

and a length of several miles, is of economic importance for polishing, packing, making explosives and other purposes.

FOLIO 17, MARYSVILLE, CALIFORNIA, 1895.

This folio consists of 2 pages of text descriptive of the Marysville tract, signed by Waldemar Lindgren and H. W. Turner, geologists, and G. F. Becker, geologist in charge; a topographic map (scale 1:125,000) of the tract, a sheet showing the areal geology, another showing the economic geology and a third exhibiting structure sections.

The Marysville tract includes the territory between the meridians $121^{\circ}30'$ and 122° and the parallels 39° and $39^{\circ}30'$, and contains 925 square miles. The tract is located near the center of the Sacramento Valley. The larger part of it is occupied by the alluvial plains of the Sacramento and Feather rivers. The extreme northeastern corner includes the first rolling foot hills of the Sierra Nevada. In the center of the tract rises the isolated mountain group of the Marysville Buttes.

The alluvial lands consist of sands, clays and gravels, deposited by the shifting currents of the streams. The foot-hill region of the northeastern corner is principally occupied by the gravels of Pleistocene and Neocene age. The area composed of the bed-rock series of the Sierra Nevada is small and consists of diabase and porphyrite. The mountain group of the Marysville Buttes is an extinct volcano of probably late Neocene age, the internal structure of which is to a certain extent laid bare by erosion. The eruptive rocks of the buttes are andesites and rhyolites. In describing the structure of the group three parts may be distinguished: First, the central core of massive andesite and rhyolite; second, the upturned sedimentary rocks surrounding the massive core, evidently brought into their present position

by the force of the ascending lavas; the sediments are of Eocene and Neocene age; third, the external ring of tuffs and breccias. The feature of greatest interest in connection with the Marysville Buttes is doubtless the presence of upturned sediments around the central core.

The shore gravels in the northeastern corner contain some gold and have been washed superficially. Somewhat auriferous gravels are also found in the upturned sediments of the Marysville Buttes. Coal and natural gas have been found in small amounts in the Marysville Buttes.

A GLACIER IN THE MONTANA ROCKIES.

THE section of the Rocky Mountains lying between the Great Northern Railway and the international boundary has thus far been but little explored. Until the advent of the railway there was such difficulty in reaching these mountains that only an occasional prospector or trapper penetrated their fastness. As access has become easier it has been growingly evident that it is a region of remarkable scenic and geological interest. Thus far it has been reached largely from the eastern side, but this has been troublesome from the fact that skirting the eastern slope of the mountains is the great Blackfoot Indian reservation, over which it is impossible to travel without much annoyance.

Several glaciers have been known to exist in these mountains and two are located upon the military maps of the department of Dakota. The largest of these is known as the Grinnell glacier from Mr. George Bird Grinnell, who has made a number of expeditions into the region and has done more than anyone else to attract attention to it. The Grinnell glacier is not easily accessible and for some time efforts have been made to discover others which could be more easily reached by the ordinary tourist. About a year and a half ago Dr.

Lyman B. Sperry, of Bellvue, Ohio, became interested in the matter and determined to organize a party for exploration. In July last the party, consisting of Dr. Sperry; Mr. A. L. Sperry, of Owatoune, Minn.; Mr. E. R. Shepard, of Minneapolis, and the writer, with guides, pack animals and camp equipage, entered the mountains. I can best convey an idea of the region by following somewhat in detail the movements of the party.

The Great Northern road crosses the mountains about forty miles south of the international boundary, following on the western side of the divide the Middle Fork of the Flathead River. Twenty miles from the summit, at Two Medicine pass, is Belton station. Here there falls into the Fork a large and rapid mountain creek. It comes from McDonald Lake, three miles away in the mountains northward. From station to lake there is a mountain road over which a buckboard travels as often as tourists call for its service. The lake is already much resorted to, since its waters afford most excellent fishing and its shore unexcelled camping places. A small steamer makes regular trips over the fifteen miles of deeply blue water. The lake has a depth of twelve hundred or more feet in some parts and its surface is thirty-four hundred feet above sea level. The mountains along the sides of the lake are covered with pines to the summit. Near the northern end are several mountains of greater altitude, their summits rising above timber line and covered with great snow fields. The most prominent of these mountains have been named Mt. Lottie Stanton, Mt. Brown, Mt. Edwards and Mt. Sperry.

At the northern end of the lake several cabins have been erected and several packers and guides have established themselves to provide horses and other necessities for travel. Our party, starting from this point, made its first essay into a small lateral

valley discovered by a prospector sent out by Dr. Sperry a year ago. In June last Dr. Sperry penetrated the valley and found the avalanches falling frequently and such masses of snow upon the ground as to preclude any careful survey or any mountain climbing. The valley is called Avalanche Basin and is twelve miles from Lake McDonald, eight miles northward along McDonald Creek, thence four miles eastward to the main divide. The Basin is three miles long by one mile wide, much of its area filled with a delightful lake. Our attention was particularly drawn to this valley, in connection with our hunt for glaciers, because the lake had that peculiar milky appearance so characteristic of glacial water. In the valley we spent two weeks. A transit instrument had been packed in, and by means of it we measured carefully the heights of the surrounding mountains. The most prominent of them was found to be from twenty-eight hundred to five thousand feet above the surface of the lake, making the loftiest between nine and ten thousand feet above the sea. On every side the evidences of former glacial action on an immense scale were to be found. The strata, of gray and greenish shales and red slates for the most part, dip to the northwest. On the south side of the valley the exposed edges are scored and polished beautifully. Behind each 'sheep back' is a dazzling little pool of mountain water. To this series of pools we gave the name of Terrace Pools. Eastward from these pools is a slope which has been ploughed over and over by the ancient glacier and is now yearly harrowed by the avalanches. We twice made the ascent of the mountain at this place, reaching a point over nine thousand feet above sea level. From this point, at the foot of a still higher and very precipitous mountain peak, looking northward can be seen numberless peaks of the main range, while westward is the very distinct secondary range which

accompanies the main range for more than sixty miles. On the northward and eastward slopes are many large snow fields which might be the heads of glaciers, but which give no satisfactory evidences of being such in a distant view. We also endeavored to find a trail to the summit at the eastern end of the basin. The view from the point mentioned above suggested strongly that on the northeastern slope might be found several small glaciers. It was, however, found impossible to reach the summit by any route which we were able to try. It may still prove that the glacial looking water of Avalanche Lake is not misleading. Our evidence regarding it is wholly negative. While it may prove impossible to reach any glacier of importance by way of this valley, it must continue to be both to tourist and geologist a place of fascinating interest, for nowhere, so far as I am aware, are glacial phenomena on such a scale so easily accessible.

Being thus disappointed in Avalanche Basin, our party determined to try its fortune further north. Recently some mining properties have been located at a point where the main range, after trending almost due north from Lake McDonald for about thirty miles, suddenly sweeps around to the westward. To secure access to these properties those interested have cut a very good trail from Lake McDonald to their camps. The trail follows for a large part of the distance McDonald Creek, which flows along the valley between the main and the secondary ranges. By this route our party took up its march. The lower part of the trail rises slowly, but near the end it becomes steeper, although nowhere so difficult as to make it troublesome riding even for unaccustomed horsemen. We made our final camp near a group of mines in which development and locating work was going on. The group is called the International Camp. Its altitude is sixty-five hundred

feet above the sea, and from it there is a wonderful mountain view, especially of the secondary range west and south. To the east there is a saddle of the main range some two thousand feet above the camp. To this saddle our attention was directed as affording access to the eastern side of the range, and our mining friends asserted that immediately over the divide a glacier was to be found. Accordingly the morning after our arrival we made the ascent, finding it not difficult and entirely practicable for saddle horses up to less than a thousand feet below the ridge and easily made passible for pack animals to the summit. We found the point where we crossed the divide to be 8,400 feet above sea level. Immediately on stepping down from the rocks on the eastern side of the range we were upon an immense snow field filling an amphitheater some four miles in diameter. While of greater extent than any which we had before visited it did not seem to be different, and we thought again that the glacier must be farther on. As we crossed the snow field to the east, there appeared running parallel with the curving wall of the amphitheater lines upon the surface whose significance we did not at first apprehend. Observation with the field glass soon indicated what closer examination afterward confirmed, that these were long crevasses in the ice. We then knew that we stood upon the upper snow fields of a glacier not of great size, but in many respects very typical. The crevasses first noted were found to be of varying width from one so narrow that the finger could scarcely be thrust into it to one some five feet across at its widest. In this we made soundings to the depth of forty feet, this being the length of all our available cord. From dropping stones into the crevasse we judged that it reached a depth of one hundred feet or more. Passing on to the eastern side of the amphitheater we ascended the rocky ridge which

formed its boundary. Then suddenly there burst upon us one of the most tremendous mountain scenes any of the party had ever had the good fortune to witness. Sheer down below was a cliff which repeated experiments with falling rocks showed to be more than sixteen hundred feet of perpendicular precipice. From the base of this cliff the talus sloped down sharply to the bottom of the valley no less than three thousand feet below. Across the valley in front of us towered a mountain ridge which we called the Bear's Teeth. It rose three thousand feet above us as the valley dropped below. Around the northern end of the ridge on which we stood swept the glacier narrowed into a true ice river. As it broke over the cliff to plunge into the valley it was fractured with crevasses of much greater size than those mentioned before. The largest was about twenty feet across and into it plunged one of the surface streams which came down the glacier. Below in the valley lay a succession of lakes. The first of so deep and dark a blue that without hesitation we called it Emerald Lake. The second, opposite the foot of the glacier, was of that peculiar milkiness thought to be always indicative of a glacier. For this Glacier Lake seemed the one appropriate name. The moraine at the foot of the glacier was evidently almost entirely ground moraine. There were very few large rocks lying in a mass of finely divided gray detritus. Across this rushed the stream which came from the foot of the glacier. Where the stream entered the lake the silt carried by it was borne out into the waters like the smoke from a cannon's mouth. In the time at our command it was not possible to descend the mountain to the level of the lakes, but they seemed to be of great depth with sandy and shingly beaches and closely surrounded on all sides by the forests of fir and hemlock.

From the point of our first observations

of the valley we proceeded northward, crossing the ice river at the point where it left the main amphitheater to descend into the valley. At each point of vantage photographs were taken by Mr. Shepard. The writer and one guide descended along the northern margin of the ice about two thousand feet, finding some glacial scorings of interest, and under one edge several caves of considerable size. These were not of sufficient height to stand upright in, but extended for forty or fifty feet under the ice. The roof of clear blue ice was carved into low arches through which the light came, subdued into a wonderfully soft and grateful tone after the glare of the snow fields.

From this vicinity we had a most satisfactory view of the valley. The first portion of it passing athwart the foot of the glacier had a direction almost due north and south. Turning then to the east, it extended some eight or ten miles, flanked on either side by lofty mountains. Two of these particularly attracted attention. The dip of the strata in all this region, so far as observed, is toward the northwest. They consist of gray and yellowish shales and brilliant red slates. The two mountains in question have at their summits the outcroppings of two strata of red slates. This flaming head gear suggested the names North and South Red Mountain. Extending toward them were two more of the valley lakes, one of which, from its position, we called Centre Lake, and the other, six miles in length by three-fourths of a mile wide, seemed to deserve the name Long Lake. Still beyond Long Lake, its farther shore hidden by the foot of South Red Mountain, the fifth lake gleamed, a vivid contrast to the vermilion peaks on either hand. For the valley, as a whole, I have thus far sought vainly to learn the Indian equivalent for 'The Valley of the Five Lakes,' hoping that it might be something which would be musical and usable. From

other sources of information it seems that probably there are not five, but seven lakes in the valley. It may well, therefore, be nameless until more fully explored. It should be remarked in passing, that beginning with South Red Mountain, and extending northward, is a geological section of remarkable extent. No less than five miles in thickness of strata is presented before the observer with diagrammatic clearness.

Leaving the glacier we passed northward over a rocky upland where the 'sheep backs' testified of former glacial work on a tremendous scale. This led us into another amphitheater of smaller dimensions than the one occupied by the snow fields of the glacier. In this basin, eight thousand feet above sea level, a small lake met our sight. The mountain wall on its western shore was covered by what may be called glacial snow fields. These fields were of sufficient extent to be partially compacted into ice. As these ice masses moved down into the lake great cakes were broken off after the manner of icebergs where glaciers descend into the sea. This lake we called Summit Lake.

The outlet of this lake dropped by a series of cascades into a deep valley on whose far side rose a mountain of such form that Pyramid Mountain must be its name.

Returning from Summit Lake we crossed the snow fields, again traversing nearly its greatest diameter. Noting the time required gave a basis for estimating this diameter at about three and one-half miles. We also examined the lateral moraine, finding it to consist of basaltic fragments mainly of large size. There appeared to be considerable mineral bearing material in this mass. A surface moraine of yellow slate was of considerable interest. An enormous mass of rock had evidently fallen upon the surface of the ice from the overhanging mountain. Through and under it were a number of water-worn tunnels of curious

form, which I did not have time to examine with care.

Some crude observations were made as to rate of movement. Between two days there seemed to be a movement of the center of the mass of about two inches. This is not reliable, however, since conditions for accuracy could not be supplied.

To the peaks north and south of the ice field we gave the names of Mt. Blanchard and Mt. Cunningham, in honor of the guides who had served us during the expedition.

At some future time I hope to return to this region and extend these explorations further. In the meantime I commend it to those who wish to study mountain forms or glaciers and glaciation. There is an abundant and very interesting fauna and flora to be investigated, and on every side the majesty and glory of one of the noblest mountain ranges. In accessibility, in varied interest, in all which may attract either the lover of splendid scenery or the devotee of scientific exploration, no American or foreign locality is more enticing.

L. W. CHANEY, JR.

CARLETON COLLEGE, NORTHFIELD, MINN.

THE HUXLEY MEMORIAL.

THE first meeting of the general committee formed for the purpose of establishing a memorial to Huxley was held in the Museum of Practical Geology, London, on the afternoon of November 27th. We take from the detailed report in *The Times* the following particulars:

The chair was occupied by the Duke of Devonshire, who opened the proceedings by referring to the official side of Huxley's career, stating that he did this as the official head of the Science and Art Department. Prof. Huxley immediately after leaving the Navy, in which he commenced his career, succeeded, in 1854, Prof. Forbes as Lecturer on Natural History in the Central School of Science in Jermyn-street.