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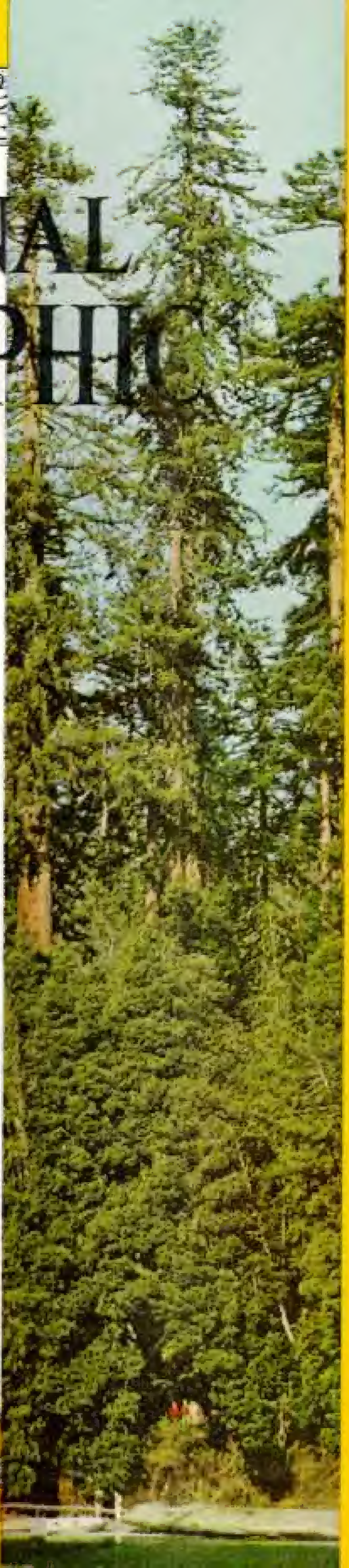


July
1964

NATIONAL
GEOGRAPHIC

World's Tallest Tree Discovered

By MELVILLE BELL GROSVENOR
President and Editor, National Geographic Society

Photographs by
GEORGE F. MOBLEY
National Geographic Staff

"DON'T KEEP FOREVER on a public road . . . following one after the other like a flock of sheep. Leave the beaten track occasionally and dive into the woods. Every time you do so you will be certain to find something that you have never seen before."

Those words—written by Alexander Graham Bell, my grandfather, in a 1914 NATIONAL GEOGRAPHIC—ran through my mind like a prophecy as we made a "dive into the woods" from the rushing sparkle of California's Redwood Creek.

Miles from manicured parklands and trails, we climbed logs head high and mossy green. Fallen branches made uncertain footing, splitting explosively under a man's weight.

Quickly the forest changed to a somber mood: an almost subterranean dimness. I raised my eyes: like a limitless view of the ocean or a night sky filled with stars, this wilderness of great trees stretched upward and away to infinity.

Overhead, a bar of golden sunlight slanted into our wooded world, treating leaves like stained glass, etching the texture of ribbed bark, finding Gothic gargoyles in the burls. I reached out to touch the dry, coarse bark of a great redwood.

"Visitors always want to touch the redwoods," said Howard A. Libbey, my host and President of the Arcata Redwood Company, owner of this grove in Humboldt County. Now I knew why: Only by touching them can we be sure that these marvels are real.

Apparently the wonder remains even for those who know the redwoods best. I watched as this man, a 40-year veteran of the forests, moved toward another big tree—and spread his hand across its bark.

Forest Giants Set New Records

A voice called us back to important business. "The surveyors have good news!" It was Dr. Paul A. Zahl, senior naturalist of the National Geographic Society, who had hurried on ahead to talk with the team of surveyors measuring these giant coast redwoods for us.

The news was good indeed. It confirmed the National Geographic Society discovery that Dr. Zahl describes this month: finding the world's tallest known living things (page 10).

Here, in a hidden valley, Paul Zahl had found —just days earlier—the monarch of all trees, a coast redwood measuring an incredible 367.8 feet. Moreover, the forest cathedral that we now reverently explored also held the second, third, and sixth tallest trees—giants just as awesome as the world's champion (list, page 16). Two of these record redwoods were found by Chester C. Brown, leader of a National Park Service—National Geographic Society research project.

Dr. Zahl's report offers us a sharp challenge: Within the United States, the Age of Discovery has not yet receded into history. Lewis and Clark, Boone and Frémont have left us an exciting legacy, but their explorations did not strip away all mystery from our familiar world.

I first began to wonder about taller, undiscovered trees when, with Conrad L. Wirth, then Director of the National Park Service, I visited the scene of a great natural disaster: California's

(Continued on page 8)

Glen of Giants explored by Dr. Paul A. Zahl, naturalist of the National Geographic Society senior staff, lies along Redwood Creek in northern California's Humboldt County. Here coast redwoods (*Sequoia sempervirens*) grow taller than any other living thing yet found by man. Crowns of the loftiest trees soar more than 367 feet above the rushing waters. The tallest lifts its slender spire from a clump that appears just to the left of the airplane. Third tallest also stands within the creek bend, and the second tallest rises a short distance downstream, just out of the photograph at top (map, page 81). The champion's trunk, still expanding, indicates it may be only 400 to 800 years old.

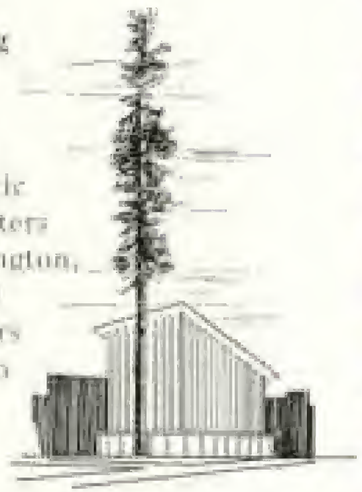
Though the trees grow within ten miles of the coast, their record height went unnoticed until Dr. Zahl spied them from the partly cleared slope at left. Georgia-Pacific loggers, who built the road, spared some trees. Seedlings and sprouts now are rapidly covering the slope.

◀ **THIS PAGE FOLDS OUT**

Redwood seedling, a few weeks old, is not much bigger than the common pin at its roots. It still wears the blossomlike husk on whose wings the seed fluttered down from a cone high above.

NEW CHAMPION, 367.8 feet, soars well above its fellows. Until discovery of the Redwood Creek titans, the 356.5-foot Rockefeller Tree in Humboldt Redwoods State Park claimed the record.

Men standing on the bank 75 feet in front of the giant include Howard A. Libbey, President of Arcata Redwood Company, owner of the tract, and Dr. Melville Bell Grosvenor, National Geographic Society President and Editor. The two discussed means of preserving the grove.



Dwarfing the new 10-story National Geographic headquarters in Washington, the tallest tree towers more than twice as high.

The Tallest Tree in the World

ging roads, through miles of mountainous timber, then across open spaces of young second growth. Finally, with dramatic suddenness, we came to the bright waters of Redwood Creek.

The view inspired pure silence.

Throughout the world, it has been my good fortune to see many dramatic panoramas: Fuji by moonlight, the Grand Canyon, the Taj Mahal—each is superlative in its own way. Yet for sheer impact, the view of the magnificent grove and Redwood Creek Valley compares with any one of these.

Viewing Easy Along Redwood Creek

Here crystal waters flex into a sweeping bend of stream with a margin of gravel beach. And from the rich flatlands just beyond rise the heavy red columns of living trees that soar up, up—as eyes and spirits lift—into the deep sky itself. Other groves of coast redwoods present a viewing problem; the higher trees often crowd far into the forest, where it is impossible to see them from base to crown. But here the redwoods stand forth in their full vertical splendor.

We crossed the stream on bobbing rubber rafts and scuffed ashore. The tallest of the grove's trees was a curiously forked redwood. Perhaps the shorter trunk had braced the taller one for its prodigious growth. Watery ripples of reflected sunlight danced on the massive lower trunk, and blackened bark told of long-dead forest fires and the healing force of nature.

All day we explored the idyllic grove. When the surveyors' computations were complete, we returned to the great forked tree. It was the new world's champion—367.8 feet tall!

I learned much about forests that day. Howard Libbey told of his company's tree-farm techniques: the way helicopters are used to reseed logged land, the building of dams to prevent erosion, the new milling techniques that make better use of each log.

Unsurprisingly, it was Mr. Libbey who provided one of the truly stirring moments of that memorable day on Redwood Creek. After a long view of the grove, he turned to me with great feeling.

"Someday," he said, "I hope this grove can be opened to the public and preserved for future generations." ❀ ❀ ❀

Sunlight and shadow dapple forest foliage beside Redwood Creek as Arthur B. Hanson, General Counsel of the National Geographic Society, emerges from the grove of giant trees.

Massive girth of the tallest redwood measures 44 feet. Chester C. Brown of the National Park Service (center) and Dr. Paul Zahl pull a tape around the tree at breast height while Mrs. Brown watches. National Geographic Society support has enabled the Park Service to study factors involved in preservation of California's coast redwoods.

Finding the Mt. Everest of All Living Things

By PAUL A. ZAHL, Ph.D.
National Geographic Senior Staff (Natural Sciences)

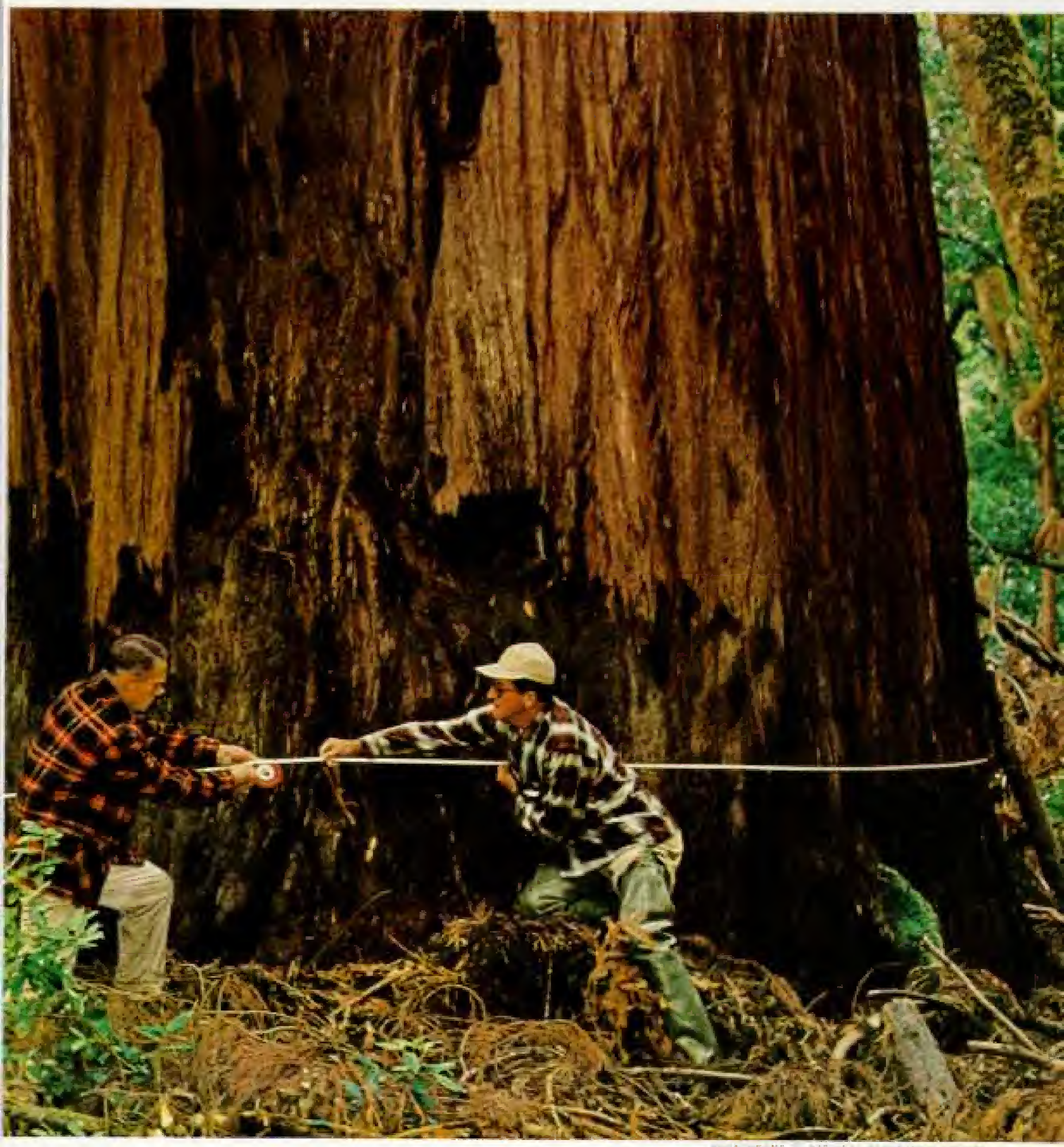
Photographs by the author

I STILL WONDER what lured me to the hidden valley of Redwood Creek. Was it a hunch or plain curiosity?

Whatever the reason, I knew the moment I beheld the tantalizing little stream that eventually I must explore it. But I had no idea I would spend many memorable weeks going into and out of that wilderness—nor could I possibly know that the valley would yield a fascinating discovery: the world's tallest known living things.

I first glimpsed Redwood Creek from a logging road that twisted through patches of steep forest and past slopes of partially logged land. From a ridge behind me I had seen the shimmering blue Pacific. Now, atop an inland height, Clarence A. (Casey) Casebier stopped the pickup for a long look eastward.

"You see the trees down in the valley? Great timber!" exclaimed Casey. "But those big ones aren't on our land. Everything east of the creek belongs to the Arcata Redwood Company." Casey spoke with authority as a logging superintendent for the Georgia-Pacif-



ic Corporation, along whose logging road we were driving. Heavy trucks grinding through these private domains make travel dangerous for the uninitiated; outsiders can enter only with permission. Generously, Georgia-Pacific had sent Casey with me as a guide.

"Is there any way to get down there?" I asked him.

"There's no road at all beyond Redwood Creek," he said. "The only way to get into that grove is on foot."

Casey's words jogged my memory. I had heard vague references to the coast redwoods in this secluded valley. But no one knew much about those wilderness trees. Their isolation had protected them.

Now, gazing into the sunlit valley, I promised myself, "I'll come back."

Big Trees Influence Life's Career

My personal interest in redwoods began longer ago than I can recall, when I was a boy in California. My father loved the redwoods, and he made no distinction between the giant

THIRD TALLEST TREE
would top Rainbow Bridge in Utah by 55 feet.

Fluted pylon of third tallest redwood soars 364.3 feet into the mist, fading out of sight. "The giant's hoary companions crowded so close about," reports Dr. Zahl, "the photographer could not back off. The only view rose straight up." Moss-fringed dead branch writhes above the camera, a Nikon with a 180-degree Fisheye lens laid on the litter of the forest floor. Mops of greenery far above seem inadequate for such massive trunks.

ENTACHROME BY NATIONAL GEOGRAPHIC PHOTOGRAPHER GEORGE F. MOBLEY © N.G.S.

Bright-orange "banana slug" *(Ariolimax columbianus)* glides over the moist, mossy floor of the forest. It protrudes and retracts bulbous eyes set on fleshy "horns." A relative of snails, the slug appears here life-size.

sequoias and their taller cousins, the coast redwoods. To him, they were all more or less the same—and all magnificent. On family outings I played among the great reddish-brown surface roots and stared upward with wonder along trunks that touched the sky.

Certainly those boyhood trips to redwood forests influenced me strongly in later years to become a biologist and naturalist. And though my work took me far from California, those pleasant memories made me want to introduce my own children, Paul and Eda Kristin, to the redwoods.

Big Timber Built California Towns

For years we talked about our family redwood expedition without actually making it. Yet I knew that with each passing year there were fewer trees to visit.

Large numbers of redwoods used to stand nearly within the ocean's spray in such coastal counties as Marin and Mendocino. Pioneers and loggers leveled many of these trees in the mid-to-late 1800's to build San Francisco and northern California towns.

Then motorized equipment enabled loggers to reach more deeply inland. The National Park Service estimates that, of two million virgin acres of coast redwoods that once ranged from Monterey Bay to southern Oregon, 15 percent remains. Of these 300,000 acres, only about 50,000 acres lie within public parks and groves.

Nor is the trend encouraging: At the current rate of logging, all the available virgin growth may be cut half a century from now.

Furthermore, the whining chain saw is not the only hazard to the stately redwoods. During the late 1950's, floods softened the earth and high winds toppled thousands of tall trees. Many foresters have wondered if the unchecked runoff from logged-over hillsides is not at least partly responsible for the floods. Since the greatest trees are found in the river flats, the choice groves are exposed to the greatest danger.

These were the conditions that prompted Conrad Wirth, former Director of the National Park Service, to ask the National Geographic Society for a grant to study coast redwoods. Chester C. Brown of the Park Service would head this research, much of it concerned with ecology—the interrelationships of the trees with their environment. I was curious to look in on his work and also to take some photographs of forest life that

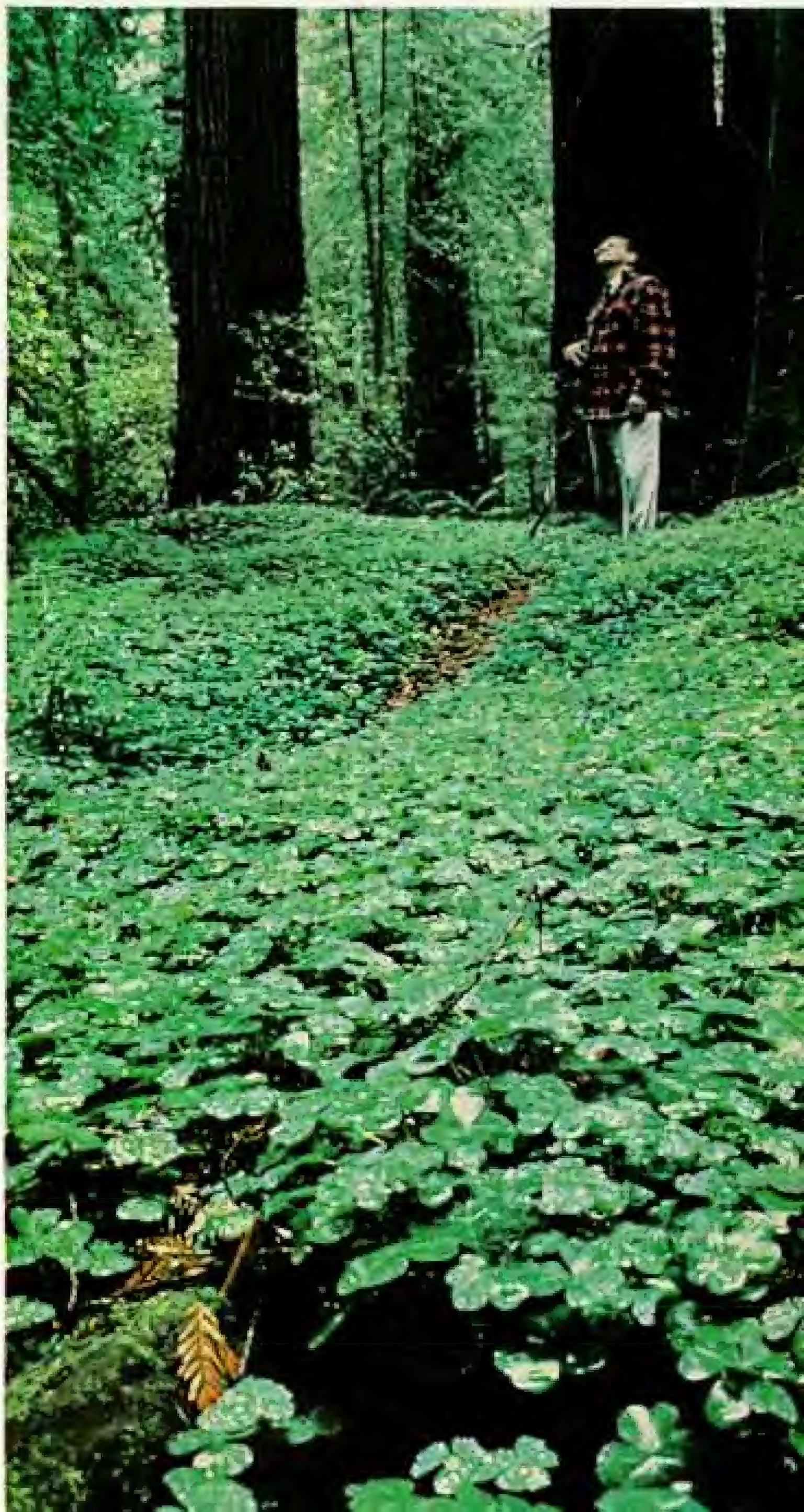
Sugar-scoop (*Tiarella unifoliata*) nods a bloom only about a fifth as wide as seen in this picture.

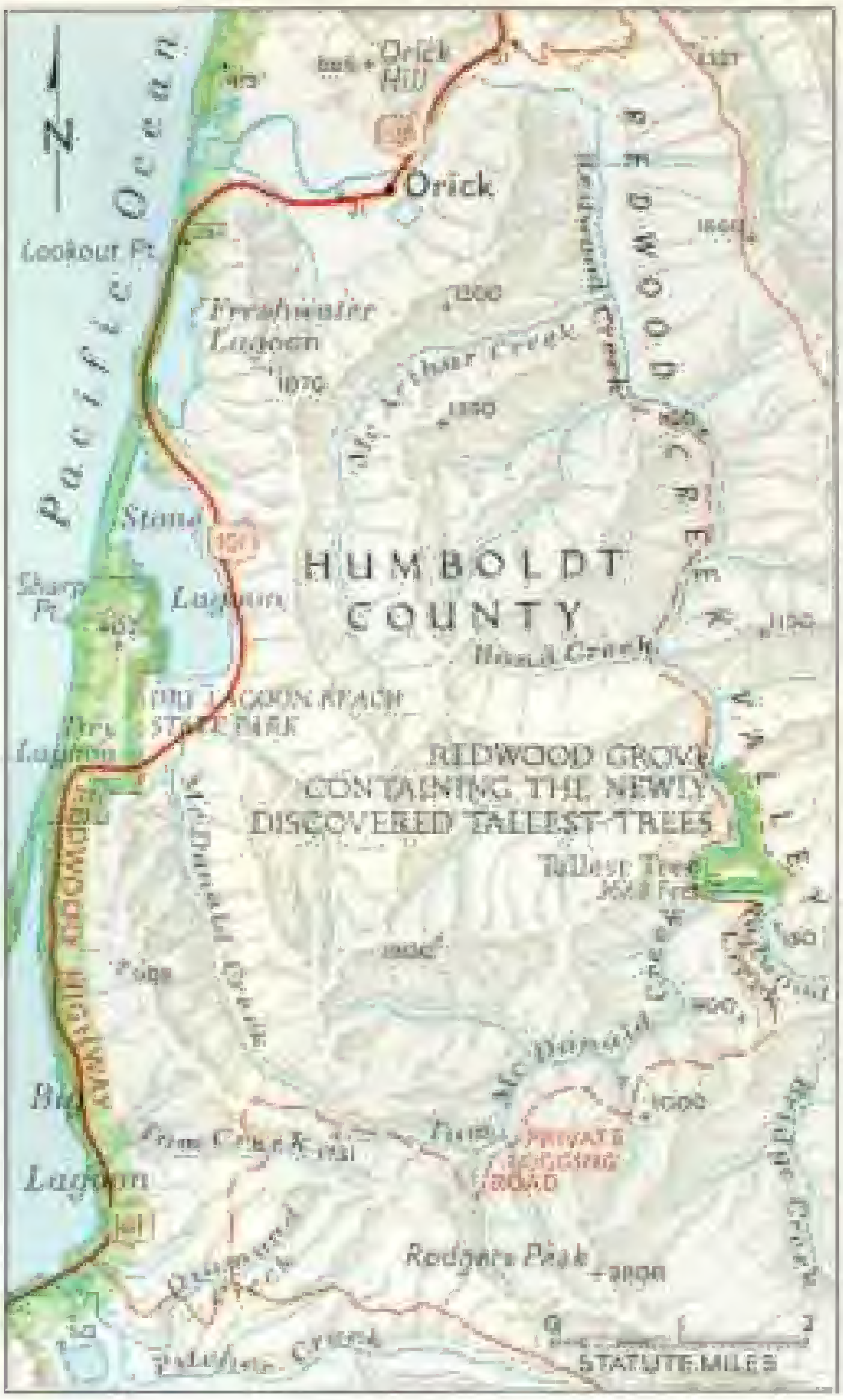
Oxalis wears a violet undercoat.

European garden snail (*Helix aspersa*) drags its shell over a mossy course. This Old World immigrant has spread across North America.

FAR BELOW THE REDWOODS' whispering tops lies a world of small things. Across the darkened forest floor animals and insects creep, crawl, and fly; mosses and lichens cling; and plants hide miniature blooms among massive trunks.

Magnificent Pepperwood Grove still stands intact beside the Redwood Highway. The Pacific Lumber Company, despite high taxes on uncut timber, has refrained from cutting the glorious trees. Save-the-Redwoods League hopes through gifts to buy and preserve Pepperwood for the Nation. Its leafy carpet of oxalis wilts in sunlight but revives in the grove's accustomed shade.





WORLD'S TALLEST KNOWN TREES

ONLY California and a pocket in southern Oregon produce earth's tallest living things—the coast redwoods, *Sequoia sempervirens*. Trees grow in a belt 500 miles long and hardly more than 30 miles wide. Largest untouched stands flourish in northern California's Humboldt and Del Norte Counties.

In order of height, the top six trees are:

HEIGHT IN FEET	LOCATION
367.8	Redwood Creek grove Humboldt County, Calif.
367.4	Redwood Creek grove
364.3	Redwood Creek grove
356.5	Rockefeller Tree, Humboldt Redwoods State Park, Calif.
352.6	Founders Tree, Humboldt Redwoods State Park, Calif.
352.3	Redwood Creek grove

Forest monarchs of three other species grow in Pacific coast states and in Tasmania and Australia. They include a 324-foot Douglas fir (*Pseudotsuga taxifolia*) at Ryderwood, Washington, a 322-foot *Eucalyptus regnans* in the Styx River Valley of Tasmania, a 305-foot tree of the same species in Victoria, Australia; and two *Sequoia gigantea* in California—the 291-foot McKinley Tree and the 272-foot General Sherman, both in Sequoia National Park.

might illustrate the broad subject. Such a trip seemed ideal for the whole family.

And so it was that we loaded our car to browse California's 500-mile-long coastal belt, known as the Redwood Empire. All four of us—my wife Edie; daughter Eda Kristin, 15; and son Paul, 12—had a marvelous summer, and none of us had any notion of making serious explorations. Yet, in retrospect, one barely remembered incident pointed in the direction of discovery.

We were following a forest footpath in California's Humboldt Redwoods State Park, 240 miles north of San Francisco. Unconsciously we lowered our voices. On all sides of us stretched a forest floor covered with fallen needles and cones, leaves and twigs, patches of sorrel, fern, moss—an acoustical matting that quieted this grove to the reverent hush of a cathedral (pages 24-5).

Child's Remark Proves Prophetic

We drew near a great redwood surrounded by tourists as silent as we. My eyes traveled upward. Layered by coarse, deeply furrowed red-brown bark, and splotched here and there with yellow lichens, the trunk was bare of limbs for about 200 feet; above, branches formed a verdant headdress now partly obscured by the morning mists.

A neat wooden plaque described Founders Tree: circumference at chest level, 40 feet; diameter, 12.7 feet; height 346.1 feet. Recent measurements show this tree has grown; its present height is 352.6 feet, making it the fifth tallest tree.

Age was unspecified, for only after a redwood tree is cut and its rings are counted can its life span be accurately determined. We know, however, that a tree of this size could have been well along at the time of the Magna Carta, A.D. 1215, a seedling perhaps even before the birth of Jesus.

I explained to the youngsters that Founders had been accepted as the world's tallest tree —until 1957. Then a rival was discovered in nearby Rockefeller Forest, a tree measuring 359.3 feet (page 35). Surveys indicate this "world's tallest" tree has lost height, possibly by storm damage to its crown. It now measures 356.5 feet, giving it fourth rank after the three new discoveries on Redwood Creek.

"But all the redwoods still aren't measured," said one of the children. "Maybe someone else will discover a new world's record."

Prophetic as the remark now seems, it was purely casual that day. And even now not one of us remembers who said it. For the duration

Stopping in a gigantic hole, the Zahls look up at forking boughs that inspired the Chandelier Tree's name. Fungus and fire began the tunnel; man completed it. The tree stands in Underwood Park, a private development on the Redwood Highway.

Taxation of uncut timber makes it costly to keep private groves. The National Park Service estimates that little of the original two million acres of virgin redwood will remain unlogged half a century from now if cutting continues at the current rate. Public parks and groves preserve 50,000 acres.

of the summer we continued to marvel at the height of the redwoods, like every other traveling family. Beneath these mighty trees the imagination falters.

Even the great Galileo thought such heights impossible for trees. Of course, when the Italian astronomer lived four centuries ago, he did not know about the existence of redwoods. Instead, Galileo conjectured that "an oak 200 cubits

Redwoods never die, it would appear, considering the myriad green plumelike sprouts on this fallen trunk. Such new growth, rising from the long trunk of a downed tree, occasionally produces straight colonnades of redwoods.

Losing its footing, this behemoth toppled in a high wind. Ferns spring from its bared roots. With huge trunks rising from broad, shallow root systems, redwoods resemble gigantic nails standing on their heads.

Flat leaves grow green on a redwood's low branches; its top produces short needles that often turn rust color.

high"— 300 feet—"would not be able to sustain its own branches if they were distributed as in a tree of ordinary size."

His statement was vague, but if Galileo thought a tree's height could be limited by the hydrostatics of sap transport, then the astronomer was wrong. The amazing fact is that the redwood can lift tons of water hundreds of feet with no pumps of any sort.

Modern plant physiologists know that the vertical movement of sap is due mainly to the extraordinary cohesive properties of the water molecule. As the molecule moves, it tugs its neighbors along.

Within the wood's sap tissues, water-filled capillaries extend from the lowest rootlets to the highest foliage. The capillaries end there in minute openings on the surface of leaf or needle, where water constantly evaporates. As one molecule vaporizes, another replaces it from below; in other words, because of the forces of molecular cohesion, the entire water column moves upward by the volume of one molecule. If trillions of molecules evaporate,

as in fact they do, the water column rises correspondingly.

So what limits the height of a tree? Why don't we find trees 1,000 feet tall? No one knows precisely, but mechanical factors surely are involved. For example, the higher the structure, the more massive its base needs to be. If wood were stone, a tree conceivably could outscale the Washington Monument; if iron, the Eiffel Tower. But wood is neither stone nor iron and must adapt to its own intrinsic properties. Also, there is the matter of wind and air turbulence encountered high above the ground. Throughout every redwood forest one sees trees "topped" by such forces, and indeed often laid flat.

Tenting Has Problems in Big Grove

Our first campsite taught the youngsters an important lesson in redwood structure. Surrounded by *Sequoia sempervirens*, we fastened one of our tent lines to a giant at least eight feet in diameter. As our son Paul drove a stake into the ground for another line, he struck a heavy root. Shifting locations, he pounded again and again, only to encounter more subterranean timber.

I am sure Paul will never forget his tent-stake experience. *Sempervirens* has no deeply sunken tap root; it must depend for stability solely on the holding power of surface roots spreading widely around the base.

Such underpinning proves quite adequate within the shelter of a grove but not in an exposed location. In a clearing not far from our camp we saw an example of a redwood that had crashed to earth not many decades before. Its root disk, now at a right angle to the ground, had become a perfect trellis for vines, ferns, and mosses. A similar monarch lies sprawled in Humboldt Redwoods State Park (pages 18-19).

A fallen trunk eventually disintegrates, but it may leave a legacy of sprouting burls to carry on. Burls are humps of germinative tissue on the redwoods, and they explain the occasional woodland sight of giant trees growing in a line as straight as the trunk of the parent tree that fell to the forest floor.

The casual visitor to the redwood forest tends to gaze upward. It is a paradox in this world of giants that the little things are also fascinating. When we lower our sights for a moment, we discover a microcosm with a splendor of its own.

Oxalis Hides From Sunshine

One afternoon in Pepperwood Grove I photographed little patches of sorrel (*Oxalis oregana*), whose emerald leaves suggest clover (page 15). From high overhead, a beam of light filtered through the forest canopy; where it struck, the oxalis leaves drooped. Then, as the sunbeam passed, the leaves returned to normal. The nature and purpose of this reaction is not known, although the conservation of moisture may well be a factor.

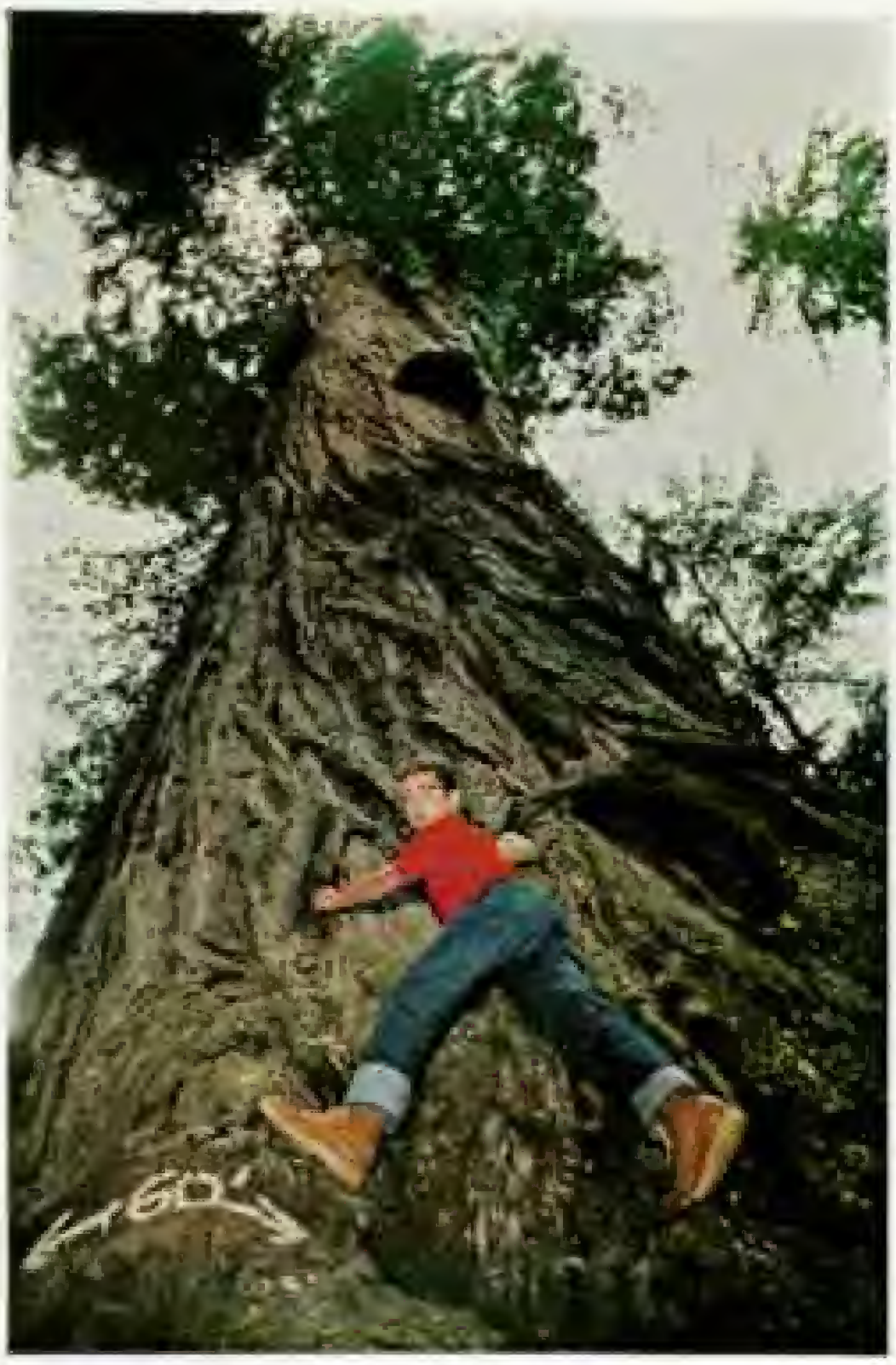
The soil from which the sorrel grew was a blend of twigs, needles, and general forest litter. Here and there lay small cones, each no larger than an olive—last year's redwood seed bearers. The previous autumn, millions of them, maturing both in the upper and lower branches of the trees, had released their diminutive tissue-edged seeds to scatter far and wide on the winds as they drifted down to earth. Each tiny seed has the potential to produce a colossus (page 6).

I was on my knees photographing an oxalis cluster when I spotted something easing straight toward me—a so-called banana slug, bright-orange and as long but not quite as thick as its namesake (page 14). Common in the humid redwood forest, this creature is too interesting and colorful to be repulsive. It feeds on plant tissue, leaving a path of glistening slime as it inches along.

I shifted my position to avoid the slug, then picked up a twig bristling with redwood needles, or, in more correct botanic usage, leaves. The needles were about three-quarters of an inch long and arranged with linear precision along the stem; each contained millions of chlorophyll-bearing cells in which the chemi-

Spared From Saw and Ax, Brown-ribbed Trunks Lift Their Vertical Poetry

Majestic aisles lead through Rockefeller Forest, part of Humboldt Redwoods State Park. This grove, named for John D. Rockefeller, Jr., whose generosity saved the monarchs, contains Rockefeller Tree, now the fourth tallest. Of California's titans, poet Edwin Markham said: "These great trees belong to the silences and milleniums. They seem, indeed, to be forms of immortality, standing there among the transitory shapes of time."



Like Jack the Giant Killer, 12-year-old Paul Zahl tackles the 253-foot Arco Giant near Orick. The trunk measures 60 feet in circumference.

Spice of evergreens and tang of frying bacon pervade a family room walled by nature in Prairie Creek Redwoods State Park. Floor of intertwining roots made it difficult for the Zahls to drive pegs for their tent. Sword ferns provide a natural decor of greenery.

After breakfast the travelers devote their day to hiking, fishing, exploring, or simply relaxing, "lost in worship of those lordly trees," as Stanton A. Coblentz wrote in *Songs of the Redwoods*.

cal transformations by photosynthesis take place to produce the staggering tonnage that makes up each redwood titan. Oddly, those growing in the redwood's heights are short and scalelike, while those on the lower branches are distinctly bladelike (page 18).

Handsome ferns of many species, together with luxuriant mosses, lichens, and liverworts, flourished everywhere here on the damp forest floor. Basic moisture was provided by rain. But there was another important source of water—the fog that so frequently sweeps in from the nearby ocean. Fly over Humboldt County almost any morning and the valleys are half-hidden by a low-hanging mist (pages 50-51). The extent and pattern of the fog's inland penetration—some 30 miles—correspond almost precisely to the areas occupied by coast redwoods.

This fact leads some authorities to suspect a correlation between the trees and fog. But other scholars point out that redwoods have not always been limited to coastal zones. In times past, there were as many as ten distinct

sequoia species, some in Alaska and Labrador, others in Europe and Asia. Only the two California species survive: the massive *Sequoia gigantea** of the High Sierras (some botanists prefer to call it *Sequoiadendron giganteu*) and the taller *sempervirens* (evergreen) of the northern coastal mountains. Both species have been in California for 40 million years, a testimonial to their hardihood.

*See "Giant Sequoias Draw Millions to California Parks," by John Michael Kauffmann, NATIONAL GEOGRAPHIC, August, 1959.

Sylvan sanctuary in Humboldt Redwoods State Park recalls William Cullen Bryant's words: "The groves were God's first temples." Afternoon sun, like light streaming through cathedral windows, dapples an oxalis-carpeted forest. With their mother, the Zahl children marvel at these "majestic brothers," as Walt Whitman called the trees.

Home in a tree near Redwood Creek leaves no clue to the identity of its long-departed occupant. Chicken-wire ceiling catches falling debris.

Roosevelt elk, wet from rain, rests in a reseeded area. Foresters say that the elks' taste for seedlings seriously hampers redwood regrowth.

The "dawn" redwood," or *Metasequoia*, a related and perhaps ancestral form, survives in China.

Irises, trilliums, ginger, and a host of other wildflowers grow widely, although not profusely, in the deep redwood forest. But along the fringes and in clearings, where the light is strong, floral decorations are often lavish, especially in spring and early summer. In July, throughout Humboldt County, I found stands of rhododendron, azalea, and iris, brilliant with blooms; also columbine, bleeding heart, salal, huckleberry, and wild rose.

Learning Humboldt Lore

As the summer passed, I photographed this variegated life of the redwood forests all along California's Redwood Highway, U.S. 101. About 200 miles north of San Francisco, the redwood scenery grows truly spectacular. Richardson Grove State Park, with its superb trees lining both sides of the highway like closely placed monoliths; Humboldt Redwoods State Park, with its famed Avenue of the Giants and its more than 50 commemorative groves; Pepperwood's vaulting forests; Prairie Creek Redwoods State Park, with its dramatic campsites, herds of Roosevelt elk, and glass-clear streams; and finally, near the Oregon line, the ruggedly imposing Del Norte Coast and Jedediah Smith Redwoods State Parks.

For two weeks we settled in the little logging town of Orick in colorful Humboldt County, only a mile and a half inland from the crashing Pacific. There we stayed in a motel owned by Lowell and Jean Hagood and ab-

sorbed some of the local lore.

Fray Juan Crespi, chronicler of the Gaspar de Portola expedition to upper California, first recorded seeing redwoods in 1769. He wrote of "very high trees of a red color," but his giants were hundreds of miles from Humboldt County.

The Spanish, in fact, hardly penetrated the Humboldt area, and so it is that the names of geographic features date mostly from the gold rush in the mid-19th century.

To Humboldt County came Capt. Ulysses S. Grant to pacify Indian tribes, and here Bret Harte wrote his first newspaper stories and got his first impressions of western local color.

Yet the dramatic development of the area waited for loggers. To this day, lumber remains the basic industry of Humboldt County, and the outdoor traditions of the logger give towns like Orick their zest. When Lowell Hargood talks about the magnificent timber in the roadless valleys here, the visitor does well to remember.

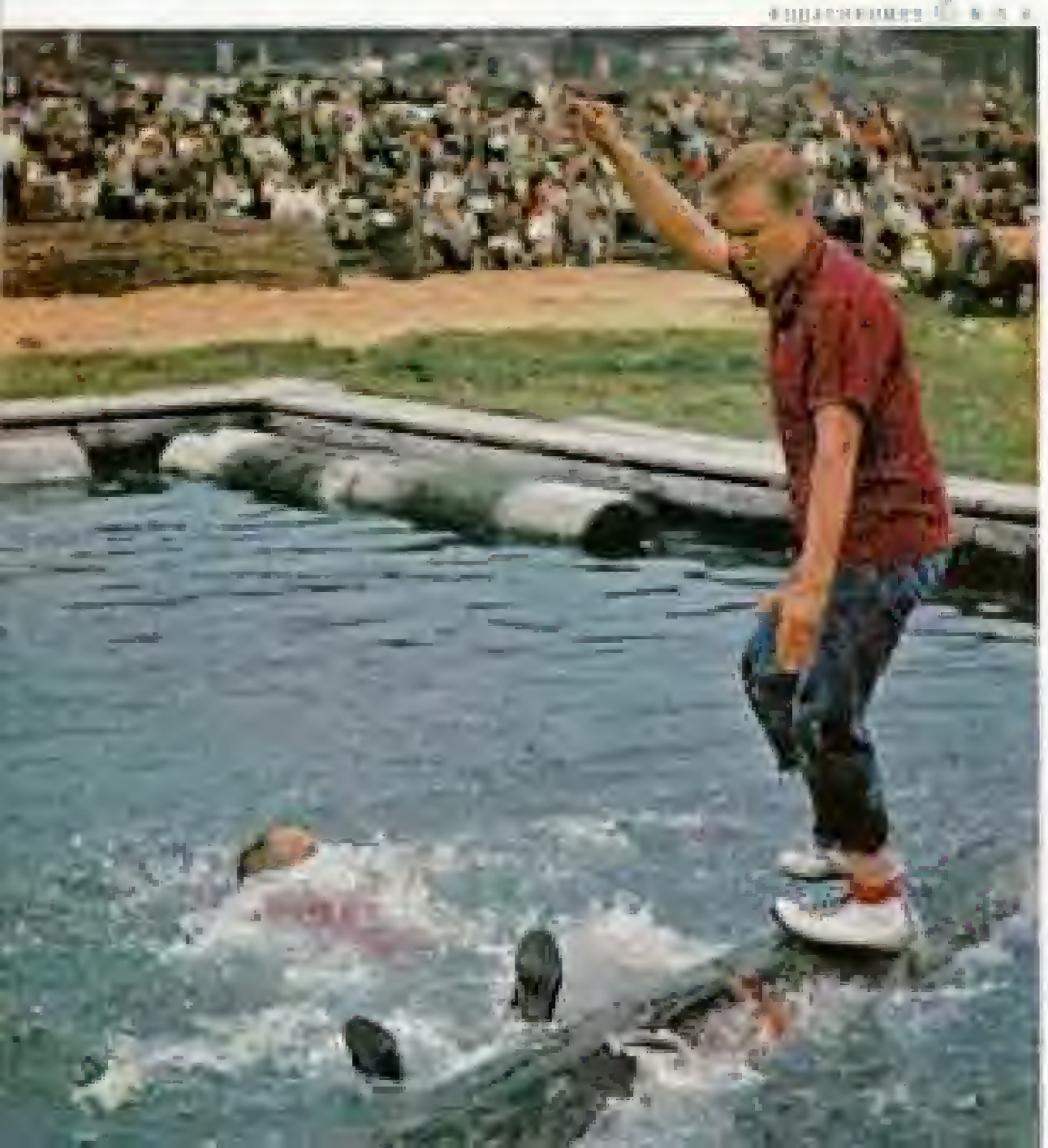
Road Leads Into Wilds

While Eda and the youngsters fished for trout in the creek, I visited some of the forest hinterlands. North of Orick about six miles I found an old logger's road that passed through state parkland, then twisted up a hillside to emerge in a logged-over wilderness. Along this road I could observe every phase in the rise and fall of *Sequoia sempervirens*, every aspect of its growth, harvest, and regrowth.

Within the parkland I often left the car to wander through the pathless forest. Shafts of misty light pierced the superstructure, here and

Each bloom a bouquet, pink rhododendrons fringe a tall-tree grove

Study of water runoff from a cut-over redwood forest absorbs Dr. Peter E. Black of Humboldt State College, Arcata. His neutron meter accurately measures moisture in the soil. Dr. Black was one of a team of experts conducting the National Park Service—National Geographic Society survey of the conditions coast redwoods need for survival.



Round and round, faster and faster, goes the log in the water sport known as birling. The contest enlivens the Loggers' and Lumbermen's Jubilee held every July at Arcata, California. At its climax Jack Culver takes a ducking while John Wickheim holds the log. Lumberjacks with spiked poles still ride logs in millponds, herding them to the saw.

Green wall of redwoods enhances Johnson's Beach on the Russian River in Guerneville, California. Cut nearly a century ago, the forest grew anew, mainly from sprouting stumps. Many trees now tower well above 100 feet. The grove shades private resorts

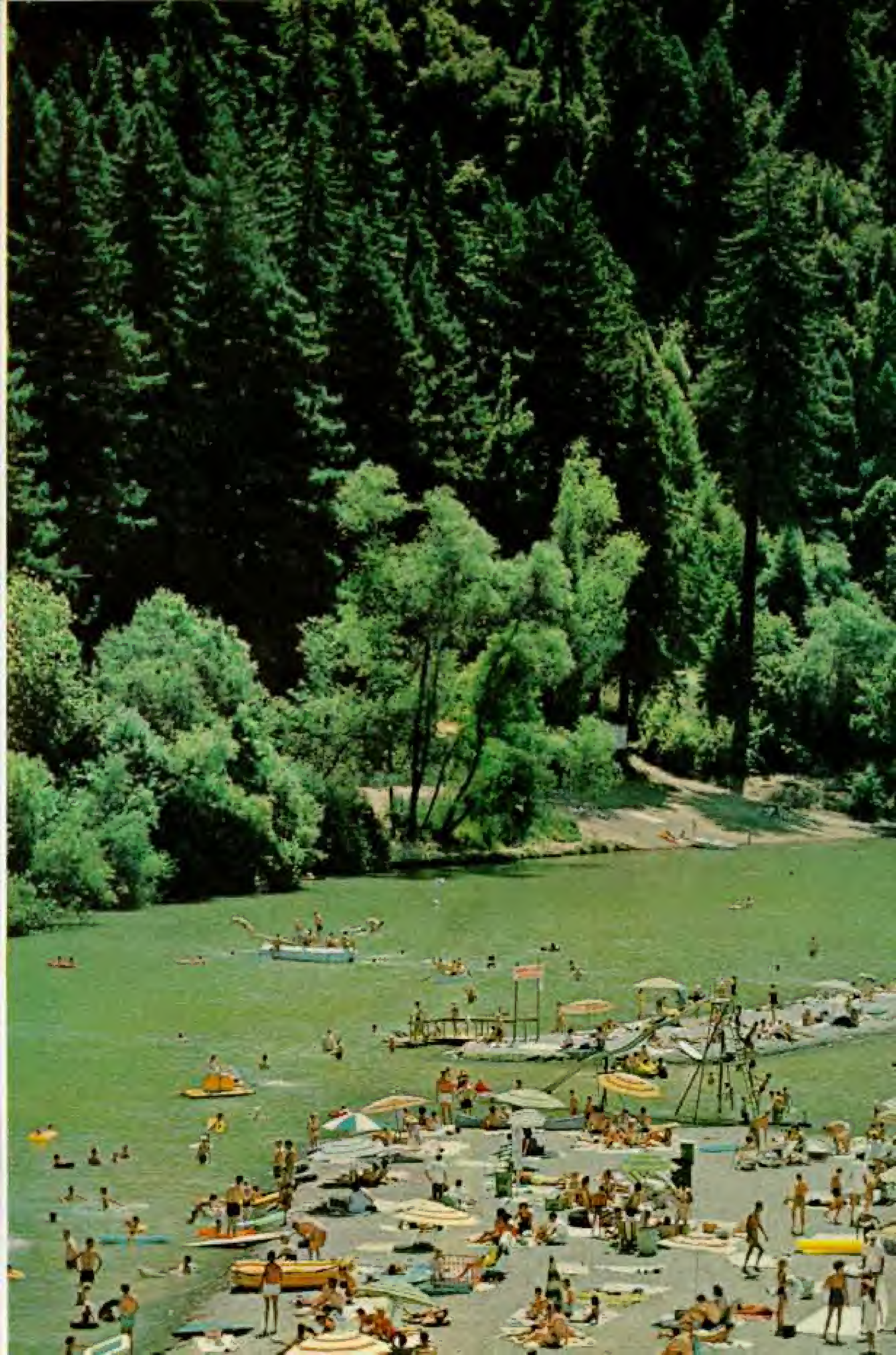
there splashing brightly on the otherwise somber forest floor.

I needed no logger's eye to tell me that these trees—many approaching heights of 300 feet—had enormous market value. A single giant might yield 40,000 board feet of top-grade lumber—enough to build five modest homes. The wood of *sempervirens* is highly regarded for reasons other than quantity. It has strength, straight grain, a satiny luster when polished, and, most important, is extraordinarily resistant to rot and insects—qualities possessed in like measure by few other woods, not even that of the Sierra Big Trees.

The harvesting of *sempervirens* remains an important source of prosperity to California and the Nation. Logging in itself does not alarm conservationists. But early in this century they realized that if logging continued at random and unchecked, all the giants would soon fall. By 1918 certain individuals had banded together, not in opposition to the lumber industry, but to preserve for the people of the Nation some of California's most impressive redwood groves. Relying on private donors and organizations for financial help, this group emerged in 1919 as the Save-the-Redwoods League. Since then, its members have raised $10,000,000—more than half the funds needed to establish northern California's four main redwood state parks.

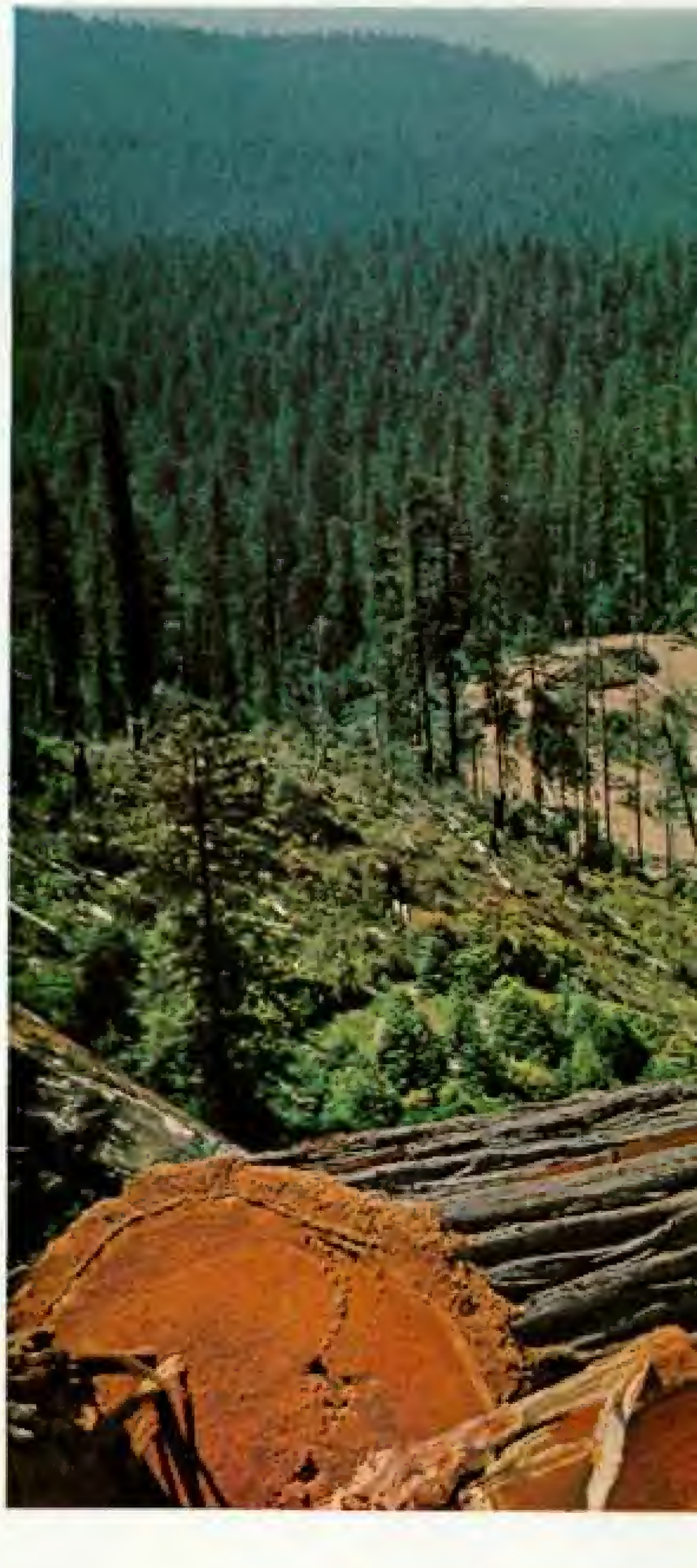
People around the world owe a debt of gratitude to the Save-the-Redwoods League for its efforts to safeguard America's giant trees. To preserve private groves still standing along the Redwood Highway, contributions (tax deductible) are desperately needed. Send your gifts to:

Save-the-Redwoods League
114 Sansome Street
San Francisco 4, California



Above 90 feet of nothing, a "high climber" hangs a pulley on a redwood that leans downhill. Cable to a tractor will guide the tree's fall uphill onto a bed of soft dirt, lest it crash to a lower slope and splinter.

Felled giant comes apart under the chain saw. Seed trees on near slopes were spared by Arcata Redwood Company loggers in the 1950's. Scores blew down and had to be removed, damaging young trees. When the company logged the far hillside in 1960, it cleared all but a few trees. Now redwood stumps sprout among Douglas fir seedlings.

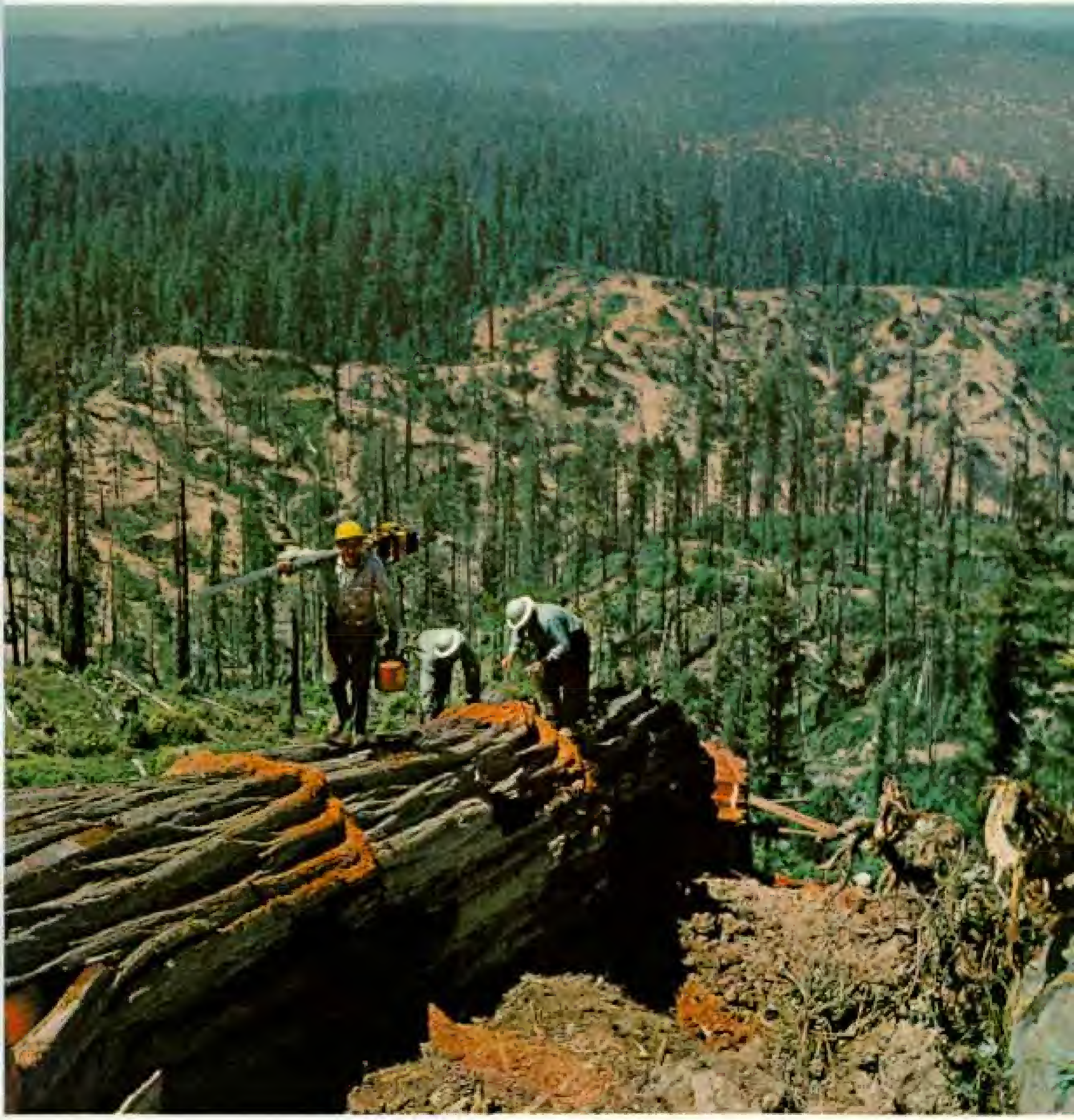


Farther up the ridge, in privately owned forest, I passed a scene that was, on first sight, depressing: miles of stumps . . . areas deeply rutted by tractors . . . the dross of logging.

Yet a closer look showed a cycle of renewed growth already under way. Most of the stumps were luxuriantly bushy, revealing a most fortunate characteristic of *sempervirens*. I climbed up on one stump almost big enough for a dance floor. Around its edge were dozens of healthy sprouts three to six feet high. These shoots grow at a phenomenal rate, taking advantage of the still viable parent root system, which affords them far more nutrient than a seedling could get.

A totally logged-over area is a thriving forest again in 40 or 50 years. In fact, I saw in Eureka's city park second-growth redwoods that were three feet in diameter. Yet they had grown to that enormous size within the memory of living men.

Many of the larger lumber companies here call their holdings "tree farms." They practice sustained-yield logging: One area produces a crop while another fosters regrowth. But logging men are in agreement that it takes at



least 500 years to produce a giant. "We're in the lumber business, of course," said forester Gene Hofsted of Arcata, "but that doesn't mean we are blind to our responsibilities in regard to conservation. There are practical reasons—we want to be in business 50 years from now."

He explained the two chief logging procedures: selective logging, which leaves about 50 percent of the trees as a seeding source; and clean logging, which takes everything.

Hofsted believes in the latter, especially as it applies to the region around Orick, where high winds often sweep the forests. Trees left standing for seeding purposes in a partially logged area, he explains, are frequently blown down. During one two-hour windstorm in 1939, for example, Arcata lost 10 million board feet of timber. Fallen trees create a summer fire hazard and require removal.

"Better to take everything the first time, smooth the soil, and reseed. Then we needn't send in 'cats' to tear up the land again," says Hofsted.

Lumbermen are not only concerned that new forests shall rise where old ones have been cut. Private industry has in many instances served the public interest by saving particularly magnificent groves in the Redwood Empire. Eventually, they hope, these stands can be bought and preserved.

Georgia-Pacific, for example, has left virgin trees in key spots along the Van Duzen River; Pacific Lumber Company has guarded the unspoiled beauty of Pepperwood Grove, adjoining the Avenue of the Giants; and Simpson Timber Company still keeps its loggers out of scenic tracts alongside Jedediah Smith Redwoods State Park.

Bed Cushions the Fall of a Titan

One day I joined a team of timbermen to witness the fall of a redwood giant. A normal tree on level ground can be felled easily; not so the tree that leans downhill or toward a gully. Falling down a slope or across a ravine can splinter the timber—a big loss to the mill.

The tree I was about to see cut had a downhill lean. Like surgeons in consultation, the logging superintendent and his crew studied its lean, the position of its neighbors, the slope, problems of cutting and removal—even wind velocity.

Now, like an insect on a stalk, a "high climber" wearing iron spurs scales the giant. About 100 feet above the ground, he attaches a steel cable (page 30). Below him other crewmen clear small trees and shrubs from a corridor: the line of fall. Earth-moving equipment roars in and quickly converts the corridor into a soft, loamy bed to cushion the impact.

Sawyers with double-bitted axes and 7½-foot chain saws cut a wedge out of the trunk only a few feet above the ground. The wedge must be precise, for on its size and shape will depend the exact di-

Mighty tusks of a LeTourneau log stacker reach for steaming, rain-wet timbers at an Arcata Redwood Company mill. The machine

can lift 33 tons of timber, run it up its 70-foot boom, and stack it on a pile. Men with chisel-tipped iron bars strip fibrous bark from logs. Once discarded as saw-clogging waste, the bark now goes into building insulation, mattress stuffing, roofing felt, and oil filters.

Growth rings

ADDING one ring each 12 months, the redwood sapling cross section at left (enlarged four times) records 13 years of varying growth.

Some species have laid down accurate weather calendars for centuries past. Building dates of southwestern Indian ruins have been pinpointed by growth rings in their pine beams, a technique

rection of fall; if the tree deviates only a fraction of a degree, thousands of board feet of quality redwood may in one instant be reduced to splinters.

At last the foreman signals, and a heavy tractor waiting well out of range tugs at the cable. Crack! The tree angles ever so slowly at first, then gaining momentum, sweeps down, and with a low, thunderous thud lands on the prepared bed. A cloud of dust and debris is the patriarch's only requiem.

Once, as I scouted the forest, I heard the whir of Chet Brown's chartered Cessna on a reconnaissance flight. I was eager to talk with Chet and the National Park Service planners and other specialists making the Society-supported study of redwood ecology. In fact, I hoped to make some field trips with them.

The fall term of school was starting. So I interrupted my redwood projects long enough to take my family home and return alone. Then I visited Chet to ask him what he knew about the trees along Redwood Creek.

"Yes, we've flown over that area, and walked it, too," said Chet. He added that he was familiar with the Georgia-Pacific road used by Casey Casebier and me.

Chet unfolded a map to point out details of the terrain. The Cessna had flown too high for the men aboard to get more than an impression, but the forest there on the east slope looked spectacular, so it was marked for exploration on foot. One member of the party thought the trees on the creek flats

tell a tree's life history

developed with National Geographic Society backing.

Young Paul Zahl in Muir Woods, near San Francisco, counts the rings of a giant that was 584 years old when Columbus reached America. Determining the ages of uncut monarchs, such as the Rockefeller Tree at right, poses a problem: rain, drought, shade, and crowding vary yearly growth rates, and cores from trunks prove difficult to obtain and interpret. Stumps 12 feet across have shown ages ranging from 550 to more than 2,200 years, the oldest coast redwood on record. Recent measurements show the Rockefeller Tree has lost 2.8 feet off its top.

seemed exceptionally tall, even for redwoods.

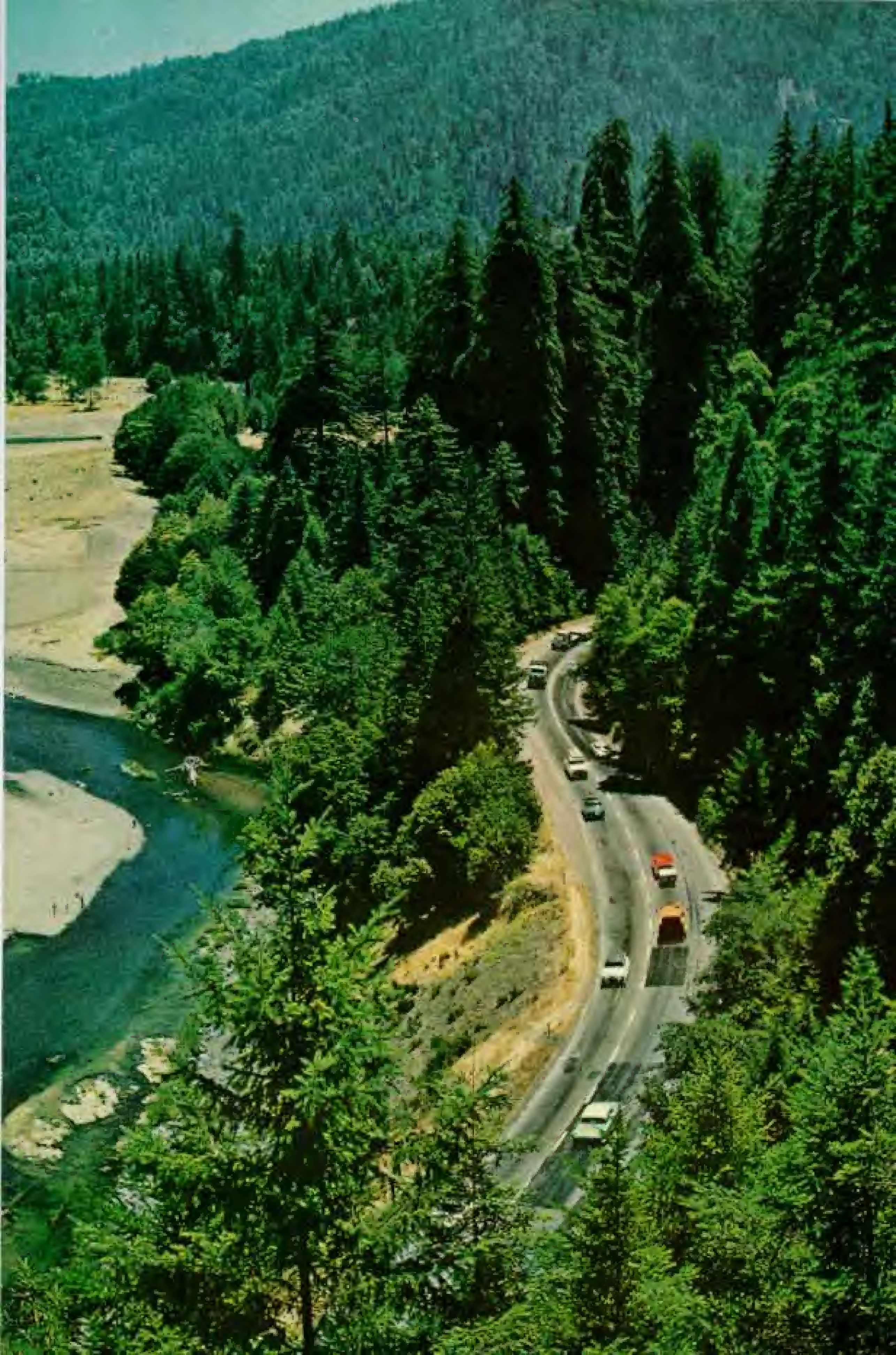
I recalled what Lowell Hagood had told me in Orick about those trees. He, too, had described them as "great timber." Lowell had never seen the trees himself, but he knew logging lore. He had pointed to dense ridges rising like walls east of town: "The valley behind that ridge is real virgin country. Too bad there's no road."

But now, as a result of my trip with Casey, I knew there *was* a road. Curiosity gnawed as I prepared for my first lone visit to the valley of Redwood Creek.

The sun was shining brightly that October day as I drove eastward off U. S. Highway 101 (map, page 16). About ten miles inland, the road descended into the valley; Redwood Creek flowed northward, bright and blue. I parked by the stream's gravelly bed and took my bearings. Rising several hundred feet to the left was a ridge recently logged. To the right, eastward beyond the stream as far as eye could see, lay a forest of virgin redwood, towering, richly dense (foldout, pages 2-4).

Rain had been sparse, and the creek at this point was only knee deep and 100 feet across. The tracks of elk, deer, and even bear were scattered along the water's edge, and fighting to get upstream against the rapids were several big steelhead trout. To complete the picture of authentic wilderness, a flock of merganser ducks sped low over the water, veering sharply as they saw me.

I hiked half a mile or so downstream, then



back, wading when necessary. At one point where the stream seemed shallowest, I forded it to enter the woods. I was immediately enveloped by deep shade. Massive trunks crowded round me as I moved over a centuries-old accumulation of forest litter. There was no sound, except for my own almost inaudible footfalls.

Columns Loom on Every Side

I stopped in a small clearing and, pivoting slowly, counted the number of great trees visible from that single spot: 30 with trunks at least ten feet in diameter, some perhaps 14, even 16 feet. From my earlier vantage point across the creek, I had seen that they were sky-piercingly tall—just how tall I had no idea. But I determined to find out.

On my next visit to this spot I brought an Abney level, a small sighting instrument for determining the height of anything, from a tree to a skyscraper. To be sure, figures indicated by this simple device are only approximate, but they are useful in preliminary measurement. For absolute precision, a surveyor's transit, chain, and book of tables are, of course, essential.

On the 12th of October, anyone hovering in a helicopter over Redwood Creek Valley about seven miles southeast of Orick would have seen a lone man there on the gravel bars, pounding in stakes, attaching twine, sighting through an instrument, wading the stream, disappearing into the woods, reappearing, writing in a notebook—then repeating the whole routine at other points along the stream. I had already spotted at least half a dozen trees that should be among the tallest in California's Redwood Empire.

But in a redwood forest, one's senses play strange tricks. Scale and comparisons are missing, and it is hazardous to guess tree height without the support of an instrument. My Abney figures indicated that some of the spires rising there on the flat before me, as well as some farther downstream, were about 320 feet high; several were of the order of 335 feet; and one even seemed to reach 350 feet—still nearly ten feet short of the great tree in Rockefeller Forest, then thought to be a record 359.5 feet high.

Even so, this was a forest I devoutly hoped would never hear the ring of an ax.

I returned to the spot again and again. Then one afternoon I set out to climb the partially logged ridge west of the stream, hoping to make some pictures to document the little-known grove. The going was not easy, what with the steep incline, the stumps, brambles, and logging debris. Every so often I turned to photograph the great grove to the east where the trees stood so tall. Finally, when I had climbed about 300 feet above the valley floor, I felt tired. Fortunately, I decided to sit down—otherwise I might have missed the discovery altogether.

Record Tree Soars Above Rivals

While catching my breath, I scanned the treetops before me—then suddenly started. One particular redwood rose above the others like a giant candle. I had already measured its companions—all of them about 320 feet tall. But this great tree stood somewhat inland—and that explained my missing it earlier. From the stream it had looked no taller than its neighbors. Hastily I sketched its position on a piece of paper, then hurried down the bank to get my level and measuring line.

I tried to take careful readings but ran at once into difficulties. In triangulating with an Abney level, it is essential to take an accurate measure of the distance from one's sighting position to the tree's base. For this job I had a 300-foot length of heavy twine. I attached one end to the trunk, then stretched it taut across Redwood Creek to a stake on the far bank. Naturally, the twine got soaked in the stream. Had this changed its length?

After several readings from different points, I came to an astonishing figure. Much as I wanted to believe my rough computation, I

Traffic Curves Into Lofty Arcades of Greenery Along the Eel River

For 400 miles in California, U. S. 101 bears the name Redwood Highway. The route often tunnels among trees so tall and dense they cloak the roadway in twilight, even at midday. Here traffic flows below Inspiration Point in Richardson Grove State Park.

Proposed freeways through redwood country pose a threat to publicly owned groves, notably this and Prairie Creek State Park. Governor Edmund G. (Pat) Brown, a champion of the trees, has declared: "As long as I am Governor in California, none of the state's redwood groves will be destroyed or cut down in order to build freeways."

Measurement of colossi calls for a team

BESIDE the chill current of Redwood Creek, pipe-smoking Dr. Zahl and Paul Fritz (right) of the National Park Service pull a rubber raft across the stream. Rodman William L. Hebard (left) uses a two-way radio to discuss the proper placement of his surveyor's rod.

Holding steel tape taut, Jarrold B. Cone establishes his base line from a tree to a sighting point. By establishing a triangle, the men determine the big tree's height. Cone's red ribbon will mark a surveyor's stake.

Leaning Tower of Pisa would rise just above the mid-point of the sixth tallest tree, a 352.3-foot pillar seen in the center of the page opposite.

Planting time: Helicopter pilot Robert Griffith whirls above redwoods en route to his low-flying job of broadcasting redwood, Douglas fir, and spruce seeds over a lumber company's tree farm.

Douglas fir seeds, treated with rodent repellent, will drop onto logged redwood lands that require a quick cover to hold the soil. Redwoods grow more slowly, but the two thrive in mixed groves.

Copter swoops across a logged-out tract seeded three years previously. Many seedlings and sprouts have already reached five to six feet and in another five years will blanket the slope.

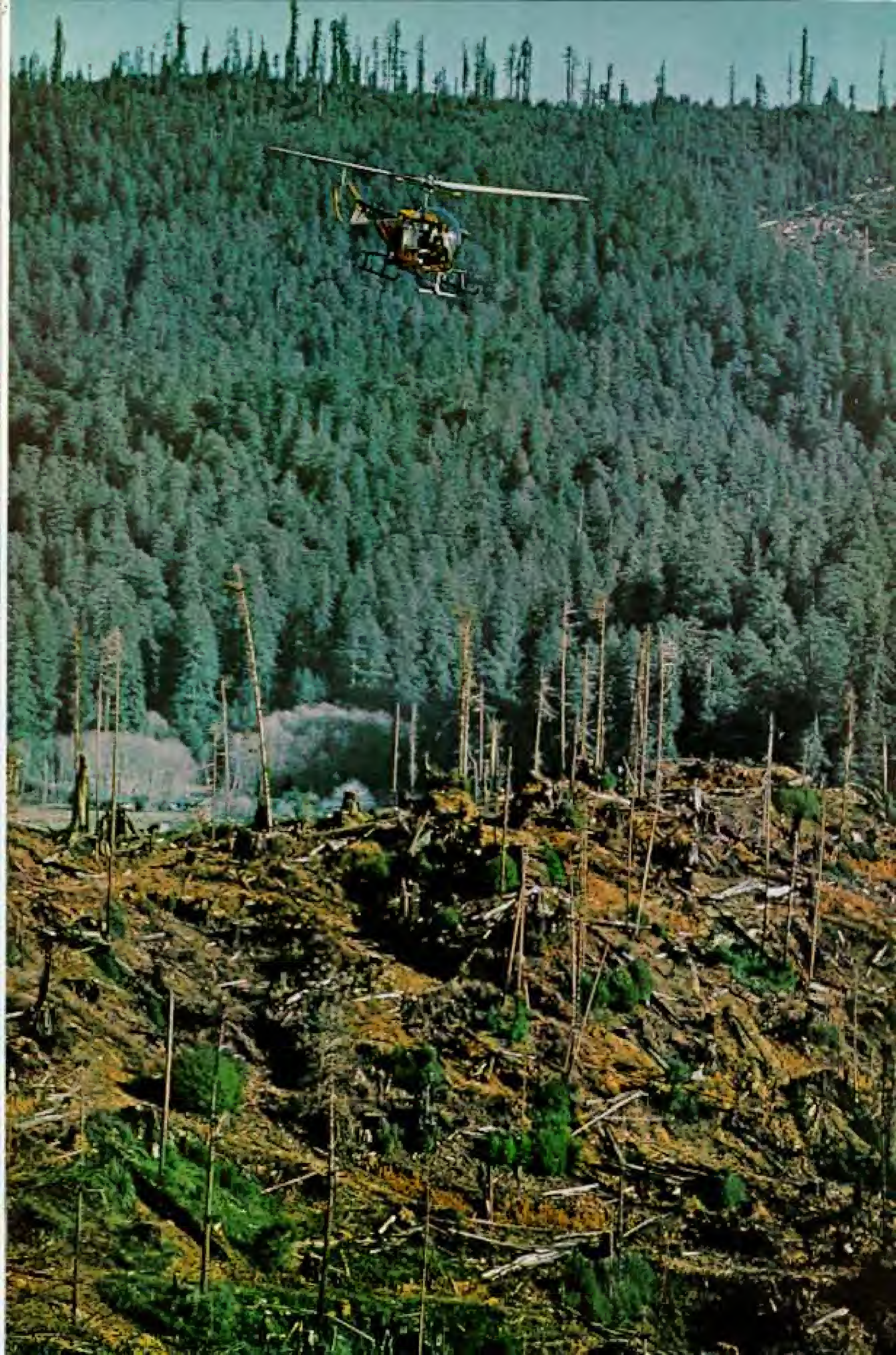
simply could not: According to the Abney level, this was easily the world's tallest known tree—about 370 feet!

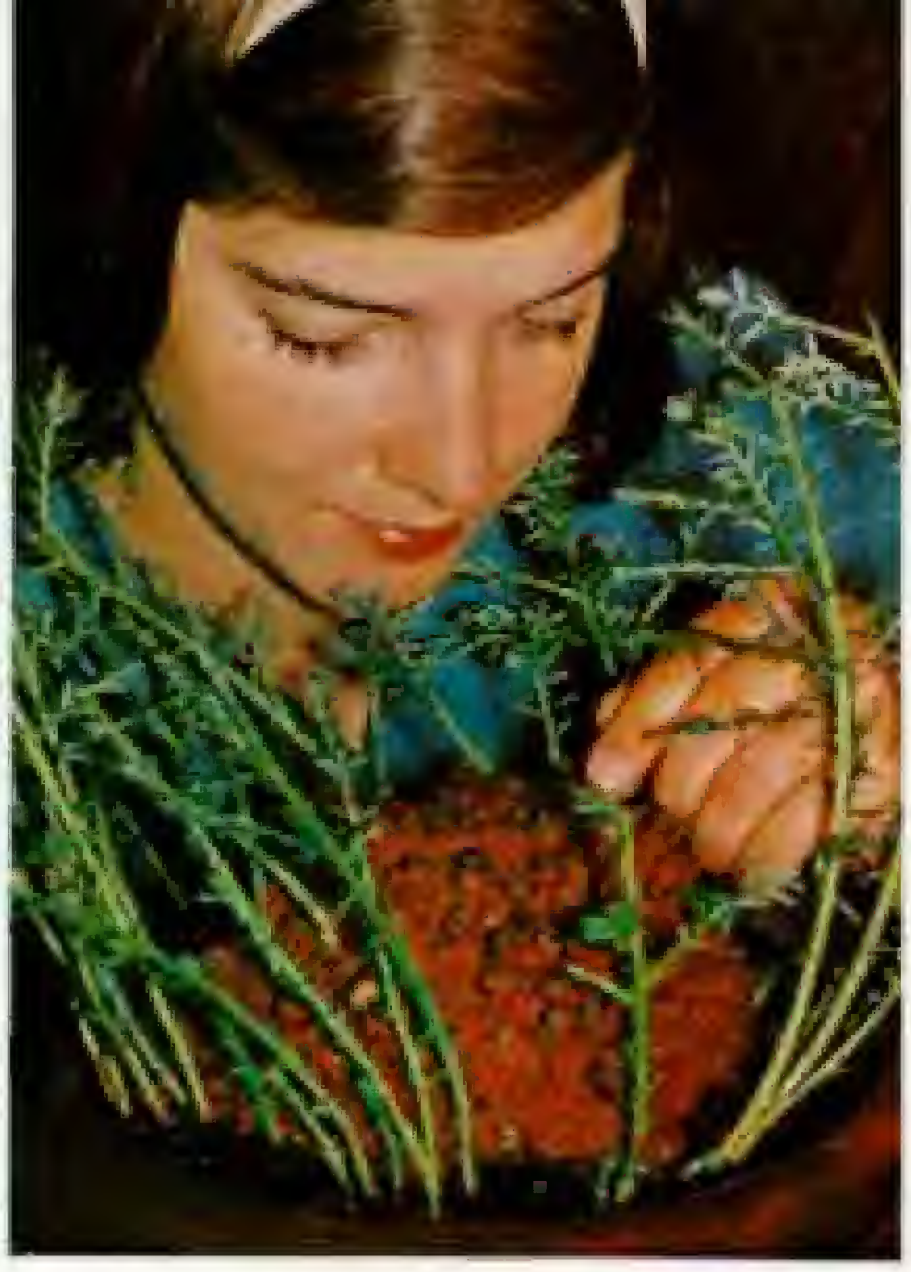
My misgivings increased when I drew a tape around the massive trunk. Four and a half feet above the ground, where circumference is measured, the tape showed 44 feet —and several trees in this very grove had a greater girth (pages 10-11).

I stepped back and sighted straight up the trunk. It was a strange-looking tree. About 14 feet above ground, the trunk divided into two spires, one rising perhaps 250 feet, the other soaring far higher. For symmetrical beauty, this tree was not queen of the forest, yet this specimen—for reasons known only to nature—had shot up through the woods and left its thicker, sleeker brothers far behind.

Why had no one bothered to measure it before? It had been accessible only to loggers and timber cruisers, men more interested in the board-foot content than in records of height. Furthermore, any logger or early trapper could only have noticed this tree's towering nature from the high, opposite hillside.

I took other readings. Each came close to the same 370 feet. True, my level could give only approximate height; and possibly the creek water had affected my measuring twine. But even allowing for a wide margin of error, I was convinced that this redwood must be a contender for the title of the tallest tree.





Feathery shoots of a burl tickle the chin of Eda Kristin Zahl. Planted burls can become giant-size trees.

Like crocuses popping up in spring, redwood sprouts grow from a burl that Dr. Zahl soaked in water for three weeks.

Bushy seedling, less than a year old, grows in wet humus.

There was only one thing to do. I would hire professional surveyors to check my figures. And so, representatives of Kleiner and Nilson of Arcata, California, and the Reed Engineering Company of Eureka, came to the creek bottom. Their findings were by no means final: a slight lean of the tree would have to be reckoned for, along with a correction for base-line angle. But perhaps my own early measurements were not too far afield.

With growing excitement, I met Chet Brown in the lobby of his Eureka motel. Handing him the sheet of preliminary figures, I watched him read. He whistled softly.

Next day, Chet accompanied me back into the valley where we spent the day inspecting various trees I had singled out. Within just a few acres we counted more than a hundred

New generation, growing from stumps, replaces a grove logged 20 years ago. Beyond blossoming spikes of fireweed, a jagged snag testifies to fire which foresters believe occurred three and a half centuries earlier.

Wire-mesh trap collects the natural fall of redwood seeds. Thus foresters can estimate the number of offspring likely to result. Chuck Bender and the author's son count seeds in a trap set on a sprouting stump to prevent curious elk from trampling it.

giants ten feet or more in diameter—most of them at least 300 feet high. In this grove of giants there might be other trees even taller than the contender I had found.

I was unable to join Chet when he and associates Paul Fritz and Richard Vouse went back to the grove for further study. They took Abney readings on other high trees and marked them for measurement by surveyors.

By this time I had called National Geographic Society headquarters with word of the spectacular grove. Melville Bell Grosvenor, the Society's President and Editor, responded with typical enthusiasm: He stepped aboard a California-bound plane so that he could be on hand the day the surveyors made final measurements.

The big, dynamic President of Arcata

Three swimmers get acquainted. Zahl children found the newt (*Taricha granulosa*) under a rock in glass-clear Eel River (page 56).

Green plumes of five-finger fern billow from perpendicular walls of Fern Canyon, near Prairie Creek Redwoods State Park. The canyon carries runoff from some 100 inches of rain in winter. The Save-the-Redwoods League hopes to preserve this green bower.

Sandy calling cards, footprints of a black bear and her cub lie near Redwood Creek within a hundred feet of the tallest tree. Seeds and cones sprinkle the ground.

Redwood Company, Howard A. Libbey, had a similar reaction. Grinning broadly, he placed long-distance calls to timberlands manager Harry W. Wier and the company's chief forester, Gene Hofsted.

"I've just heard we've got some very tall trees on our property," he said. "We're going out for a look tomorrow. Try to be here."

Surveyors Tackle a Difficult Task

With Chet and his Park Service colleagues, our party numbered 14 men—"Probably the largest crowd of palefaces ever assembled in this grove," someone observed.

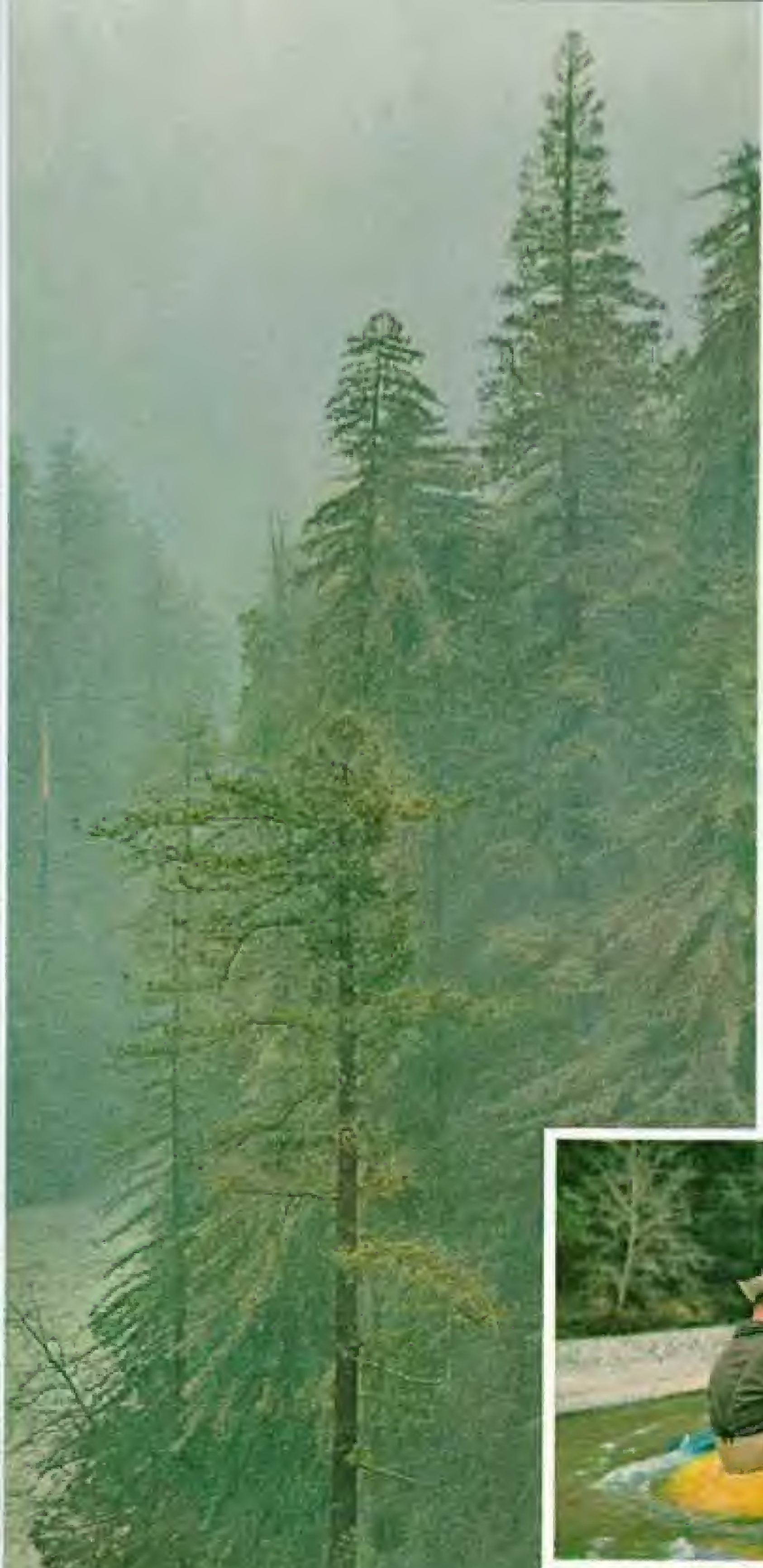
But on this particular day the most important members of our party were Oscar G. Larson, a surveyor for Arcata, and the surveyors I had retained earlier. We were asking these men to perform a difficult task: to measure accurately some of the world's tallest trees, to arrive at precise figures, and to issue a joint affidavit.

Each surveyor had his professional pride and reputation at stake. Chet and I felt even more personally involved. Would these trees really be close contenders—or champions?

It was a slow, careful process. The surveyors sighted treetops, read angles, measured base lines, consulted books of tables—and then went through the whole procedure again. Finally, the three men compared their computations—and the figures agreed.

Giants Sweep Win, Place, and Show

Their agreement would completely change the tree world's hall of fame. The four tallest trees in this grove—as attested by the surveyors' jointly signed statement—showed heights of 367.8 feet, 367.4 feet, 364.3 feet, and 352.3 feet. These trees would rank as the first, second, third, and sixth tallest living things known on earth (list, page 16).



London's Big Ben would fall short of the second tallest tree, 367.4 feet high.

Rain-drenched second tallest tree spears above its companions. Redwood Creek surges through a misty canyon of green.

Leafy crown in this air view hides the monumental trunk of the second tallest tree (center). Far below, a yellow raft lies beached beside Redwood Creek.

Riding the current, Paul Fritz and the author splash downstream to the highway near Orick. The voyage gave them a chance to appraise other groves along Redwood Creek.

Running salmon lure shoals of fishermen

IN BLUE-GRAY MIST on an August morning, anglers flock to the Klamath River, only 20 miles from the newly explored redwood grove. Salmon and steelhead trout by the hundreds of thousands run the gantlet to upstream spawning grounds. At the run's height, the small-boat fleet covers the river.

Regrowth redwoods on surrounding hillsides hide cabins of summer visitors, many escaping from the heat of California's central valley. Town of Klamath lies two and a half miles away, beyond the ridge at right.

Lucky angler, calling it a day, uses a hefty pole to carry his catch. Larger of the two Chinook salmon weighs about 40 pounds.

The second and third trees were among those that Chet and his men had pointed out. Less than five inches of height separated my find, the champion, from No. 2.

"Wouldn't it be marvelous," mused Dr. Grosvenor that evening, as some of us discussed the day's events, "if that grove could be preserved for the American people?"

That, of course, lay in the future. For the moment, Mr. Libbey of the Arcata Company had assured us that no lumbering would be done in this vicinity for an indefinite period.

Meantime, I had one more field trip to make. I had still not seen the seven miles of Redwood Creek downstream from the big grove. What if another champion lay just beyond the next bend of the creek?

With the announcement of a new world's record, I knew that other redwood enthusiasts would begin searching for a new and even taller champion. Perhaps quite soon someone would find a greater tree—and perhaps, down Redwood Creek, we ourselves might make that discovery.

"Has anyone ever gone down Redwood Creek by boat?" I asked Paul Fritz of the National Park Service.

"Not that I know of," he replied. In fact, old-timers had cautioned against such a trip. In wet weather, waters can rise suddenly and dangerously; we would also have to watch out for swirling rapids.

But what's the point in exploring if there aren't a few unknowns?

George Mobley, NATIONAL GEOGRAPHIC photographer, joined us on the bright, dry day when we set out in two inflated life rafts. On the first bend we learned how to use our little aluminum oars; we whirled like tops until we had the hang of it.

Paul Fritz shared my raft, and since he weighs somewhat more than 200 pounds, our gunwales were frequently awash. Thanks to the dry fall weather, the stream was at its seasonal low (page 46).

Walls of Green Form Canyon

We floated with the current down this evergreen canyon, sometimes becalmed in long stretches of slow water, sometimes whirled suddenly around hairpin bends into

swift rapids. Struggling with the ours, we managed to prevent swamping.

Twice we had to make portages. But the scenery lightened these mild difficulties. Alternately deep and narrow, wide and shallow, the creek carried us between sheer walls of towering redwoods, past broad flats rich with maple, oak, alder, and man-high bracken.

On a reconnaissance sortie ashore, we came upon one of the thickest trunks I had seen anywhere in the valley—almost 20 feet. But, alas, some years or decades back it had been snapped off clean 70 or 80 feet above the ground. What a tree that must have been!

During the greater part of our journey, as we drifted past line after line of redwood treasure, we saw no sign of human intrusion. This was certainly one of the few remaining

Sunset over the Pacific silhouettes a seed tree that loggers spared to start a new stand of redwoods.

Rolling mists nourish trees

Tongues of fleecy fog off the ocean fill the fingers of a valley north of Eureka. All up and down the Redwood Empire this scene repeats itself day after day. Mists blanket glades, drip from evergreen needles, and veil spiky branches. Largest stands of timber thrive where the fog prevails, suggesting that mist-borne moisture spurs coast redwood growth.

redwood wildernesses neither protected within public preserves nor yet scheduled for logging. If we saw no giants to challenge our new champions, we still saw some of the most extraordinary scenery in the world.

Paul Fritz was especially caught by it. A talented landscape architect, Paul knows what to do with extraordinary scenery. Once, when we pulled our rafts up on a gravel heap, I listened to him think aloud. He considered the planning that would be required to give access to the magnificent redwoods. He talked of the protection they would need.

"These are things we could do for the public," he said. "They should be able to view these trees forever."

I wondered whether those were words of prophecy. I hoped so. THE END