

The Glacier Meadows

By John Muir

After the lakes on the High Sierra come the glacier meadows. They are smooth, level, silky lawns, lying embedded in the upper forests, on the floors of the valleys, and along the broad backs of the main dividing ridges, at a height of about 8000 to 9500 feet above the sea.

They are nearly as level as the lakes whose places they have taken, and present a dry, even surface free from rock-heaps, mossy bogginess, and the frowsy roughness of rank, coarse-leaved, weedy, and shrubby vegetation. The sod is close and fine, and so complete that you cannot see the ground; and at the same time so brightly enameled with flowers and butterflies that it may well be called a garden-meadow, or meadow-garden; for the plushy sod is in many places so crowded with gentians, daisies, ivesias, and various species of orthocarpus that the grass is scarcely noticeable, while in others the flowers are only pricked in here and there singly, or in small ornamental rosettes.

The most influential of the grasses composing the sod is a delicate calamagrostis with fine filiform leaves, and loose, airy panicles that seem to float above the flowery lawn like a purple mist. But, write as I may, I cannot give anything like an adequate idea of the exquisite beauty of these mountain carpets as they lie smoothly outspread in the savage wilderness. What words are fine enough to picture them? to what shall we like them? The flowery levels of the prairies of the old West, the luxuriant savannahs of the South, and the finest of cultivated meadows are coarse in comparison. One may at first sight compare them with the carefully tended lawns of pleasure-grounds; for they are as free from weeds as they, and as smooth, but here the likeness ends; for these wild lawns, with all their exquisite fineness, have no trace of that painful, licked, snipped, repressed appearance that pleasure-ground lawns are apt to have even when viewed at a distance. And, not to mention the flowers with which they are brightened, their grasses are very much finer both in color and texture, and instead of lying flat and motionless, matted together like a dead green cloth, they respond to the touches of every breeze, rejoicing in pure wildness, blooming and fruiting in the vital light.

Glacier meadows abound throughout all the alpine and subalpine regions of the Sierra in still greater numbers than the lakes. Probably from 2500 to 3000 exist between latitude 36° 30' and 39°, distributed, of course, like the lakes, in concordance with all the other glacial features of the landscape.

On the head waters of the rivers there are what are called "Big Meadows," usually about from five to ten miles long. These occupy the basins of the ancient ice-seas, where many tributary glaciers came together to form the grand trunks. Most, however, are quite small, averaging perhaps but little more than three fourths of a mile in length.

One of the very finest of the thousands I have enjoyed lies hidden in an extensive forest of the Two-leaved Pine, on the edge of the basin of the ancient Tuolumne Mer de Glace, about eight miles to the west of Mount Dana.

Imagine yourself at the Tuolumne Soda Springs on the bank of the river, a day's journey above Yosemite Valley. You set off northward through a forest that stretches away indefinitely before you, seemingly unbroken by openings of any kind. As soon as you are fairly into the woods, the gray mountain-peaks, with their snowy gorges and hollows, are lost to view. The ground is littered with fallen trunks that lie crossed and recrossed like storm-lodged wheat; and besides this close forest of pines, the rich moraine soil supports a luxuriant growth of ribbon-leaved grasses--bromus, triticum, calamagrostis, agrostis, etc., which rear their handsome spikes and panicles above your waist. Making your way through the fertile wilderness,--finding lively bits of interest now and then in the squirrels and Clark crows, and perchance in a deer or bear,--after the lapse of an hour or two vertical bars of sunshine are seen ahead between the brown shafts of the pines, showing that you are approaching an open space, and then you suddenly emerge from the forest shadows upon a delightful purple lawn lying smooth and free in the light like a lake. This is a glacier meadow. It is about a mile and a half long by a quarter of a mile wide. The trees come pressing forward all around in close serried ranks, planting their feet exactly on its margin, and holding themselves erect, strict and orderly like soldiers on parade; thus bounding the meadow

with exquisite precision, yet with free curving lines such as Nature alone can draw. With inexpressible delight you wade out into the grassy sun-lake, feeling yourself contained in one of Nature's most sacred chambers, withdrawn from the sterner influences of the mountains, secure from all intrusion, secure from yourself, free in the universal beauty. And notwithstanding the scene is so impressively spiritual, and you seem dissolved in it, yet everything about you is beating with warm, terrestrial, human love and life delightfully substantial and familiar. The resinous pines are types of health and steadfastness; the robins feeding on the sod belong to the same species you have known since childhood; and surely these daisies, larkspurs, and goldenrods are the very friend-flowers of the old home garden. Bees hum as in a harvest noon, butterflies waver above the flowers, and like them you lave in the vital sunshine, too richly and homogeneously joy-filled to be capable of partial thought. You are all eye, sifted through and through with light and beauty. Sauntering along the brook that meanders silently through the meadow from the east, special flowers call you back to discriminating consciousness. The sod comes curving down to the water's edge, forming bossy outswelling banks, and in some places overlapping countersunk boulders and forming bridges. Here you find mats of the curious dwarf willow scarce an inch high, yet sending up a multitude of gray silky catkins, illumined here and there with the purple cups and bells of bryanthus and vaccinium.

Go where you may, you everywhere find the lawn divinely beautiful, as if Nature had fingered and adjusted every plant this very day. The floating grass panicles are scarcely felt in brushing through their midst, so fine are they, and none of the flowers have tall or rigid stalks. In the brightest places you find three species of gentians with different shades of blue, daisies pure as the sky, silky leaved ivesias with warm yellow flowers, several species of orthocarpus with blunt, bossy spikes, red and purple and yellow; the alpine goldenrod, pentstemon, and clover, fragrant and honeyful, with their colors massed and blended. Parting the grasses and looking more closely you may trace the branching of their shining stems, and note the marvelous beauty of their mist of flowers, the glumes and pales exquisitely penciled, the yellow dangling stamens, and feathery pistils. Beneath the lowest leaves you discover a fairy realm of mosses,--hypnum, dicranum, polytrichum, and many others,--their precious spore-cups poised daintily on polished shafts, curiously hooded, or open, showing the richly ornate peristomas worn like royal crowns. Creeping liverworts are here also in abundance, and several rare species of fungi, exceedingly small, and frail, and delicate, as if made only for beauty. Caterpillars, black beetles, and ants roam the wilds of this lower world, making their way through miniature groves and thickets like bears in a thick wood.

And how rich, too, is the life of the sunny air! Every leaf and flower seems to have its winged representative overhead. Dragon-flies shoot in vigorous zigzags through the dancing swarms, and a rich profusion of butterflies--the leguminosæ of insects--make a fine addition to the general show. Many of these last are comparatively small at this elevation, and as yet almost unknown to science; but every now and then a familiar vanessa or papilio comes sailing past. Humming-birds, too, are quite common here, and the robin is always found along the margin of the stream, or out in the shallowest portions of the sod, and sometimes the grouse and mountain quail, with their broods of precious fluffy chickens. Swallows skim the grassy lake from end to end, fly-catchers come and go in fitful flights from the tops of dead spars, while woodpeckers swing across from side to side in graceful festoon curves,--birds, insects, and flowers all in their own way telling a deep summer joy.

The influences of pure nature seem to be so little known as yet, that it is generally supposed that complete pleasure of this kind, permeating one's very flesh and bones, unfits the student for scientific pursuits in which cool judgment and observation are required. But the effect is just the opposite. Instead of producing a dissipated condition, the mind is fertilized and stimulated and developed like sun-fed plants. All that we have seen here enables us to see with serer vision the fountains among the summit-peaks to the east whence flowed the glaciers that ground soil for the surrounding forest; and down at the foot of the meadow the moraine which formed the dam which gave rise to the lake that occupied this basin before the meadow was made; and around the margin the stones that were shoved back and piled up into a rude wall by the expansion of the lake ice during long bygone winters; and along the sides of the streams the slight hollows of the meadow which mark those portions of the old lake that were the last to vanish.

I would fain ask my readers to linger awhile in this fertile wilderness, to trace its history from its earliest glacial beginnings, and learn what we may of its wild inhabitants and visitors. How happy the birds are all summer and some of them all winter; how the pouched marmots drive tunnels under the snow, and how fine and brave a

life the slandered coyote lives here, and the deer and bears! But, knowing well the difference between reading and seeing, I will only ask attention to some brief sketches of its varying aspects as they are presented throughout the more marked seasons of the year.

The summer life we have been depicting lasts with but little abatement until October, when the night frosts begin to sting, bronzing the grasses, and ripening the leaves of the creeping heathworts along the banks of the stream to reddish purple and crimson; while the flowers disappear, all save the goldenrods and a few daisies, that continue to bloom on unscathed until the beginning of snowy winter. In still nights the grass panicles and every leaf and stalk are laden with frost crystals, through which the morning sunbeams sift in ravishing splendor, transforming each to a precious diamond radiating the colors of the rainbow. The brook shallows are plaited across and across with slender lances of ice, but both these and the grass crystals are melted before mid-day, and, notwithstanding the great elevation of the meadow, the afternoons are still warm enough to revive the chilled butterflies and call them out to enjoy the late-flowering goldenrods. The divine alpenglow flushes the surrounding forest every evening, followed by a crystal night with hosts of lily stars, whose size and brilliancy cannot be conceived by those who have never risen above the lowlands.

Thus come and go the bright sun-days of autumn, not a cloud in the sky, week after week until near December. Then comes a sudden change. Clouds of a peculiar aspect with a slow, crawling gait gather and grow in the azure, throwing out satiny fringes, and becoming gradually darker until every lake-like rift and opening is closed and the whole bent firmament is obscured in equal structureless gloom. Then comes the snow, for the clouds are ripe, the meadows of the sky are in bloom, and shed their radiant blossoms like an orchard in the spring. Lightly, lightly they lodge in the brown grasses and in the tasseled needles of the pines, falling hour after hour, day after day, silently, lovingly,--all the winds hushed,--glancing and circling hither, thither, glinting against one another, rays interlocking in flakes as large as daisies; and then the dry grasses, and the trees, and the stones are all equally abloom again. Thunder-showers occur here during the summer months, and impressive it is to watch the coming of the big transparent drops, each a small world in itself,--one unbroken ocean without islands hurling free through the air like planets through space. But still more impressive to me is the coming of the snow-flowers,--falling stars, winter daisies,--giving bloom to all the ground alike. Raindrops blossom brilliantly in the rainbow, and change to flowers in the sod, but snow comes in full flower direct from the dark, frozen sky.

The later snow-storms are oftentimes accompanied by winds that break up the crystals, when the temperature is low, into single petals and irregular dusty fragments; but there is comparatively little drifting on the meadow, so securely is it embosomed in the woods. From December to May, storm succeeds storm, until the snow is about fifteen or twenty feet deep, but the surface is always as smooth as the breast of a bird.

Hushed now is the life that so late was beating warmly. Most of the birds have gone down below the snow-line, the plants sleep, and all the fly-wings are folded. Yet the sun beams gloriously many a cloudless day in midwinter, casting long lance shadows athwart the dazzling expanse. In June small flecks of the dead, decaying sod begin to appear, gradually widening and uniting with one another, covered with creeping rags of water during the day, and ice by night, looking as hopeless and unvital as crushed rocks just emerging from the darkness of the glacial period. Walk the meadow now! Scarce the memory of a flower will you find. The ground seems twice dead. Nevertheless, the annual resurrection is drawing near. The life-giving sun pours his floods, the last snow-wreath melts, myriads of growing points push eagerly through the steaming mold, the birds come back, new wings fill the air, and fervid summer life comes surging on, seemingly yet more glorious than before.

This is a perfect meadow, and under favorable circumstances exists without manifesting any marked changes for centuries. Nevertheless, soon or late it must inevitably grow old and vanish. During the calm Indian summer, scarce a sand-grain moves around its banks, but in flood-times and storm-times, soil is washed forward upon it and laid in successive sheets around its gently sloping rim, and is gradually extended to the center, making it dryer. Through a considerable period the meadow vegetation is not greatly affected thereby, for it gradually rises with the rising ground, keeping on the surface like water-plants rising on the swell of waves. But at length the elevation of the meadowland goes on so far as to produce too dry a soil for the specific meadow-plants, when, of course, they have to give up their places to others fitted for the new conditions. The most characteristic of the newcomers at this elevation above the sea are principally sun-loving gilies, eriogonæ,

and compositæ, and finally forest-trees. Henceforward the obscuring changes are so manifold that the original lake-meadow can be unveiled and seen only by the geologist.

Generally speaking, glacier lakes vanish more slowly than the meadows that succeed them, because, unless very shallow, a greater quantity of material is required to fill up their basins and obliterate them than is required to render the surface of the meadow too high and dry for meadow vegetation. Furthermore, owing to the weathering to which the adjacent rocks are subjected, material of the finer sort, susceptible of transportation by rains and ordinary floods, is more abundant during the meadow period than during the lake period. Yet doubtless many a fine meadow favorably situated exists in almost prime beauty for thousands of years, the process of extinction being exceedingly slow, as we reckon time. This is especially the case with meadows circumstanced like the one we have described--embosomed in deep woods, with the ground rising gently away from it all around, the network of tree-roots in which all the ground is clasped preventing any rapid torrential washing. But, in exceptional cases, beautiful lawns formed with great deliberation are overwhelmed and obliterated at once by the action of land-slips, earthquake avalanches, or extraordinary floods, just as lakes are.

In those glacier meadows that take the places of shallow lakes which have been fed by feeble streams, glacier mud and fine vegetable humus enter largely into the composition of the soil; and on account of the shallowness of this soil, and the seamless, water-tight, undrained condition of the rock-basins, they are usually wet, and therefore occupied by tall grasses and sedges, whose coarse appearance offers a striking contrast to that of the delicate lawn-making kind described above. These shallow-soiled meadows are oftentimes still further roughened and diversified by partially buried moraines and swelling bosses of the bed-rock, which, with the trees and shrubs growing upon them, produce a striking effect as they stand in relief like islands in the grassy level, or sweep across in rugged curves from one forest wall to the other.

Throughout the upper meadow region, wherever water is sufficiently abundant and low in temperature, in basins secure from flood-washing, handsome bogs are formed with a deep growth of brown and yellow sphagnum picturesquely ruffled with patches of kalmia and ledum which ripen masses of beautiful color in the autumn. Between these cool, spongy bogs and the dry, flowery meadows there are many interesting varieties which are graduated into one another by the varied conditions already alluded to, forming a series of delightful studies.

Hanging Meadows

Another very well-marked and interesting kind of meadow, differing greatly both in origin and appearance from the lake-meadows, is found lying aslant upon moraine-covered hillsides trending in the direction of greatest declivity, waving up and down over rock heaps and ledges, like rich green ribbons brilliantly illumined with tall flowers. They occur both in the alpine and subalpine regions in considerable numbers, and never fail to make telling features in the landscape. They are often a mile or more in length, but never very wide--usually from thirty to fifty yards. When the mountain or cañon side on which they lie dips at the required angle, and other conditions are at the same time favorable, they extend from above the timber line to the bottom of a cañon or lake basin, descending in fine, fluent lines like cascades, breaking here and there into a kind of spray on large boulders, or dividing and flowing around on either side of some projecting islet. Sometimes a noisy stream goes brawling down through them, and again, scarcely a drop of water is in sight. They owe their existence, however, to streams, whether visible or invisible, the wildest specimens being found where some perennial fountain, as a glacier or snowbank or moraine spring sends down its waters across a rough sheet of soil in a dissipated web of feeble, oozing rivulets. These conditions give rise to a meadowy vegetation, whose extending roots still more obstruct the free flow of the waters, and tend to dissipate them out over a yet wider area. Thus the moraine soil and the necessary moisture requisite for the better class of meadow plants are at times combined about as perfectly as if smoothly outspread on a level surface. Where the soil happens to be composed of the finer qualities of glacial detritus and the water is not in excess, the nearest approach is made by the vegetation to that of the lake-meadow. But where, as is more commonly the case, the soil is coarse and bouldery, the vegetation is correspondingly rank. Tall, wide-leaved grasses take their places along the sides, and rushes and nodding carices in the wetter portions, mingled with the most beautiful and imposing flowers,--orange lilies and larkspurs seven or eight feet high, lupines, senecios, aliums, painted-cups, many species of mimulus and pentstemon, the ample boat-leaved *veratrum alba*, and the magnificent alpine columbine, with spurs an inch and a

half long. At an elevation of from seven to nine thousand feet showy flowers frequently form the bulk of the vegetation; then the hanging meadows become hanging gardens.

In rare instances we find an alpine basin the bottom of which is a perfect meadow, and the sides nearly all the way round, rising in gentle curves, are covered with moraine soil, which, being saturated with melting snow from encircling fountains, gives rise to an almost continuous girdle of down-curving meadow vegetation that blends gracefully into the level meadow at the bottom, thus forming a grand, smooth, soft, meadow-lined mountain nest. It is in meadows of this sort that the mountain beaver (*Haplodon*) loves to make his home, excavating snug chambers beneath the sod, digging canals, turning the underground waters from channel to channel to suit his convenience, and feeding the vegetation.

Another kind of meadow or bog occurs on densely timbered hillsides where small perennial streams have been dammed at short intervals by fallen trees. Still another kind is found hanging down smooth, flat precipices, while corresponding leaning meadows rise to meet them.

There are also three kinds of small pot-hole meadows one of which is found along the banks of the main streams, another on the summits of rocky ridges, and the third on glacier pavements, all of them interesting in origin and brimful of plant beauty.

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