12-1-1880

The Ancient Glaciers of the Sierra.

John Muir

Follow this and additional works at: https://scholarlycommons.pacific.edu/jmb

Recommended Citation
https://scholarlycommons.pacific.edu/jmb/192

This Article is brought to you for free and open access by the John Muir Papers at Scholarly Commons. It has been accepted for inclusion in John Muir: A Reading Bibliography by Kimes by an authorized administrator of Scholarly Commons. For more information, please contact mgibney@pacific.edu.
which she had arisen perfectly forgetful of me, of her marriage, of all but the haunting consciousness of a rooted sorrow. Her father had died abroad, and her mother and sister returned to find that the estate had melted away in the settlement, and now they were taking scholars. Neil seemed to understand their position, but any intellectual employment distressed her since her illness; so, with the influence of her father’s friends, she had taken up her present occupation. She clung to our little house as her home, and they rented two of the sunniest rooms for her. She was fad- ing rapidly; was unfit for any work, especially for the confinement of sewing, but she would not relinquish the pleasure of adding something to the family treasury. I determined that she should have rest; and, braving the black looks and hatred of her family, bent my prude to persuade them of my affection and repentance, and to beg that my wife should be given back into my keeping. I took what employment I could get—not elevated nor elevating—and put my poor girl into more secluded and commodious rooms; and, with a physician’s aid, strove to bring her back to life and memory. She seemed to know that she could not live long, but deprecated whatever was done for her, imagining all to be the work of her mother and sister, and they never tried to make her comprehend my return; but I waited in patience, with an aching heart. At night, when she slept, I used to sit by her bedside, when she once said. “When I am dead at last, bury me with red flowers, half-faded, fiery blossoms, full of bitter summer.”

The fine lips press restfully upon each other, the shadowy lids, so slow to close in sleep, are quite drooped. And the great, true heart is still, and the flame of the abounding life that I had so prodigally wasted, burned out as consumed with desire of Death’s strange eyes.

And I rave impotently, O my well beloved! while your untamed, long-imprisoned soul rejoices to spurn its cage and be at liberty. You have been stretched out upon the rack of this tough world, but the torture is over. The cry of my heart is as old as the sin of the world: “My punishment is greater than I can bear.”

PHILIP SHIRLEY.

THE ANCIENT GLACIERS OF THE SIERRA.

All California has been heavily glaciated, the broad plains and valleys so warm and fertile now, and the coast ranges and foothills, covered with forests and chaparral, as well as the bald, rocky summits of the Sierra Nevada, swelling high in the cold sky.

Go where you may, throughout the length and breadth of the State, unmistakable evidence is everywhere presented of the former existence of an ice-sheet, thousands of feet in thickness, beneath whose heavy folds all the present landscapes have been molded; while on both flanks of the Sierra we find the fresher and more appreciable traces of the individual glaciers, or ice-rivers, into which that portion of the ice-sheet which covered the range was divided toward the close of the glacial period.

No other mountain chain on the globe seems to be so rich in emphatic, well preserved glacial monuments, easily seen by anybody capa-
ble of looking. Every feature is more or less glacial. Not a peak, ridge, dome, or mere rock, *cañon*, lake-basin, forest, or stream, but in some way explains the past existence and modes of action of flowing, grinding ice. For, notwithstanding the post-glacial agents—the air, rain, snow, frost, rivers, etc.—have been incessantly at work upon the greater portion of the range for tens of thousands of stormy years, each engraving their own characters more and more deeply over those of the ice, the latter are so enduring and so heavily emphasized, they still rise in sublime relief, clear and legible, through every after inscription, whether of the mighty avalanche, the torrent, or universal, eroding atmosphere. To-day, in higher latitudes, the great glacial winter still prevails in all its cold, white grandeur. The unborn landscapes of North Greenland, and some of those of our own Alaska, are still being fashioned beneath a deep, slow-crawling mantle of ice, from a quarter of a mile to more than a mile in thickness, presenting noble illustrations of the ancient condition of California, when all its sublime scenery was sealed up, or in process of formation. On the Himalaya, and the mountains of Norway and Switzerland, and on most of those of Alaska, the ice-mante has been melted away from the ridges and table-lands, where it was thinnest, thus separating it into distinct glaciers that flow, river-like, through the valleys, illustrating a similar past condition in the Sierra, when every *cañon* and valley was the channel of an ice-stream, all of which may be easily traced back to where their fountains lay in the recesses of the alpine summits, and where some sixty-five of their topmost residual branches still linger beneath cool shadows.

The transition from one to the other of those glacial conditions was gradual and shadow-like. When the great cycle of cold, snowy years—called the glacial period—was nearly complete, the ice-mante, wasting from season to season faster than it was renewed, began to withdraw from the lowlands along the base of the range, and gradually became shallower everywhere. Then the highest of the granite domes began to appear above the icy sea, and, long, dividing ridges, containing distinct glaciers, between them. These glaciers at first remained united in one continuous sheet toward the summit of the range for many centuries. But as the snow-fall diminished, and the climate became milder, this upper ice-sheet was also in turn separated into distinct glaciers, and these again into smaller ones, as one tributary after another was cut off from its trunk and became independent; while at the same time all were growing shorter and shallower, though fluctuations of the climate would now and then occur which would bring the receding snouts to a stand-still, or even enable them to advance for a few tens or hundreds of years, when they would again begin to recede.

In the meantime the plants were coming on, the hardest species establishing themselves on the moraine soils and in fissures of the rocks, pushing upward along every sun-warmed slope, and following close upon the retreating ice, which, like shreds of summer slope, at length vanished from the new-born mountains, leaving them in all their main telling features nearly as we find them now.

It will be seen, therefore, that the lowlands near the level of the sea, and the foothills, and the tops of the highest domes and ridges, were the first to see the light, and therefore have been longer exposed to post-glacial weathering. Accordingly, we find that their glacial characters are more worn and obscured than those of the higher regions, though all are still legible to the patient student.

**GLACIER PAVEMENTS.**

By far the most striking and attractive of the glacial phenomena presented to the non-scientific observer in the Sierra are the polished glacier pavements, because they are so beautiful, and their beauty is of so rare a kind, so unlike any portion of the loose, earthy lowlands where people make homes and earn their bread. They are simply flat or gently undulating areas of solid granite, which present the unchanged surface upon which the ancient glaciers flowed, and are found in the most perfect condition in the sub-alpine region, at an elevation of from eight thousand to nine thousand feet. Some are miles in extent, only slightly interrupted by spots that have given way to the weather, while the best preserved portions are bright and stainless as the sky, reflecting the sunbeams like glass, and shining as if polished afresh every day, notwithstanding they have been exposed to corroding rains, dew, frost, and snow for thousands of years.

The attention of the game-seeking and gold-seeking mountaineer is seldom commanded by other glacial phenomena, as moraines, however regular and artificial in form, or *cañons*, however deep, or strangely modeled rocks, however high and sheer; but when he comes to these bare pavements he stoops and rubs his hand admiringly on their shining surfaces, and tries hard to account for their mysterious smoothness and brilliancy. He may have seen the winter avalanches of snow descending in awful majesty through the woods, sweeping away the trees

**THE ANCIENT GLACIERS OF THE SIERRA.**
that stood in their way like slender weeds, but concludes that this cannot be the work of avalanches, because the scratches and fine polishing strie show that the agent, whatever it was, moved along, and up over the rocks, as well as downward. Neither can he see how water may possibly have been the agent, for he finds the same strange polish upon lofty, isolated tables beyond the reach of any conceivable flood. Only the winds seem capable of moving across the face of the country in the directions indicated by the scratches and grooves. Even dogs and horses, when first led up the mountains, study geology to this extent, that they gaze wonderingly at the strange brightness of the ground, and smell it, and place their feet cautiously upon it, as if afraid of falling or sinking.

In the production of this admirable hard finish, the glaciers, in many places, bored down with a pressure of more than a hundred tons to the square foot, slipping, and pressing, and planing down granite, slate, and quartz alike, and bringing out the veins and crystals of the rocks with beautiful distinctness. Most of the granite below the sources of the Tuolumne and Merced is porphyritic, the feldspar crystals in many places forming the greater part of the rock, and these, when planed off level with the general surface, give rise to a beautiful mosaic, and when the sunlight falls upon it the multitude of starry crystals shining at different angles make a blaze of white beams, as if the ground were covered with burnished silver.

The brightest and most elaborately finished of the Sierra landscapes lie on the headwaters of the Tuolumne and Merced, above Yosemite Valley. The mountains, both to the north and south of this region, were, perhaps, subjected to about as long and intense a glaciation; but, because the rocks are less resisting, their polished surfaces have succumbed to the attacks of the weather, leaving only here and there small, imperfect patches. The lowest remnants of the old glacial surface are about from three thousand to five thousand feet above the level of the sea, and thirty to forty miles from the axis of the range, on the west flank. The short, steeply inclined canons of the eastern flank also contain enduring montoned bosses, and sloping aprons, brilliantly striated and finished, but these are far less magnificent than those of the broad western flank.

Perhaps the one best general view of these brilliant landscapes, that is easily accessible, and comprehends specimens of all the more striking of the glacial characters, is to be had from the top of a lofty conoidal rock that I have called the Glacier Monument. It is a majestic monolith of porphyry, about fifteen hundred feet high, situated on the left bank of the ancient Tuolumne mer de glace, a short distance to the north of Cathedral Peak. At first sight it seems absolutely inaccessible, though a good climber will find that it may be scaled on the south side. Approaching it on this side, you pass through a beautiful spruce forest growing on the lateral moraine, catching glimpses now and then of what appears to be a perfect cone of granite, towering to an immense height above the dark evergreens; and when at length you have made your way across the woods, wading through thickets of azalea and ledeum, you step abruptly out of the tree shadows and leafy, mossy softness, upon a naked curve of porphyry, that forms the base of the monument, which is now beheld unveiled in all its grandeur. Fancy a well proportioned monument, of comprehensible size, say eight or ten feet high, formed of one stone, exquisitely finished, and set, not in a graveyard, but in a wild pleasure-ground. Now, magnify it to a hight of fifteen hundred feet, retaining its simplicity of form, and fineness, and brilliancy, and fill its surface with crystals; then you may have some conception of the rare beauty and sublimity of this ice-burnished cone, one of the noblest monuments of the glacial period to be found in the range.

In making the ascent we find that the curves of the base rapidly steepen, but the feldspar crystals, two or three inches long, having offered greater resistance to atmospheric erosion than the mass of the rock in which they are imbedded, have been brought into relief, roughening the surface here and there, and offering slight footholds, while some of them have been weathered out altogether, and rolled to the bottom, forming a glittering ring around the base. And it is interesting to observe that, after the outer layer of crystals, whose upper surfaces formed part of the original glaciated surface, have been weathered out, the lower layers, as they successively come to the surface, unprotected by the glacier polish, have but little superior power of resisting disintegration, and, therefore, the whole surface is subsequently weathered off at about the same general rate.

The summit of the monument is burnished and scored like the sides and base, the scratches and strie indicating that the mighty glacier of the Tuolumne Basin overwhelmed it while it lay dark and steadfast beneath the crystal flood, like a boulder at the bottom of a river. How enormous the pressure it withstood! Had it been less solidly built, it would have been carried away—ground into moraine fragments, like the adjacent rock in which it lay imbeded; for it is only a residual knot, brought into relief by the removal of the less resisting rock about it.
an illustration in stone of the survival of the strongest and most favorably situated.

Hardly less wonderful is its present unwasted condition, when we contemplate the long, dark procession of storms that have fallen upon it since first its crown rose above the icy sea. The whole quantity of post-glacial wear and tear it has suffered has not degraded it a single inch, as may readily be shown by measuring from the level of the polished portions of the surface.

A few erratic boulders, nicely poised on the rounded summit, tell an interesting story, for they came from the alpine peaks twelve miles away, drifting like chips on the frozen sea, and were stranded here, while their companions, whose positions chanced to be above the slopes of the sides, where they could not come to rest, were carried farther on by falling back on the shallowing ice.

The general view from the summit consists of a sublime assemblage of ice-born rocks and mountains, lakes and meadows, and moraines covered with forests and groves—hundreds of square miles of them—built together into one of the brightest and most openly harmonious landscapes to be found in all the range. The alps rise grandly along the sky to the east, the gray pillared slopes of the Hoffmann Range toward the west, and a billowy sea of shining montoned rocks seem, from their peculiar sculpture, to roll on westward in the middle ground. Immediately beneath you are the Big Tuolumne Meadows, eight miles long, with an ample swath of dark, pine woods on either side, stretching east and west, enlivened by the young glistening river that is seen coming fresh from its fountain snow, tracing the lowest portion of the ancient Tuolumne mer de glace, which, during the snow period, was lavishly flooded by many a noble affluent from the ice-laden flanks of Mounts Dana, Lyell, Maclure, Ord, Gibbs, Conness, and others that are yet nameless. The mer de glace thus formed was over four miles wide, and poured its majestic outflowing current full against the end of the Hoffmann Range, which divided and deflected it to right and left, just as a river of water is divided against an island that stands in the middle of its current. Two distinct glaciers were thus formed, one of which flowed through the great Tuolumne Cañon and Hetch Hetchy Valley, while the other swept upward for five hundred feet in a broad current across the divide between the basins of the Tuolumne and Merced, into the Tenaya Basin, and thence down the Tenaya Cañon into Yosemite Valley.

The map-like distinctness and freshness of this glacial landscape cannot fail to excite the attention of every beholder, no matter how little its scientific significance may be recognized. These bald, westward-leaning rocks, with their rounded backs and shoulders toward the glacier fountains, and their split, angular fronts looking in the opposite direction, explained the tremendous grinding force with which the glaciers passed over them, and also the direction whence the glaciers flowed; and the mountain peaks around the sides of the upper general Tuolumne Basin, with their sharp, unglaciated summits and polished, rounded sides, indicate the hight to which the glaciers rose; while the numerous moraines, curving and swaying in beautiful lines, mark the boundaries of the main trunk and its subordinate tributaries as they existed toward the close of the glacial winter just before they vanished. None of the great commercial highways of the land or sea, marked with buoys and lamps, fences and guide-boards, is so unmistakably indicated as are these abandoned pathways of the vanished Tuolumne glaciers.

I would like now to offer some nearer views of a few characteristic specimens of these old dead ice-streams, which have exerted so profound an influence on the scenery of the mountains, and concerning which so little is generally known, though it is not easy to make a selection from so vast a system so intimately inter-blended. The main affluents of the great Merced glacier are perhaps best suited to our purpose, because their basins, upon which their histories are vividly portrayed, are more approachable to the general traveler, and are comparatively well defined. They number five, and may well be called Yosemite glaciers, since they were the agents by which beauty-loving nature created the grand valley, grinding and fashioning it out of the solid flank of the range, block by block, particle by particle, with sublime deliberation and repose.

The names I have given them are, beginning with the northmost, Yosemite Creek, Hoffmann, Tenaya, South Lyell, and Illilouette Glaciers. These all converged in admirable poise around from north-east to south-east, welding themselves together into one huge trunk which swept down through the valley, filling it brimful from end to end, receiving small tributaries on its way from the Indian, Sentinel, and Pohono Caños; and at length flowed out of the valley, and on down the range in a general westerly direction. At the time that the tributaries mentioned above were well defined as to their boundaries, the upper portion of the valley walls, and the highest rocks about them, such as the Domes, the uppermost of the Three Brothers, and the Sentinel, rose above the surface of the ice. But during the valley's earlier history,
all its rocks, however lofty, were buried beneath a continuous sheet, which swept on above and about them like the wind, the upper portion of the current flowing steadily, while the lower portion went maz ing and sw eeding down in the crooked, dome-blocked ca liones. Every glacier of the Sierra fluctuated in width and depth and length, and consequently in degree of individuality, down to the latest glacial days. It must, therefore, be borne in mind that the following descriptions apply only to their separate condition, and to that phase of their separate condition that they presented toward the close of the period when most of their work was done, and all the more telling features of the valley and the region adjacent were already brought into relief.

THE YOSEMITE CREEK GLACIER.

The broad, many-fountained glacier to which the present Yosemite Creek Basin belonged, was about fourteen miles in length by four or five in width, and from five hundred to a thousand feet deep. Its principal tributaries, drawing their sources from fountains set far back among the northern spurs of the Hoffman Range, at first pursued a westerly course; then, uniting with each other, and absorbing a series of short affluents from the western rim of the basin, the trunk thus formed swept around to the southward in a magnificent curve, and poured its ice over the north wall of Yosemite in cascades two miles wide.

This broad and comparatively shallow glacier formed a sort of crawling, wrinkled ice-cloud, that gradually became more regular in shape and river-like as it grew older. Encircling peaks began to overshadow its highest fountains, rock islets rose here and there amid its ebbing currents, and its picturesque banks, adorned with domes and battlements, extended in massive grandeur down to the brink of the Yosemite walls. When the long winter had nearly passed, the main trunk, melting and ebbing from season to season, at length vanished altogether in the sunshine, and a multitude of waiting plants made their way into the new grounds prepared for them.

In the meantime the chief Hoffman tributaries, slowly receding to the shelter of their fountain shadows, continued to live and work independently, spreading garden soils, deepening lake basins, and giving finishing touches to the sculpture of their fountain rocks. At length these also vanished, and the whole basin is now full of light. Forests flourish luxuriantly upon its ample moraines, lakes and meadows nestle everywhere amid its shining rocks, and a thou-
sand gardens, filled with the fairest flowers, are blooming along the banks of its streams.

THE HOFFMANN GLACIER.

The short, swift-flowing Hoffmann Glacier offered a striking contrast to the one just described, both in appearance and manner of working. The erosive energy of the latter was diffused over a wild field of sunken, bowlder-like domes and ridges. The Hoffmann Glacier, on the contrary, moved right ahead on a comparatively smooth surface, making a descent of nearly five thousand feet in five miles, steadily contracting and deepening its current, and finally thrusting itself between the Yosemite domes in the form of a solid wedge of ice.

The concentrated action of this energetic glacier, combined with the Tenaya, accomplished the greater portion of the disinterment and sculpture of the great Half Dome, North Dome, and the rocks adjacent to them. Its fountains, extended along the southern slopes of the Hoffmann Range, gave birth to a series of short, fan-shaped tributaries, separated from each other by picturesque walls, that are built of massive granite blocks, bedded and jointed like masonry.

The story of its death is not unlike that of its companion, already described, though the declivity of its channel, and its uniform exposure to sun-heat, prevented any considerable portion of its current from becoming torpid. It was first burned off on its lower course, slowly withdrawing, and lingering only well up on the mountain slopes, beneath its fountains, to finish their sculpture, and encircle them with a zone of moraine soil for forests and gardens.

The gray slopes of Mount Hoffmann are singularly barren and forbidding in aspect, but the traveler who is so hopeful as to ascend them will find there some of the very loveliest of the Sierra gardens. The lower banks and braes of the basin toward Yosemite are richly planted with chaparral, which yields a lavish abundance of bloom and berries, and is, therefore, a favorite place of resort for bees and bears, while the middle region is heavily wooded with silver-firs. Nowhere in all this wonderful region will you find more beautiful trees and shrubs and flowers. Nowhere will you find the cold traces of glaciers more warmly clothed with life and light.

THE TENAYA GLACIER.

The Tenaya Glacier was rugged, and broken up with yawning crevices and ice-falls, on account of the extreme hardness and solidity of the ridges it had to pass over.
Instead of drawing its sources directly from the summit of the range, it formed, as we have seen, one of the outlets of the Tuolumne *mer de glace*, issuing from this noble fountain like a river from a lake, two miles wide, about fourteen long, and from five hundred to fifteen hundred feet deep.

In leaving its source, it first flowed upward about five hundred feet over the divide between the waters of the Tuolumne and Merced, into the basin of Lake Tenaya. Hence, after contracting its wide current, which had been partially separated in crossing the divide, and receiving a strong affluent from the fountains about Cathedral Peak, it began to move with renewed vigor, pouring its massive flood over the south-western rim of the Tenaya Basin in splendid cascades. Then, crushing heavily against the Cloud's Rest ridge, it curved toward the west, compressed and welded its creviced current, and bore down upon the Yosemite domes with its whole concentrated energy.

Toward the end of the ice period, while its Hoffmann companion continued to grind rock-meal for coming plants, the whole trunk of the Tenaya Glacier became torpid, and vanished, exposing wide areas of rolling rock-waves and glistening pavements, on whose channelless surface water ran wild and free. And because the main trunk vanished almost simultaneously throughout its whole extent, we, of course, do not find terminal moraines curved across its channels; nor, since its banks are, in most places, too steeply inclined to admit of the deposition of moraine matter, do we find much of the two main laterals. The lowest of the residual glaciers belonging to this basin was developed beneath the shadow of the Yosemite Half Dome. Others were formed along the base of Coliseum Peak, on the south side of Lake Tenaya, and along the precipitous wall extending from the lake to the Big Tuolumne Meadows. The latter, on account of the uniformity and continuity of their protecting shadows, formed moraines of considerable length and regularity, that are liable to be mistaken for portions of the left lateral of the main glacier.

The pathway of this grand old glacier is noted for the depth of its cañon, the beauty of its lakes and cascades, and the extent of its resplendent glacier pavements.

**THE SOUTH LYELL, OR NEVADA GLACIER.**

The South Lyell Glacier was longer and more symmetrical than the last, and the only one of the Merced system whose sources extended directly back to the main summits on the axis of the range. Its numerous ice-wombs, now most-ly barren, are ranged side by side in three distinct series, at an elevation of from ten to twelve thousand feet above the sea. The first series on the right side of the basin extends from the Matterhorn to Cathedral Peak. That on the left extends through the Merced group, and these two parallel series are united by a third, which extends around the head of the basin in a direction at right-angles to that of the others.

The three ranges of summits in which these fountain-wombs are laid, together with the Cloud's Rest ridge, nearly inclose a rectangular basin, that was once a massive *mer de glace*, leaving an outlet toward the west opposite to the most fruitful of the fountains. The grand trunk glacier, lavishly filled by the tributaries derived from these numerous ice-wombs, was from three-fourths of a mile to a mile and a half wide, fifteen miles long, and from one thousand to fifteen hundred feet deep.

After flowing in a north-westerly direction for a few miles, it swerved to the left, and poured its shattered cascading current into Yosemite Valley between the Half Dome and Mount Starr, King.

Could we have visited Yosemite Valley at this period of its history, we should have found its ice cascades vastly more glorious than their tiny water representatives of the present day. One of the grandest of these was formed by that portion of the Lyell Glacier that fell over the shoulder of Half Dome.

This glacier, as a whole, resembled an oak, with a gnarled, swelling base and wide-spread branches. Picturesque rocks of every conceivable form adorn its banks, among which glistened the numerous tributaries, mottled with black and gray boulders, from the fountain-peaks, while ever and anon, as the deliberate centuries passed away, some dome raised its burnished crown above the ice to enrich the slowly opening landscape.

The principal moraines occur in short, irregular sections, scattered along the sides of the *cañons*, without manifesting subordination to any system. This fragmentary condition is due to interruptions, caused by portions of the sides of the *cañons* being too steep for moraine matter to lie on, and to the breaking and down-washing of torrents and avalanches, while the obscurity resulting from these is still further augmented by forests and their underbrush, making a patient study of details indispensable to the recognition of their real unity and grandeur.

The left lateral of the trunk may be traced about five miles from the mouth of the first main tributary to the Illilouette Cañon. The corresponding section of the right lateral, ex-
tending from Cathedral tributary to the Half Dome, is more complete because of the evenness of the ground. A short side-glacier came in against it from the slopes of Cloud's Rest; but, being fully exposed to the sun, it was melted long before the main trunk, allowing the latter to deposit this portion of its moraine undisturbed. Some conception of the size and appearance of this fine moraine may be gained by following the Cloud's Rest trail from Yosemite, which crosses it obliquely and conducts past several sections made by streams. Slate boulders may be seen that must have come from the Lyell group, twelve miles distant. But the bulk of the moraine is composed of granite and porphyry, the latter derived from Feldspar and Cathedral Valleys.

On the sides of the moraines we find a series of terraces firmly expressed, indicating fluctuations in the level of the glacier, caused by variations of snow-fall, temperature, etc., showing that the climate of the glacial period was diversified by cycles of milder or stormier seasons similar to those of past-glacial time.

After the depth of the main trunk diminished to about five hundred feet, the greater portion became torpid, as is shown by the moraines, and lay dying in its crooked channel, like a wounded snake, maintaining for a time a feeble squirming motion in places of exceptional depth, or where the bottom of the carnon was more steeply inclined. The numerous fountain-wombs, however, continued fruitful long after the trunk had vanished, giving rise to an imposing array of short residual glaciers, extending around the rim of the general basin a distance of nearly twenty-four miles. Most of these have but recently succumbed to the new climate, dying in turn as determined by elevation, size, and exposure, leaving only a few feeble survivors beneath the coolest shadows, which are now completing the history of the South Lyell Glacier, one of the clearest and most symmetrical sheets of ice-manuscript in the Sierra.

THE ILLILLOUETTE GLACIER.

The shallow glacier that filled the Illilouette Basin more resembled a lake than a river of ice, being nearly half as wide as it was long. Its greatest length was about ten miles, and its depth perhaps nowhere much exceeded eight hundred or a thousand feet. Its chief fountains, ranged along the west side of the Merced group, at an elevation of about ten thousand feet, gave birth to fine tributaries that flowed in a westerly direction, and united in the center of the basin. The broad trunk at first flowed north-westward, then curved to the northward, deflected by the lofty wall forming its western bank, and finally united with the grand Yosemite trunk, opposite Glacier Point.

All the phenomena relating to glacial action in this basin are remarkably simple and orderly, on account of the sheltered positions occupied by its ice-fountains, with reference to the disturbing effects of larger glaciers from the axis of the main range earlier in the period. From the eastern base of the Starr King cone, you may obtain a fine view of the principal moraines sweeping grandly out into the middle of the basin from the shoulders of the peaks, between which the ice-fountains were laid. The right lateral of the tributary which took its rise between Red and Black Mountains measures two hundred and fifty feet in height at its upper extremity, and displays three well defined terraces, similar to those of the South Lyell Glacier.

The comparative smoothness of the uppermost terrace shows that it is considerably more ancient than the others, many of the boulders of which it is composed having crumbled. A few miles to the westward, this moraine has an average slope of twenty-seven degrees, and an elevation above the bottom of the channel of six hundred and sixty feet.

Near the middle of the main basin, just where the regularly formed medial and lateral moraines flatten out and disappear, there is a remarkably smooth field of gravel, planted with *arctostaphylos*, that looks at the distance of a mile or two like a delightful meadow. Stream-sections show the gravel deposit to be composed of the same materials as the moraines, but finer, and more water-worn from the action of the converging torrents issuing from the tributary glaciers after the trunk was melted.

The southern boundary of the basin is a strikingly perfect wall, gray on the top, and white down the sides and at the base enduring snow, in which many a crystal brook takes its rise. The northern boundary is made up of smooth, undulating masses of gray granite, that rise here and there into beautiful domes, dotted with junipers and fringed around their bases with pine and silver-fir; while on the east tower the majestic fountain peaks of the Merced group, with wide *caños* and *nevés* amphitheatres between them, whose variegated rocks show out gloriously against the azure sky.

The ice-plows of this charming basin, ranged side by side in orderly gangs, furrowed the rocks with admirable uniformity, producing irrigating channels for a brood of wild streams, and abundance of rich soil adapted to every requirement of garden and grove. No other section of the Yosemite uplands is in so perfect a state of glacial cultivation. Its domes, and peaks,
and swelling rock-waves, however majestic in themselves, are yet submissively subordinate to the garden center. The other basins we have been describing are combinations of sculptured rocks, embellished with gardens and groves; the Illilouette is one grand garden and forest, embellished with rocks, each of the five beautiful in its own way, and all as harmoniously related as are the five petals of a flower. After uniting in the Yosemite Valley, and expending the down-thrusting energy derived from their combined weight and the declivity of their channels, the grand trunk flowed on out of the valley without yielding much compliance to the crooked cañon extending from the foot of the main valley proper. In effecting its exit, a considerable ascent was made, traces of which may still be seen on the abraded rocks at the lower end of the valley, while the direction pursued after leaving the valley is surely indicated by the immense lateral moraines extending from the ends of the walls, at an elevation of from fifteen hundred to eighteen hundred feet. The right moraine was disturbed by a large tributary glacier that occupied the basin of Cascade Creek, causing considerable complication in its structure. The left lateral is simple in form for several miles of its length, or to the point where a tributary came in from the south-east. But both are greatly obscured by the forests and underbrush growing upon them, and by the denuding action of rains and melting snows, etc. It is, therefore, the less to be wondered at that these moraines, forming so important a part of the chips derived from the valley rocks in the process of their formation, were not sooner recognized.

The ancient glacier systems of the Tuolumne, San Joaquin, Kern, and King's River Basins were developed on a still grander scale, and are so replete with interest that the most sketchy outline descriptions of each, with the works they have accomplished—the mountains they have brought into existence, the cañons they have furrowed, the rocks they have crushed, and worn, and scattered in moraines—would fill many a volume. Therefore, I can do but little more than invite everybody who is free to visit these interesting regions and see for themselves.

The work of glaciers, especially the part they have played in sculpturing the face of the earth, is as yet but little understood, because they have so few loving observers willing to remain with them long enough to appreciate them. Water rivers work openly where people dwell, and so does the rain and the dew, and the great salt sea embracing all the world; and even the universal ocean of air, though invisible, yet it speaks aloud in a thousand voices, and explains its modes of working and its power. But glaciers, back in their cold solitudes, work apart from men, exerting their tremendous energies in silence and darkness. Outspread, spirit-like, they brood above the long predestined landscapes, working on unwearied through unmeasured ages, until, in the fullness of time, the mountains and valleys and plains are brought forth, channels furrowed for the rivers, basins made for the lakes and meadows and long, deep arms of the sea, soils spread for the forests and the fields—then they shrink and vanish like summer clouds.

JOHN MUIR.

"UTOPIA."

The incidental mention in a rambling article recently published in THE CALIFORNIAN, of a desire to found a new city or community somewhere in the warm and roomy South-west, has brought upon me a deluge of letters.

No man who is much in earnest in this world can have either time or inclination to answer the chronic letter-writer of America. He or she is the most prolific growth of this great land. Idle-handed and empty-headed, this creature, which cheap postage and thin education has made possible, is the nuisance of the nineteenth century.

But among all these letters there are half a dozen, at least, from earnest, honest, and thoughtful people, and these letters, so far from vexing me, give the greatest encouragement—not from what they say, propose, or promise, for they are mostly merely brief inquiries, with here and there a thoughtful suggestion; yet the fact that so many solid-minded men and women are in sympathy with an enterprise of this kind shows not only its need, but that it can succeed.

I do not count Brook Farm at all a failure. Indeed, I am almost ready to reckon it the greatest success ever achieved. I know it is the custom to say that such minds as those of Fuller, Hawthorne, Ripley, Dana, Curtis, and so on, conceived Brook Farm. I think it more