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## THE SEQUOIA

**T**HE Big Tree (*Sequoia gigantea*) is Nature's forest masterpiece, and, so far as I know, the greatest of living things. It belongs to an ancient stock, as its remains in old rocks show, and has a strange air of other days about it, a thoroughbred look inherited from the long ago — the auld lang syne of trees. Once the genus was common, and with many species flourished in the now desolate Arctic regions, in the interior of North America, and in Europe, but in long, eventful wanderings from climate to climate only two species have survived the hardships they had to encounter, the *gigantea* and *sempervirens*, the former now restricted to the western slopes of the Sierra, the other to the Coast Mountains, and both to California, excepting a few groves of redwood which extend into Oregon. The Pacific Coast in general is the paradise of conifers. Here nearly all of them are giants, and display a beauty and magnificence unknown elsewhere. The climate is mild, the ground never freezes, and moisture and sunshine abound all the year. Nevertheless it is not easy to account for the colossal size of the sequoias. The largest are about three hundred feet high and thirty feet in diameter. Who of all the dwellers of the plains and prairies and fertile home forests of round-headed oak and maple, hickory and elm, ever dreamed that earth could bear such growths, — trees

that the familiar pines and firs seem to know nothing about, lonely, silent, serene, with a physiognomy almost godlike; and so old, thousands of them still living had already counted their years by tens of centuries when Columbus set sail from Spain and were in the vigor of youth or middle age when the star led the Chaldean sages to the infant Saviour's cradle! As far as man is concerned they are the same yesterday, to-day, and forever, emblems of permanence.

No description can give any adequate idea of their singular majesty, much less of their beauty. Excepting the sugar pine, most of their neighbors with pointed tops seem to be forever shouting *Excelsior*, while the Big Tree, though soaring above them all, seems satisfied, its rounded head, poised lightly as a cloud, giving no impression of trying to go higher. Only in youth does it show like other conifers a heavenward yearning, keenly aspiring with a long quick-growing top. Indeed the whole tree for the first century or two, or until a hundred to a hundred and fifty feet high, is arrowhead in form, and, compared with the solemn rigidity of age, is as sensitive to the wind as a squirrel-tail. The lower branches are gradually dropped as it grows older, and the upper ones thinned out until comparatively few are left. These, however, are developed to great size, divide again and again, and terminate in bossy, rounded masses of leafy branchlets, while the head becomes dome-shaped. Then poised in fullness of strength and beauty, stern and solemn in mien, it glows with eager, enthusiastic life, quivering to the tip of every leaf and branch and far-reaching root, calm as a granite dome, the first to feel

the touch of the rosy beams of the morning, the last to bid the sun good-night.

Perfect specimens, unhurt by running fires or lightning, are singularly regular and symmetrical in general form, though not at all conventional, showing infinite variety in sure unity and harmony of plan. The immensely strong, stately shafts, with rich purplish-brown bark, are free of limbs for a hundred and fifty feet or so, though dense tufts of sprays occur here and there, producing an ornamental effect, while long parallel furrows give a fluted columnar appearance. It shoots forth its limbs with equal boldness in every direction, showing no weather side. On the old trees the main branches are crooked and rugged, and strike rigidly outward mostly at right angles from the trunk, but there is always a certain measured restraint in their reach which keeps them within bounds. No other Sierra tree has foliage so densely massed or outline so finely, firmly drawn and so obediently subordinate to an ideal type. A particularly knotty, angular, ungovernable-looking branch, five to eight feet in diameter and perhaps a thousand years old, may occasionally be seen pushing out from the trunk as if determined to break across the bounds of the regular curve, but like all the others, as soon as the general outline is approached the huge limb dissolves into massy bosses of branchlets and sprays, as if the tree were growing beneath an invisible bell-glass against the sides of which the branches were moulded, while many small, varied departures from the ideal form give the impression of freedom to grow as they like.

Except in picturesque old age, after being struck by

lightning and broken by a thousand snow-storms, this regularity of form is one of the Big Tree's most distinguishing characteristics. Another is the simple sculptural beauty of the trunk and its great thickness as compared with its height and the width of the branches, many of them being from eight to ten feet in diameter at a height of two hundred feet from the ground, and seeming more like finely modeled and sculptured architectural columns than the stems of trees, while the great strong limbs are like rafters supporting the magnificent domed head.

The root-system corresponds in magnitude with the other dimensions of the tree, forming a flat, far-reaching spongy network two hundred feet or more in width without any taproot, and the instep is so grand and fine, so suggestive of endless strength, it is long ere the eye is released to look above it. The natural swell of the roots, though at first sight excessive, gives rise to buttresses no greater than are required for beauty as well as strength, as at once appears when you stand back far enough to see the whole tree in its true proportions. The fineness of the taper of the trunk is shown by its thickness at great heights — a diameter of ten feet at a height of two hundred being, as we have seen, not uncommon. Indeed the boles of but few trees hold their thickness as well as sequoia. Resolute, consummate, determined in form, always beheld with wondering admiration, the Big Tree always seems unfamiliar, standing alone, unrelated, with peculiar physiognomy, awfully solemn and earnest. Nevertheless, there is nothing alien in its looks. The madrona, clad in thin, smooth, red and yellow

bark and big glossy leaves, seems, in the dark coniferous forests of Washington and Vancouver Island, like some lost wanderer from the magnolia groves of the South, while the sequoia, with all its strangeness, seems more at home than any of its neighbors, holding the best right to the ground as the oldest, strongest inhabitant. One soon becomes acquainted with new species of pine and fir and spruce as with friendly people, shaking their outstretched branches like shaking hands, and fondling their beautiful little ones; while the venerable aboriginal sequoia, ancient of other days, keeps you at a distance, taking no notice of you, speaking only to the winds, thinking only of the sky, looking as strange in aspect and behavior among the neighboring trees as would the mastodon or hairy elephant among the homely bears and deer. Only the Sierra juniper is at all like it, standing rigid and unconquerable on glacial pavements for thousands of years, grim, rusty, silent, uncommunicative, with an air of antiquity about as pronounced as that so characteristic of sequoia.

The bark of full-grown trees is from one to two feet thick, rich cinnamon-brown, purplish on young trees and shady parts of the old, forming magnificent masses of color with the underbrush and beds of flowers. Toward the end of winter the trees themselves bloom, while the snow is still eight or ten feet deep. The pistillate flowers are about three eighths of an inch long, pale green, and grow in countless thousands on the ends of the sprays. The staminate are still more abundant, pale yellow, a fourth of an inch long; and when the golden

pollen is ripe they color the whole tree and dust the air and the ground far and near.

The cones are bright grass-green in color, about two and a half inches long, one and a half wide, and are made up of thirty or forty strong, closely packed, rhomboidal scales with four to eight seeds at the base of each. The seeds are extremely small and light, being only from an eighth to a fourth of an inch long and wide, including a filmy surrounding wing, which causes them to glint and waver in falling and enables the wind to carry them considerable distances from the tree.

The faint lisp of snowflakes as they alight is one of the smallest sounds mortal can hear. The sound of falling sequoia seeds, even when they happen to strike on flat leaves or flakes of bark, is about as faint. Very different is the bumping and thudding of the falling cones. Most of them are cut off by the Douglas squirrel and stored for the sake of the seeds, small as they are. In the calm Indian summer these busy harvesters with ivory sickles go to work early in the morning, as soon as breakfast is over, and nearly all day the ripe cones fall in a steady pattering, bumping shower. Unless harvested in this way they discharge their seeds and remain on the trees for many years. In fruitful seasons the trees are fairly laden. On two small specimen branches one and a half and two inches in diameter I counted four hundred and eighty cones. No other California conifer produces nearly so many seeds, excepting perhaps its relative, the redwood of the Coast Mountains. Millions are ripened annually by a single tree, and the product of one of the main groves in a fruitful year

would suffice to plant all the mountain ranges of the world.

The dense tufted sprays make snug nesting places for birds, and in some of the loftiest, leafiest towers of verdure thousands of generations have been reared, the great solemn trees shedding off flocks of merry singers every year from nests, like the flocks of winged seeds from the cones.

The Big Tree keeps its youth far longer than any of its neighbors. Most silver firs are old in their second or third century, pines in their fourth or fifth, while the Big Tree growing beside them is still in the bloom of its youth, juvenile in every feature at the age of old pines, and cannot be said to attain anything like prime size and beauty before its fifteen hundredth year, or under favorable circumstances become old before its three thousandth. Many, no doubt, are much older than this. On one of the King's River giants, thirty-five feet and eight inches in diameter exclusive of bark, I counted upwards of four thousand annual wood-rings, in which there was no trace of decay after all these centuries of mountain weather. There is no absolute limit to the existence of any tree. Their death is due to accidents, not, as of animals, to the wearing out of organs. Only the leaves die of old age, their fall is foretold in their structure; but the leaves are renewed every year and so also are the other essential organs — wood, roots, bark, buds. Most of the Sierra trees die of disease. Thus the magnificent silver firs are devoured by fungi, and comparatively few of them live to see their three hundredth birth year. But nothing hurts the Big Tree. I never saw

one that was sick or showed the slightest sign of decay. It lives on through indefinite thousands of years until burned, blown down, undermined, or shattered by some tremendous lightning-stroke. No ordinary bolt ever seriously hurts sequoia. In all my walks I have seen only one that was thus killed outright. Lightning, though rare in the California lowlands, is common on the Sierra. Almost every day in June and July small thunderstorms refresh the main forest belt. Clouds like snowy mountains of marvelous beauty grow rapidly in the calm sky about midday and cast cooling shadows and showers that seldom last more than an hour. Nevertheless these brief, kind storms wound or kill a good many trees. I have seen silver firs two hundred feet high split into long peeled rails and slivers down to the roots, leaving not even a stump, the rails radiating like the spokes of a wheel from a hole in the ground where the tree stood. But the sequoia, instead of being split and slivered, usually has forty or fifty feet of its brash, knotty top smashed off in short chunks about the size of cord-wood, the beautiful rosy red ruins covering the ground in a circle a hundred feet wide or more. I never saw any that had been cut down to the ground or even to below the branches except one in the Stanislaus Grove, about twelve feet in diameter, the greater part of which was smashed to fragments, leaving only a leafless stump about seventy-five feet high. It is a curious fact that all the very old sequoias have lost their heads by lightning. "All things come to him who waits." But of all living things sequoia is perhaps the only one able to wait long enough to make sure of being struck by lightning.

Thousands of years it stands ready and waiting, offering its head to every passing cloud as if inviting its fate, praying for heaven's fire as a blessing; and when at last the old head is off, another of the same shape immediately begins to grow on. Every bud and branch seems excited, like bees that have lost their queen, and tries hard to repair the damage. Branches that for many centuries have been growing out horizontally at once turn upward and all their branchlets arrange themselves with reference to a new top of the same peculiar curve as the old one. Even the small subordinate branches halfway down the trunk do their best to push up to the top and help in this curious head-making.

The great age of these noble trees is even more wonderful than their huge size, standing bravely up, millennium in, millennium out, to all that fortune may bring them, triumphant over tempest and fire and time, fruitful and beautiful, giving food and shelter to multitudes of small fleeting creatures dependent on their bounty. Other trees may claim to be about as large or as old: Australian gums, Senegal baobabs, Mexican taxodiums, English yews, and venerable Lebanon cedars, trees of renown, some of which are from ten to thirty feet in diameter. We read of oaks that are supposed to have existed ever since the creation, but strange to say I can find no definite accounts of the age of any of these trees, but only estimates based on tradition and assumed average rates of growth. No other known tree approaches the sequoia in grandeur, height and thickness being considered, and none as far as I know has looked down on so many centuries or opens such im-

pressive and suggestive views into history. The majestic monument of the King's River Forest is, as we have seen, fully four thousand years old, and, measuring the rings of annual growth, we find it was no less than twenty-seven feet in diameter at the beginning of the Christian era, while many observations lead me to expect the discovery of others ten or twenty centuries older. As to those of moderate age, there are thousands, mere youths as yet, that —

"Saw the light that shone  
On Mahomet's uplifted crescent,  
On many a royal gilded throne  
And deed forgotten in the present,  
    . . . saw the age of sacred trees  
And Druid groves and mystic larches,  
And saw from forest domes like these  
The builder bring his Gothic arches."

Great trees and groves used to be venerated as sacred monuments and halls of council and worship. But soon after the discovery of the Calaveras Grove, one of the grandest trees was cut down for the sake of a stump! The laborious vandals had seen "the biggest tree in the world," then, forsooth, they must try to see the biggest stump and dance on it.

The growth in height for the first two centuries is usually at the rate of eight to ten inches a year. Of course all very large trees are old, but those equal in size may vary greatly in age on account of variations in soil, closeness or openness of growth, etc. Thus a tree about ten feet in diameter that grew on the side of a meadow was, according to my own count of the wood-

rings, only two hundred and fifty-nine years old at the time it was felled, while another in the same grove, of almost exactly the same size but less favorably situated, was fourteen hundred and forty years old. The Calaveras tree cut for a dance-floor was twenty-four feet in diameter and only thirteen hundred years old, another about the same size was a thousand years older.

The following sequoia notes and measurements are copied from my notebooks: —

Diameter.	Height in	Age.
Feet.	Feet.	Years.
0	1 3-4	7
0	5	20
0	5	41
0	6	66
0	6	39
0	8	29
0	11	71
1	0	71
3	2	260
6	0	240
7	3	339
7	3	506
7	6	493
7	7	424
9	0	259
9	3	280
10	6	1440
12		1825 <sup>1</sup>
15		2150 <sup>2</sup>
24		1300
25		2300
35	8 inside bark	over 4000

<sup>1</sup> 6 feet in diameter at height of 200 feet.

<sup>2</sup> 7 feet in diameter at height of 200 feet.

Little, however, is to be learned in confused, hurried tourist trips, spending only a poor noisy hour in a branded grove with a guide. You should go looking and listening alone on long walks through the wild forests and groves in all the seasons of the year. In the spring the winds are balmy and sweet, blowing up and down over great beds of chaparral and through the woods now rich in softening balsam and rosin and the scent of steaming earth. The sky is mostly sunshine, oftentimes tempered by magnificent clouds, the breath of the sea built up into new mountain ranges, warm during the day, cool at night, good flower-opening weather. The young cones of the Big Trees are showing in clusters, their flower time already past, and here and there you may see the sprouting of their tiny seeds of the previous autumn, taking their first feeble hold of the ground and unpacking their tender whorls of cotyledon leaves. Then you will naturally be led on to consider their wonderful growth up and up through the mountain weather, now buried in snow, bent and crinkled, now straightening in summer sunshine like uncoiling ferns, shooting eagerly aloft in youth's joyful prime, and towering serene and satisfied through countless years of calm and storm, the greatest of plants and all but immortal.

Under the huge trees up come the small plant people, putting forth fresh leaves and blossoming in such profusion that the hills and valleys would still seem gloriously rich and glad were all the grand trees away. By the side of melting snowbanks rise the crimson sarcodes, round-topped and massive as the sequoias themselves, and beds of blue violets and larger yellow ones with

leaves curiously lobed; azalea and saxifrage, daisies and lilies on the mossy banks of the streams; and a little way back of them, beneath the trees and on sunny spots on the hills around the groves, wild rose and rubus, spiræa and ribes, mitella, tiarella, campanula, monardella, forget-me-not, etc., many of them as worthy of lore-immortality as the famous Scotch daisy, wanting only a Burns to sing them home to all hearts.

In the midst of this glad plant work the birds are busy nesting, some singing at their work, some silent, others, especially the big pileated woodpeckers, about as noisy as backwoodsmen building their cabins. Then every bower in the groves is a bridal bower, the winds murmur softly overhead, the streams sing with the birds, while from far-off waterfalls and thunder-clouds come deep rolling organ notes.

In summer the days go by in almost constant brightness, cloudless sunshine pouring over the forest roof, while in the shady depths there is the subdued light of perpetual morning. The new leaves and cones are growing fast and make a grand show, seeds are ripening, young birds learning to fly, and myriads of insects glad as birds keeping the air whirling, joy in every wing-beat, their humming and singing blending with the gentle ah-ing of the winds; while at evening every thicket and grove is enchanted by the tranquil chirping of the blessed hylas, the sweetest and most peaceful of sounds, telling the very heart-joy of earth as it rolls through the heavens.

In the autumn the sighing of the winds is softer than ever, the gentle ah-ah-ing filling the sky with a fine uni-



versal mist of music, the birds have little to say, and there is no appreciable stir or rustling among the trees save that caused by the harvesting squirrels. Most of the seeds are ripe and away, those of the trees mottling the sunny air, glinting, glancing through the midst of the merry insect people, rocks and trees, everything alike drenched in gold light, heaven's colors coming down to the meadows and groves, making every leaf a romance, air, earth, and water in peace beyond thought, the great brooding days opening and closing in divine psalms of color.

Winter comes suddenly, arrayed in storms, though to mountaineers silky streamers on the peaks and the tones of the wind give sufficient warning. You hear strange whisperings among the tree-tops, as if the giants were taking counsel together. One after another, nodding and swaying, calling and replying, spreads the news, until all with one accord break forth into glorious song, welcoming the first grand snow-storm of the year, and looming up in the dim clouds and snowdrifts like lighthouse towers in flying scud and spray. Studying the behavior of the giants from some friendly shelter, you will see that even in the glow of their wildest enthusiasm, when the storm roars loudest, they never lose their godlike composure, never toss their arms or bow or wave like the pines, but only slowly, solemnly nod and sway, standing erect, making no sign of strife, none of rest, neither in alliance nor at war with the winds, too calmly, unconsciously noble and strong to strive with or bid defiance to anything. Owing to the density of the leafy branchlets and great breadth of head the Big

Tree carries a much heavier load of snow than any of its neighbors, and after a storm, when the sky clears, the laden trees are a glorious spectacle, worth any amount of cold camping to see. Every bossy limb and crown is solid white, and the immense height of the giants becomes visible as the eye travels the white steps of the colossal tower, each relieved by a mass of blue shadow.

In midwinter the forest depths are as fresh and pure as the crevasses and caves of glaciers. Grouse, nut-hatches, a few woodpeckers, and other hardy birds dwell in the groves all winter, and the squirrels may be seen every clear day frisking about, lively as ever, tunneling to their stores, never coming up empty-mouthed, diving in the loose snow about as quickly as ducks in water, while storms and sunshine sing to each other.

One of the noblest and most beautiful of the late winter sights is the blossoming of the Big Trees like gigantic goldenrods and the sowing of their pollen over all the forest and the snow-covered ground — a most glorious view of Nature's immortal virility and flower-love.

One of my own best excursions among the sequoias was made in the autumn of 1875, when I explored the then unknown or little known sequoia region south of the Mariposa Grove for comprehensive views of the belt, and to learn what I could of the peculiar distribution of the species and its history in general. In particular I was anxious to try to find out whether it had ever been more widely distributed since the glacial period; what conditions favorable or otherwise were affecting it; what were its relations to climate, topo-

graphy, soil, and the other trees growing with it, etc.; and whether, as was generally supposed, the species was nearing extinction. I was already acquainted in a general way with the northern groves, but excepting some passing glimpses gained on excursions into the high Sierra about the headwaters of King's and Kern rivers I had seen nothing of the south end of the belt.

Nearly all my mountaineering has been done on foot, carrying as little as possible, depending on camp-fires for warmth, that so I might be light and free to go wherever my studies might lead. On this sequoia trip, which promised to be long, I was persuaded to take a small wild mule with me to carry provisions and a pair of blankets. The friendly owner of the animal, having noticed that I sometimes looked tired when I came down from the peaks to replenish my bread sack, assured me that his "little Brownie mule" was just what I wanted, tough as a knot, perfectly untirable, low and narrow, just right for squeezing through brush, able to climb like a chipmunk, jump from boulder to boulder like a wild sheep, and go anywhere a man could go. But tough as he was and accomplished as a climber, many a time in the course of our journey when he was jaded and hungry, wedged fast in rocks or struggling in chaparral like a fly in a spiderweb, his troubles were sad to see, and I wished he would leave me and find his way home alone.

We set out from Yosemite about the end of August, and our first camp was made in the well-known Mariposa Grove. Here and in the adjacent pine woods I spent nearly a week, carefully examining the boundaries

of the grove for traces of its greater extension without finding any. Then I struck out into the majestic trackless forest to the southeastward, hoping to find new groves or traces of old ones in the dense silver fir and pine woods about the head of Big Creek, where soil and climate seemed most favorable to their growth, but not a single tree or old monument of any sort came to light until I climbed the high rock called Wamellow by the Indians. Here I obtained telling views of the fertile forest-filled basin of the upper Fresno. Innumerable spires of the noble yellow pine were displayed rising above one another on the braided slopes, and yet nobler sugar pines with superb arms outstretched in the rich autumn light, while away toward the southwest, on the verge of the glowing horizon, I discovered the majestic domelike crowns of Big Trees towering high over all, singly and in close grove congregations. There is something wonderfully attractive in this king tree, even when beheld from afar, that draws us to it with indescribable enthusiasm; its superior height and massive smoothly rounded outlines proclaiming its character in any company; and when one of the oldest attains full stature on some commanding ridge it seems the very god of the woods. I ran back to camp, packed Brownie, steered over the divide and down into the heart of the Fresno Grove. Then, choosing a camp on the side of a brook where the grass was good, I made a cup of tea, and set off free among the brown giants, glorying in the abundance of new work about me. One of the first special things that caught my attention was an extensive landslide. The ground on the side of a stream had given way

to a depth of about fifty feet and with all its trees had been launched into the bottom of the stream ravine. Most of the trees — pines, firs, incense cedar, and sequoia — were still standing erect and uninjured, as if unconscious that anything out of the common had happened. Tracing the ravine alongside the avalanche, I saw many trees whose roots had been laid bare, and in one instance discovered a sequoia about fifteen feet in diameter growing above an old prostrate trunk that seemed to belong to a former generation. This slip had occurred seven or eight years ago, and I was glad to find that not only were most of the Big Trees uninjured, but many companies of hopeful seedlings and saplings were growing confidently on the fresh soil along the broken front of the avalanche. These young trees were already eight or ten feet high, and were shooting up vigorously, as if sure of eternal life, though young pines, firs, and libocedrus were running a race with them for the sunshine with an even start. Farther down the ravine I counted five hundred and thirty-six promising young sequoias on a bed of rough, bouldery soil not exceeding two acres in extent.

The Fresno Big Trees covered an area of about four square miles, and while wandering about surveying the boundaries of the grove, anxious to see every tree, I came suddenly on a handsome log cabin, richly embowered and so fresh and unweathered it was still redolent of gum and balsam like a newly felled tree. Strolling forward, wondering who could have built it, I found an old, weary-eyed, speculative, gray-haired man on a bark stool by the door, reading a book. The discovery

of his hermitage by a stranger seemed to surprise him, but when I explained that I was only a tree-lover sauntering along the mountains to study sequoia, he bade me welcome, made me bring my mule down to a little slanting meadow before his door and camp with him, promising to show me his pet trees and many curious things bearing on my studies.

After supper, as the evening shadows were falling, the good hermit sketched his life in the mines, which in the main was like that of most other pioneer gold-hunters — a succession of intense experiences full of big ups and downs like the mountain topography. Since “’49” he had wandered over most of the Sierra, sinking innumerable prospect holes like a sailor making soundings, digging new channels for streams, sifting gold-sprinkled boulder and gravel beds with unquenchable energy, life’s noon the meanwhile passing unnoticed into late afternoon shadows. Then, health and gold gone, the game played and lost, like a wounded deer creeping into this forest solitude, he awaits the sundown call. How sad the undertones of many a life here, now the noise of the first big gold battles has died away! How many interesting wrecks lie drifted and stranded in hidden nooks of the gold region! Perhaps no other range contains the remains of so many rare and interesting men. The name of my hermit friend is John A. Nelder, a fine, kind man, who in going into the woods has at last gone home; for he loves nature truly, and realizes that these last shadowy days with scarce a glint of gold in them are the best of all. Birds, squirrels, plants get loving, natural recognition, and delightful it

was to see how sensitively he responded to the silent influences of the woods. His eyes brightened as he gazed on the trees that stand guard around his little home; squirrels and mountain quail came to his call to be fed, and he tenderly stroked the little snow-bent sapling sequoias, hoping they yet might grow straight to the sky and rule the grove. One of the greatest of his trees stands a little way back of his cabin, and he proudly led me to it, bidding me admire its colossal proportions and measure it to see if in all the forest there could be another so grand. It proved to be only twenty-six feet in diameter, and he seemed distressed to learn that the Mariposa Grizzly Giant was larger. I tried to comfort him by observing that his was the taller, finer formed, and perhaps the more favorably situated. Then he led me to some noble ruins, remnants of gigantic trunks of trees that he supposed must have been larger than any now standing, and though they had lain on the damp ground exposed to fire and the weather for centuries, the wood was perfectly sound. Sequoia timber is not only beautiful in color — rose-red when fresh — and as easily worked as pine, but it is almost absolutely unperishable. Build a house of Big Tree logs on granite and that house will last about as long as its foundation. Indeed fire seems to be the only agent that has any appreciable effect on it. From one of these ancient trunk-remnants I cut a specimen of the wood, which in neither color, strength, nor soundness could be distinguished from specimens cut from living trees, although it had certainly lain on the damp forest floor for more than three hundred and eighty years, probably more than

thrice as long. The time in this instance was determined as follows: When the tree from which the specimen was derived fell, it sunk itself into the ground, making a ditch about two hundred feet long and five or six feet deep; and in the middle of this ditch, where a part of the fallen trunk had been burned, a silver fir four feet in diameter and three hundred and eighty years old was growing, showing that the sequoia trunk had lain on the ground three hundred and eighty years plus the unknown time that it lay before the part whose place had been taken by the fir was burned out of the way, and that which had elapsed ere the seed from which the monumental fir sprang fell into the prepared soil and took root. Now because sequoia trunks are never wholly consumed in one forest fire and these fires recur only at considerable intervals, and because sequoia ditches, after being cleared, are often left unplanted for centuries, it becomes evident that the trunk-remnant in question may have been on the ground a thousand years or more. Similar vestiges are common, and together with the root-bowls and long straight ditches of the fallen monarchs, throw a sure light back on the post-glacial history of the species, bearing on its distribution. One of the most interesting features of this grove is the apparent ease and strength and comfortable independence in which the trees occupy their place in the general forest. Seedlings, saplings, young and middle-aged trees are grouped promisingly around the old patriarchs, betraying no sign of approach to extinction. On the contrary, all seem to be saying, "Everything is to our mind and we mean to live forever." But, sad to tell,

a lumber company was building a large mill and flume near by, assuring widespread destruction.

In the cones and sometimes in the lower portion of the trunk and roots there is a dark gritty substance which dissolves readily in water and yields a magnificent purple color. It is a strong astringent, and is said to be used by the Indians as a big medicine. Mr. Nelder showed me specimens of ink he had made from it, which I tried and found good, flowing freely and holding its color well. Indeed everything about the tree seems constant. With these interesting trees, forming the largest of the northern groves, I stopped only a week, for I had far to go before the fall of the snow. The hermit seemed to cling to me and tried to make me promise to winter with him after the season's work was done. Brownie had to be got home, however, and other work awaited me, therefore I could only promise to stop a day or two on my way back to Yosemite and give him the forest news.

The next two weeks were spent in the wide basin of the San Joaquin, climbing innumerable ridges and surveying the far-extending sea of pines and firs. But not a single sequoia crown appeared among them all, nor any trace of a fallen trunk, until I had crossed the south divide of the basin, opposite Dinky Creek, one of the northmost tributaries of King's River. On this stream there is a small grove, said to have been discovered a few years before my visit by two hunters in pursuit of a wounded bear. Just as I was fording one of the branches of Dinky Creek I met a shepherd, and when I asked him whether he knew anything about the

Big Trees of the neighborhood he replied, "I know all about them, for I visited them only a few days ago and pastured my sheep in the grove." He was fresh from the East, and as this was his first summer in the Sierra I was curious to learn what impression the sequoias had made on him. When I asked whether it was true that the Big Trees were really so big as people say, he warmly replied, "Oh, yes, sir, you bet. They're whales. I never used to believe half I heard about the awful size of California trees, but they're monsters and no mistake. One of them over here, they tell me, is the biggest tree in the whole world, and I guess it is, for it's forty foot through and as many good long paces around." He was very earnest, and in fullness of faith offered to guide me to the grove that I might not miss seeing this biggest tree. A fair measurement four feet from the ground, above the main swell of the roots, showed a diameter of only thirty-two feet, much to the young man's disgust. "Only thirty-two feet," he lamented, "only thirty-two, and I always thought it was forty!" Then with a sigh of relief, "No matter, that's a big tree, anyway; no fool of a tree, sir, that you can cut a plank out of thirty feet broad, straight-edged, no bark, all good wood, sound and solid. It would make the brag white pine planks from old Maine look like laths." A good many other fine specimens are distributed along three small branches of the creek, and I noticed several thrifty moderate-sized sequoias growing on a granite ledge, apparently as independent of deep soil as the pines and firs, clinging to seams and fissures and sending their roots far abroad in search of moisture.

The creek is very clear and beautiful, gliding through tangles of shrubs and flower-beds, gay bee and butterfly pastures, the grove's own stream, pure sequoia water, flowing all the year, every drop filtered through moss and leaves and the myriad spongy rootlets of the giant trees. One of the most interesting features of the grove is a small waterfall with a flowery, ferny, clear brimming pool at the foot of it. How cheerily it sings the songs of the wilderness, and how sweet its tones! You seem to taste as well as hear them, while only the subdued roar of the river in the deep cañon reaches up into the grove, sounding like the sea and the winds. So charming a fall and pool in the heart of so glorious a forest good pagans would have consecrated to some lovely nymph.

Hence down into the main King's River cañon, a mile deep, I led and dragged and shoved my patient, much-enduring mule through miles and miles of gardens and brush, fording innumerable streams, crossing savage rock-slopes and taluses, scrambling, sliding through gulches and gorges, then up into the grand sequoia forests of the south side, cheered by the royal crowns displayed on the narrow horizon. In a day and a half we reached the sequoia woods in the neighborhood of the old Thomas Mill Flat. Thence striking off north-eastward I found a magnificent forest nearly six miles long by two in width, composed mostly of Big Trees, with outlying groves as far east as Boulder Creek. Here five or six days were spent, and it was delightful to learn from countless trees, old and young, how comfortably they were settled down in concordance with climate and soil and their noble neighbors.

Imbedded in these majestic woods there are numerous meadows, around the sides of which the Big Trees press close together in beautiful lines, showing their grandeur openly from the ground to their domed heads in the sky. The young trees are still more numerous and exuberant than in the Fresno and Dinky groves, standing apart in beautiful family groups, or crowding around the old giants. For every venerable lightning-stricken tree, there is one or more in all the glory of prime, and for each of these, many young trees and crowds of saplings. The young trees express the grandeur of their race in a way indefinable by any words at my command. When they are five or six feet in diameter and a hundred and fifty feet high, they seem like mere baby saplings as many inches in diameter, their juvenile habit and gestures completely veiling their real size, even to those who, from long experience, are able to make fair approximation in their measurements of common trees. One morning I noticed three airy, spiry, quick-growing babies on the side of a meadow, the largest of which I took to be about eight inches in diameter. On measuring it, I found to my astonishment it was five feet six inches in diameter, and about a hundred and forty feet high.

On a bed of sandy ground fifteen yards square, which had been occupied by four sugar pines, I counted ninety-four promising seedlings, an instance of Sequoia gaining ground from its neighbors. Here also I noted eighty-six young sequoias from one to fifty feet high on less than half an acre of ground that had been cleared and prepared for their reception by fire. This was a small bay

burned into dense chaparral, showing that fire, the great destroyer of tree life, is sometimes followed by conditions favorable for new growths. Sufficient fresh soil, however, is furnished for the constant renewal of the forest by the fall of old trees without the help of any other agent, — burrowing animals, fire, flood, landslide, etc., — for the ground is thus turned and stirred as well as cleared, and in every roomy, shady hollow beside the walls of upturned roots many hopeful seedlings spring up.

The largest, and as far as I know the oldest, of all the King's River trees that I saw is the majestic stump, already referred to, about a hundred and forty feet high, which above the swell of the roots is thirty-five feet and eight inches inside the bark, and over four thousand years old. It was burned nearly half through at the base, and I spent a day in chopping off the charred surface, cutting into the heart, and counting the wood-rings with the aid of a lens. I made out a little over four thousand without difficulty or doubt, but I was unable to get a complete count, owing to confusion in the rings where wounds had been healed over. Judging by what is left of it, this was a fine, tall, symmetrical tree nearly forty feet in diameter before it lost its bark. In the last sixteen hundred and seventy-two years the increase in diameter was ten feet. A short distance south of this forest lies a beautiful grove, now mostly included in the General Grant National Park. I found many shake-makers at work in it, access to these magnificent woods having been made easy by the old mill wagon-road. The Park is only two miles square, and the largest of its many fine

trees is the General Grant, so named before the date of my first visit, twenty-eight years ago, and said to be the largest tree in the world, though above the craggy bulging base the diameter is less than thirty feet. The Sanger Lumber Company owns nearly all the King's River groves outside the Park, and for many years the mills have been spreading desolation without any advantage.

One of the shake-makers directed me to an "old snag bigger 'n Grant." It proved to be a huge black charred stump thirty-two feet in diameter, the next in size to the grand monument mentioned above.

I found a scattered growth of Big Trees extending across the main divide to within a short distance of Hyde's Mill, on a tributary of Dry Creek. The mountain ridge on the south side of the stream was covered from base to summit with a most superb growth of Big Trees. What a picture it made! In all my wide forest wanderings I had seen none so sublime. Every tree of all the mighty host seemed perfect in beauty and strength, and their majestic domed heads, rising above one another on the mountain-slope, were most imposingly displayed, like a range of bossy upswelling cumulus clouds on a calm sky.

In this glorious forest the mill was busy, forming a sore, sad centre of destruction, though small as yet, so immensely heavy was the growth. Only the smaller and most accessible of the trees were being cut. The logs, from three to ten or twelve feet in diameter, were dragged or rolled with long strings of oxen into a chute and sent flying down the steep mountain-side to the mill

flat, where the largest of them were blasted into manageable dimensions for the saws. And as the timber is very brash, by this blasting and careless felling on uneven ground, half or three fourths of the timber was wasted.

I spent several days exploring the ridge and counting the annual wood-rings on a large number of stumps in the clearings, then replenished my bread sack and pushed on southward. All the way across the broad rough basins of the Kaweah and Tule rivers Sequoia ruled supreme, forming an almost continuous belt for sixty or seventy miles, waving up and down in huge massy mountain billows in compliance with the grand glacier-ploughed topography.

Day after day, from grove to grove, cañon to cañon, I made a long, wavering way, terribly rough in some places for Brownie, but cheery for me, for Big Trees were seldom out of sight. We crossed the rugged, picturesque basins of Redwood Creek, the North Fork of the Kaweah, and Marble Fork gloriously forested, and full of beautiful cascades and falls, sheer and slanting, infinitely varied with broad curly foam fleeces and strips of embroidery in which the sunbeams revel. Thence we climbed into the noble forest on the Marble and Middle Fork Divide. After a general exploration of the Kaweah basin, this part of the sequoia belt seemed to me the finest, and I then named it "the Giant Forest." It extends, a magnificent growth of giants grouped in pure temple groves, ranged in colonnades along the sides of meadows, or scattered among the other trees, from the granite headlands overlooking the hot foothills and plains of the San Joaquin back to within a few miles of

the old glacier fountains at an elevation of 5000 to 8400 feet above the sea.

When I entered this sublime wilderness the day was nearly done, the trees with rosy, glowing countenances seemed to be hushed and thoughtful, as if waiting in conscious religious dependence on the sun, and one naturally walked softly and awe-stricken among them. I wandered on, meeting nobler trees where all are noble, subdued in the general calm, as if in some vast hall pervaded by the deepest sanctities and solemnities that sway human souls. At sundown the trees seemed to cease their worship and breathe free. I heard the birds going home. I too sought a home for the night on the edge of a level meadow where there is a long, open view between the evenly ranked trees standing guard along its sides. Then after a good place was found for poor Brownie, who had had a hard, weary day sliding and scrambling across the Marble cañon, I made my bed and supper and lay on my back looking up to the stars through pillared arches finer far than the pious heart of man, telling its love, ever reared. Then I took a walk up the meadow to see the trees in the pale light. They seemed still more marvelously massive and tall than by day, heaving their colossal heads into the depths of the sky, among the stars, some of which appeared to be sparkling on their branches like flowers. I built a big fire that vividly illumined the huge brown boles of the nearest trees and the little plants and cones and fallen leaves at their feet, keeping up the show until I fell asleep to dream of boundless forests and trail-building for Brownie.



Joyous birds welcomed the dawn; and the squirrels, now their food cones were ripe and had to be quickly gathered and stored for winter, began their work before sunrise. My tea-and-bread-crumbs breakfast was soon done, and leaving jaded Brownie to feed and rest I sauntered forth to my studies. In every direction Sequoia ruled the woods. Most of the other big conifers were present here and there, but not as rivals or companions. They only served to thicken and enrich the general wilderness. Trees of every age cover craggy ridges as well as the deep moraine-soiled slopes, and plant their magnificent shafts along every brookside and meadow. Bogs and meadows are rare or entirely wanting in the isolated groves north of King's River; here there is a beautiful series of them lying on the broad top of the main dividing ridge, imbedded in the very heart of the mammoth woods as if for ornament, their smooth, plushy bosoms kept bright and fertile by streams and sunshine.

Resting awhile on one of the most beautiful of them when the sun was high, it seemed impossible that any other forest picture in the world could rival it. There lay the grassy, flowery lawn, three fourths of a mile long, smoothly outspread, basking in mellow autumn light, colored brown and yellow and purple, streaked with lines of green along the streams, and ruffled here and there with patches of ledum and scarlet vaccinium. Around the margin there is first a fringe of azalea and willow bushes, colored orange yellow, enlivened with vivid dashes of red cornel, as if painted. Then up spring the mighty walls of verdure three hundred feet high, the

brown fluted pillars so thick and tall and strong they seem fit to uphold the sky; the dense foliage, swelling forward in rounded bosses on the upper half, variously shaded and tinted, that of the young trees dark green, of the old yellowish. An aged lightning-smitten patriarch standing a little forward beyond the general line with knotty arms outspread was covered with gray and yellow lichens and surrounded by a group of saplings whose slender spires seemed to lack not a single leaf or spray in their wondrous perfection. Such was the Kaweah meadow picture that golden afternoon, and as I gazed every color seemed to deepen and glow as if the progress of the fresh sun-work were visible from hour to hour, while every tree seemed religious and conscious of the presence of God. A free man revels in a scene like this and time goes by unmeasured. I stood fixed in silent wonder or sauntered about shifting my points of view, studying the physiognomy of separate trees, and going out to the different color-patches to see how they were put on and what they were made of, giving free expression to my joy, exulting in Nature's wild immortal vigor and beauty, never dreaming any other human being was near. Suddenly the spell was broken by dull bumping, thudding sounds, and a man and horse came in sight at the farther end of the meadow, where they seemed sadly out of place. A good big bear or mastodon or megatherium would have been more in keeping with the old mammoth forest. Nevertheless, it is always pleasant to meet one of our own species after solitary rambles, and I stepped out where I could be seen and shouted, when the rider reined in his galloping mustang and waited my

approach. He seemed too much surprised to speak until, laughing in his puzzled face, I said I was glad to meet a fellow mountaineer in so lonely a place. Then he abruptly asked, "What are you doing? How did you get here?" I explained that I came across the cañons from Yosemite and was only looking at the trees. "Oh then, I know," he said, greatly to my surprise, "you must be John Muir." He was herding a band of horses that had been driven up a rough trail from the lowlands to feed on these forest meadows. A few handfuls of crumb detritus was all that was left in my bread sack, so I told him that I was nearly out of provision and asked whether he could spare me a little flour. "Oh yes, of course you can have anything I've got," he said. "Just take my track and it will lead you to my camp in a big hollow log on the side of a meadow two or three miles from here. I must ride after some strayed horses, but I'll be back before night; in the mean time make yourself at home." He galloped away to the northward; I returned to my own camp, saddled Brownie, and by the middle of the afternoon discovered his noble den in a fallen sequoia hollowed by fire — a spacious log house of one log, carbon-lined, centuries old yet sweet and fresh, weather-proof, earthquake-proof, likely to outlast the most durable stone castle, and commanding views of garden and grove grander far than the richest king ever enjoyed. Brownie found plenty of grass and I found bread, which I ate with views from the big round, ever-open door. Soon the good Samaritan mountaineer came in, and I enjoyed a famous rest listening to his observations on trees, animals, adventures, etc., while he was busily pre-

paring supper. In answer to inquiries concerning the distribution of the Big Trees he gave a good deal of particular information of the forest we were in, and he had heard that the species extended a long way south, he knew not how far. I wandered about for several days within a radius of six or seven miles of the camp, surveying boundaries, measuring trees, and climbing the highest points for general views. From the south side of the divide I saw telling ranks of sequoia-crowned headlands stretching far into the hazy distance, and plunging vaguely down into profound cañon depths foreshadowing weeks of good work. I had now been out on the trip more than a month, and I began to fear my studies would be interrupted by snow, for winter was drawing nigh. "Where there is n't a way make a way," is easily said when no way at the time is needed, but to the Sierra explorer with a mule traveling across the cañon lines of drainage the brave old phrase becomes heavy with meaning. There are ways across the Sierra graded by glaciers, well marked, and followed by men and beasts and birds, and one of them even by locomotives; but none natural or artificial along the range, and the explorer who would thus travel at right angles to the glacial ways must traverse cañons and ridges extending side by side in endless succession, roughened by side gorges and gulches and stubborn chaparral, and defended by innumerable sheer-fronted precipices. My own ways are easily made in any direction, but Brownie, though one of the toughest and most skillful of his race, was oftentimes discouraged for want of hands, and caused endless work. Wild at first, he was tame enough

now; and when turned loose he not only refused to run away, but as his troubles increased came to depend on me in such a pitiful, touching way, I became attached to him and helped him as if he were a good-natured boy in distress, and then the labor grew lighter. Bidding good-by to the kind sequoia cave-dweller, we vanished again in the wilderness, drifting slowly southward, sequoias on every ridge-top beckoning and pointing the way.

In the forest between the Middle and East forks of the Kaweah, I met a great fire, and as fire is the master scourge and controller of the distribution of trees, I stopped to watch it and learn what I could of its works and ways with the giants. It came racing up the steep chaparral-covered slopes of the East Fork cañon with passionate enthusiasm in a broad cataract of flames, now bending down low to feed on the green bushes, devouring acres of them at a breath, now towering high in the air as if looking abroad to choose a way, then stooping to feed again, the lurid flapping surges and the smoke and terrible rushing and roaring hiding all that is gentle and orderly in the work. But as soon as the deep forest was reached the ungovernable flood became calm like a torrent entering a lake, creeping and spreading beneath the trees where the ground was level or sloped gently, slowly nibbling the cake of compressed needles and scales with flames an inch high, rising here and there to a foot or two on dry twigs and clumps of small bushes and brome grass. Only at considerable intervals were fierce bonfires lighted, where heavy branches broken off by snow had accumulated, or around some venerable giant whose head had been stricken off by lightning.

I tethered Brownie on the edge of a little meadow beside a stream a good safe way off, and then cautiously chose a camp for myself in a big stout hollow trunk not likely to be crushed by the fall of burning trees, and made a bed of ferns and boughs in it. The night, however, and the strange wild fireworks were too beautiful and exciting to allow much sleep. There was no danger of being chased and hemmed in, for in the main forest belt of the Sierra, even when swift winds are blowing, fires seldom or never sweep over the trees in broad all-embracing sheets as they do in the dense Rocky Mountain woods and in those of the Cascade Mountains of Oregon and Washington. Here they creep from tree to tree with tranquil deliberation, allowing close observation, though caution is required in venturing around the burning giants to avoid falling limbs and knots and fragments from dead shattered tops. Though the day was best for study, I sauntered about night after night, learning what I could and admiring the wonderful show vividly displayed in the lonely darkness, the ground fire advancing in long crooked lines gently grazing and smoking on the close-pressed leaves, springing up in thousands of little jets of pure flame on dry tassels and twigs, and tall spires and flat sheets with jagged flapping edges dancing here and there on grass tufts and bushes, big bonfires blazing in perfect storms of energy where heavy branches mixed with small ones lay smashed together in hundred-cord piles, big red arches between spreading root-swells and trees growing close together, huge fire-mantled trunks on the hill-slopes glowing like bars of hot iron, violet-colored fire running up the tall

trees, tracing the furrows of the bark in quick quivering rills, and lighting magnificent torches on dry shattered tops, and ever and anon, with a tremendous roar and burst of light, young trees clad in low-descending feathery branches vanishing in one flame two or three hundred feet high.

One of the most impressive and beautiful sights was made by the great fallen trunks lying on the hillsides all red and glowing like colossal iron bars fresh from a furnace, two hundred feet long some of them, and ten to twenty feet thick. After repeated burnings have consumed the bark and sapwood, the sound charred surface, being full of cracks and sprinkled with leaves, is quickly overspread with a pure, rich, furred, ruby glow almost flameless and smokeless, producing a marvelous effect in the night. Another grand and interesting sight is the fire on the tops of the largest living trees flaming above the green branches at a height of perhaps two hundred feet, entirely cut off from the ground fires, and looking like signal beacons on watch-towers. From one standpoint I sometimes saw a dozen or more, those in the distance looking like great stars above the forest roof: At first I could not imagine how these sequoia lamps were lighted, but the very first night, strolling about waiting and watching, I saw the thing done again and again. The thick, fibrous bark of old trees is divided by deep, nearly continuous furrows, the sides of which are bearded with the bristling ends of fibres broken by the growth swelling of the trunk, and when the fire comes creeping around the feet of the trees, it runs up these bristly furrows in lovely pale-blue quivering, bick-

ering rills of flame with a low, earnest whispering sound to the lightning-shattered top of the trunk, which, in the dry Indian summer, with perhaps leaves and twigs and squirrel-gnawed cone-scales and seed-wings lodged in it, is readily ignited. These lamp-lighting rills, the most beautiful fire streams I ever saw, last only a minute or two, but the big lamps burn with varying brightness for days and weeks, throwing off sparks like the spray of a fountain, while ever and anon a shower of red coals comes sifting down through the branches, followed at times with startling effect by a big burned-off chunk weighing perhaps half a ton.

The immense bonfires where fifty or a hundred cords of peeled, split, smashed wood has been piled around some old giant by a single stroke of lightning is another grand sight in the night. The light is so great I found I could read common print three hundreds yards from them, and the illumination of the circle of onlooking trees is indescribably impressive. Other big fires, roaring and booming like waterfalls, were blazing on the upper sides of trees on hill-slopes, against which limbs broken off by heavy snow had rolled, while branches high overhead, tossed and shaken by the ascending air current, seemed to be writhing in pain. Perhaps the most startling phenomenon of all was the quick death of childlike sequoias only a century or two of age. In the midst of the other comparatively slow and steady fire work one of these tall, beautiful saplings, leafy and branchy, would be seen blazing up suddenly, all in one heaving, booming, passionate flame reaching from the ground to the top of the tree and fifty to a hundred feet or

more above it, with a smoke column bending forward and streaming away on the upper, free-flowing wind. To burn these green trees a strong fire of dry wood beneath them is required, to send up a current of air hot enough to distill inflammable gases from the leaves and sprays; then instead of the lower limbs gradually catching fire and igniting the next and next in succession, the whole tree seems to explode almost simultaneously, and with awful roaring and throbbing a round, tapering flame shoots up two or three hundred feet, and in a second or two is quenched, leaving the green spire a black, dead mast, bristled and roughened with down-curling boughs. Nearly all the trees that have been burned down are lying with their heads uphill, because they are burned far more deeply on the upper side, on account of broken limbs rolling down against them to make hot fires, while only leaves and twigs accumulate on the lower side and are quickly consumed without injury to the tree. But green, resinless sequoia wood burns very slowly, and many successive fires are required to burn down a large tree. Fires can run only at intervals of several years, and when the ordinary amount of fire-wood that has rolled against the gigantic trunk is consumed, only a shallow scar is made, which is slowly deepened by recurring fires until far beyond the centre of gravity, and when at last the tree falls, it of course falls uphill. The healing folds of wood layers on some of the deeply burned trees show that centuries have elapsed since the last wounds were made.

When a great sequoia falls, its head is smashed into fragments about as small as those made by lightning,

which are mostly devoured by the first running, hunting fire that finds them, while the trunk is slowly wasted away by centuries of fire and weather. One of the most interesting fire actions on the trunk is the boring of those great tunnel-like hollows through which horsemen may gallop. All of these famous hollows are burned out of the solid wood, for no sequoia is ever hollowed by decay. When the tree falls the brash trunk is often broken straight across into sections as if sawed; into these joints the fire creeps, and, on account of the great size of the broken ends, burns for weeks or even months without being much influenced by the weather. After the great glowing ends fronting each other have burned so far apart that their rims cease to burn, the fire continues to work on in the centres, and the ends become deeply concave. Then heat being radiated from side to side, the burning goes on in each section of the trunk independent of the other, until the diameter of the bore is so great that the heat radiated across from side to side is not sufficient to keep them burning. It appears, therefore, that only very large trees can receive the fire-auger and have any shell rim left.

Fire attacks the large trees only at the ground, consuming the fallen leaves and humus at their feet, doing them but little harm unless considerable quantities of fallen limbs happen to be piled about them, their thick mail of spongy, unpitchy, almost unburnable bark affording strong protection. Therefore the oldest and most perfect unscarred trees are found on ground that is nearly level, while those growing on hillsides, against which falling branches roll, are always deeply scarred on

the upper side, and as we have seen are sometimes burned down. The saddest thing of all was to see the hopeful seedlings, many of them crinkled and bent with the pressure of winter snow, yet bravely aspiring at the top, helplessly perishing, and young trees, perfect spires of verdure and naturally immortal, suddenly changed to dead masts. Yet the sun looked cheerily down the openings in the forest roof, turning the black smoke to a beautiful brown, as if all was for the best.

Beneath the smoke-clouds of the suffering forest we again pushed southward, descending a side gorge of the East Fork cañon and climbing another into new forests and groves not a whit less noble. Brownie, the meanwhile, had been resting, while I was weary and sleepy with almost ceaseless wanderings, giving only an hour or two each night or day to sleep in my log home. Way-making here seemed to become more and more difficult, "impossible," in common phrase, for four-legged travelers. Two or three miles was all the day's work as far as distance was concerned. Nevertheless, just before sundown we found a charming camp-ground with plenty of grass, and a forest to study that had felt no fire for many a year. The camp-hollow was evidently a favorite home of bears. On many of the trees, at a height of six or eight feet, their autographs were inscribed in strong, free, flowing strokes on the soft bark where they had stood up like cats to stretch their limbs. Using both hands, every claw a pen, the handsome curved lines of their writing take the form of remarkably regular interlacing pointed arches, producing a truly ornamental effect. I looked and listened, half expecting

to see some of the writers alarmed and withdrawing from the unwonted disturbance. Brownie also looked and listened, for mules fear bears instinctively and have a very keen nose for them. When I turned him loose, instead of going to the best grass, he kept cautiously near the camp-fire for protection, but was careful not to step on me. The great starry night passed away in deep peace and the rosy morning sunbeams were searching the grove ere I awoke from a long, blessed sleep.

The breadth of the sequoia belt here is about the same as on the north side of the river, extending, rather thin and scattered in some places, among the noble pines from near the main forest belt of the range well back towards the frosty peaks, where most of the trees are growing on moraines but little changed as yet.

Two days' scramble above Bear Hollow I enjoyed an interesting interview with deer. Soon after sunrise a little company of four came to my camp in a wild garden imbedded in chaparral, and after much cautious observation quietly began to eat breakfast with me. Keeping perfectly still I soon had their confidence, and they came so near I found no difficulty, while admiring their graceful manners and gestures, in determining what plants they were eating, thus gaining a far finer knowledge and sympathy than comes by killing and hunting.

Indian summer gold with scarce a whisper of winter in it was painting the glad wilderness in richer and yet richer colors as we scrambled across the South cañon into the basin of the Tule. Here the Big Tree forests are still more extensive, and furnished abundance of work in tracing boundaries and gloriously crowned

ridges up and down, back and forth, exploring, studying, admiring, while the great measureless days passed on and away uncounted. But in the calm of the camp-fire the end of the season seemed near. Brownie too often brought snow-storms to mind. He became doubly jaded, though I never rode him, and always left him in camp to feed and rest while I explored. The invincible bread business also troubled me again; the last mealy crumbs were consumed, and grass was becoming scarce even in the roughest rock-piles, naturally inaccessible to sheep. One afternoon, as I gazed over the rolling bossy sequoia billows stretching interminably southward, seeking a way and counting how far I might go without food, a rifle-shot rang out sharp and clear. Marking the direction, I pushed gladly on, hoping to find some hunter who could spare a little food. Within a few hundred rods I struck the track of a shod horse, which led to the camp of two Indian shepherds. One of them was cooking supper when I arrived. Glancing curiously at me, he saw that I was hungry, and gave me some mutton and bread, and said encouragingly as he pointed to the west, "Putty soon Indian come, heap speak English." Toward sundown two thousand sheep beneath a cloud of dust came streaming through the grand sequoias to a meadow below the camp, and presently the English-speaking shepherd came in, to whom I explained my wants and what I was doing. Like most white men, he could not conceive how anything other than gold could be the object of such rambles as mine, and asked repeatedly whether I had discovered any mines. I tried to make him talk about trees and the

wild animals, but unfortunately he proved to be a tame Indian from the Tule Reservation, had been to school, claimed to be civilized, and spoke contemptuously of "wild Indians," and so of course his inherited instincts were blurred or lost. The Big Trees, he said, grew far south, for he had seen them in crossing the mountains from Porterville to Lone Pine. In the morning he kindly gave me a few pounds of flour, and assured me that I would get plenty more at a sawmill on the South Fork if I reached it before it was shut down for the season.

Of all the Tule basin forest the section on the North Fork seemed the finest, surpassing, I think, even the Giant Forest of the Kaweah. Southward from here, though the width and general continuity of the belt is well sustained, I thought I could detect a slight falling off in the height of the trees and in closeness of growth. All the basin was swept by swarms of hoofed locusts, the southern part over and over again, until not a leaf within reach was left on the wettest bogs, the outer edges of the thorniest chaparral beds, or even on the young conifers, which, unless under the stress of dire famine, sheep never touch. Of course Brownie suffered, though I made diligent search for grassy sheep-proof spots. Turning him loose one evening on the side of a carex bog, he dolefully prospected the desolate neighborhood without finding anything that even a starving mule could eat. Then, utterly discouraged, he stole up behind me while I was bent over on my knees making a fire for tea, and in a pitiful mixture of bray and neigh, begged for help. It was a mighty touching prayer, and I answered it as well as I could with half of what was

left of a cake made from the last of the flour given me by the Indians, hastily passing it over my shoulder, and saying, "Yes, poor fellow, I know, but soon you'll have plenty. To-morrow down we go to alfalfa and barley," speaking to him as if he were human, as through stress of trouble plainly he was. After eating his portion of bread he seemed content, for he said no more, but patiently turned away to gnaw leafless ceanothus stubs. Such clinging, confiding dependence after all our scrambles and adventures together was very touching, and I felt conscience-stricken for having led him so far in so rough and desolate a country. "Man," says Lord Bacon, "is the god of the dog." So, also, he is of the mule and many other dependent fellow mortals.

Next morning I turned westward, determined to force a way straight to pasture, letting Sequoia wait. Fortunately ere we had struggled down through half a mile of chaparral we heard a mill whistle, for which we gladly made a bee-line. At the sawmill we both got a good meal, then, taking the dusty lumber road, pursued our way to the lowlands. The nearest good pasture I counted might be thirty or forty miles away. But scarcely had we gone ten when I noticed a little log cabin a hundred yards or so back from the road, and a tall man straight as a pine standing in front of it observing us as we came plodding down through the dust. Seeing no sign of grass or hay, I was going past without stopping, when he shouted, "Travelin'?" Then drawing nearer, "Where have you come from? I did n't notice you go up." I replied I had come through the

woods from the north, looking at the trees. "Oh, then, you must be John Muir. Halt, you're tired; come and rest and I'll cook for you." Then I explained that I was tracing the sequoia belt, that on account of sheep my mule was starving, and therefore must push on to the lowlands. "No, no," he said, "that corral over there is full of hay and grain. Turn your mule into it. I don't own it, but the fellow who does is hauling lumber, and it will be all right. He's a white man. Come and rest. How tired you must be! The Big Trees don't go much farther south, nohow. I know the country up there, have hunted all over it. Come and rest, and let your little doggone rat of a mule rest. How in heavens did you get him across the cañons — roll him? or carry him? He's poor, but he'll get fat, and I'll give you a horse and go with you up the mountains, and while you're looking at the trees I'll go hunting. It will be a short job, for the end of the Big Trees is not far." Of course I stopped. No true invitation is ever declined. He had been hungry and tired himself many a time in the Rocky Mountains as well as in the Sierra. Now he owned a band of cattle and lived alone. His cabin was about eight by ten feet, the door at one end, a fireplace at the other, and a bed on one side fastened to the logs. Leading me in without a word of mean apology, he made me lie down on the bed, then reached under it, brought forth a sack of apples and advised me to keep "chawing" at them until he got supper ready. Finer, braver hospitality I never found in all this good world so often called selfish.

Next day with hearty, easy alacrity the mountaineer



procured horses, prepared and packed provisions, and got everything ready for an early start the following morning. Well mounted, we pushed rapidly up the South Fork of the river and soon after noon were among the giants once more. On the divide between the Tule and Deer Creek a central camp was made, and the mountaineer spent his time in deer-hunting, while with provisions for two or three days I explored the woods, and in accordance with what I had been told soon reached the southern extremity of the belt on the South Fork of Deer Creek. To make sure, I searched the woods a considerable distance south of the last Deer Creek grove, passed over into the basin of the Kern, and climbed several high points commanding extensive views over the sugar pine woods, without seeing a single sequoia crown in all the wide expanse to the southward. On the way back to camp, however, I was greatly interested in a grove I discovered on the east side of the Kern River divide, opposite the North Fork of Deer Creek. The height of the pass where the species crossed over is about seven thousand feet, and I heard of still another grove whose waters drain into the upper Kern opposite the Middle Fork of the Tule.

It appears, therefore, that though the sequoia belt is two hundred and sixty miles long, most of the trees are on a section to the south of King's River only about seventy miles in length. But though the area occupied by the species increases so much to the southward, there is but little difference in the size of the trees. A diameter of twenty feet and height of two hundred and seventy-five is perhaps about the average for anything like ma-

ture and favorably situated trees. Specimens twenty-five feet in diameter are not rare, and a good many approach a height of three hundred feet. Occasionally one meets a specimen thirty feet in diameter, and rarely one that is larger. The majestic stump on King's River is the largest I saw and measured on the entire trip. Careful search around the boundaries of the forests and groves and in the gaps of the belt failed to discover any trace of the former existence of the species beyond its present limits. On the contrary, it seems to be slightly extending its boundaries; for the outstanding stragglers, occasionally met a mile or two from the main bodies, are young instead of old monumental trees. Ancient ruins and the ditches and root-bowls the big trunks make in falling were found in all the groves, but none outside of them. We may therefore conclude that the area covered by the species has not been diminished during the last eight or ten thousand years, and probably not at all in post-glacial times. For admitting that upon those areas supposed to have been once covered by Sequoia every tree may have fallen, and that fire and the weather had not left a vestige of them, many of the ditches made by the fall of the ponderous trunks, weighing five hundred to nearly a thousand tons, and the bowls made by their upturned roots would remain visible for thousands of years after the last remnants of the trees had vanished. Some of these records would doubtless be effaced in a comparatively short time by the inwashing of sediments, but no inconsiderable part of them would remain enduringly engraved on flat ridge tops, almost wholly free from such action.

In the northern groves, the only ones that at first came under the observation of students, there are but few seedlings and young trees to take the places of the old ones. Therefore the species was regarded as doomed to speedy extinction, as being only an expiring remnant vanquished in the so-called struggle for life, and shoved into its last strongholds in moist glens where conditions are exceptionally favorable. But the majestic continuous forests of the south end of the belt create a very different impression. Here, as we have seen, no tree in the forest is more enduringly established. Nevertheless it is oftentimes vaguely said that the Sierra climate is drying out, and that this oncoming, constantly increasing drought will of itself surely extinguish King Sequoia, though sections of wood-rings show that there has been no appreciable change of climate during the last forty centuries. Furthermore, that Sequoia can grow and is growing on as dry ground as any of its neighbors or rivals, we have seen proved over and over again. "Why, then," it will be asked, "are the Big Tree groves always found on well-watered spots?" Simply because Big Trees give rise to streams. It is a mistake to suppose that the water is the cause of the groves being there. On the contrary, the groves are the cause of the water being there. The roots of this immense tree fill the ground, forming a sponge which hoards the bounty of the clouds and sends it forth in clear perennial streams instead of allowing it to rush headlong in short-lived destructive floods. Evaporation is also checked, and the air kept still in the shady sequoia depths, while thirsty robber winds are shut out.

Since, then, it appears that Sequoia can and does grow on as dry ground as its neighbors and that the greater moisture found with it is an effect rather than a cause of its presence, the notions as to the former greater extension of the species and its near approach to extinction, based on its supposed dependence on greater moisture, are seen to be erroneous. Indeed, all my observations go to show that in case of prolonged drought the sugar pines and firs would die before Sequoia. Again, if the restricted and irregular distribution of the species be interpreted as the result of the desiccation of the range, then, instead of increasing in individuals toward the south, where the rainfall is less, it should diminish.

If, then, its peculiar distribution has not been governed by superior conditions of soil and moisture, by what has it been governed? Several years before I made this trip, I noticed that the northern groves were located on those parts of the Sierra soil-belt that were first laid bare and opened to preëmption when the ice-sheet began to break up into individual glaciers. And when I was examining the basin of the San Joaquin and trying to account for the absence of Sequoia, when every condition seemed favorable for its growth, it occurred to me that this remarkable gap in the belt is located in the channel of the great ancient glacier of the San Joaquin and King's River basins, which poured its frozen floods to the plain, fed by the snows that fell on more than fifty miles of the Summit peaks of the range. Constantly brooding on the question, I next perceived that the great gap in the belt to the northward, forty miles wide, be-

tween the Stanislaus and Tuolumne groves, occurs in the channel of the great Stanislaus and Tuolumne glacier, and that the smaller gap between the Merced and Mariposa groves occurs in the channel of the smaller Merced glacier. The wider the ancient glacier, the wider the gap in the sequoia belt, while the groves and forests attain their greatest development in the Kaweah and Tule River basins, just where, owing to topographical conditions, the region was first cleared and warmed, while protected from the main ice-rivers that flowed past to right and left down the King's and Kern valleys. In general, where the ground on the belt was first cleared of ice, there the sequoia now is, and where at the same elevation and time the ancient glaciers lingered, there the sequoia is not. What the other conditions may have been which enabled the sequoia to establish itself upon these oldest and warmest parts of the main soil-belt I cannot say. I might venture to state, however, that since the sequoia forests present a more and more ancient and long-established aspect to the southward, the species was probably distributed from the south toward the close of the glacial period, before the arrival of other trees. About this branch of the question, however, there is at present much fog, but the general relationship we have pointed out between the distribution of the Big Tree and the ancient glacial system is clear. And when we bear in mind that all the existing forests of the Sierra are growing on comparatively fresh moraine soil, and that the range itself has been recently sculptured and brought to light from beneath the ice-mantle of the glacial winter, then many lawless mysteries vanish, and harmonies take their places.

But notwithstanding all the observed phenomena bearing on the post-glacial history of this colossal tree point to the conclusion that it never was more widely distributed on the Sierra since the close of the glacial epoch; that its present forests are scarcely past prime, if, indeed, they have reached prime; that the post-glacial day of the species is probably not half done; yet, when from a wider outlook the vast antiquity of the genus is considered, and its ancient richness in species and individuals, comparing our Sierra giant and *Sequoia sempervirens* of the coast, the only other living species, with the many fossil species already discovered, and described by Heer and Lesquereux, some of which flourished over large areas around the Arctic Circle, and in Europe and our own territories, during Tertiary and Cretaceous times, — then, indeed, it becomes plain that our two surviving species, restricted to narrow belts within the limits of California, are mere remnants of the genus both as to species and individuals, and that they probably are verging to extinction. But the verge of a period beginning in Cretaceous times may have a breadth of tens of thousands of years, not to mention the possible existence of conditions calculated to multiply and reëxtend both species and individuals. No unfavorable change of climate, so far as I can see, no disease, but only fire and the axe and the ravages of flocks and herds threaten the existence of these noblest of God's trees. In Nature's keeping they are safe, but through man's agency destruction is making rapid progress, while in the work of protection only a beginning has been made. The Mariposa Grove belongs to and is guarded by the State; the

General Grant and Sequoia National Parks, established ten years ago, are efficiently guarded by a troop of cavalry under the direction of the Secretary of the Interior; so also are the small Tuolumne and Merced groves, which are included in the Yosemite National Park, while a few scattered patches and fringes, scarce at all protected, though belonging to the national government, are in the Sierra Forest Reservation.

Perhaps more than half of all the Big Trees have been sold, and are now in the hands of speculators and mill men. Even the beautiful little Calaveras Grove of ninety trees, so historically interesting from its being the first discovered, is now owned, together with the much larger South, or Stanislaus, Grove, by a lumber company.

Far the largest and most important section of protected Big Trees is in the grand Sequoia National Park, now easily accessible by stage from Visalia. It contains seven townships and extends across the whole breadth of the magnificent Kaweah basin. But large as it is, it should be made much larger. Its natural eastern boundary is the high Sierra, and the northern and southern boundaries, the King's and Kern rivers, thus including the sublime scenery on the headwaters of these rivers and perhaps nine tenths of all the Big Trees in existence. Private claims cut and blotch both of the sequoia parks as well as all the best of the forests, every one of which the government should gradually extinguish by purchase, as it readily may, for none of these holdings are of much value to their owners. Thus as far as possible the grand blunder of selling would be corrected. The value of these forests in storing and dispensing the bounty of the

mountain clouds is infinitely greater than lumber or sheep. To the dwellers of the plain, dependent on irrigation, the Big Tree, leaving all its higher uses out of the count, is a tree of life, a never-failing spring, sending living water to the lowlands all through the hot, rainless summer. For every grove cut down a stream is dried up. Therefore, all California is crying, "Save the trees of the fountains," nor, judging by the signs of the times, is it likely that the cry will cease until the salvation of all that is left of *Sequoia gigantea* is sure.