Birds Surrender Their Nest

Driven by instinct, bees occasionally send out armies of colonists under their own queens to found separate hives. Most swarms on leaving the old quarters gather close by and dispatch scouts to scour the region for a proper home. This photograph records a rare sight: bees building comb in the open instead of seeking shelter. The warblers that built the nest promptly decamped.

Hooded Honey Hunter Reaps a Golden Reward

Gathering wild honey calls for the skills of beekeeper, woodsman, logger, and surveyor.

Experts trap a score of wild bees, feed them syrup, and release them at widely spaced points. Plotting the captives' lines of flight and the time they take to go to the hive and return, the hunters pinpoint the honey tree.

Swathed in gloves and canvas veil, this New England honey fancier breaks open a felled tree. Scraping away dirt and rotting wood, he removes the coveted comb.

Few inmates of the hive resist. The shock of the falling tree stuns the colony; smoke pots keep the peace.

This cache yielded 42 pounds of honeycomb.

Like stacked waffles, gleaming sections of comb lie beside their stupefied owners.

Wild colonies plundered in autumn face certain starvation. These bees, robbed in midsummer, may rebuild and survive.

types were added for convenience in photographing, some of them spilling out into the orchard. Bees are generally content and industrious in any sort of enclosure affording enough room and protection from the elements. They will collect as much pollen and honey in a hollow tree, discarded box, or nail keg as in the finest hive made, but once a one-piece hive is filled, the bees must either stop work or swarm.

Cramped Bees Go Hive Hunting

Before long the birth rate in all hives had so exceeded losses that they were literally jammed. Such prosperous conditions early in the season made me decide to use one of the standard hives for honey production.

As I approached, the voice of the queen could be heard distinctly. As though this piping "zeep-zeep" were a signal, bees began to pour from the hive. By the time I had picked up a camera a few feet away in the studio, the swarm was airborne and circled overhead with an awesome roar, like a hurricane.

Reaching a near-by shrub, the mass of bees dropped down and clustered on it. Here they were photographed in comfort without gloves, veil, or smoke. They were full of honey brought along to provision their new home, and so intent on their migration that they were completely docile.

For the next two days bees continually left and rejoined the clustered swarm. They went to poke around knotholes and out-of-the-way places that could hardly interest a bee unless it was scouting for a home.

At dinner one evening I thought something was wrong with our screens because so many of my pets were coming into the house. The next morning our living room was alive with bees. A look at the swarm outside disclosed a line of bees leading to the top of the chimney. Quickly I put an armful of burlap and excelsior into the fireplace and lit a smudge. The balance of the swarm was then cut down, shaken into a spare hive, and returned to the apiary.

Back in the house I found turmoil. Hundreds of bees were buzzing around the superheated living room, and on the upstairs telephone arrangements were tearfully being made to transfer the Tuesday afternoon bridge meeting to the Women's Club.

Seeking to photograph a swarm emerging from a hive, I first removed the glass from one observation hive for a close examination, to see if these bees might be ready to go.

Brushed off, the comb disclosed nine queen cells in various stages, unnoticed previously because they were generally covered by a double layer of bees. The largest queen cell had already been capped. This indicated that swarming might come at any moment; the old queen could leave since a new queen would be ready soon to carry on in the hive.

I screwed a strong bracket to the outside wall next to the bees' exit, and bolted to it a camera and flash. Swarms issue around noon in fine weather. I waited for three brilliant days, but no swarm came out. The hive was reinspected and all the queen cells found torn open. But new ones were being started, and so the camera was left in place.

After two weeks without success I moved the setup to another hive which was boiling over and ready to swarm. The bees still wouldn't cooperate. Since the camera was now needed for field work, the setup was broken down. Both hives swarmed the next day.

Bear Trees Beekeeper

Another picture possibility I'm sorry I missed was described by Pat and Betty Miville, who handle several thousand colonies in Bee Ridge, Florida.

Pat was working hives on a platform 15 feet high, nailed to trees to keep the bees above floodwaters. With him was a friend noted for practical jokes. As Pat lifted a frame of honey from the hive, he felt pushed, almost shoved off the platform. My friend is up to some trick, he thought, and swung around with the dripping honeycomb in his hand. He hit a bear straight in the neck.

The bear backed down the tree, ate the honey, and looked ready to come back for more. Pat threw him two more frames. The bear ate them and ambled off.

As I said, I am sorry I couldn't photograph Pat's face.

Wings Flashing 200 Times a Second Appear Frozen in Mid-air

To capture this dramatic scene, exposed at 1/5000 second, the author used a section from a bee tree with honey inside to attract the bees. He rigged an electric-eye beam across the aperture and synchronized it with the camera shutter. One hungry worker, lured by clusters of hive mates, flew in, broke the beam, and snapped her own picture.

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A modern Noah rescues a small antelope from Kariba Lake (opposite). The rising reservoir already has cost the lives of many animals, but game wardens have saved hundreds of creatures from death on its shrinking islands.

Global Changes Reflected on New Wall Maps

POLITICAL CHANGES erase old names and create new nations. Alaska and Hawaii are voted in as the 49th and 50th States of the Union. Netherlanders, reclaiming a vast expanse of sea bottom, add to Europe's land area. Africa's infant republics take their first uncertain steps.

Thus the map makers' work never ends.

While charting the entire world anew with the uniform-sheet-size Atlas Series, the National Geographic Society's cartographers are constantly producing up-to-date editions of The Society's larger 10-color Wall Maps.

Five of these large maps, 1959 model, are now obtainable from The Society's headquarters—the World, Western Europe, Germany, Top of the World, and South America. The new, enlarged map of the World measures 68 by 47 inches. The other four are approximately double the size of the Atlas Maps now being issued to members at the rate of seven a year. All reflect the latest surveys, boundaries, place-name spellings, and the changes that busy man's giant dams and other engineering marvels are making in his earth.*

On the **World** map perhaps the most noticeable changes appear in Africa, where a dozen new republics have blossomed as member states of the new French "fraternal Community of free and equal peoples."

What was once French West Africa has become the republics of Mauritania, Senegal, Soudan, Ivory Coast, Volta, Dahomey, Niger, and the new nation of Guinea. Four other states—Chad, Gabon, Congo, and the Central African Republic—replace French Equatorial Africa. Madagascar, fourth largest island in the world (after Greenland, New Guinea, and Borneo), has become the Malgache Republic. Except Guinea—which chose complete sovereignty and joined the United Nations—these new states look to France for foreign policy, defense, currency, and the like.

Place names in Soviet Russia have been brought up to date. For example, the White Sea city of Molotovsk—named for the former No. 2 Communist who was banished to the embassy in the Mongolian Republic—has reverted to its old label of Severodvinsk.

An insert lists the 82 United Nations. Newest members: Ghana, Guinea, and Malaya.

The new **Western Europe** map shows more land than its predecessors, for in the Netherlands the Dutch have transformed the Zuider Zee into a fresh-water lake, the IJssel Meer, and reclaimed thousands of acres where salty waves once rolled. Behind a 20-mile dam holding back the North Sea, new areas called polders are being diked and drained. The project has been described as equivalent to damming Long Island Sound and filling in two-thirds of its 1,299 square miles.

Of timely interest is a new Wall Map of

* Copies of the new 1959 standard Wall Maps, Top of the World, Western Europe, and South America, may be obtained from the National Geographic Society, Department 18, Washington 6, D. C., at $1.00 each; new enlarged map of the World, 68 by 47 inches, $3.75. Wall Map of Germany, 42 x 32½ inches, $1.00. Also available are additional copies of the maps of the Atlas Series, especially designed for binding in the Atlas Folio. Atlas Maps, 50¢ each; Atlas Folio, $4.85, postpaid. Atlas Maps already published: Northeastern U. S. (No. 6), Southeastern U. S. (8), North Central U. S. (9), U. S.-Canadian National Parks (13), Alaska (18), Southern South America (28), British Isles (31), Germany (35), Poland and Czechoslovakia (38), Greece and the Aegean (40), and Lands of the Eastern Mediterranean (47).

Germany. On a scale of 15 miles to the inch, it portrays troubled East Germany and the thriving West German Republic described in the June GEOGRAPHIC by Robert Leslie Conly.

On the **Top of the World** map—showing the vast Soviet Union confronting Canada and the United States across the shifting wastes of the Arctic Ocean—much new information concerning ocean currents has been added by scientists, both American and Russian, drifting on ice islands and Arctic floes. Map notes record historic explorations.

Among the many changes in the map of **South America** is the addition of thriving new cities in Brazil's State of Paraná. Coffee plantations, modern farms, and such cities as Londrina (population 60,000) and Maringá (46,000) have been carved out of the forest.

Two Amazon tributaries—the Tapajós and Xingu Rivers—are newly mapped in the light of aerial surveys, as much as 60 miles in some places from previously charted positions.

The map pinpoints Brazil's embryonic capital, Brasília, now rising from wilderness in a 2,000-square-mile Federal District established 600 miles northwest of Rio de Janeiro on a high, healthful plateau in the State of Goiás. Construction workers mill like ants on the site, which recalls Thomas Moore's lines about Washington, D. C., in its infancy:

This embryo capital, where Fancy sees
Squares in morasses, obelisks in trees;
Which second-sighted seers, ev'n now, adorn
With shrines unbuilt and heroes yet unborn....

Altering Africa's Face, Kariba Dam Impounds a Vast Man-made Lake

Two thousand square miles of Northern and Southern Rhodesia will vanish beneath the advance of the reservoir. Ultimately Kariba Lake will back up 175 miles into the Zambezi River, cover an area the size of Delaware, and contain four times the water of Hoover Dam's Lake Mead. Many other changes appear on The Society's new Wall Maps of the World, Top of the World, Western Europe, Germany, and South America.

BRITISH INFORMATION SERVICE

Maurice Fiévet

A laughing baby proves the best ambassador for a French expedition painting the little-known tribes of Nigeria and the Cameroons

Beyond the Bight of Benin

By JEANNETTE AND MAURICE FIÉVET

Paintings and photographs by the authors

WE HAVE ALREADY reckoned with much on our travels in Africa. Our old Dodge truck, stored in Nigeria's capital city of Lagos since our previous visit, has been severely damaged by mildew. Next, a trusted expedition aide has vanished with a cashbox containing $1,200. My husband and I sharply revise our family budget.

"Such things happen," Maurice and I tell ourselves. "We must expect the unexpected."

But now, on the very day that we have purchased a second truck and arrangements are complete, the physician looks at me with an amused smile. "Before too long, Madame Fiévet," he remarks, "your expedition will have one more member."

A baby! This is the one event we have not considered. What should we do? Reason suggests that we should return to our home in France. How could we cope with an infant in a land once called "the white man's grave"?

We recall the fate of other explorers unable to survive the climate. On the Niger River an expedition of 145 British was reduced by 48 deaths in two months during 1841. European travelers sang a chilling refrain about the swampy, malarial coast:

Beware and take heed
Of the Bight of Benin,
Where few come out
Though many go in!

As the first surprise wears off, our perspective clarifies. This is modern Africa, where airports and hospitals are no longer rare. Not all of Nigeria is even uncomfortably warm. In the north, grassy plateaus of 3,000 to 5,000 feet provide a climate mild enough for any newborn heir. Besides, do we not see hordes of children every day who seem to enjoy perfect health?

Thus did we decide to continue our expedition and to welcome our baby in the tropics.

Painters Record Primitive Tribes

Our field of study was immense. The Federation of Nigeria, a colony marked for independence within the British Commonwealth of Nations in 1960, is nearly seven times the size of England. It has 34,000,000 people, more than Canada, Australia, and New Zealand combined. The Cameroons is divided into two United Nations Trust Territories. The British-administered part has 1,600,000 people; adjoining French Cameroons, 3,300,000 (map, page 232).

Grouped into countless overlapping tribes, clans, and communities, Nigeria and the Cameroons offer a rich array of languages, customs, and religions—Christian, Moslem, and pagan.

Our purpose as explorers was remarkably simple: To record the human images of Africa before primitive tribal ways could be blurred by the movement of progress.

We are artists, Maurice and I. To finance earlier African travels, we even sold our wedding presents and books. But the paintings which we brought back to France were well received in exhibitions. So, too, were our films, sound recordings, and copious notes.

Our harvest of African mementos won us the means for returning to Africa promptly. We felt the need to hurry, for tribal life every-

Chief Titatako in Ceremonial Dress Convenes a Dance in Bali, Cameroons

During three expeditions to Africa, Parisian artists Jeannette and Maurice Fiévet have dwelt among people untouched by civilization. The couple's prize-winning paintings and photographs capture the magic and mystery of primitive tribal rites.

Chief Titatako, clutching his staff of office, wears a hat of feathers and a skirtlike loincloth belted with leopard skin. In his left hand he holds a feather fan. Ivory and leather bracelets and a necklace of amulets studded with cowry shells complete his costume. Sculptured masks hang in the palace yard.

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Artists Pitch Camp in the Nigerian Hills

"Our home, studio, and citadel." Jeannette Fiévet describes the Silver Van, a surplus U. S. Army truck (center). Here she sets up beds, while a helper inflates the pneumatic tent.

Boniface, the expedition's interpreter, gets instructions from Maurice Fiévet. Mrs. Fiévet usually drives the red Dodge truck. Insignia on door combines a movie camera, palette, and Eiffel Tower, and the Latin motto of Paris, "It is tossed about but does not sink."

Living toy, an ungainly chameleon, delights Boniface and Bichon, the Fiévets' infant son.

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where is today undergoing a rapid evolution.

To record all that we have seen and experienced would fill a book, but Maurice and I are far more at home with brush and canvas than with typewriter and carbon paper. What follows, then, is an effort to highlight some of our adventures in raising our "bush baby" as we traveled and painted among the friendly peoples of Nigeria and the Cameroons.*

"During these early months, you may travel," my doctor had explained. So we have come among the Yoruba peoples, painting as we go.

First Hurdle: the Language Problem

Practice has taught us the technique for establishing pleasant relations with new folk. Often the news of our coming precedes us by the mysterious bush telephone, the tom-tom. As we enter a village, 20 black children surround us, their timidity giving way to curiosity. Then the chief advances, accompanied by his court.

Boniface, a young man who has been in our service since he was 14, undertakes to find an interpreter. Boniface speaks his native Ibo language, plus the Yoruba tongue, and English learned in a mission; these three languages serve us well in forested southern Nigeria. In the north, Boniface speaks Hausa, the lingua franca of much of West Africa. Usually, then, Boniface can find a villager with whom he can speak.

The language problem, however, can become complicated when the linguist-villager lacks sufficient social status to permit his addressing the king, for Africans are very strict about protocol. In such cases we must speak through Boniface, who speaks to the low-class villager, who speaks to a higher-class villager, who then speaks to the local king. Thus we explain our paints and palettes.

Usually we must do the chief's portrait first. He settles himself apprehensively before our easel; after all, he does not know what to expect. Courtiers may observe quietly over our shoulders—exclaiming when at last they perceive a likeness of their chief.

When the portrait is complete, we please its model by hanging it in a public place, ostensibly to dry. Then others will gladly sit for us.

And as we paint, we chat, thus learning about the people and their customs. During the long hours necessary to execute a portrait, I have learned about native ceremonies of initiation and marriage, child rearing and worship—a wealth of anthropological detail. Often these confidences lead us to motion-picture films and sound recordings.

My own pregnancy, I have found, also encourages the confidence of the native women. When I become tired, as I do easily these days, I try to rest near a group of them, and then when they observe my condition and ask me friendly questions, I counter with questions of my own.

Artists, I learn, enjoy unusual prestige here, since Yoruba sculptors are also expected to be soothsayers. In fact, among many tribes we have found that artists are considered akin to magicians, even by the witch doctors themselves. My husband and I, because we are thus "in the business," have as a result been permitted to witness ceremonies usually forbidden to nonbelievers.

Yoruba mothers have told me the secrets of their *ibejis*. It seems that when twins are born, the local witch doctor sculptures two statuettes about a foot high, representing the two children. The mother safeguards these figurines, or ibejis. If one twin dies, its ibeji is returned to the diviner, in whose care it has oracular powers. Ask it questions, offer it chicken sacrifices, break a kola nut and throw the fragments into the air—and the arrangement of the fallen pieces gives a prophetic reply. What, I find myself wondering, is the protocol for a female artist-magician who also becomes the mother of twins?

Plateau Affords Cooler Climate

Happily, I won't have to worry about that problem. Maurice has decided that the Bauchi Plateau town of Jos, with its cooler climate and modern hospital, is the best place in which to welcome the newest member of the Fiévet family.

"It resembles a town of the American West," is how Maurice, who knows the Rocky Mountains well, describes Jos.

Its small cottages have roofs of zinc; some stores and offices are built of corrugated iron, others of concrete. Behind these structures hills rise richly blue in the background, and a setting sun produces a grandiose panorama of magic color. The atmosphere seems arti-

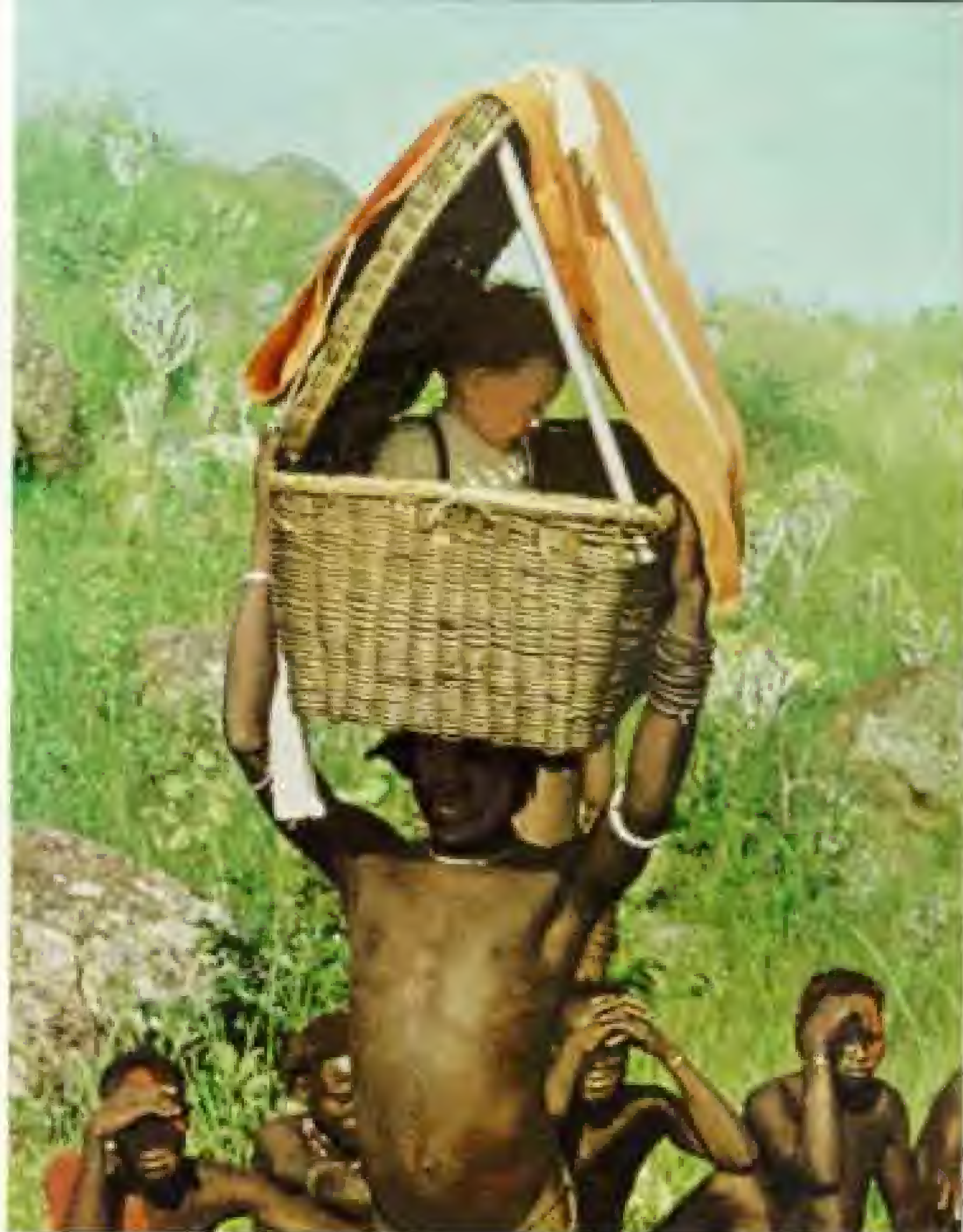
* See, in the National Geographic: "Progress and Pageantry in Changing Nigeria," by W. Robert Moore, September, 1956; and "Nigeria: From the Bight of Benin to Africa's Desert Sands," by Helen Trybulowski Gilles, May, 1944.

Baby Rides High as His Caravan Penetrates the Bush

Seeking out the most primitive tribes, the Fiévets often left their trucks and hiked into the wilds. Porters carried food and supplies atop their heads.

Snugly installed in a half-open basket shaded by a blanket, Bichon sat quietly. Lulled by the gentle swaying, he slept much of the time in his lofty palanquin.

Bichon's mother showed more concern. "It was not without apprehension," she writes, "that I watched my son's bearer scramble down a cliff or ford a stream."



Rest stop: Boniface, in straw hat, hands a bottle of powdered milk to Bichon in his portable tent.

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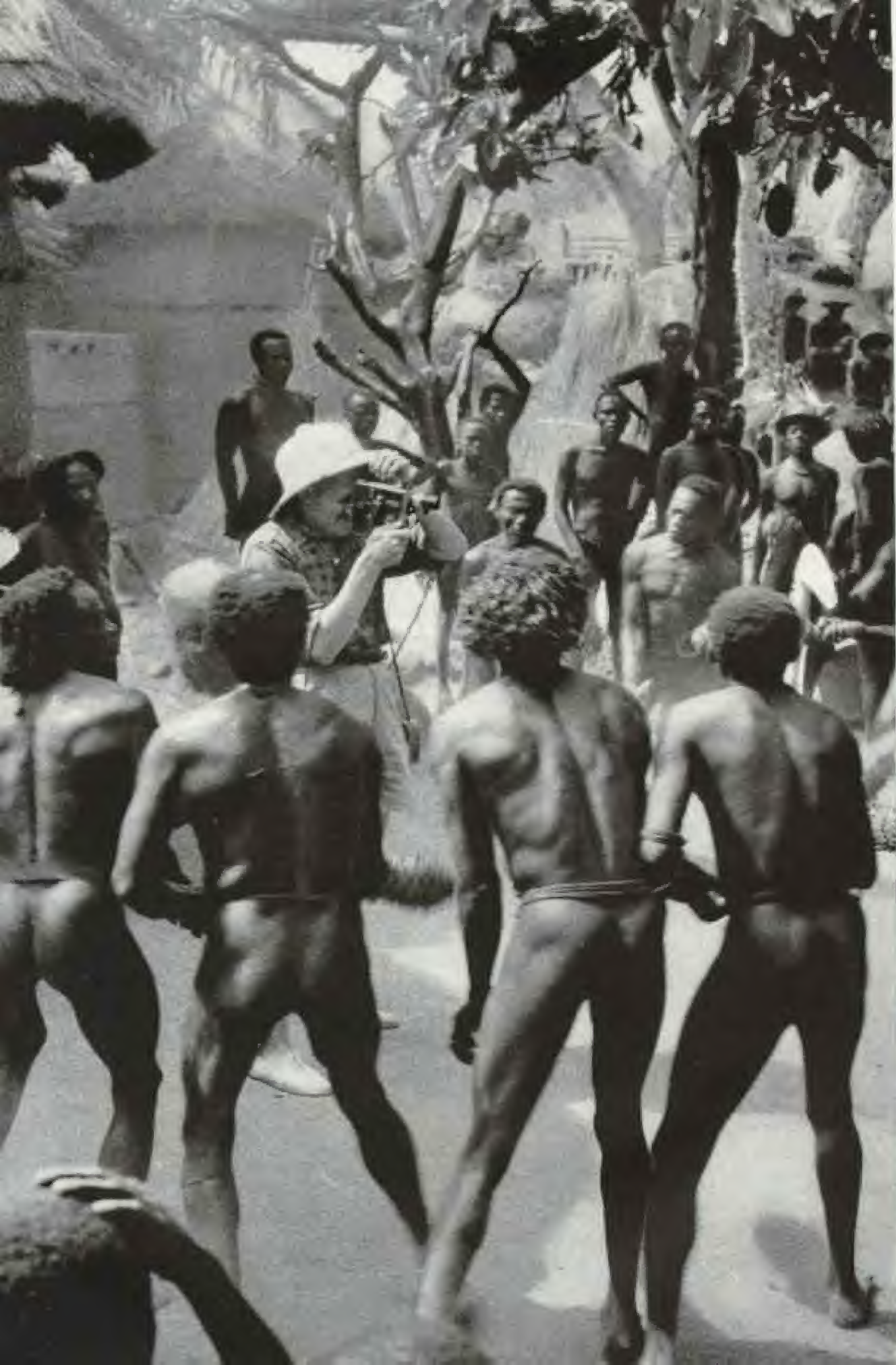

ficial, for this settlement was created in a great hurry to satisfy the needs of tin prospectors and miners.

Maurice has left on a trip to the northwest, but my time does not drag during these weeks of waiting. Our friend the ethnographer Bernard Fagge was building and equipping a government museum here in Jos, and he and his able assistant, Mrs. Fagge, placed the new museum darkroom at my disposal. I have plenty of work to do in developing and printing the photographs we have made thus far on our travels, and the museum is a rich store of Nigerian lore.

Pebbles Tell of Bichon's Birth

Bichon has arrived!

And Maurice has returned to his three-week-old son with a remarkable tale to tell. He has been out to the British Cameroons this time, in the Mandara Mountains.

There he met the diviner of Sukur. This old magician is the chief of the ironsmiths, a group greatly feared among his people, since they also act as undertakers.

Maurice was eager to film the magician at work in his retreat, so he paid him a professional visit on the pretext of asking a question.

Like all the people of Sukur, other than the chief, the diviner was nude except for a piece of goatskin hanging from his belt. An old man with white hair and beard, he crouched like a tailor and fingered a handful of pebbles.

"Will I become the father of a boy or a girl?" Maurice asked through an interpreter.

The old man threw his pebbles into the air, removed a few, and tossed the remaining pebbles. Each stone had a special meaning. The old man turned to Maurice.

"The child is a boy. He has already been born!" said the diviner of Sukur.

As Maurice later discovered, the magician had been quite right. Our son, Bichon, had chosen a lucky Friday, the 13th of June, for his birth date in Jos.

Kaleri Sway to Throbbing Drums in a Pagan Funeral Dance

"Savage-looking, warlike, yet one of the most likable tribes we encountered," the authors write of the Kaleri, who inhabit the Bauchi Plateau. "Fierce yet timid, cruel yet thoughtful of others, they never failed to lend us a hand on our exhausting trips."

When a Kaleri dies, villagers honor his memory with five dances a day. Maurice Fiévet, in the center of the circle, films the rites.

Kaleri Spearmen Dance a Prayer for Good Hunting

Warriors smear their bodies with palm oil, then dab on red laterite, believing the rock powder wards off evil spells. Using a laterite paste, they roll their hair into scarlet ringlets, then pour on palm oil to make the curls shiny or satiny.

Hunters wear only G strings, game bags, and sheathed swords (upper right). Masked dancer in sisal costume (extreme left) represents an evil spirit.

Millet straws pierce a warrior's nose and ears. Glass-bead chaplet circles his forehead. "Among many African tribes, the boys are more coquettish and ornamented than the girls," report the authors.

Black-on-white design fascinates the Kaleri, who cannot read. They giggle in delight as Madame Fiévet clicks the typewriter.

ALL KODACHROMES AND PAINTINGS BY MAURICE FIÉVET © NATIONAL GEOGRAPHIC SOCIETY

"And that," Maurice tells me, "is the reason I never worried. I knew what had happened."

We have moved to Wamba, a mining village 94 miles by road from Jos, where a French tin prospector's family has kindly loaned us some land on a hill. Maurice has built a small native hut of *pisé*—unbaked clay—with a thatched roof. Here we are living while he makes daily trips to study the Mama tribe, descendants of early Nigerian inhabitants living a short distance from our village, and I attempt to turn packing crates into closets and book shelves. Above our door we have put a sign:

THE CRIB
J. AND M. FIÉVET EXPEDITION
BABY ON HIS SHAKEDOWN RUN

Baby Thrives in Midst of Danger

Blithely unconscious of the problems he has raised, Bichon is growing like a mushroom. He sleeps half-naked under a mosquito net in the shade of a great parasol beneath an oil palm. When he awakes, the leaves trace a graceful shadow pantomime to delight his eyes. Through the mesh of his mosquito net, he is discovering the images of life. His bathtub is a large calabash filled with filtered water, and he is weighed on the scales used by the tin diggers.

From the moment Bichon begins to crawl over his blankets with Teddy Bear, our black griffon, always at his side, he learns to be wary of all moving creatures—caterpillars, snakes, even harmless ladybird beetles and scurrying lizards.

Letters from my family in France betray alarm that our baby lives in the midst of serpents, scorpions, and ferocious wild animals. I can allay their fears of large beasts, since we rarely see them. But insects are another matter. Each morning, as a preventive for malaria, Bichon takes a spoonful of quinine syrup, not minding its bitterness at all. Teddy Bear keeps a close watch for scorpions, whose sting is extremely painful, if not fatal; she barks furiously whenever one appears on a box or chest.

One morning recently, just before dawn, we were awakened by Teddy Bear's wild alarm. I leaped from bed and suddenly felt an excruciating sting. Maurice took one look and shouted, "Ants!"

Passing under the door in grim, military file, large driver ants carpeted the floor as they made their inexorable way through our hut and out the window. We were in the path of an invading insect army!

The walls, too, were covered by moving black bodies of insects. Even our thatched roof had ants clinging to it in heavy clusters—but the baby's cradle was not yet in the path! I gathered Bichon in my arms and fled outdoors to safety.

With flaming gasoline, Maurice and our boy Boniface fought back the nightmare of insects. Then Boniface, his legs cruelly stung, dragged our things from the hut and set fire to some old tire tubes inside our home. The acrid smoke dispersed and killed the enemy. Hours later, Boniface swept out whole shovels full of these destroyers.

So it is as well that Bichon is learning to be wary of all moving creatures.

Soon, though, other problems arose. Maurice needed my help with the near-by Mada tribe. We decided to take Bichon with us and return to the hut each night.

Bichon Travels on Wetpack's Head

For Bichon's transport we devised a big basket with a bed inside. One of our porters, Wetpack by name, was the father of a baby the same age as Bichon. Since Wetpack was altogether reliable, we selected him to carry Bichon in his basket—loaded atop his head!

I confess that I hesitated, however, when Maurice decided to film the Kaleri—the most primitive of all pagan tribes on the escarpment of the Bauchi Plateau.

"Leave Bichon with me," a friend of ours suggested. It seemed a sensible idea—until our friend suddenly came down with typhoid. So Bichon went with us. And he turned out to be not only a good traveler but a diplomat too.

We had no introductions to the Kaleri, and it was necessary to approach them indirectly. This we did by visiting market places of the Hausa and Fulani near the Kaleri region. In these markets Maurice and I took out our crayons and papers and began to sketch the

Aroma of Boiling Beef Tantalizes Hungry Kaleri at a Community Banquet

Tribesmen climax most ceremonies with a feast. Each family brings a big bowl carved from a block of wood. Chefs clad in hats and bracelets cut up a cow and cook the flesh in clay pots. Raw skin in foreground serves as the cooks' tablecloth.

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Africa's most populous country, Nigeria covers less than a thirtieth of the continent but contains a seventh of its people. British Cameroons is administered as a part of it. Like Nigeria, French Cameroons has the promise of independence in 1960.

portraits of the noisy, colorful bargainers.

Kaleri visitors to the market became curious, then bold enough to sit for us. We gave them their pictures, which they tucked away in their skin game bags. Thus the seed of interest was sown.

A few days later, when we reached a Kaleri village, our market-place models recognized us and made introductions. Even so, the other Kaleri were cautious, showing unconcealed hostility and refusing to sell us food at any price. I admit, too, a certain anxiety when we came upon a grisly collection of human skulls. After all, the Kaleri have acquired in some circles the sinister reputation of being "head cutters."

"We might as well finish our incomplete paintings," Maurice said when we settled in camp near the village. We did.

Meantime, Bichon—quite undaunted by the fierce looks of the proud Kaleri—played with his toys and pebbles. Kaleri children eventually gathered around him. They had never seen a white baby before. Gradually, their parents began to play gently with Bichon.

"*Zaki*," Bichon stammered one day to our

reluctant hosts. It was the Kaleri salutation, and they were overjoyed. So Bichon was already playing a role as our liaison agent, and distrust changed to welcome as the Kaleri presented us bananas and lemons for the little white boy. It was not long before we could say that these people were among the most likable we had encountered in all our travels.

"We could call them the red Negroes," Maurice declared. It was an apt name, for the Kaleri rub their bodies with palm oil and smear themselves with near-scarlet laterite, which they believe wards off evil spells (pages 228-9).

Later, as their confidence in him grew, the Kaleri permitted Maurice to witness a funeral ceremony. I, a mere woman, was not allowed to be present.

The rites, Maurice reported, were for a man who had died three months before. The diviner had disinterred the body to read the augury of its skull. Depending on the skull's sutures, the condition of the jaws and appearance of the teeth, the diviner then makes a decision. If the augury is bad, the bones are thrown into the bush. If good, the skull is placed in a fork of a tree near the deceased man's house.

In this way the skull is thought to protect the home, for it shows that the deceased has acquired the power to kill evil-doers who pass near by.

Thus Maurice learned the reason for the many skulls that may be found near all Kaleri villages—and allayed the myth of Kaleri head-hunting. Such are the real rewards of our work here in Nigeria.

Art Revered in Moslem North

We have paid a visit to the Etsu, or emir, of Nupe at Bida, in Nigeria's Moslem Northern Region. He authorized us to enter his harem and photograph his women. Then he personally led us to the mosque.

"He who possesses the hand of God," said the etsu, "is not a stranger to us."

We learn again the reverence these people have for art and those who practice it.

Most of our travel over the Nigerian countryside has been in our two motor vehicles (page 222). Bichon's hammock rides suspended in the interior of our rolling home; his bottles of powdered milk are warmed in water from our truck's radiator. For him, the essential thing is to find a familiar setting at the end of the day's journey: his folding bed, surrounded by a plastic mosquito net when he needs it, his plush rabbit, our great black dog—very much alive—and the smiles of our faithful Boniface.

Sharo Tests Fulani Bravery

Today we have seen the *sharo*. This is a cruel ceremony now forbidden by Nigeria's British administrators. It is practiced in the greatest secrecy, and we needed both patience and guile in arranging to see it.

A sharo tests the endurance of young men. During the ceremony, youths scourge each other with a stick about an inch in diameter. They must betray no emotion.

Starting a sharo may take several hours.

Defying pain, a young Fulani demonstrates courage in a *sharo* ceremony. Lashed on the bare body with a wiry, inch-thick stick, he watches his face in a mirror to make sure he shows no sign of suffering. The flogging often raises angry weals, but he does not even flick an eyelid.

A friend rubs the victim to ease the pain.

Mada Tribesmen, Who Dance as Gods, Mask Their Faces in Sisal Cowls

The Mada, neighbors of the Kaleri, may sacrifice goats or chickens during pagan ceremonies. Performer at left wears a monkey-fur shako. Pompons of dyed cotton dangle from his neck. To shoo away flies, the men carry horsetail whisks.

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Hausa boxers may strike only with the bandaged right hand, which hides a stone, or with the right foot. Left leg, encircled with a chain and tinkling seed bags, must not move. Leather-bound amulets in the left hand ward off blows.

Embroidered great robe of the Kano Moslems contains 8 to 10 yards of cloth. Three-foot-wide sleeves, when outstretched, give the garment a batwinged appearance. White slashes indicate the pockets. Kano is northern Nigeria's trade center.

Drums rumble and reverberate. Then two young men clear a space in the midst of a tumultuous mass of spectators by making great flourishes with their sticks. Next, one of the young men—he who will soon be flogged—addresses the crowd, issuing a general challenge and proclaiming his courage and strength. The other young man maneuvers around the challenger, brandishing his stick to produce an effect of suspense. Drums follow the rhythm of this pantomime.

When the scourger finally delivers his blow, it is a mighty one. The tense crowd presses close. Often the blow causes blood to flow profusely, even sometimes tearing off a strip of flesh. But the victim must betray no pain.

Thorns Help Fulani Bear Pain

To control their expressions, some contestants hold thorns in their mouths; with these they prick their lips, probably to distract their attention from one point of pain to another. At arm's length they also hold a mirror adorned with ostrich feathers. In this they watch their facial appearance (page 233).

Meantime, the victim's friends are encouraging him. Girls caress him and wipe his forehead. The flogger throws himself at the feet of the musicians, imploring pardon.

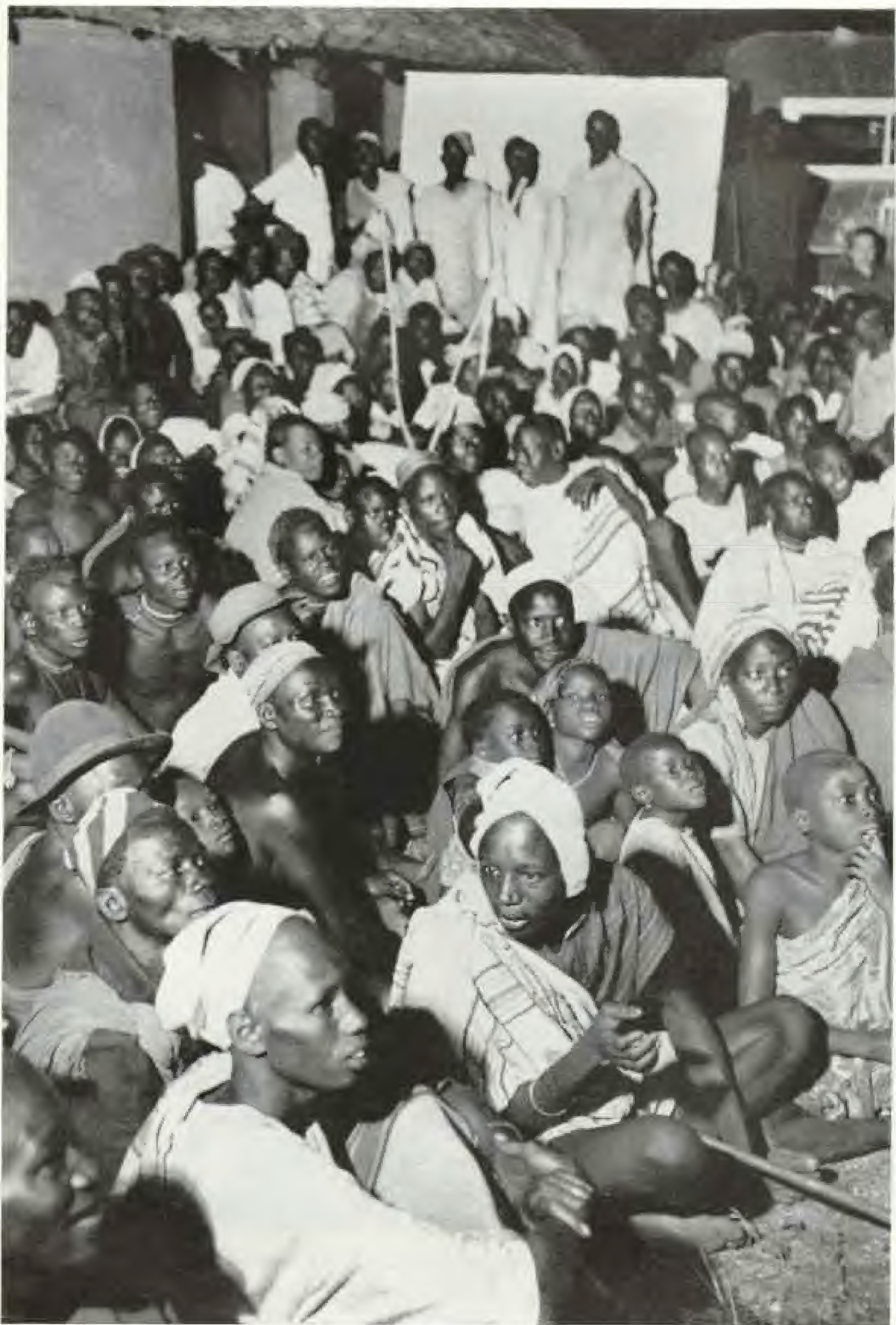
Each youth receives three blows during the sharo. The blows must be

Wonder, Fear, and Delight Etch the Faces of Tribesmen at a Movie

In Richa, Nigeria, the authors projected a film one night for neighboring Kaleri and Fulani villagers, who had never seen a motion picture.

A sheet stretched between trees served as a screen. Across it suddenly flashed pictures made by the Fiévets on a visit to Richa four years earlier. Kaleri farmers and Fulani shepherds, hereditary enemies, forgot their quarrels when they recognized themselves and their friends. Spectators laughed and screamed and dug one another in the ribs. They talked of the show for days.

"We had hoped that this new trick of magic would impress them favorably," says Jeannette Fiévet. "It proved the most astonishing, and successful, lecture we ever presented."



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Artist Fiévet Captures the Madonna-like Air of a Young Fulani

Mystery shrouds the origin of the Fulani, a slender, light-skinned people with straight noses. The daughter of the Etsu, or king, of Bida cradles her infant son. A bracelet girdles the baby's wrist; his ears have already been pierced for rings.

placed between the belt and the end of the spine—and woe to the flogger whose blow is not properly placed, because he will receive the same treatment from the man he has beaten. Yet the flogger must strike with all his might, showing no mercy.

Strangely, the partners in these events are two friends. They must choose each other while very young, and they remain partners in the sharo until they are married, and even after they become fathers of one or two children.

The meaning of this ancient ceremony is the subject of much debate among ethnographers. Some see it as an initiation rite; others claim that it is a test which must be passed before a young man may marry.

Probably the Fulani themselves have the best explanation: The sharo is simply a test of endurance and courage which toughens young men to bear suffering without complaint and to prove themselves before taking a bride. Youths who wince during the performance are disgraced in the eyes of the young women.

The violence of the blows may cause severe wounds, even fatal ones, which led Europeans to prohibit the practice. The hardy nomads among the Fulani protest quietly by making sure no white person witnesses their secret rites.

Yet we have succeeded in photographing this spectacle. Even our motion-picture camera was used during one sharo; it hummed merrily until the machine received a blow from a magistrate that sent it rolling between the feet of the crowd. The people grumbled angrily, and we judged it more prudent to pack our photographic gear and watch passively—storing recollections for future drawings and paintings.

Blue Paint Brings Attack of Colic

Now we are in the grasslands of the British Cameroons, and Maurice has completed a portrait of the Fon, or village head, of Bafut. While Maurice painted, he and the fon were entertained by African music; the chief's wives sang, danced, and played their bamboo-and-calabash *gidigos* (page 245).

In the village of Banso our painting has led us not to music but to the medical arts. We had both been much intrigued by one of the village elders, a man of noble features whose beard was plaited in long, slender braids like those of the ancient Pharaohs. Costumed in a stylized loincloth, his torso bare except for numerous necklaces, and wearing his saber slung from a shoulder, he was indeed a proud figure. Maurice immediately painted him.

But next day, the old man—followed by a retinue—was at our door before breakfast.

"A terrible attack of colic made me suffer the whole night," he told our interpreter. The reason? Some blue paint Maurice had used in painting a shadow on his stomach.

Maurice had to remove that dab of color from his canvas to repair the damage. Meantime, I administered a few drops of paregoric to the sufferer. By nightfall, our patriarch had recovered so well that he invited us to his drinking house for a party to commence at dawn the following day.

Society Holds Secret Revels

This Cameroons drinking house is not a tavern but a very private club, where the members of a secret society meet frequently for a feast and libations. It is a large bamboo house, flanked by enormous sculptured columns representing German soldiers. These decorations are mementos of the German Cameroons protectorate, which ended with the Treaty of Versailles in 1919.

When we arrive, the room is full of noisy, excited people. Since the room has no window, our eyes are slow to adjust to the half-light filtered through bamboo walls and roof. Totem poles are sculptured with motifs: crocodiles with jaws agape, spiders, serpents, lizards, even portraits of local people.

The sacred drums, as tall and broad as barrels, and the vats filled with palm wine are also decorated with these stylized but recognizable forms.

Guests sit on little bamboo stools. A banana leaf at their feet serves as a plate. A servant brings a piece of meat, then three or four balls of *fufu*—yam or cassava paste—each of them as large as a two-pound loaf of bread.

This quantity is each guest's share, and we learn that the whole feast has required two goats and great quantities of yams, cassava, and palm wine, all supplied by one of the members.

The excitement increases. Songs arise, choruses of bawling, intoxicated voices. Whistles pierce the air, drums resound. Stamping up and down in the same spot, the celebrants begin to dance. Then suddenly unsheathing their swords, the dancers hurl themselves at

Black Knights of French Cameroons Borrow Trappings of Crusader Days

Moslem tribesmen celebrate Ramadan, a month of fasting and festival, with pomp. During this period, Moslems believe, "the gates of Heaven are opened, the gates of Hell closed, and the devils

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put in chains." Horsemen wear plumed helmets, and sometimes coats of mail, straight out of the Middle Ages. "Their costumes may have been inspired by Crusaders captured by Arabs in the Holy Land a thousand years ago," say the authors. High mud walls surround the Lamido's palace in Reï Bouba. The pillared, blue-domed porch provides the only entrance.

one another. A veritable parody of duels ensues, with the shock of swords marking the cadence and full-skirted breechclouts swinging like ballet skirts. The scene is all the stranger since most of these dancers are old men.

But all is not humor. Certain revelers wear in their bonnets the red feather of a parrot's tail, indicating that one day its wearer has killed a lion, a leopard—or a man!

From time to time the dancers pause to recover strength at the vat of palm wine. They grow more and more excited, and at last we consider it wise to slip away, reserving until later our thanks to our host.

From Banso we have moved on to the village of Bali and another kind of Cameroons hilarity. The fon, or chief, has cleared out a room in his bamboo-and-clay palace for our use.

As we unpacked our gear, he seemed particularly interested in our tape recorder. Maurice inconspicuously turned the switch on the machine.

"You want to know the use of this device?" Maurice asked. "Well, just listen."

We played back the fon's own words. He was momentarily dumfounded. Then he gave way to uncontrolled laughter, completely forgetting his dignity. He jumped and danced from one end of the room to the other, holding his sides.

We continued this demonstration all morning, with the fon and all his courtiers convulsed with merriment.

In his princely robes, the Premier of Nigeria's Northern Region stands for a life-sized portrait by the author. Under Great Britain's policy of gradualism, Nigerians have gained an increasing voice in their government; in 1960 they will achieve total independence.

Fun for the Fon

Roguishly, the fon decided to surprise some of his subjects. So he summoned musicians and bade them play for us. The orchestra—a drum more than a yard high, bells, and gongs—gave its concert routinely.

When the musicians had finished, we played their music back to them, with our recorder standing atop a carved throne set with beads. Again, the scene was one of boisterous unbelief.

With this sure-fire attraction it is not necessary for us to wait for ceremonial days. Our Bali friends sing and dance for us at every opportunity for the pleasure of hearing their voices afterward. Maurice has been permitted to film in its entirety a secret dance absolutely forbidden to women; to satisfy the taboo, I remained hidden behind a curtain.

But alas for our electronic magic! Our recorder's batteries have become exhausted, and there is sadness throughout Bali. Our magic has died on the job, and we have become mere mortals again. . .

Once more in Nigeria, we are journeying southward toward the heavy forests. After the fatigue of dry, corrugated motor roads and then the frustration of sticking fast in the *poto-poto*, or slippery clay, it is a real delight to travel by pirogue, the gently gliding boats of the Niger Delta.

Clinging to the banks of the Niger and the lagoons of the Gulf of Guinea, clusters of native craft present a rich scene. These floating homes are topped by raffia roofs; assembled in gregarious confusion, they form whole floating villages.

The fishermen at Idah present such a panorama, eating, sleeping, rearing families, and fishing aboard their craft. Luxuriant vegetation surrounds this village. Beyond the floating village are straw huts on the land, and over the waterscape looms a cliff with the home of the administrator and a resthouse for travelers.

Fulani Princesses Wear Their Braids in Cotton Snakes

Mama (above) and Nana, daughters of a chief, choose brocade robes and multicolored headdresses for the Ramadan festival at Sabga, British Cameroons. Copper rings weight ears and braids.

"Inquisitive women formed a circle about us, laughing and joking, while we painted Nana," the authors write. "Soon we perceived that the laughter was upsetting our model. She burst into sobs. It was difficult to console her and to drive the jealous gossips away."

ALL PAINTINGS BY MAURICE FIÉVET
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Wives Sing and Dance. Their Master Smokes a Beaded Bronze Pipe

The Fon of Bafut, a British Cameroons chief, lolls in his elephant-hair headdress and embroidered robes. Carved wooden figures support his royal couch. His pillow, with its lion's face, symbolizes strength and power. One foot feels the cool ivory of an elephant tusk, a reminder that his ancestors never trod bare ground but always veritable roads of ivory. As they chant, the women play the *gidigo*, similar to a marimba.

Chief of the hunters in Nigeria's Kano, like many West African tribesmen, carries amulets on his chest to protect against evil. Leather sacks and bits of horn contain verses from the Koran. The feather-tipped cane serves as staff of office. On his back the man carries antelope horns as spare weapons.

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At Idah Maurice lost his wedding ring!

He had just completed a portrait of the Atta of Igala, ruler of the area (page 249), when the king's emissary arrived to announce that His Majesty was graciously pleased to present us with a turkey. We were immensely pleased until we heard the rest of the message. In return for this gift, the king wanted a little of our "magic oil"—actually, plain linseed oil with which we mixed our colors—and my husband's wedding ring.

In vain we tried to explain that the ring plays no part in portraiture; that its loss would mean misfortune for our household. The bottle of linseed oil we offered was not enough. So Maurice had to give up his ring.

In future, we decide, we will wear nothing but cheap jewelry. Then, when we encounter similar situations, we'll be ready.

Good Deed Wins Over Ibo Tribesmen

Rarely in our travels have we experienced a feeling of danger or unwelcome. But the Ibo, here in the forests of southern Nigeria, seemed to be an exception. In our opinion, they were the most unfriendly to the white man seeking to photograph them.

We first tried our blandishments by sketch-

 Shrouded in Blue, a Dead Kapsiki Rides a Giant Pallbearer's Shoulders to the Grave;

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Mourners Dance About the Body. Setting Sun Lights an Eerie Scene Amid the Mandara Peaks

ing in near-by markets, as we had done with the Kaleri, but we could attract no curious bystanders or signs of good will. We considered using the hatch in our truck roof—one usually used for photographing animals—to take pictures of the Ibo. But this idea seemed unsatisfactory. Nevertheless, we decided to drive through the Ibo country. And here we are, although for a while our popularity and well-being hung by a thread, or more exactly, by a cable.

Driving through one Ibo village, we noticed a large gathering. Mistaking it for a funeral, we stopped. We found instead that a cow had fallen into a well, and the whole village was watching the rescue attempt. There was much shouting and pulling on the rope the rescuers had secured around the horns, but no success at all.

"Why couldn't we use our truck winch?" I asked. Maurice agreed, and we offered our help to the Ibo. Eager to free the cow, they assented and helped attach the steel cable.

Since it was I who was driving the truck, I restarted the engine. Suddenly, I was seized with doubt: What if the horns should break—or the animal's neck?

I released the clutch and the winch began

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Ensconced on His Throne, the Emir of Kano Holds Court

Fourteen million Moslems inhabit Nigeria. Five times a day they turn toward Mecca and prostrate themselves in prayer.

Moslems in Kano regard the emir as their king. Here, flanked by the chief of protocol (left), he receives his subjects in a palace courtroom. Clad in cloak, embroidered gown, and snowy turban—his favorite costume—he has removed his slippers before ascending the throne. Clay walls bear geometrical designs and verses from the Koran.

Alhaji Abdullahi Bayero, who was Emir of Kano when Maurice Fiévet made the painting, has since died. His successor now rules.

Beaded helmet fringed with feathers adorns the Atta, or king, of Igala. His luxurious mantle is of silk. The bronze mask on his chest passes down from king to king. Attired in these regal robes, the chief visits his father's tomb once a year to meditate.

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Stormy seas endanger fishermen hauling in nets in the Bight of Benin. "The men are singing to take heart," says the artist, "as an enormous swell threatens to capsize their dugout."

Pagan priests at Ererukpe start a ceremony beneath grotesque wooden fetishes. Wide hats suggest those of 15th-century Portuguese explorers. Necklaces support balls of ivory and coral.

to turn. Gradually, the cow rose out of the well to face a bewildered crowd. At that moment, we ourselves were too surprised at our success to take pictures, missing some superb expressions of astonishment. The Ibo crowd was petrified.

Our interpreter, though, is never one to miss an opportunity. He turned toward the silent villagers and announced:

"My master is a juju man!" Thus identified as magicians, we received a great ovation.

The Ibo give no credit to our truck winch; the prodigious feat is our own. And now we are their friends, and we have complete freedom to draw and photograph whatever we please among these highly suspicious people.

Cheeks puffed to orange size, a court jester plays for the emir of a Nigerian village. Good-luck talismans dangle from his *algaita*, a trumpetlike instrument of wood and metal. When not entertaining musically, the jester shouts the merits of his chief.

Not always do we entirely understand the distrust that often surrounds the outsider here in Africa. Some weeks ago Sam, one of our interpreters, initiated us into the curious rites of divination by spider. And now he is dead.

"The gods have avenged themselves," claims our boy Atoro.

But we cannot help wondering. Though Sam was a convert to Christianity, his own remorse at his indiscretion may have played a part in his mysterious illness. In Africa one can accept such explanations. But there remains the lingering suspicion that the tribal elders, jealous of their traditions, might have had something to do with Sam's death. We shall never be sure.

Movies Electrify Kaleri Audience

We have returned once more to the Bauchi Plateau to show our processed motion-picture film to our models themselves in the Kaleri village of Richa. Perhaps, seeing this added demonstration of our "magic," they will reveal more of their secret beliefs to us.

Our first "big show" has been an unqualified success.

Bichon has been given his soup, bathed, and put to bed while our audience arrives. Then Maurice starts the generator in our truck, and the lights go on. Emotion! None of our audience has ever seen electric light.

I turn on the projector—and suddenly our guests see our truck on the screen, driving straight at them. Their wild scurries are subdued by the next scene: views of their own village, the huts, men, their own companions, and themselves! They laugh, cry out in amazement, howl in frenzied voices, and identify friends appearing on the screen: "Abonto . . . Akenack . . . Atundock . . . Akwonge. . . ."

The appearance on the screen of babies or children fills them with delight. Women grinding millet produce bursts of laughter. Dancing scenes bring forth spontaneous song from the audience, thus adding sound effects to our silent film.

Suddenly there is silence. A close-up of one Kaleri has locked the lips of our guests, and I sense the trouble. This man has died since our last visit. Our audience is dumb with surprise, and perhaps terror.

Abruptly, the scene shifts. We see war dances, funeral dances; while the pictured villagers perform, the watching villagers also

Ostrich plumes cap the padded-felt helmet of the chief of cavalry as he rides through Kano during the Ramadan festival. Plumed metal epaulets guard his shoulders.

Winged Helmet and Coral Tunic Dress the Oba of Benin for a Ritual

Bodyguards constantly fanned the Nigerian chief with palm leaves while he sat for the artists. "So hot and heavy was the outfit," they report, "that he removed it piece by piece as we finished painting each article."

PAINTINGS BY [illegible] © NATIONAL GEOGRAPHIC SOCIETY

jig and sing. So we have introduced the cinema to the village of Richa.

The Kaleri quickly spread the story of our magic. Two days later, in response to pleas from neighboring tribes, we gave a repeat performance.

We were uneasy. The Kaleri and one of the new groups, the Fulani, were bitter enemies. But our fears were groundless. These hereditary foes sat peacefully through the show (page 236).

Our travels have nourished a growing respect for these diverse people of Nigeria and the Cameroons. Bichon is proof of their reliability. He was a healthy two-year-old when we returned to France.

"Their faces are so open, so happy," an astonished French friend remarked when he saw our photographs.

Maurice and I could certainly agree. For strange as their customs sometimes seem, these people have a valid culture. Though they live under their own stern code, deprived of almost every material comfort, their ways still bring them peace and happiness. Perhaps on some future expedition to Africa we will discover this most valuable human secret. But I suspect Bichon knows it already.

Wary of Fulani invaders, villagers in the Mandara Mountains perch their compounds on rocky hillsides. They wrap straw mats around mud huts to prevent walls from washing away during rains. Inhabitants farm terraced gardens.

CANADA'S WINGED VICTORY

THE *Silver Dart*

Canadians Re-enact Their Historic First Flight of Half a Century Ago

Article and photographs by GILBERT M. GROSVENOR, National Geographic Staff

IT WAS LATE when I glanced up from a table littered with faded 50-year-old blueprints, photographs, and yellowed handwritten notes. Outside the Alexander Graham Bell Museum, snow had crept up to the window sills. It blew gently across the Nova Scotia February night.

Light from a quarter moon reflected from ice-covered Baddeck Bay. Beyond loomed the peninsula known as Beinn Bhreagh, Gaelic for "beautiful mountain."

The bay must have looked much the same half a century ago, I thought. Here on February 23, 1909, a frail bamboo-and-silk contraption called the *Silver Dart* trundled on three motorcycle wheels across the ice. Piloted by J. A. D. McCurdy, a native of Baddeck who became Nova Scotia's lieutenant governor, it took to the air and flew for half a mile.

Alexander Graham Bell and his companions of the Aerial Experiment Association had successfully brought about man's first airplane flight in Canada, indeed the first by a British subject anywhere in the British Empire.

History Turns Back 50 Years

Now another *Silver Dart*, a reproduction built by the Royal Canadian Air Force, had come to Baddeck. On February 23, 1959—50 years later to the day—it was to re-create that historic flight above the frozen bay, an arm of the Bras d'Or Lakes.

The documents I was studying in the Bell Museum were the detailed notes and photographs that my great-grandfather, Dr. Bell, had insisted the old AEA keep. These had been preserved by the National Geographic Society, of which he was second President.

On September 30, 1907—less than a year and a half before that historic flight—five men had signed an agreement establishing their association. Their aim was simple: "To get into the air." They would pool their ideas and construct an "aerodrome" (a term Dr. Bell always preferred to "aeroplane"). The AEA was Mrs. Bell's brilliant idea. She provided $35,000 to finance its experiments.

The team was ideal: Bell, wise and experienced, to guide and advise; McCurdy and F. W. "Casey" Baldwin, bright young Canadian engineers; Lt. Thomas E. Selfridge of the U. S. Army, already working with Bell on extraordinary man-carrying kites; and Glenn H. Curtiss, motorcycle builder and racer and engine maker (page 266).

The AEA contributed immensely to early aeronautical development. By 1908 it had built four successful powered aircraft at Hammondsport, New York, where Curtiss had his motorcycle factory. And it was first in the New World to use hinged-surface, wing-tip ailerons. (The experimenters did not know of earlier uses of such devices in Europe.)

In hundreds of old photographs presented to the museum by the National Geographic Society we had been following the AEA's progress. I asked R.C.A.F. Flight Lt. William Bell, an aeronautical engineer, how closely the new *Dart* resembled the 1908 blueprints.

"Almost identical, except for some structural changes we made to conform with our safety requirements," Bell answered. "Our *Dart* is very close to the original as McCurdy flew it in 1909."

The snow had stopped when we left the museum that night. Even the wind had died.

"I hope it's this calm on the 23d," Bell said. "We can't fly the *Dart* safely in much over 10 knots. Dr. Bell's notes show that sometimes the AEA waited three weeks for favorable weather. But we're scheduled to be on television at 11:30 a.m. Monday the 23d. The AEA didn't have *that* problem."

◀ **Flying out of the past,** *Silver Dart II* soars above Nova Scotia as its namesake did 50 years earlier. Flimsy cloth and struts emphasize aviation's immense strides and the courage of men who, since the fabled Daedalus and Icarus, have risked their lives on wings. This 1959 Kodachrome by the author captures a sight that had been preserved only in black-and-white photographs and in the memories of a few pioneer airmen.

KODACHROME (ABOVE) AND SUPER ANSCOCHROME © N.G.S.

Triangular windows in the Alexander Graham Bell Museum, Baddeck, Nova Scotia, symbolize the inventor's tetrahedral structure, a cell alignment designed to strengthen various devices from kites to towers. The museum displays Dr. Bell's notes, experimental diagrams, and photographs. There, too, are scores of his "impractical" inventions—the hydrofoil boat, for example, whose value has only recently been rediscovered.

When the Aerial Experiment Association was formed in 1907, Dr. Bell insisted that members keep accurate records. By studying AEA notes, the Royal Canadian Air Force reproduced *Silver Dart* (page 260).

Dart's **pilot** in 1909, Baddecker J. A. D. McCurdy, meets Wing Comdr. Paul Hartman, R.C.A.F. test pilot chosen to fly the new *Dart.*

First Flight in Canada: McCurdy Lifts *Silver Dart* from the Ice

Some 150 spectators witnessed J.A.D. McCurdy's take-off on the Bras d'Or Lakes, February 23, 1909. For a few moments ice skaters kept pace with the spindly craft as it rolled along the runway gathering speed. Then *Dart* lifted gently and left them behind. Nova Scotians, who had openly expressed doubt that it would ever fly, cheered when they saw daylight under the wheels.

Mr. McCurdy landed after spanning about half a mile. Considering his venture only a test, he prepared immediately to fly "clear across the lake." But Dr. Bell, unwilling to risk an accident that would mar the historic achievement, insisted the aviator put *Dart* away for the day.

AEA's wing-tip ailerons, tricycle landing gear, and double-decked bow control, or horizontal stabilizer, stand out in this old photograph.

Pilot McCurdy tests the controls during *Dart*'s 1908 flight trials at Hammondsport, New York.

In the United States, only five men flew before Mr. McCurdy. Now 72 years old and Canada's senior pilot, he vividly recalls aviation's pioneer days. During the 1959 celebration he was named an honorary air commodore of the R.C.A.F.

THE BELL FAMILY

© H. M. BENSON

Early next morning I hurried to the polyethylene-covered shelter where the fragile *Dart*, still in sections, awaited assembly.

Everyone pitched in. I spent more time with a wrench and screw driver than with my cameras. Flying Officer Charles Walker, consulting engineer, treated me as an unofficial member of his crew. "How do you expect us to put the plane together if you waste time taking pictures?" he asked. "Grab that wing tip . . . steady, now. O.K. She's bolted."

When finally the *Dart* was ready, a 14-inch snow blanketed the ice runway. Huge snow rollers from Sydney, 30 miles away, were brought to Baddeck to smooth the surface. High, gusty winds rose to prevent any test flight, and for a week we sat and waited.

Flight Lt. Bell kept busy rechecking his measurements. Like Casey Baldwin and John A. D. McCurdy before him, he is a graduate of the University of Toronto. A meticulous man, he worried constantly.

"We've probably done something stupid in rigging the *Dart*," he would say. "It's the obvious things that could hurt us—forgetting to sweat home a nut or tighten a turnbuckle."

We passed the hours talking about the new *Silver Dart* and how the project began.

R.C.A.F. interest in old planes was sparked by a homemade, half-scale model representing no known aircraft. Built by Leading Aircraftman (now Corporal) Lionel G. McCaffrey, it stole the show on Canadian Air Force Day in 1956. McCaffrey attracted more attention taxiing down the runway than did the acrobatics of supersonic jets overhead.

With Squadron Leader Roy Wood's backing, McCaffrey then began construction of a full-scale *Silver Dart*. Visiting the Bell Museum, he copied the blueprints.

"I found a mistake in the AEA's original drawing," he told me. "It was only a small mathematical error, but I got a great kick out of discovering it."

"Did you duplicate the early fittings?" I asked.

"Naturally," McCaffrey answered, a little hurt. "Our turnbuckles, bamboo framing, and spruce struts are identical. Of course, the aviation friction nuts we used were not available in 1909."

That day at dusk we drove across the frozen bay to Beinn Bhreagh and up the snow-covered road to the mountaintop where Dr. Bell and his wife lie at rest.

The telephone's inventor would have mar-

Canadians Check Out the New *Dart* for Flight

Built in Trenton, Ontario, and shipped to Baddeck, the aircraft stands under a polyethylene shelter a few days before the 50th anniversary flight.

Flight Lt. William Bell makes final measurements of the rigging to be sure it meets specifications. After making modifications, he discovered old photographs proving that the 1909 *Dart's* builders had carried out similar changes following its first trials.

Bamboo rods, linen wings, and spruce struts go into the 1959 craft. Lionel McCaffrey (right) and Maxwell Trimm, R.C.A.F. noncoms, fit the parts together. McCaffrey, encouraged by Squadron Leader Roy Wood, conceived and built the *Dart* replica.

KODACHROMES (UPPER) AND ANSCOCHROME BY GILBERT M. GROSVENOR © N. G. S.

veled at the television relay station erected for the event. Because of it, all Canada would witness the *Silver Dart* anniversary, instead of some 150 townspeople who saw the 1909 flight.

Across the bay the Bell Museum lights shone through the triangular windows, symbolic of Bell's recurrent use of tetrahedral design (page 257).*

"The old gentleman's going to peer right down my neck when I fly that bucket," R.C.A.F. Wing Commander Paul Hartman said. "I'd better not prang her."

"What do you mean, 'prang'?" I asked.

Hartman laughed. "That's slang for bending an airplane. A rough landing—the kind the pilot walks away from."

Dr. Bell Suggests Movable Wing Tips

Later that evening in the museum, we looked for the aileron blueprints. Did the AEA really conceive of this important principle independently?

We easily found their first aircraft equipped with ailerons. Working backward, we discovered the idea stemmed from Casey Baldwin's bad accident in the *Red Wing* on March 17, 1908, near Hammondsport.

Casey had had no lateral stability. His airplane simply slipped sideways, striking the ground with its wing tip. Dr. Bell, in a letter to Baldwin dated March 20, wrote:

"It is obvious that aerodromes of the type of the Red Wing lack the important element of automatic stability.... If we substitute voluntary control, there are two methods to choose from, 1) shifting the center of gravity, or 2) shifting movable surfaces at the ends of the wing piece."

"There's the aileron!" Hartman exclaimed.

Further in his letter, Dr. Bell suggested: "... the instinctive attempt to lean to the left to counterbalance an undesirable tip downwards of the right wing could cause the body to press against a lever which should elevate the tip of the right wing, and depress the tip of the left, etc."

"That's just how our *Silver Dart* is controlled," Hartman said. "When I lean to either side, my shoulder pushes a yoke which moves a lever that in turn moves the hinged wing tips. That levels the wings."

Hartman's flight would commemorate not only the 50th anniversary of powered flight on Canadian soil, but also the R.C.A.F.'s 35th birthday. It was an important assignment. But Hartman's flying record was outstanding: During the war he flew night torpedo bombers off Malta; as a test pilot and during his years of service he has flown more than 60 different aircraft, including the first glider over the Canadian Rockies.

Saturday the 21st came, still windy. Again we waited. This was the last day that the *Dart* could be test flown in any privacy, for on Sunday visitors would be streaming in.

Toward sundown the breeze died. We rolled out the *Dart* for the test hop.

Hartman warmed up the engine; then a crewman ignited a red smoke bomb to indicate wind direction. Three quarters of a mile away, Flying Officer Charles Walker lit another. The smoke wafted straight up. Conditions at last were ideal.

Hartman revved the engine, then released the brake. The *Dart* moved forward, struggling, for about 150 feet. Then she was airborne at about 40 miles an hour. At 10 feet the spindly craft leveled and flew straight and true without wobbling or dipping.

One of the few witnesses to the test flight was an elderly man who had just arrived.

"A magnificent flight," he exclaimed excitedly. "Thank you for making it possible for me to see the *Silver Dart* fly. All my life I've longed to watch the machine in the air again."

The surprised crew quieted.

"I piloted the original *Silver Dart*," said the Honorable J. A. D. McCurdy.

Native Son Recalls Historic Day

That Saturday night Baddeck honored Mr. McCurdy. With the same humor and quickness of mind that had made him a popular lieutenant governor, McCurdy recalled his historic flight. His pride in the original *Dart* was strong. "Don't forget, in the early days we didn't have any fancy equipment," he said. "We built our airplanes from curtain rods and bamboo fishing poles!

"Nature had provided us with a frozen proving ground on the Bras d'Or Lakes.... I took off and flew at an altitude of about 60 feet for about half a mile. That was to be a trial flight.

"Dr. Bell, who was present on the ice, seemed the only one to realize that this was a historic occasion. He jumped down from his

* See "Alexander Graham Bell Museum: Tribute to Genius," by the Hon. Jean Lesage, NATIONAL GEOGRAPHIC, August, 1956.

Bell's Red Sleigh Tows the New *Dart*, as It Did the Original in 1909

Thousands of spectators stood on frozen Baddeck Bay last February 23 to see the new *Silver Dart* in flight. They came from as far away as Florida and British Columbia.

As the craft's 65-horsepower engine revved up, the cheering crowds lining the icy runway rushed in for a closer view, exactly as spectators did half a century earlier, but this time Royal Canadian Mounted Police restrained them.

The day was windy, making flight uncertain, for *Silver Dart*'s top speed was only 40 miles an hour.

Mrs. Gilbert Grosvenor, Dr. Bell's daughter, has carefully preserved the sleigh in her barn since his death 37 years ago.

KODACHROMES BY GILBERT M. GROSVENOR AND (LOWER LEFT) JOSEPH P. BLAIR III © NATIONAL GEOGRAPHIC SOCIETY

Shelter sections pushed aside, airmen roll *Silver Dart* onto the icy lake. As fragile and ungainly as a newly hatched chick, the plane bears little resemblance to the streamlined, metal-clad jetliners that have developed from the baling-wire-and-chewing-gum contraptions of half a century ago.

"Can this spindly crate really fly?" spectators wondered.

"I feel naked," said Wing Commander Hartman as he took the pilot's seat amid a spider's web of wires and bamboo. Aloft, he found himself exposed to biting cold and rushing air (page 267).

red sleigh, and I shall never forget the pleasure and animation in his face when he said to me, 'My boy, put the machine away today. There'll be no more flying. Fly tomorrow, or the next day, but today is almost a sacred day. We'll have nothing to mar it!' "

Those were wise words, because the next day McCurdy barely missed disaster. According to the Washington *Star's* account datelined February 24, 1909: "He flew . . . taking a wide circle, and the people on the opposite shore . . . did not know what to do when they saw this 'wizard' coming their way. . . . In landing, one of the wings skidded on the ice and was damaged slightly, and one of the front wheels was bent. . . ."

But such mishaps were common in early aviation. McCurdy had his *Dart* flying again in a short time.*

Baddeck Relives a Day in 1909

The 23d dawned beautifully. Evening winds had scattered the clouds, leaving only a thin veil of new snow. Chimney smoke hung lazily over a building. Flight conditions were perfect.

The cold, crunchy snow stuck to my warm boots as I walked to the Baddeck schoolhouse to watch the Victoria Players make up for their part in the celebration.

In the hallway stood a life-sized portrait of Alexander Graham Bell. Many an elder Baddecker could remember its subject in person: his jovial laugh; those ridiculous-looking kites fluttering above Beinn Bhreagh; his hydrofoil boats skipping across the bay at more than 70 miles an hour, setting a world's record; and, of course, the *Silver Dart* itself.

In the schoolroom everyone crowded around Roddie MacMillan, the "leading man." As "Dr. Bell" he would ride the inventor's red sleigh and tow the *Dart II* down the bay.

Sarah MacDonald MacKinnon, who has worked at Beinn Bhreagh for more than 50 years, spoke to me. I asked her if she remembered the original flight.

"Indeed I do. Dr. Bell insisted we all watch it. He made everyone sign the register. I was just a teen-ager and can remember ice skating around the *Silver Dart*" (page 258).

Dr. Clarence Bethune deftly applied a white beard to Roddie's chin. Frequently he referred to the NATIONAL GEOGRAPHIC'S color reproduction of Dr. Bell's portrait (August, 1956, page 228).

"Doc, you were at that first flight, weren't you?" I asked.

"Sure was," he replied, adding more beard. "My father took me. I was quite small then."

"Do you remember it?"

"Can't actually recall the flight," he answered. "But I do remember seeing my first Thermos of hot tea. My father had it along."

"And *that* impressed you?" I asked.

"Aye, and it will again today, if it's as cold," he exclaimed.

It was 9:30 a.m., and I glanced out the window. Only two hours to flight time. To my horror, the wind was tipping the chimney smoke into horizontal ribbons. On the ice, whirls of snow danced here and there.

I hurried to the shelter. Bell and Hartman wore long faces.

"We may not get it off the ground today, Gil," Flight Lt. Bell groaned. "Already it's blowing 6 to 9 knots, gusting to 12. Can't tell how it'll be in an hour."

"Let's get the *Dart* ready anyway," Flying Officer Walker ordered.

Slowly the huge plastic shelter slid aside on its greased cradle. The crowd cheered and moved in for a better view of the *Dart* (page 262).

"Warm up the engine," Walker ordered. The cold machine sputtered to life.

"Wind's 8 to 10, gusting to 15 knots," Bell noted with dismay. "Mighty windy, sir."

Hartman glanced at the crowded stand. Everyone waited anxiously.

"Let's go," Hartman told the crew.

Smoke Signal Reveals Gusts

As Dr. Bell's red sleigh towed the *Dart* by the reviewing stand, Hartman turned in his seat to face the breeze. Had the wind slackened? Far up the runway, the red smoke bomb put up its signal. It swirled in the gusts.

Then Hartman decided to fly.

The engine revved up, and slowly the *Silver Dart* rolled down the snow-packed runway. Gathering speed, the fragile aircraft struggled to get into the air. Suddenly a wicked wind gust swirled past me. Flying snow blotted out the plane momentarily. When it settled, I saw light under the wheels. The *Dart* was airborne (page 267).

The ailerons steadied the aircraft, and with the box-kitelike stabilizer functioning properly, the *Dart* gained altitude and leveled out.

* The full account of Mr. McCurdy's achievements is given in the book *The Silver Dart*, by H. Gordon Green. Fredericton, New Brunswick, Canada, Brunswick Press Limited, 1959.

"Greatest day of my life," says McCurdy on the anniversary of his flight. Others on the stand: Mrs. Lilian Grosvenor Jones (left), Dr. Bell's granddaughter; Mrs. F. W. Baldwin; the Hon. Robert Muir, M.P.; Mrs. David Fairchild, Bell's daughter; R. N. Redmayne; Vice Adm. H. G. De Wolfe. Nova Scotia's Premier Robert Stanfield (out of picture) introduced Mr. McCurdy.

In familiar white beard and the inventor's own gloves and raccoon coat, Roddie MacMillan impersonates Dr. Bell. Kenny MacDermid (right) plays his own father, John, long-time caretaker of the Bell estate, a job he himself holds today. Georgie MacRae represents Mrs. Bell, and Mrs. MacDermid (in front seat) portrays Mabel McCurdy, the flyer's cousin.

Flight Lt. Bell, much nearer the *Dart* than I, reported the entire flight on my tiny tape recorder: "Winds steady at 8 to 12 . . . Here she comes . . . she started down the runway with a wind speed of 10 knots . . . aircraft laboring, but still moving . . . *there, she's in the air!* . . . she's leveled off, flying at about 10 feet . . . hit a gust . . . he's leveling out . . . wind velocity 12 knots . . . having a little trouble . . . *one wing way down . . . he's got her back again!*

"She's rocking pretty badly . . . height about 50 feet . . . he's now 60 feet . . . *she's climbing very abruptly* . . . he tries to straighten out, but he's almost at 100 feet . . . aircraft has nosed down level now, but is sliding to the left . . . *she's crabbing almost 20 degrees . . . he's in trouble . . . he's trying to get her down low for a landing . . . he's at 20 feet now . . . left wing way down . . . strikes the ground with his wing tip . . . aircraft down, damaged.*"

I ran toward the plane, arriving just after Hartman climbed out unhurt. "Gil, I goofed," he said calmly.

"Goofed!" I exclaimed. "Paul, that was the greatest display of flying anyone in that stand ever saw. How you brought that plane down without really pranging her, I'll never know."

Later everyone from Air Vice Marshal Hugh Campbell to J. A. D. McCurdy agreed that Hartman's airmanship and courage ranked with the R.C.A.F.'s greatest achievements.

Carefully we surveyed the damage: a crumpled left wing tip and a collapsed landing gear. It was quite minor.

But Hartman was dejected. He looked up toward Beinn Bhreagh's mountaintop and asked, "What would that old gentleman up there say today if he could see this mess?"

I recalled Dr. Bell's notes of February 24, 1909, after McCurdy's similar rough landing. "The same thing Dr. Bell told Mr. McCurdy," I answered, and then I quoted: "'Don't worry over temporary setbacks. Take these things philosophically. They are good for us and urge us on to completeness in our work.'"

Hartman stood silent a minute, then said, "Gil, I take my hat off to Mr. McCurdy and his like. I wonder what made them go on?"

I thought of Mr. McCurdy's concluding words at the Baddeck banquet. "Remember that in those days we were looking into the darkness," he said. "Looking into darkness gave us a sense of romance and a spirit of adventure. Without those two characteristics, life loses its full meaning."

AEA's Pioneers of Flight: the Five Men Behind the *Silver Dart*

Glenn H. Curtiss (left), motorcycle maker and "fastest man in the world," later rose to fame as an aircraft builder. Mr. McCurdy, *Dart*'s designer, served as Nova Scotia's lieutenant governor. Dr. Bell, inventor of the telephone, was a guiding spirit of the AEA and the infant National Geographic Society. F. W. (Casey) Baldwin, who piloted the association's *Red Wing*, was elected to the Nova Scotia Legislature, where he led a successful fight for a Cape Breton national park. Lt. Thomas E. Selfridge became aviation's first casualty in 1908 in the crash of the Wright plane during a test for the U. S. Army at Fort Myer, Virginia. Of the five, McCurdy alone survives.

THE BELL FAMILY

BOB BROOKS

Buffeted Like a Moth in a Hurricane, *Silver Dart II* Fights for Control

Defying gusty winds, Wing Commander Hartman took off from the ice on the Bras d'Or Lakes. *Dart* thrashed violently upward, tossing from side to side, and after a half-minute flight that covered a third of a mile, was forced down. Miraculously, the pilot walked off unscathed and the plane escaped serious damage. Royal Canadian Navy helicopters park on the lake below the primitive craft.

CHILDREN'S VILLAGE IN SWITZERLAND

Pestalozzi

Love and understanding give new meaning to life for the waifs of Europe

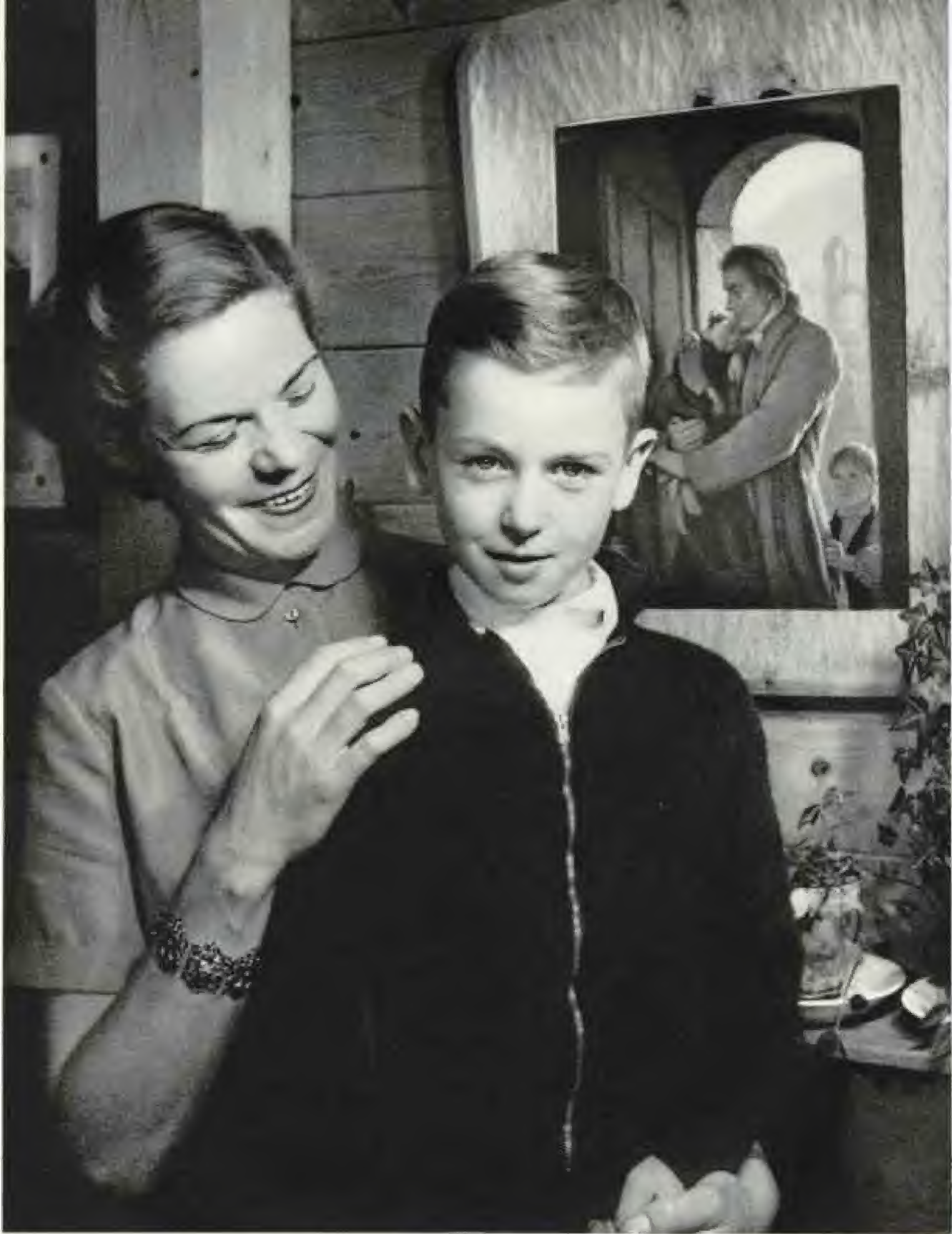
Photographs by ALFRED LAMMER

LILTING LAUGHTER echoes across green fields; carefree youngsters dart in and out of red-roofed chalets. The scene is Pestalozzi village, in the foothills of the Alps.

Here dwell 220 children from France, Finland, Austria, Great Britain, Italy, Greece, Hungary, and Germany, as well as from Switzerland itself. Since opening its doors in 1946, the village has sheltered more than a thousand boys and girls 6 to 18 years old.

World War II left hordes of homeless, haunted orphans wandering the face of Europe. For many, Pestalozzi was their only refuge. As they left the community, other youngsters took their places.

The village inoculates its brood with the powerful serum of tolerance, teaching children of diverse nationalities to live together peacefully, to accept one another simply as fellow beings. Graduated with training in arts and crafts, they return to their homelands ready to play an active role in society.



Eyes mirroring his hope, seven-year-old Brian arrives at Pestalozzi. Housemother Jean Marsden welcomes him to Stepping Stones, one of two British homes in the village. They stand before a portrait of Johann Heinrich Pestalozzi, 18th-century Swiss educator who dedicated his life to underprivileged children. Mr. Pestalozzi harbored scores of orphans in a castle at Yverdon. He bathed and fed them, taught them to read and write, sing and draw. Unlike most schoolmasters of his day, he taught with heart as well as head. His creed: Give the children love, and keep them occupied.

Crusading Zürich editor Walter Robert Corti founded Pestalozzi village in the closing days of World War II.

"There is great need," he told fellow Swiss, "for a village where innocent victims of the war can develop into constructive citizens of a better tomorrow."

Mr. Corti's countrymen responded generously. Swiss children swarmed the streets selling ladybird-beetle emblems of the village; they polished cars, shoveled snow, and gave puppet shows. Within a year Corti collected a quarter of a million dollars, and a humanitarian's dream neared realization. The village is still financed by voluntary contributions.

A budding artist, Giuseppina paints a mother and child.

Workshop sessions each afternoon bring together children of all nationalities. In the morning youngsters attend classes in their own homes.

House parents give instruction in the mother tongue. Pestalozzi encourages each child to cherish the language, religion, and customs of his homeland.

A potential architect, Patrick builds a cardboard village in the communal kindergarten. Son of a Swiss father and Moroccan mother, he lives in the Swiss house.

Patrick's calm demeanor contrasts sharply with the mood of children who streamed in from devastated countries following World War II. Houses with roofs, windows with glass, beds with sheets were unreal to them. For months, in some cases years, war orphans awoke nightly out of terror-filled dreams.

Girls in junior class study the ABC's from a primary reader; schoolmates in the rear row fashion clay animals. Gerald A. Atkinson, housefather of Thames House, who teaches this group each morning, follows the current British curriculum. A second Pestalozzi Children's Village opened this year in Sussex, England.

French children on a stroll through the neighboring town of Trogen chat with a Swiss granny. They speak the regional German.

Orphans Tour a Steep, Cobbled Lane Beneath Trogen's Old-fashioned Shops

A cluster of handsome chalets, Trogen nestles on a rolling hillside overlooking the Lake of Constance; the lofty Alpstein massif lies to the south.

Settled by linen merchants in the 17th century, the town felt its fame lay in the past until the day its warmhearted citizens voted unanimously to donate land for the children's village. Today a new spotlight turns the world's attention on Trogen. Educators, writers, and photographers make it their base while visiting Pestalozzi.

Trogen people encourage their young neighbors to call at their homes. They invite some to attend classes in the local school. Master craftsmen engage apprentices from Pestalozzi.

Roofs pitch steeply above the winding Oberdorfstrasse to let winter's snows slide off. Shopkeepers display hand-carved, hand-painted insignia to proclaim their trades.

Each House Is a Home, Its Occupants a Family

"The home is the center of influence," wrote Heinrich Pestalozzi. The village of his name carries out his teaching. Pestalozzi has no asylum stigma, dormitory gloom, or corporal punishment. Children tend their own gardens, take care of their own pets. Living like brothers and sisters, they share chores and pleasures. Here in Butendiek, the German chalet, Joachim washes dishes while Elke dries.

Suppertime at Heimetli, the Swiss house, finds youngsters entertaining house parents with the day's events.

Janet's Nightly Ritual: Reading a Bedtime Story to Her Toy Dog

Cherished photographs and other mementos of her nine years crowd Janet's bedtop shelf in Thames House. She shares the room with two other English girls. Each has her own cupboard and chest of drawers. Walls are whitewashed, furniture is pine.

Dark Woods and Frosted Meadows Checker the Rolling Hills of Appenzell Canton

When snow smothers Pestalozzi (foreground), junior sportsmen take to skis and sleds and streak down the slopes. Townspeople of Trogen donated 11 acres on this hillside above their homes in

1946. A Swiss architect gave his services. Six hundred young workers, all volunteers, poured in from 17 nations. Donations came from all parts of the world: coal from Poland, woolens from England, oranges from Palestine, honey from Australia. By the end of the year the first orphans moved in from war-shattered Marseille. Pestalozzi was officially open.

Tuning his violin, 15-year-old Antonio gets a helping hand from music teacher Ernst Klug.

Pestalozzi Orchestra Rehearses in Spacious Canada Hall

"Learning," wrote Mr. Pestalozzi, "is not worth a penny when courage and joy are lost along the way." The Swiss humanitarian saw each child as an individual. The teacher's job, he said, was to develop personalities to the fullest.

Each afternoon the children pursue their chosen avocation: art, sports, dramatics, music, handicrafts. One group writes and prints the village newspaper, *Friendship*.

"Music knows no frontiers. It leads to understanding," says Mr. Klug, who directs the orchestra. "National hatred and prejudice, so strong after World War II, break down in fellowship under the guidance of teachers who believe. It is in the minds of children that the foundations of peace must be laid."

Pestalozzi's banner drapes the wall. Circling the ladybird symbol are flags of some of the nations represented. Clockwise, they are: United Kingdom, Italy, Finland, Poland, Switzerland, Austria, Greece, France, and West Germany. Poland later closed its house and recalled its children.

For the Career-minded, Hobbies Lead to Jobs

Pestalozzi requires each child to master a trade. During his last year a youngster may sample as many as six crafts before choosing a career.

Training is completed either in Switzerland or in the home country, whichever offers the better facilities. Village officials find jobs for graduates and follow their progress.

Carsten (above) likes to work with his hands. In the basement workshop at Butendiek, he tools models of ships and planes.

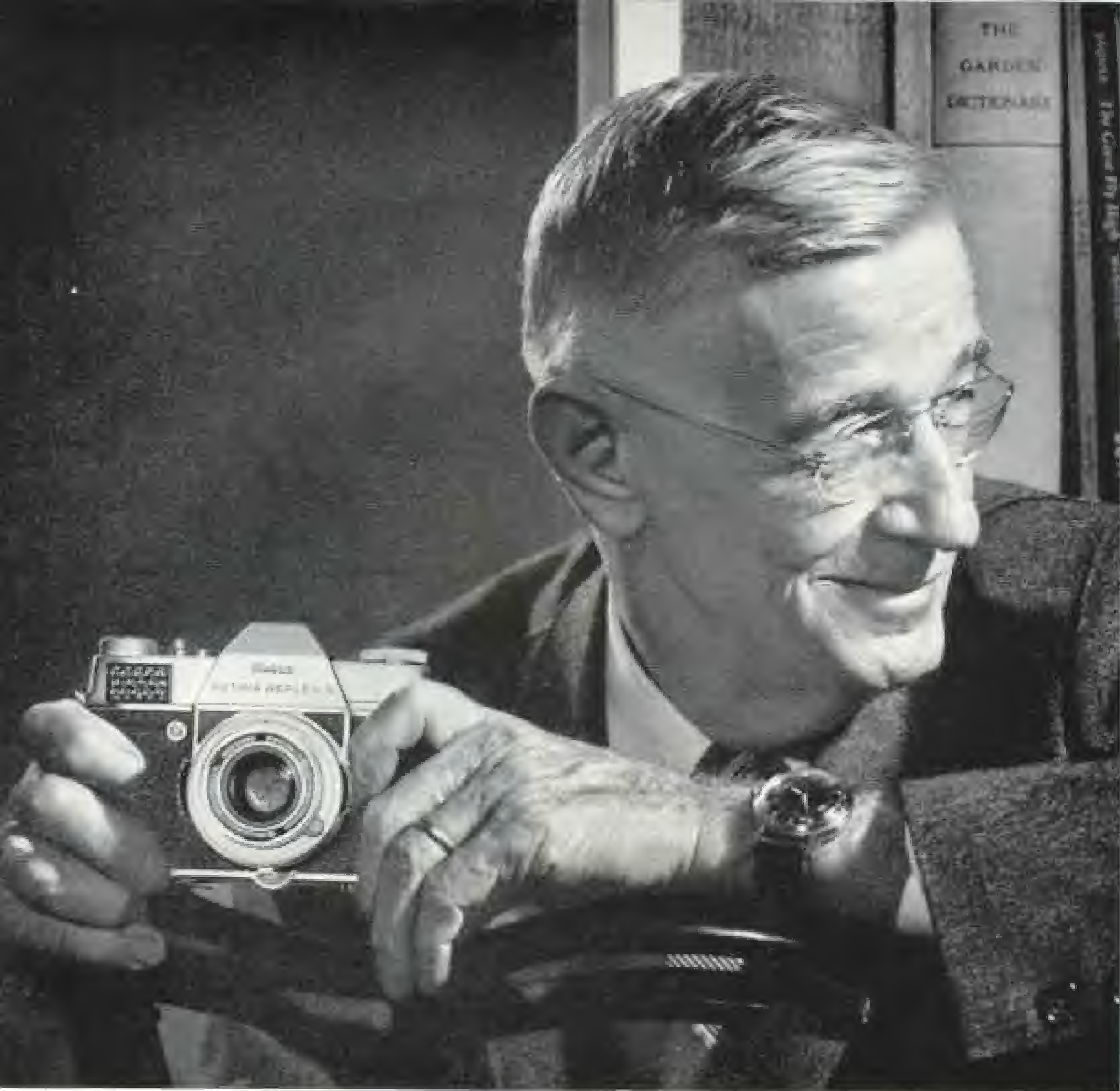
An intent seamstress, 14-year-old Anna stitches curtains for Pinocchio, the Italian house where she dwells.

Youngsters Frolic in a Pool Made with Their Own Labor

Switzerland's dazzling sunshine and crisp mountain air perform miracles on frail bodies. Children rescued from dank city slums quickly put on pounds and sprout inches. Maintenance work gives them a feeling that the village belongs to them and they to it.

Shepherded by a Housefather, Austrian Children Hike to Sunday Service

When Pestalozzi village opened, officials feared urban youngsters would find country life dull. But city-bred tots screamed with delight when they first saw cows and sheep. A walk in a forest or a swim in a lake proved an adventure. A 15-minute stroll through grassy meadows leads these churchgoers to the hamlet of Bendlehn.



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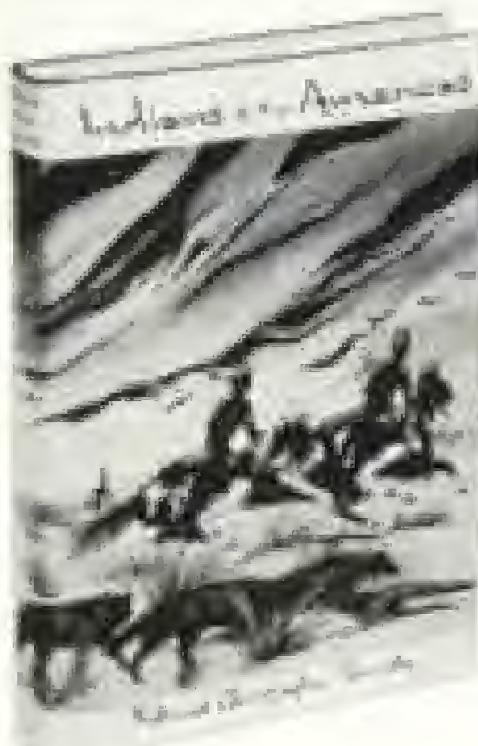

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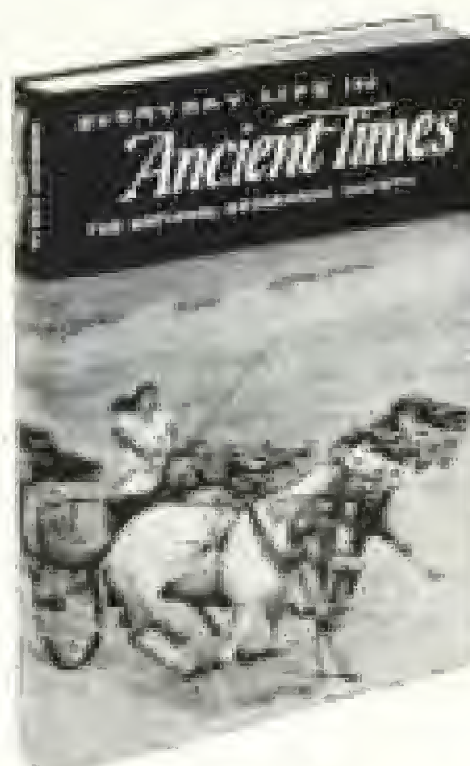

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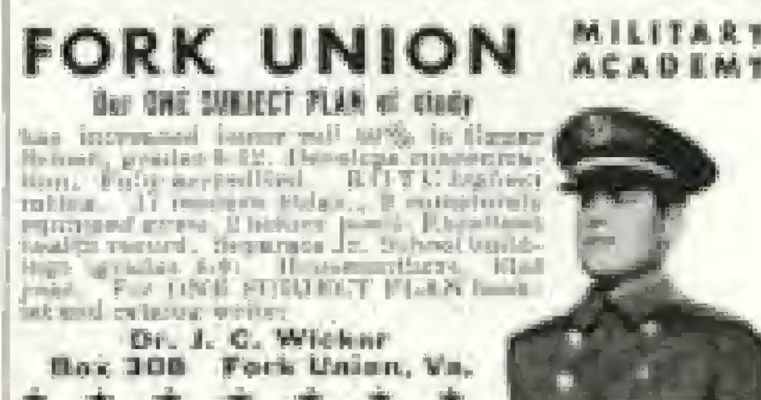
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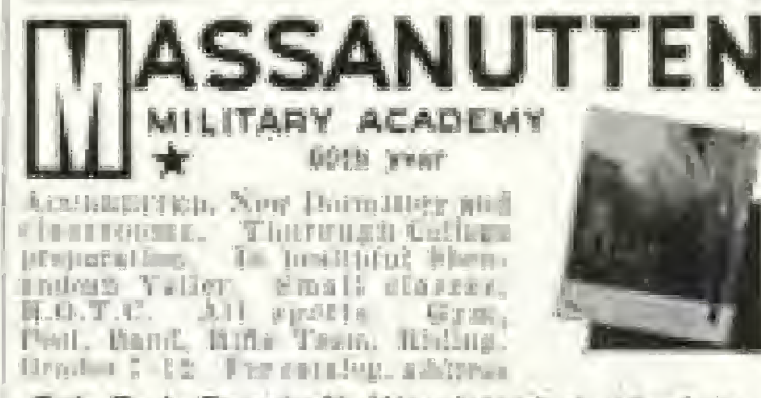
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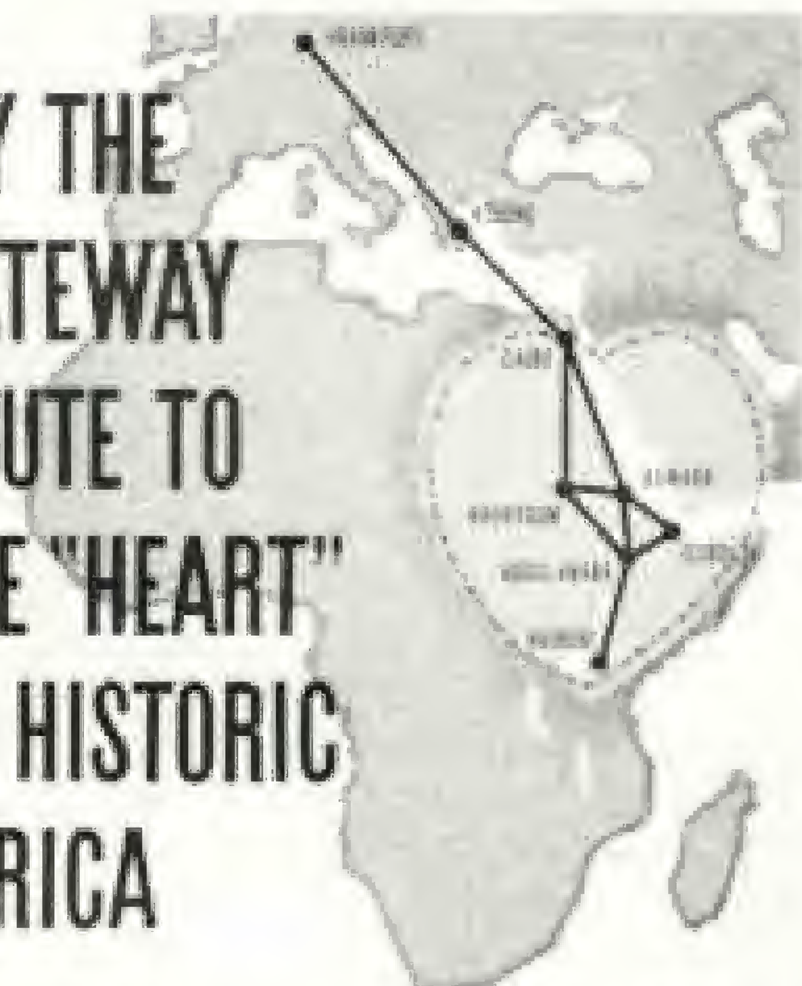

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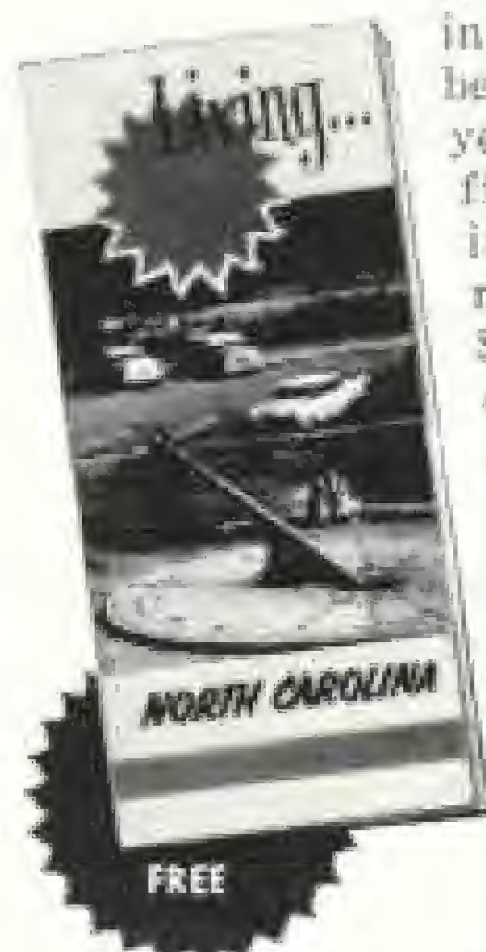

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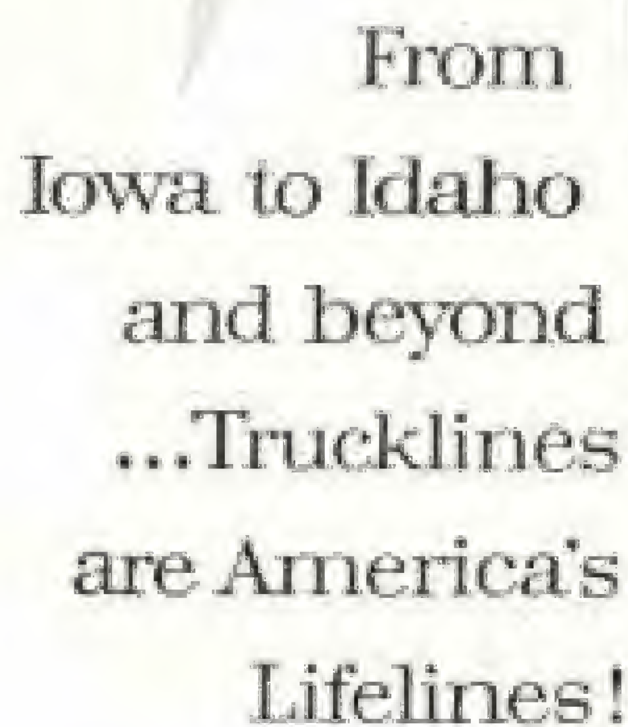

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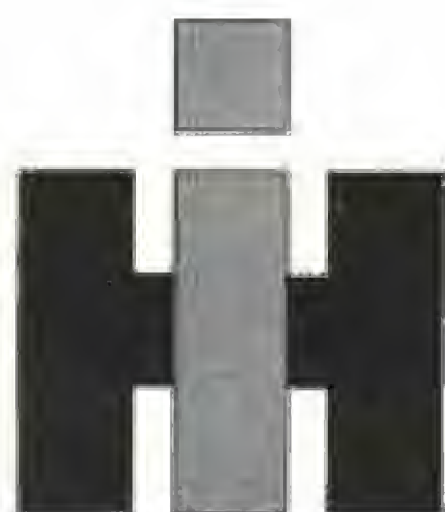

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