# Western trip, Spring of 1899: Colorado, Utah, Nevada, California, Oregon, Yellowstone Park: [specimens] 29345-29354. No. 322 Spring of 1899

Van Hise, Charles Richard, 1857-1918
[s.l.]: [s.n.], Spring of 1899

# U. S. GEOLOGICAL SURVEY

# FIELD SECTION BOOK

9-891

# LAKE SUPERIOR DIVISION.

## INSTRUCTIONS.

1. Ordinarily at least two pages of this book will be devoted to one section. On the left-hand page, place a map of as much of the section as has *actually been seen*. Denote rivers, lakes, marshes, etc., by the usual topographical signs. Denote the ledges of rock, when no structure is made out, by cross-hatching, making the cross-hatching cover as nearly as possible the areas occupied by the exposures. If the rock is a massive one, but still more or less plainly bedded, use the same sign with a dip arrow and number attached, showing the direction and amount of the dip. Denote a shaly or other very plainly bedded ledge by right parallel lines, and a ledge having a secondary structure by wavy parallel lines running in the direction of the strike, with dip arrow and number attached as before. The greatest care must be taken to avoid confusing slaty or schistose structure with bedding, and in all cases where there is the least doubt about the true bedding direction, indicate it by a query. To each exposure on the face of the map attach the number of the specimen representing it. In mapping the section count each of the spaces between the blue lines as 100 paces, and twenty of these spaces to one mile, or 2,000 paces. Usually the southeast corner will be placed at the bottom of the page, or at the first black line above the bottom of the page, and at the right-hand side. If, however, for any reason, it is desirable to show portions of an adjoining section, the southeast corner may be shifted up, or the map may be turned around and the north placed at the left-hand side of the page. The ruling of the left-hand pages is also arranged so that, if desirable, a larger or a smaller scale can be used, eight inches, two inches, one inch, or one-half inch to the mile. With the two-inch scale, the squares outlined in black represent sections, and those in red, quarter sections and "forties," while the space between the blue lines is 200 paces.

2. On the right-hand page place the notes descriptive of the exposures. Begin in each case with the number of the specimen, placing the number on the left-hand side of the red line, after which give in order on the right of the same red line the position of the ledges as reckoned in paces from the southeast corner of the section and the dip and strike when observable, the latter always being expressed from the north; for instance 4025, 250 *N.*, 300 *W.*, *Strike*, *N.* 78° *E.*, *Dip* 50° *S.* Then follow with a full description of the ledge. When topographical maps are used for locations this paragraph applies only in part.

3. Collect a specimen from every ledge, or wherever there is a change of rock on any one ledge, taking care to get fresh material, unless for a special purpose the weathered surface is desired. In case of trips made on foot or in canoes, for long distances, neighboring ledges, unquestionably of one kind of rock, need not be specimened. The position and extent of the ledges not specimened should be marked on the map, with notes that each is of a rock identical with specimen so-and-so. Under the same conditions small-sized specimens, trimmed to a uniform size of 2 x 2½ x ¾ inches will be allowed, but in all other cases *large-sized specimens*, trimmed to a size of 3 x 4 x 1 inches, must be selected, in accordance with section 3, chapter IV, p. 44, Regulations of the U. S. Geological Survey. Specimens should not be placed together without protection in the collecting bag, as the fresh surfaces, important in determining the character of rocks, are thus destroyed. They should be damaged by no temporary mark, but the numbers should be at once marked in at least two places upon the inclosing paper or cloth bags. Specimens may be permanently marked in camp by painting the numbers upon them in white upon a black background, using Silver White and Ivory Black oil tubes for color, with turpentine as a diluent.

4. On the last twenty-five pages of the book give, as may seem desirable, a general account of the examination of the region mapped in the previous pages, correlation of observations, sketches, cross sections, etc.

5. Forward this note book as soon as filled as registered mail matter to C. R. Van Hise, U. S. Geologist, Madison, Wis.

Western trip, Spring of 1899.
Col., Utah, Nevada, Cal., Oregon,
Yellowstone Park.

C. R. Van Hise.

Specimens 9345-9354

Notebook No. 372.

To come after p. 36.
In first part of this
section p. 13.

June 9th and 10th.

Made bicycle trip from San Mateo across the Montara Range to Spanish Town, on Half Moon Bay, thence along the coast road north to where it turns east to Colma, thence to Colma, thence east along the county road to Palo Alto.

Leaving San Mateo, found the Franciscan series in typical development to well up the slope on Montara Mountain. The Franciscan schists, serpentines, other eruptives, and cherts, all were seen. At various places the chert occurs in considerable quantities, and at one place was quarried for road material. It is very ferruginous, and resembles to a remarkable degree, the cherts of the Lake Superior iron-bearing formation. I told Professor Hoskins, that if the Lake Superior iron miner should chance to visit this region, he would begin to prospect for iron ore. The Montara granite is a coarse, hornblendic rock. In some places it is so much brecciated as to resemble a conglomerate. Between the different fragments are slickensided surfaces and shear zones. Evidently the rock has undergone very important movements. In places near the center of the mountain, the rock is much less broken. The surface of the granite is weathered into a soil, which passes gradually downward into the dark colored rock. Near the surface the rock is so reddened by peroxidation of iron that it might be mistaken for a different rock from the fresh dark colored granite

exposed on the cliffs of the sea. The Montara granite thus affords as good an illustration of disintegration and deposition of granite, as the Southern Appalachians.

The contact between the Montara granite and the Franciscan series to the east was not seen; a small ravine, with no exposure, separating the two.

The actual contact was seen between the Montara granite and the Miocene to the southwest, on the somewhat bold exposure just north of the road to Half Moon Bay. The Montara granite is here so broken as to have a pseudo-conglomeratic appearance,- in fact, at first I was uncertain as to whether the rock was a breccia or conglomerate. Resting directly upon the granite, with a knife-edge contact, was the Miocene sandstone. This sandstone was not broken at all, and at the contact, the two rocks are firmly welded. It seemed to me perfectly clear that the sandstone was deposited upon the brecciated granite, and that no subsequant faulting has occurred. My reasons for this belief are as follows: The sandstone is composed of small pebbles and separate crystal particles of the granite, therefore the brecciation of the granite must have taken place before the deposition of the sandstone. Where the sandstone faulted at its contact with the granite, there would be a shear zone, or at least, the sandstone would not be welded to the granite.

Directly at the contact with the granite, the sandstone is so massive that its bedding cannot be made out; but a little way to the southwest its bedding is perfectly definite,

where it dips in heavy layers to the southwest at an angle of about 30 . It appears clear that the major movement which fractured the granite and produced the pseudo-conglomerate, occurred before Miocene time; and that the post-Miocene movements were those of an uplift of the granite, causing the sandstone to dip away from it. From this contact alone, one would describe the granite as an anticlinal mass.

At a point near the mouth of San Vicente Creek, found a little of the solidified Merced series in a horizontal position upon the steeply inclined edges of shales, sandstones, and limestones, which were supposed to be of the Miocene Age. The unconformity is very marked at this locality. The Miocene is in a broad ledge a half mile or more long, and many rods wide, at such an altitude as to be covered at high tide, and to be largely exposed at low tide. This is regarded by Lawson as a Pliocene sea-beach, from which the Pliocene sediments have been stripped by the sea. The ledges, while roughly level, are, in a minute way, exceedingly irregular, the harder layers protruding as ridges and points, and the softer layers making channels and hollows. These conditions are very favorable for sea life, and the ledges are covered with an abundance of sea life, which I have not elsewhere seen surpassed.

The road along the coast over the Montara Mts. gives magnificent exposures of the granite, and show beautifully the stages of its disintegration and decomposition by water.

The actual contact between the Montara granite and the Franciscan series was not found on the coast road; but for some distance after finding the Franciscan, it contains pebbles, boulders, and crystal plainly derived from the Montara granite, showing that it is a series deposited upon the Montara granite, and derived in its basal portions, at least, I believe from Montara debris.

After passing Salt Valley, there are seen some of the most magnificent examples of sand dunes that I have ever seen. Great peaks of white sands, with somewhat gentle sea slopes, but exceedingly steep landward slopes. Some of these hills must have been a half mile or more long, and a hundred or more feet high.

June 15th,- MOUNT SHASTA.

Rode by Shasta on railway train, and had unusually fine Shasta scene from early in the morning, near Portugese Flat, to four o'clock in the afternoon at the Divide over Siskiyou Mts. The road wound close to the foot of Shasta, and at various places beautiful views of the details of the structure of Shasta, Shastin, and Sugar Loaf could be seen. Sugar Loaf is a beautifully fresh, perfectly rounded, exceedingly steep volcanic mountain with three terminal cones overlapping each other, and marking the successive stages of the dying out of its volcanic activity. This very recent volcanic tuff cone is in marked contrast to the much older Shasta, which, while retaining its general conduct of character, is cut by deep ravines and gulches, as a result of stream and glacial erosion. These ravines and gulches have a concave curve quite to the crest, many of them ending in great nearly vertical cliffs. The views of Shasta when down below the snow line, five thousand feet or more from the summit, from the Siskiyou Ridge forty to fifty miles away, were quite as impressive as those close by. The railroad winds back and forth upon the slope of the Siskiyou, in order to make the crest, and thus gives magnificent views, from various points of view, of the great Shasta mass.

June 22nd-27th.

Spent in Yellowstone National Park, the journey taken over the usual tourist route. Found that the Mammoth Hot Springs were much reduced in volume, as compared with their flow at the time I visited the region before, about a half dozen years ago. The main terrace, at that time, was filled with water; at the present time it is dry. The chief flow is now at Jupiter Terrace. In the drive from Mammoth Hot Springs to Obsidian Cliff, had fine views of the volcanic peaks of the Gallatin range, including Electric Peak. The unconformity between the Cretaceous formation and the rhyolite on Mt. Everett is beautifully seen from the road, both approaching and leaving Mammoth Hot Springs. The rhyolite is seen to cut across the beds of the Cretaceous. On the journey, the great rhyolite plateau, which constituted so much of the Yellowstone Park, was seen at many localities, at many places very largely glaciated, and at various places showing spherulitic structures. At the upper geyser basin a number of changes had taken place since the time I visited the region before. The Old Faithful appears to have lengthened its period a trifle, the interval being, upon an average, about seventy minutes, instead of sixty-five as before. The Splendid Geyser has not played for a long time, whereas it used to play at somewhat regular intervals. However, another geyser, the Daisy, has broken out near the Splendid, which plays once in about every two and one-half hours,

and, after playing, the water is much lower in the Splendid pool, and in certain other pools, and it is clear that the forces are relieved by the frequent playing of the Daisy, and thus the greater and more violent action of the Splendid has ceased.

The Bee Hive is reported not to have played since July 4th last, on which day it played twice, the second time being currently reported to have been caused by soaping. The Grand, also, has ceased to play, or has become very irregular. The Castle is very irregular, usually playing at intervals from twelve to thirty hours apart, when before it played at intervals of eight hours. When the time approaches for the Castle to play, it throws up considerable jets of water to a height of perhaps thirty or forty feet, and this appears to defer, for the time, its more violent eruption, and hence its great irregularity. After it gets to the stage of throwing up these minor streams, it may play at any time, although the final eruption may not occur for many hours, each preliminary minor eruption deferring the greater eruption. The Giant and Giantess, as near as can be made out, are about as active as in the past, although this could not be positively asserted without comparing the intervals.

Upon the whole, it seems to me that there is a decided lessening of activity in the Upper Geyser Basin, as compared with the time of my previous visit. At the Upper Geyser Basin we saw the following geysers play:

ing geysers play: The Old Faithful, repeatedly; the Daisy; The Grotto; the Mortar; the Economic; the Riverside; and the Lone Star As already stated, the Old Faithful appears to have somewhat longer intervals than when we visited the district before, and is also slightly less regular. The Daisy is a new geyser to me, the Economic also I do not remember. It is peculiar in that it plays at intervals of about six minutes, making one jet lasting for a second or two, and then ceases. The Riverside is, perhaps, the most interesting, having three funnels, one small one about 1 1/2 inches in diameter, and two large ones. The eruptions begin by bubbles of steam arising from the smallest of the openings, instead of water. These become more and more numerous, until a steam with a little water escapes; water is then thrown out from the largest of the openings. A continuous stream of water is thrown from the medium sized opening about two feet in diamete diagonally, to a height of sixty feet, falling into the river; from the other two funnels steam escapes in vast quantities, with a roar like that from a mighty steam-engine. The eruption lasts fifteen or twenty minutes, and as it dies out, the volume of water becomes less and is ejected less violently, and the steam escapes under less pressure. The interval of the Riverside is said to be seven hours. As I remember it, when I was in the district before, its interval was six hours. The eruption of the Grotto appears to be about as it was in my first visit.

The eruption of the Lone Star was seen for the first time. It is peculiar in throwing out a very small jet of water with much steam from a large, tall crater, but with a narrow funnel. Toward the end of the eruption, a large mass of snow, almost compacted to ice, was thrown from the funnel. This was partly ejected in chunks, and temporarily stopped the eruption, which, however, began again after a minute or two, but with diminished violence; however, the eruption was already on the wane, and what part of the lessened activity was due to this fact, and what part was due to the snow, is impossible to state.

At the Lower Geyser Basin, a new small geyser has broken out adjacent to the Fountain, but while this plays at frequent intervals, it does not prevent the Fountain from playing, as this occurrred at least once during our trip. The great Excelsior Pool appeared to me much the same as before; except that it did not appear the be playing so violently, and the volume of steam was much less, so that standing at the edge of the crater it was possible to see much of the lake, and in some places, the ebullition of the water; it was also possible to see the entire outlines of Prismatic Lake. When there before, it was almost impossible to see anything, on account of the great mass of vapor arising from the Excelsior and the Lake; the difference, however, may be partly due to favorable weather.

I was again impressed by the beauty of the pools, especially of the Emerald and

the Blacksand Basin at the Upper Geyser Basin, and by another pool at the Lake Basin. From near the head of Terrace Creek on the road near the Continental Divides, and near the Shoshone Lake, is the great Pitchstone Plateau; and far beyond, fifty miles from the point of view of the snow-capped Teton Range of Wyoming, which, in its whiteness and sharp cliffs, has a very Alpine aspect. At various sections, the great rhyolite and other volcanic flows are seen to lie upon one another in nearly horizontal position. Some of the best views of the succession of overlying flows were between Cinnebar and Mammoth Hot Springs. In the drive along Yellowstone Lake there are fine views of the Absaroka Rang

I was again impressed by the grandeur and delicacy of coloring of the Grand Canyon. In its delicacy of shading, in the variety of its colors, and in their brilliancy, this canon far surpasses any other I have ever seen. Carved as it is in volcanic rocks, it somewhat resembles, in its cragginess and roughness the lower part of the Canon of the Colorado, which is carved in pre-Cambrian rocks; however, the amount of slate (?) is much greater in the Yellowstone Canon than in the pre-Cambrian part of the Grand Canon. There is nothing of the orderly arrangement of structures in the Yellowstone Canon, which is so distinctive of the sedimentary part of the Colorado Canon. Near the bottom of the canon could be seen issuing, the steam from Hot Springs, also at various places on the slope. It is evident that the same fumarole action is going on at the present time in the canon, that occurs elsewhere in the plateaus.

The terrace formation from Hot Springs and Low Geyser Basin are along the Lake basins, that is, Hot Springs and the geysers are in lower grounds. It is perfectly clear that the source of the water is the rain-fall on the higher lands which have been brought together in underground channels, heated by the still hot volcanic rhyolite, and issuing laden with mineral matter.

At many places, the views across the various basins, where steam is seen issuing from an hundred openings, is so like Dore's picture of Inferno, that he must have seen fumeroles at some place, probably the sofataras of Italy.

The fall of snow during the year has been unusually large, and the snow unusually late, and as a result, snow-banks are found at various places on the pateau at altitudes above 7000 feet, and at various places at altitudes of less than 7000 ft. On the part of the plateau above 8000 ft. high, the snow in the forest was a nearly continuous mass at the day of leaving the plateau, June 27th. This continuous sheet was noticed particularly in passing from the hotel at Yellowstone Canon to Norris Geyser Basin, that is, on the Central Plateau.

Mr. Johnson, who is guide at the upper basin, says that he has noted a relation between the activity of the geysers and a heavy fall of snow, in this way: if the snow-fall is abundant, he thinks the geysers are less active than in the years in which the snow-fall is less abundant. His explanation is, that in years of abundant snow-fall the amount of

underground water to be heated is so great, that, while the flow of the geysers and springs is greater, the water is not heated so as to escape by spasmodic action. This explanation seems to be very reasonable, provided the fact of less activity in years of abundant snow-fall is established.

May 19th, 1899,- MANITOU, COL.

Today made cog-railway trip up Pike's Peak. For the most of the way coarse granite. This cut in intricate fashion by various dikes. The most interesting feature shown was that of weathering.

(1) Where rock was fresh, it had a dark gray color, but all weathered surfaces were pink, and one would call same a pink granite granite were it not for the blasting for the road.

(2) The rock, scaling, disintegrates into a coarse sand, consisting of the individual crystals of the rock, quartz, feldspar, etc. This makes the filling of the valleys; it gives a footing to the trees in the upper parts of the mountain. The various spurs and peaks are convex on top. The disintegrated material is so deep, far up, that the rock is not generally exposed on the rounded slopes, although showing in the gulches. The material is shoveled like coarse sand for the railroad beds. At various places, from some of the rounded slopes, the big boulders of disintegration protrude like hillocks.

(3) In the Canon of the Creek, and in the cuttings made by the railway, one can beautifully see the manner of the forming of the boulders of disintegration. They develope along the joints, as described by Becker, ( ) The zones of disintegration extend along the joints and along the shear zones, and, disintegration extending farther, cuts the angles and gives the round forms. The boulders may be seen in all stages of development from well rounded forms

stages of development, from well-rounded forms in completely disintegrated rock, to the films of disintegration deeper in the canyon. The boulders vary in size from a foot or two to those bigger than a meeting house.

As is so common, the joints which the disintegration followed were in various systems, in some places nearly at right angles, in others, inclined.

(4) As already noted, below the timber line the rock was largely disintegrated into the individual grains, but above the timber line, the rock is broken into large angular blocks, which hide the solid rock. This suggests that the freezing and thawing, the heating and cooling split the rocks into coarse blocks, and the vegetation may help greatly in the process beyond this,- chemically and mechanically. The roots would doubtless be quite effective in splitting the crystal apart.

(5) The solid rock is generally only exposed where the streams are doing rapid cutting, or where the cirques were, i.e. at the heads of the glaciers.

A most beautiful morainal lake, shut in by a moraine largely, but supplemented by a dam, - just what we would expect to see on Shasta and Ranier a few thousand years hence when their glories are extinct.

The wide ⌣ shaped valleys and the cirques gave marked evidence of the power of the glaciers in erosion. The effect upon the topography by the glaciers, and the little effect since glacial time, led me to raise the question, whether a given volume of water

is not more effective in erosion as ice than as water. This certainly seems plausible.

Whether generally true or not, the water under present conditions is not very effective It sinks in the coarse disintegrated sand. Much of it goes underground a long way,- of course doing chemical work; but only a little mechanical work. It is only when streams of some size from well out on the flanks of the mountains that much effect in the way of erosion is produced.

Evening of May 19th.

Rode through the Black Canyon of the Arkansas. The rock here is an intricate mixture of gneiss, granites, and schists, - laminated, banded, and intersecting in the most irregular way. For some distance the banding and sheeting, or both, seemed to dip away from the mountain desert, i.e. to the east. The hornblende-schists in some cases showed parallel injections with granite. In other cases, the rock appeared to have an easterly sheeting. The structure is similar to the Madison Canyon gneiss. Probably true Archean.

Was impressed again with the suddenness with which the Paleozoic and the Red Beds turn up from their horizontal position, or change from plateaus to rocky mountains. From the range the layers tilt up as if to pass over the mountains. At the Garden of the Gods, as well known, the Red Beds are vertical.

May 20th.

Very early passed over Tennessee Pass. The level ⌣ shaped valleys and the rounded slopes gave evidence of strong glaciation,- so strong as to change the topography from the ordinary river type to the smoothest moutonnee' so characteristic of glaciers. Here again the erosion must have been considerable.

Everywhere the horizontal or nearly horizontal Paleozoics show the rectangular vertical system of jointing. This is perhaps best exhibited in places down at the Red Canyon of the Grand. Here, too, the resultant square buttressed forms, so characteristic of the Grand Canyon of the Colorado - as the result of control by joints - is most strikingly exhibited.

May 21st and 22nd. Provo

At Salt Lake, and from Salt Lake to Wells. Saw the Bonneville and Provo shore line, as well as the intermediate terraces and sea-cliffs, beautifully along the Wausatch. The deltas and other phenomena also seen.

May 23rd.

Rode south from Wells, Nevada, to Clover Valley; then toward the Humboldt Range. Found the Lower Coal Measures of this locality to be veined and broken quartzite. The rock is so much crushed that it is difficult to determine the bedding. In fact, the fractured rock in places is a fine breccia. So far as lithology is concerned, it might be of any age. It weathers in a peculiar nodular and ridgy way, as though the quartzite might at one time have been calcareous. But, if so, the carbonate seems to have been leached out, and quartz to have taken its place. In some places, the quartzite has the appearance of cherty limestone when weathered.

Higher up, near Range, find the [illegible] to be gray limestone breccia. Is the breccia but a local phase of the limestone?

Humboldt gneiss regularly banded. Black banded biotite-gneiss with some hornblende,- injected in complex fashion parallel to schistosity, from veins to great pegmatite dikes. These parallel to schistosity.

At a distance, the regular banding has to a remarkable degree the appearance of bedding. This appearance is strengthened by the great granite intrusions parallel to schistosity, unless closely examined, where the granite may in places by seen to make across the schistosity. The appearance is also helped out by the schistosity, and the fine banding due to alternating biotite-

gneiss and granitic material in veins or injections or pegmatitizations. Furthermore, the jointing systems at right angles to bedding further strengthen the illusion. The strike of the banding and sheeting is about parallel to the range, and the dip is very flat,- less than 10 to the west.

While the high peaks of were not ascended, the rocks with exactly the same appearance as at the points examined could be seen in detail in the clear atmosphere, and I have no doubt that the material is the same. The flat dips and banded appearance strongly suggest on uplift bodily, as by a fault along the east slope; but the Lower Coal has steep dips 35° or so to the east, and thus the schistosity may be on an anticline - the top - although the precipitous slopes to the east of the range, and the long gentle slopes to the west, as shown by the topography, suggest a monocline. Did not examine the west slop, but will see same from train.

Between the L. C. and the Archean, from the outlet of Clover Valley to the northeast parallel to the range, there is a deep saddle or depression, across which are numerous big sloping ridges, strongly suggesting moraines; and behind one of these is a little lake which would be hard to explain, except as glacial.

The L. C., or this and other formations, is continuous from the outlet of Clover Valley to the end of the range to the northeast, and in places the outcrops of this formation are at least two or three miles wide. Seen from a distance, one observes the white quartzite, the gray lime-

stone, and also a deep red formation. These were not examined in detail, and whether all L. C. or not, I do not know. From the fact that the L. C. is in patches on King's maps, I suspect that they are wide along the upper valley. From the plain, one does not see continuous exposures of rocks, and thus the overlapping of the Pleistocene as shown on the map.

I was deeply impressed with the simply enormous amount of waste from the mountains. One rode along slopes of waste. On horseback, we rode up masses of waste to the snow-line, and beyond (May 23, 1899) I should estimate about 3000 feet from the top. In other parts, the mountain, rising over 5500 ft. above the plain, is buried in its own ruin.for about one-half a mile. Moreover, these ruins go off with gentler and gentler slopes as the mountains are receded from, so that the amount of waste nearly exceeds the remnants remainings, unless the solid rock expands rapidly below.

What is true of the Humboldt is true of the other ranges. Slope extends to meet slope, and as the lowest place is a lake (like Eagle Lake), or a place for a lake, which is filled a part of the year and which ever continues to raise the base from which the foregoing calculation was made.

When high up on the snow slope, looking down to the west of Eagle Lake, sand pillar after sand pillar was seen several hundred feet in height, and moving across the plain. 8 were counted at one time.

May 24th.

Rode from Wells to Reno. Purpose was to get a general view of the Basin Ranges and the flats between. At one or two places could see the monoclinal dip, I thought, of the ranges. From the Palisades for thirty or forty or more miles to Battle Mt., saw the Volcanic Mts. The lava flows are piled upon one another. To the south, I would estimate the beds to be at least 2000 ft. thick. These lava beds showed flat dips. I wondered if these extensive beds west of the railway could be the southern extension of the Snake plains.

From Humboldt to D. H., i. e. about to Wadsworth, saw beautifully the several Lahontan beaches. When I first looked for them they seemed indistinct, but as we got further west they became beautifully clear and distinct the wave-cut terraces and sea-cliffs being as fine as in the Bonneville basin.

Just about sundown, saw one isolated island of beautiful red rhyolite (?), which finely showed two strongly marked terraces and cliffs and less strongly others.

At the lower end of Humboldt Lake saw finely the dam or terrace caused by the union of the two spits as described by Russell.

In fact, Russell's description of the effects of light and shade, the character of the region, etc. in Lahontan, seemed to me particularly good.

I noted again the manner in which the

tributaries of the Humboldt split up into many meandering streams, just as does the delta of the Mississippi.

The Humboldt itself is an interesting river. Leveled to the utmost, it meanders in the most wonderful fashion. Its length, as represented by a straight line, cannot be more than one-third of its real length. Innumerable ox-bows, all out finished, and innumerable bayous, in all stages of filling, represent in minerature the lower Mississippi, only better, because the Humboldt is so small that it all can be seen.

The green and fertile meadows marking the boundaries of its meanderings, dotted with cattle, is in most marked contrast with the sage brush deserts and plazas. Where water is obtainable, a alittle oasis of green grass, fine trees, and orchards, may be noticed, which is in most agreeable and yet astonishing contrast to the sage brush desert. One of the finest is Humboldt.

May 25th,- RENO.

Rode all over Peavine Mt. looking for Archean, as mapped by King. Found
29345 volcanics everywhere. (29345) volcanic from road about three miles north of Reno.
29346 Volcanic from top of mountain. Its highest point.

The entire mountain is buried beneath its own disintegrated, decomposing debris. The rocks crop out only here and there.

The view of the Truckee Meadows, green with culture as a result of the water, fields and orchards, and, nestling in the Meadow, Reno,- made a most beautiful picture in its frame of dun and black and purple and brown mountains, upon which only a few dwarf cedars grow. The dark colors of the mountains, their volcanic aspects, etc., are very similar to those of the Mohave Desert.

The Sierra is far less suddenly approached via the railroad route than from the Mono Basin. To the south, the Sierras are higher and to a much less extent volcanic. The volcanics do not reach the peaks in the Lyell Ritte Region, as they appear to do to some extent at least in the Truckee area.

May 26th.

Rode by train through the gorge of the Truchee to Truckee, and on horseback to the outlet of Tahoe, following the river from Truckee. Saw the andesite abd basalt, the latter on top of the former, as described by Lindgren. As on the railway track, the granite appeared in places. The volcanics are nearly horizontal. Saw some steeply inclined soft beds along the railway track between Reno and Truckee. They were of a light gray color. Did not know their age, but wondered if they were not tilted mertiary

May 27th.

Rode from Tahoe outlet along lake shore, to the mountains, to the north end of Cornelian Bay; thence north over divide and along saw-mill road to Truchee Saw nothing more than on previous day. Many fine views of Tahoe, with its snow-clad mountains rising steep from the shore. Finer in some respects than Lake George. Comparable with the Italian lakes.

In afternoon rode by team to Summit, and then climbed to top of peak just north of Summit. The grano-diorite showed for most of the way after leaving Donner Lake to the summit. It has the characteristic sheeting structure nearly vertical, and sheeting parallel to the range, as in the Yosemite region. Also the granite contains many, in fact innumerable, black inclusions. Most of them are clearly defined from the matrix of granite-diorite. They are of very variable size from one or two inches to those several feet across. That they could have seggregated in situ seems impossible. The only suggestion that one can make is that the dark rock was an earlier rock, i.e., that in the intrusion simply innumerable fragments were included with the granite, and mixed like plums in a pudding in it. Yet this explanation has difficulties. Why are the contacts so sharp? Why are they all rounded, and yet with sharp contacts?

29347 Grano-diorite with black inclusions.
29348 Upon the little peak to the south of the summit; is called andesite by Lindgren, but appears to me rather acid and varying toward trachyte.

The top of the little mountain is marked as basalt; but upon it were found thick layers of coarse tuff. From the track it looks like basalt, and I wondered if Lindgren had not marked same in without actually climbing the peaks.

June 5th.

With Lawson to show me, visited the Hills back of Berkeley. There he has found a great succession of rocks. The lowest is Franciscan at the base of the hills. Upon these rests a complex set of Miocene, including various layers of volcanics. The volcanics are in two groups separated by eight evolutions, indicating a time between and two epochs of eruption.

Unconformably upon the Miocene is the Pliocene clays and limestone. There are fresh rocks at the bottom, but above there is a thick marine formation of Pliocene. Notwithstanding the recency and the unconsolidated character of the Pliocene clays, they have been folded and raised up on mountains as high as Diablo.

While the clays and sandstones are
29349 scarcely consolidated, the limestone
29350 is compacted and strong. It seems probable that it was compacted while under water. Lawson spoke of this limestone as chemical; but when asked as to his meaning, admitted that the first concentration might have been made by life. For limestone to be chemically precipitated, it must have situation (Formation of limestone through fresh water shells in present lakes, through life, Mendota).

The folding of the entire series is of a most complex character, as complex as in the L S region. The hills are rounded and flowing. While it is always easy to tell the lithological character of the rock one is on, it is not easy to determine its strike and dip, nor easy to see the character of the sedimentation. In this respect the Coast Range Hills are very similar to the Southern Appalachians. In each, along the streams exposures may be obtained; but are more numerous in the Coast Range, because less powerful streams get to rocks sooner.

The fracturing of the rocks is of the most complex character. They are, indeed, broken into angular bits, except perhaps the limestones, etc. Yet they are not much consolidated. This is positive evidence that fracturing can take place upon most extensive scale, i.e. dynamic action in the zone of fracture, and produce no schistosity or anamorphic change. Whether the Miocene and Pliocene are much indurated by cementation below the level of underground water was not determined. I saw only the rocks on the slopes and near the surface, nowhere in a deep cut.

June 6th.

Visited with Lawson, Hunter Point and the area across the Peninsula in the vicinity.

There saw finely the Franciscan sandstone. Like all the Coast Range sandstones, so-called, these have such large proportions of feldspar and bisilicates as to give them a gray color.

29351 The radiolaria cherts are interstartified with the sandstones. At the places showed me on the hill, near the west side of the Peninsula, seemed clearly to be layers of chert at the top of the hill below these sandstones, and below this again are the cherts. Lawson says there are several such alternations for the Peninsula. The cherts have the appearance of beds; but Lawson says lenticular. I see no reason why they may not be replacements in a considerable degree of limestone, or they may be, like limestone, a direct formation by great accumulation of radiolaria sponges, etc., Saw no evidence of such bunch characters as one would expect if made by springs in the ocean.

Saw great masses of the serpentine intrusive in sandstones. Those on the surface are undergoing
They are much veined, and are passing into magnesite and quartz.

The slates are shattered through and through, and the openings filled with veins, largely of quartz.

Cutting the serpentines are many basic
29352 dikes, such a dike showing parallel arrangement of mineral particles.

Lawson says dikes are not found in sandstones.

The serpentine is fractured to the last degree. Lawson thinks this is self-fracturing, due to change of altitude hydration, etc. He even a tributes the extreme fracturing of the sandstones adjacent to the serpentines to this cause. I could hardly agree to this, as such contacts are usually planes of movement.

Also saw a big basic rock intrusive in the cherts, which has the spheroidal structure exactly similar to the L. S. spheroidal schists. This is intrusive, but it may have been intruded near the surface, and partly flowed out. The spheroids are broken into minute flakes mostly less than an inch across, and the majority less than half an inch. Lawson thinks this is due to precipitation while hot, or some such action at first. I could see no adequate reason for not regarding the fracturing as dynamic, since serpentines and sandstones are broken in an intense fashion. Of course basic rock still more broken; but this may be due to lack of continuity of the parts.

June 7th.

Took a walk with Lawson north of Berkeley. There again saw the Franciscan cherts. Resting on these, according to Lawson, are the Ancilla (Knoxville) Cretaceous. Associated with the cherts, are in places a peculiar carbonate-bearing chert, much broken, the carbonate leached out on the weathered surface so as to give an exceedingly rough surface. The rock also very much broken. They are associated, according to Lawson, with the serpentines and with the glacier-plane schists (metamorphosed Franciscan sandstone). He thinks they are of chemical origin, as result of the alterations. Had not looked up chemistry of the process. If the olivine is abundant and the serpentine less abundant, then by carbonation could give the carbonates and silica. Also silica would be set free if a bisilicate changed to serpentine, a unisilicate.

29353 At one place I found a hornblende-schist or gneiss, which doubtless is a much modified igneous rock in the Franciscan.

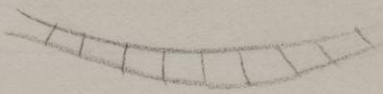
A little way up the slope from this is a very rough, jagged, round hill, apparently on top of Knoxville, composed of chert breccia. The rock is shattered into angular fragments. The majority of these are not more than an inch in diameter, although, of course, many are larger. Many of these are rounded by the dynamic action. Many of the fragments

are also themselves broken by subsequent movement or at end of first movement, so that the pieces are little displaced. The broken pieces are cemented by silica into compact whole, showing the extensiveness of chemical alteration.

Lawson thought them somewhat different from the radiolaria cherts and the carbonate-bearing cherts of the Franciscan; but I would have been inclined to regard all as of the same series. However, this is impossible to tell. The isolated character of this chert breccia, and its difference from the radiolaria cherts, leads Lawson to think possibly of spring origin. This is entirely possible. Trachyte is near by, and associated, but this is not nearly so much broken, probably it is not so brittle.

Lawson much inclined to explain many relations by faulting in the district visited during these days. Have no doubt but that the district is one of faulting, but it is dangerous to remove every difficulty of structure in the way. In some places the evidence of faulting given by Lawson is good; but in other places, as where the Miocene bears edges of the Franciscan in the ravine northeast of Berkeley, it is not so clear. Here Miocene is conglomeratic, as if resting on Franciscan. Lawson says pebbles of volcanics and of chert are not Franciscan chert, but I would not know the difference.

The general depression across the Franciscan Peninsula is also regarded as due to faulting. May be of kind which could almost as well be called folding,- it depends upon the distribution of faults; and if faulted, perhaps folded below. The principle is the same as shearing joints.



June 7th and 8th.

Crossed range via Kings to the Ocean then along the Ocean to Pescadero; then to Palo Alto, via La Honda. The range at both crossings seemed to be wholly, or almost wholly, constituted of coarse and fine sandstones. Much folded, often nearly on edge, frequently broken in complex fashion. In short, the Coast Range structure.

At the Pebble Beach of Pescadero, we studied the sandstones more closely. Here the series is steeply inclined toward the ocean. It consists of layers, from conglomerates to fine shells. interstratified in the usual manner. The alternations are in many places abrupt. The pebbles, of many varieties are plainly derived from the conglomerate.

The sandstone series is repeatedly faulted in a minor manner. In one place a double fault occurs, and is normal in both places, i.e. the intervening block is relatively upfolded Doubtless this faulting occurred before steeply tilted. The rocks weather in the most fantastic forms. The sandstones at tide water were well indurated. Upward these pass into sand. The sea has sought out the soft layers, and also in the soft layers the weaker spots, so that there are holes and projecting edges all in the most fantastic fashion. In some places, eddies in the

tidal wave, in connection with very hard pebbles, have produced true pot holes in no respect different from those in a river.

At the time the visit was made, the tide was rather low and the waves were not high, so that many of the pot holes were six to ten feet above the water. However, fresh action of the waves showed that recent waves, probably at high tide, have produced the streams. As the waves dash over the cliffs, great masses of water fall into the depressions beyond. This produces a true torrent or stream for a short time, and thus the actual formation of the pot holes is, by the same principle as where stream action does such work.

29354 Compact sandstone at the level of the water.

Did not know the age of this sandstone, but supposed that same was Miocene. This sandstone on edge is overlain with horizontal sandstone but little compacted, which is supposed to be Pliocene, but may be Pleistocene.

At Kings on top of the crest, looked over on a flat-topped sea of fog. Minor irregularities in the foreground; but top of clouds at some elevation gave wonderful flat-topped effect. As we rode down the canyon, we went under the fog, which did not descend to the surface of the sea. This fog was in horizontal strata. The reverse effect

June 9.

~~See~~ See Jr. 1

was observed in coming up from Pescadero.
Hence fog seen for two successive days.
Brreze light up the west slope of the
mountains.