

The Snow

By John Muir

The first snow that whitens the Sierra, usually falls about the end of October or early in November, to a depth of a few inches, after months of the most charming Indian summer weather imaginable. But in a few days, this light covering mostly melts from the slopes exposed to the sun and causes but little apprehension on the part of mountaineers who may be lingering among the high peaks at this time.

The first general winter storm that yields snow that is to form a lasting portion of the season's supply, seldom breaks on the mountains before the end of November. Then, warned by the sky, cautious mountaineers, together with the wild sheep, deer, and most of the birds and bears, make haste to the lowlands or foot-hills; and burrowing marmots, mountain beavers, wood rats, and such people go into winter quarters, some of them not again to see the light of day until the general awakening and resurrection of the spring in June or July. The first heavy fall is usually from about two to four feet in depth. Then, with intervals of splendid sunshine, storm succeeds storm, heaping snow on snow, until thirty to fifty feet has fallen. But on account of its settling and compacting, and the almost constant waste from melting and evaporation, the average depth actually found at any time seldom exceeds ten feet in the forest region, or fifteen feet along the slopes of the summit peaks.

Even during the coldest weather evaporation never wholly ceases, and the sunshine that abounds between the storms is sufficiently powerful to melt the surface more or less through all the winter months. Waste from melting also goes on to some extent on the bottom from heat stored up in the rocks, and given off slowly to the snow in contact with them, as is shown by the rising of the streams on all the higher regions after the first snow-fall, and their steady sustained flow all winter.

The greater portion of the snow deposited around the lofty summits of the range falls in small crisp flakes and broken crystals, or, when accompanied by strong winds and low temperature, the crystals, instead of being locked together in their fall to form tufted flakes, are beaten and broken into meal and fine dust. But down in the forest region the greater portion comes gently to the ground, light and feathery, some of the flakes in mild weather being nearly an inch in diameter, and it is evenly distributed and kept from drifting to any great extent by the shelter afforded by the large trees. Every tree during the progress of gentle storms is loaded with fairy bloom at the coldest and darkest time of year, bending the branches, and hushing every singing needle. But as soon as the storm is over, and the sun shines, the snow at once begins to shift and settle and fall from the branches in miniature avalanches, and the white forest soon becomes green again. The snow on the ground also settles and thaws every bright day, and freezes at night, until it becomes coarsely granulated, and loses every trace of its rayed crystalline structure, and then a man may walk firmly over its frozen surface as if on ice. The forest region up to an elevation of 7000 feet is usually in great part free from snow in June, but at this time the higher regions are still heavy-laden, and are not touched by spring weather to any considerable extent before the middle or end of July.

One of the most striking effects of the snow on the mountains is the burial of the rivers and small lakes.

*As the snow falls in the river
A moment white, then lost forever,*

sang Burns, in illustrating the fleeting character of human pleasure. The first snowflakes that fall into the Sierra rivers vanish thus suddenly; but in great storms, when the temperature is low, the abundance of the snow at length chills the water nearly to the freezing-point, and then, of course, it ceases to melt and consume the snow so suddenly. The falling flakes and crystals form cloud-like masses of blue sludge, which are swept forward with the current and carried down to warmer climates many miles distant, while some are lodged against logs and rocks and projecting points of the banks, and last for days, piled high above the level of the water, and show white again, instead of being at once "lost forever," while the rivers themselves are at length lost for months during the snowy period. The snow is first built out from the banks in bossy, over-curling drifts, compacting and cementing until the streams are spanned. They then flow in the dark beneath a continuous covering across the snowy zone, which is about thirty miles wide. All the Sierra rivers and their tributaries in these high regions are thus lost every winter, as if another glacial period had come on. Not a drop of running water is to be seen

excepting at a few points where large falls occur, though the rush and rumble of the heavier currents may still be heard. Toward spring, when the weather is warm during the day and frosty at night, repeated thawing and freezing and new layers of snow render the bridging-masses dense and firm, so that one may safely walk across the streams, or even lead a horse across them without danger of falling through. In June the thinnest parts of the winter ceiling, and those most exposed to sunshine, begin to give way, forming dark, rugged-edged, pit-like sinks, at the bottom of which the rushing water may be seen. At the end of June only here and there may the mountaineer find a secure snow-bridge. The most lasting of the winter bridges, thawing from below as well as from above, because of warm currents of air passing through the tunnels, are strikingly arched and sculptured; and by the occasional freezing of the oozing, dripping water of the ceiling they become brightly and picturesquely icy. In some of the reaches, where there is a free margin, we may walk through them. Small skylights appearing here and there, these tunnels are not very dark. The roaring river fills all the arching way with impressively loud reverberating music, which is sweetened at times by the ouzel, a bird that is not afraid to go wherever a stream may go, and to sing wherever a stream sings.

All the small alpine pools and lakelets are in like manner obliterated from the winter landscapes, either by being first frozen and then covered by snow, or by being filled in by avalanches. The first avalanche of the season shot into a lake basin may perhaps find the surface frozen. Then there is a grand crashing of breaking ice and dashing of waves mingled with the low, deep booming of the avalanche. Detached masses of the invading snow, mixed with fragments of ice, drift about in sludgy, island-like heaps, while the main body of it forms a talus with its base wholly or in part resting on the bottom of the basin, as controlled by its depth and the size of the avalanche. The next avalanche, of course, encroaches still farther, and so on with each in succession until the entire basin may be filled and its water sponged up or displaced. This huge mass of sludge, more or less mixed with sand, stones, and perhaps timber, is frozen to a considerable depth, and much sun-heat is required to thaw it. Some of these unfortunate lakelets are not clear of ice and snow until near the end of summer. Others are never quite free, opening only on the side opposite the entrance of the avalanches. Some show only a narrow crescent of water lying between the shore and sheer bluffs of icy compacted snow, masses of which breaking off float in front like ice-bergs in a miniature Arctic Ocean, while the avalanche heaps leaning back against the mountains look like small glaciers. The frontal cliffs are in some instances quite picturesque, and with the berg-dotted waters in front of them lighted with sunshine are exceedingly beautiful. It often happens that while one side of a lake basin is hopelessly snow-buried and frozen, the other, enjoying sunshine, is adorned with beautiful flower-gardens. Some of the smaller lakes are extinguished in an instant by a heavy avalanche either of rocks or snow. The rolling, sliding, ponderous mass entering on one side sweeps across the bottom and up the opposite side, displacing the water and even scraping the basin clean, and shoving the accumulated rocks and sediments up the farther bank and taking full possession. The dislodged water is in part absorbed, but most of it is sent around the front of the avalanche and down the channel of the outlet, roaring and hurrying as if frightened and glad to escape.

Snow-Banners

The most magnificent storm phenomenon I ever saw, surpassing in showy grandeur the most imposing effects of clouds, floods, or avalanches, was the peaks of the High Sierra, back of Yosemite Valley, decorated with snow-banners. Many of the starry snow-flowers, out of which these banners are made, fall before they are ripe, while most of those that do attain perfect development as six-rayed crystals glint and chafe against one another in their fall through the frosty air, and are broken into fragments. This dry fragmentary snow is still further prepared for the formation of banners by the action of the wind. For, instead of finding rest at once, like the snow which falls into the tranquil depths of the forests, it is rolled over and over, beaten against rock-ridges, and swirled in pits and hollows, like boulders, pebbles, and sand in the pot-holes of a river, until finally the delicate angles of the crystals are worn off, and the whole mass is reduced to dust. And whenever storm-winds find this prepared snow-dust in a loose condition on exposed slopes, where there is a free upward sweep to leeward, it is tossed back into the sky, and borne onward from peak to peak in the form of banners or cloudy drifts, according to the velocity of the wind and the conformation of the slopes up or around which it is driven. While thus flying through the air, a small portion makes good its escape, and remains in the sky as vapor. But far the greater part, after being driven into the sky again and again, is at length locked fast in bossy drifts, or in the wombs of glaciers, some of it to remain silent and rigid for centuries before it is finally melted and sent singing down the mountainsides to the sea.

Yet, notwithstanding the abundance of winter snow-dust in the mountains, and the frequency of high winds, and the length of time the dust remains loose and exposed to their action, the occurrence of well-formed banners is, for causes we shall hereafter note, comparatively rare. I have seen only one display of this kind that seemed in every way perfect. This was in the winter of 1873, when the snow-laden summits were swept by a wild "norther." I happened at the time to be wintering in Yosemite Valley, that sublime Sierra temple where every day one may see the grandest sights. Yet even here the wild gala-day of the north wind seemed surpassingly glorious. I was awakened in the morning by the rocking of my cabin and the beating of pine-burs on the roof. Detached torrents and avalanches from the main wind-flood overhead were rushing wildly down the narrow side cañons, and over the precipitous walls, with loud resounding roar, rousing the pines to enthusiastic action, and making the whole valley vibrate as though it were an instrument being played.

But afar on the lofty exposed peaks of the range standing so high in the sky, the storm was expressing itself in still grander characters, which I was soon to see in all their glory. I had long been anxious to study some points in the structure of the ice-cone that is formed every winter at the foot of the upper Yosemite fall, but the blinding spray by which it is invested had hitherto prevented me from making a sufficiently near approach. This morning the entire body of the fall was torn into gauzy shreds, and blown horizontally along the face of the cliff, leaving the cone dry; and while making my way to the top of an overlooking ledge to seize so favorable an opportunity to examine the interior of the cone, the peaks of the Merced group came in sight over the shoulder of the South Dome, each waving a resplendent banner against the blue sky, as regular in form, and as firm in texture, as if woven of fine silk. So rare and splendid a phenomenon, of course, overbore all other considerations, and I at once let the ice-cone go, and began to force my way out of the valley to some dome or ridge sufficiently lofty to command a general view of the main summits, feeling assured that I should find them bannered still more gloriously; nor was I in the least disappointed. Indian Cañon, through which I climbed, was choked with snow that had been shot down in avalanches from the high cliffs on either side, rendering the ascent difficult; but inspired by the roaring storm, the tedious wallowing brought no fatigue, and in four hours I gained the top of a ridge above the valley, 8000 feet high. And there in bold relief, like a clear painting, appeared a most imposing scene. Innumerable peaks, black and sharp, rose grandly into the dark blue sky, their bases set in solid white, their sides streaked and splashed with snow, like ocean rocks with foam; and from every summit, all free and unconfused, was streaming a beautiful silky silvery banner, from half a mile in length, slender at the point of attachment, then widening gradually as it extended from the peak until it was about 1000 or 1500 feet in breadth, as near as I could estimate. The cluster of peaks called the "Crown of the Sierra," at the head of the Merced and Tuolumne rivers,—Mounts Dana, Gibbs, Connes, Lyell, Maclure, Ritter, with their nameless compeers,—each had its own refulgent banner, waving with a clearly visible motion in the sunglow, and there was not a single cloud in the sky to mar their simple grandeur. Fancy yourself standing on this Yosemite ridge looking eastward. You notice a strange garish glitter in the air. The gale drives wildly overhead with a fierce, tempestuous roar, but its violence is not felt, for you are looking through a sheltered opening in the woods as through a window. There, in the immediate foreground of your picture, rises a majestic forest of Silver Fir blooming in eternal freshness, the foliage yellow-green, and the snow beneath the trees strewn with their beautiful plumes, plucked off by the wind. Beyond, and extending over all the middle ground, are somber swaths of pine, interrupted by huge swelling ridges and domes; and just beyond the dark forest you see the monarchs of the High Sierra waving their magnificent banners. They are twenty miles away, but you would not wish them nearer, for every feature is distinct, and the whole glorious show is seen in its right proportions. After this general view, mark how sharply the dark snowless ribs and buttresses and summits of the peaks are defined, excepting the portions veiled by the banners, and how delicately their sides are streaked with snow, where it has come to rest in narrow flutings and gorges. Mark, too, how grandly the banners wave as the wind is deflected against their sides, and how trimly each is attached to the very summit of its peak, like a streamer at a masthead; how smooth and silky they are in texture, and how finely their fading fringes are penciled on the azure sky. See how dense and opaque they are at the point of attachment, and how filmy and translucent toward the end, so that the peaks back of them are seen dimly, as though you were looking through ground glass. Yet again observe how some of the longest, belonging to the loftiest summits, stream perfectly free all the way across intervening notches and passes from peak to peak, while others overlap and partly hide each other. And consider how keenly every particle of this wondrous cloth of snow is flashing out jets of light. These are the main features of the beautiful and terrible picture as seen from the forest window; and it would

still be surpassingly glorious were the fore-and middle-grounds obliterated altogether, leaving only the black peaks, the white banners, and the blue sky.

Glancing now in a general way at the formation of snow-banners, we find that the main causes of the wondrous beauty and perfection of those we have been contemplating were the favorable direction and great force of the wind, the abundance of snow-dust, and the peculiar conformation of the slopes of the peaks. It is essential not only that the wind should move with great velocity and steadiness to supply a sufficiently copious and continuous stream of snow-dust, but that it should come from the north. No perfect banner is ever hung on the Sierra peaks by a south wind. Had the gale that day blown from the south, leaving other conditions unchanged, only a dull, confused, fog-like drift would have been produced; for the snow, instead of being spouted up over the tops of the peaks in concentrated currents to be drawn out as streamers, would have been shed off around the sides, and piled down into the glacier wombs. The cause of the concentrated action of the north wind is found in the peculiar form of the north sides of the peaks, where the amphitheaters of the residual glaciers are. In general the south sides are convex and irregular, while the north sides are concave both in their vertical and horizontal sections; the wind in ascending these curves converges toward the summits, carrying the snow in concentrating currents with it, shooting it almost straight up into the air above the peaks, from which it is then carried away in a horizontal direction.

This difference in form between the north and south sides of the peaks was almost wholly produced by the difference in the kind and quantity of the glaciation to which they have been subjected, the north sides having been hollowed by residual shadow-glaciers of a form that never existed on the sun-beaten sides.

It appears, therefore, that shadows in great part determine not only the forms of lofty icy mountains, but also those of the snow-banners that the wild winds hang on them.

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