# Summer of 1897 in the Western U. S.: [specimens] 25900-25920. No. 199 1897

Van Hise, Charles Richard, 1857-1918
[s.l.]: [s.n.], 1897

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.

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#199

Summer of 1897 in the Western U.S.

25

Specimens collected near Ely, July. 1897.

25900 Green schist, northwest side of N.W. arm of Long Lake. This appears to grade into massive form.

25901 Pebbles from conglomerate on N.W. side of little island about 75 paces from 25900. Conglomerate band about 30 ft wide. Has bowlders as large as 18" in diameter. Thickly studded with bowlders of various kinds, but especially of green-schist

25902 Graywacke just above 25901 The conglomerate grades into this in about 2 ft.

25903 Slate in contact with Є 25902. About 30 ft on island.

25904 Graywacke about ½ mile N.W. of White Iron lake depression

95905 Banded schist cut by granite, and both by greenstone. Also cut or interlaminated with green schist of Ely. The latter the oldest, – the granite younger, and the massive greenstone the youngest.

From the 25th to the 29th of July worked along the line of the C.R.R., Where the Rocky Mts were first struck, and indeed through the main mass of the system as exposed along the C.R. I was much impressed with the exceedingly complex fracturing to which they had been subjected. While the rocks are in folds, this seems not to be due to interior deformation, or at least largely not, but to fracturing. Some of the argillaceous rocks are in fissile leaves, others - the more massive ones, are broken into rectangular or polygonal blocks

No stop was made in the mountains, and no detailed statement can be made as to just the manner of the deformation.

At Glacier a stop was made to study the Selkirk series of Dawson. This seems to be predominantly a schistose quartzite or a quartz-schist, which is often strongly micaceous. It contains lesser quantities of finer

grained rocks, and there are
mica slates and mica schists.
The deformation has affected the
entire mass of the rocks. Each
individual part has been deformed
and thus the rocks are schists.
This is in contrast to the Rocky Mt.
rocks. The difference is believed to
be due to the difference in load
when deformed - the Selkirk series
being much the more deeply buried.
The best exposures observed are
on Mt. Abbott. Here the cleavage
is nearly vertical. The bedding in
places nearly corresponds with this -
in other places cuts it various
angles. The steep, almost vertical
cliffs of the mountains, and
presumably of the Hermit, Sir Donald,
and others, is due to parting or
fracturing parallel to the schistosity
following cleavage, and not
bedding, - although in places the
two may be near together.
The rocks are cut by various
sets of joints. The most ~~vertical~~
conspicuous are the vertical or

nearly vertical ones following the cleavage, and a horizontal set at or nearly at right angles to the first. A third set is at right angles to each of these two, and thus the rock breaks up into parallelopiped blocks. This was definitely observed on Mt. Abbott and inferred to be the same on the other mountains, because of the rectangular forms seen in the topographic features, resulting in castellated forms.

While the structure in the neighborhood of gb Glacier, seems to be in general as Dawson says, I felt that on account of the cleavage, and the fact that this in some places follows bedding and in others does not it would be very difficult to make any accurate estimate of the thickness of the series. Minor folds seem to me probable. Indeed in places I saw what I took to be such. Dawson anticline below Glacier appears to be not simple but a complex anticlinorium. This would much modify the thickness from an estimate made on the basis of a simple fold.

It may be suggested that the castellated forms of the west are due to rectangular systems of joints or tensile planes, and therefore at right angles to bedding. In short the story is the same as in the Alleghanies, except that the rocks, being not far from horizontal in many cases, give the castellated effect.

As described by Dawson, found the ~~Nisconlith~~ series to be mainly a black slate and graywacke, — in many places a mica-slate, in places calcareous.

For some miles before Albert Canyon is reached the series steadily dips to the N. at moderate angles - not measured but usually from 30° to 45°

The most westerly outcrops of this series seen on the ~~series~~ Ry.

has its typical character of mica-slate. This is a short distance east of Albert canyon. The first exposure to the W. is a regularly laminated biotite-gneiss, which looks as though it might possibly be a sedimentary rock. High on either side of the canyon the change is marked by an important topographic break. On each side of this break the rocks in color, weathering and fracture have the typical characters described. The gneiss dips to the west at the same angle as the Niscolith series. In this structure they are perfectly conformable, but I believe it to be secondary in each case.

If difficult to measure the thickness of the Selkirk series, it is far more so to measure the thickness of the Niscolith series, for this was an argillaceous sediment which is now a slate. Where the bedding was I could not tell in most cases. It was folded in many minor rolls. Indeed, from what I know of such uniform cleavage, I think it probable that the slate is in many minor isoclinal folds. If so nothing but the most detailed study could even approximately determine their thickness.

Like the Selkirk series, after the cleavage was formed, subsequent deformation has shattered the rocks - in places into polygonal blocks and in places rendering the slates fissile

As we pass to the westward in the gneissic series, the even schistosity soon gives place to a banding. At the same time quartz and small granite dikes appear. Close examination renders it evident that the banding of the banded gneiss is due to parallel injection.

The evenly granular non-banded uniform schist is the older rock. It may have been sedimentary, but from its uniformity is more likely igneous. If this be so, the structure is entirely secondary. This structure is followed mainly by the igneous injections, and thus the secondary banding. The above applies for a short distance downward, but a little lower the granite veins which cut across the schistosity, become more and more numerous, and of larger size and soon great granite veins are contained in the schists. We have here the same exceedingly complex passage from evenly laminated gneiss to gneiss and granite in varying proportions and the most complex relations just as observed in the Vermilion country near Ely and just as seen in the Weber canyon of

the Wasatch.
With Dawson, it seems to me highly probable that the gneissic series cut by granite is far older than the Priscolith series.
In this region the cleavage dips to the W. Is this the prevalent direction for the W., as an eastward cleavage is for the E.? If so this is very suggestive as to the manner of movements along the borders of the continents. If overfolds are the rule, this would mean deep seated movement from the sea toward the land.
Along the Frazer canyon granite seemed to be the prevalent rock. In places an older granite or gneiss seemed to be cut by the more massive kind. Again the structure seemed to be from the West. However as we did not stop here, little reliance can be placed on these suggestions.

# July 30 to Aug. 6.

From Vancouver to Portland By train up the Columbia to Hood River. By stage to Cloud Cap Inn on Mt. Hood. Ascent of Mt. Hood. Return by stage to Hood river. Down the Columbia by boat through the Cascades to Portland. By train from Portland to - - - - -

The Cascade Range as seen from rail and boat section, consists of a great series of nearly horizontal lava flows. If one may judge from the columnar structure, by the dark color and by the blocks at the foot of the Mts., and by the sections at the river the lava is mainly basalt. The walls of the Columbia canyon must in some places be nearly 1500 ft. high. In these higher places without having a full section we can count more than a score of lava flows. The great thickness of these lavas, their horizontal appearance and uniformity all agree with the accepted theory that the extrusion of the lavas was not from a few great Mts., but from innumerable vents along fissures. The lava walls of the Columbia show all the peculiar methods of columnar formation figured by Geikie as occurring in Great Britain.

Since the lava outflows there seems to have been little or no folding, properly speaking, although there may have been gentle deformation as concerns each particular stratum, but great total movements. However, these movements must have been vertical mainly, rather than horizontal.

Thus the Cascades, if one may judge by this section, was piled up by volcanic action, or subsequent to the volcanic action has been relatively lifted. The Cascade Mts. appear not a lofty range, but a high plateau cut into ridges and peaks by erosion. The few high mountains of the range, such as Ranier, Hood, Jefferson, Helens, Three-Sisters, Adams, etc., are probably individual volcanic mountains built up at a late stage of the volcanic period. As the volcanic action died out, it would be natural that the orifices would become few in number and from these orifices a few great volcanic mountains would be built up. This is certainly the case with Mt. Hood, which was ascended. It was a late great vent, from which a considerable variety of lavas flowed, and which threw out bombs forming volcanic tuffs. Many of the lavas appear rather acid, some of them apparently being trachytes, and others hornblendic rocks, either rhyolites or andesites, probably the latter. One of the great tuff beds forms a part of a ridge between two glaciers near

the summit of the Mt.
What is called "the crater" is
on the S. flank of the Mt., near
the top - a great circular
depression a half mile or
more broad breached on the
lower side, - perhaps by glacial
action. However, if this is one
crater, it is certain that others
were higher up; - for a beauti-
ful dissected lava flow extends
from near the crest for hundreds
of feet down the S.W. slope. As
one stands at the crest and
extends the lava beds which
he sees truncated on the numerous
ridges ~~which he sees bo~~ between
the glaciers, he can reconstruct
in his imagination a
great symmetrical volcanic Mt.
with moderate slopes. Now,
however, it has been breached
by the subaerial forces. A
half dozen glaciers extend in
various directions from the
base of the ~~slope~~ sharp culmin-
ating peak to well down on the

flanks of the Mt., to elevations of about 1500 ft. The heads of most of the glaciers do not reach within 2000 ft of the top. Above this are snow fields. As a result of the glacial erosion the beds of the glacier occupy cirques at the head of which in each case observed is a . . . . . . .
As a result of the glacial erosion the middle zone of the Mt. consists of ridges, between which are glaciers. The extensions of these ridges are less angular, and between them are the streams. Here the slopes are least. Through the glacial zone the ascent of the ridges is faster, but still easily climbed without use of hands. Above the glaciers is the steep Alpine Peak, clad with snow, with slopes of 15° or 20° at the base, becoming 30° as we go up, and possibly 45° very near

the top this concave Alpine curve changes to a convex curve, and a small area of extreme irregularity here a mere knife edge, there a zone 50 paces wide, marks the top. Evidently the upper part of the Mt now visible is but a remnant of the past whole.

The great differentiation of the rocks, the wide variety of flows, ropy, scoriaceous etc, the presence of tuffs, - all fear in favor of the comparatively late age of Mt. Hood. as compared with the ordinary Cascade lavas, - even if the higher position of the Hood lavas were not sufficient evidence.

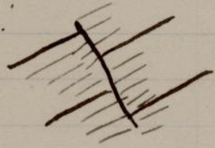
The lava flows of Hood, in contrast with the ordinary Cascade lavas furthermore have slopes corresponding with the slope of the Mt.

At some distance N of

Portland along the Ry the Portland Hills, and the exposures along the Willamette for some distance S of Portland and even well toward Drain itself, are chiefly the same columnar lavas of the Columbia. This indicates that the Cascade lava period covered much of the great valley of Washington and Oregon, although the lavas of this western region may not have been built up to such great thickness.

Near Drain I saw a dike of what I thought to be basalt, cutting through the sedimentary rocks, presumably Tertiary.

At Hood river along the Ry is consolidated river gravel containing many lava fragments, which was deposited at an angle of 10° or 12°, or else tilted since probably the former. However, the thing of interest is clearcut normal faults, with a throw of a few feet which cut these beds. One had a throw of 6 or 8 ft. and a hade estimated to be 60°. Thus:



This movement, including faulting has occurred since the high Columbia gravels were deposited.

The Columbia has recently been at a high flood. As it retired, and reached a smaller and smaller width, it has cut terraces, just as theory demands in its present flood plain.

When boat landed near Hood River, saw a half dozen of the terraces formed at the varying stages of fall of the river. Have in this case the demonstration of the formation of terraces by deposition first at high stage, and excavation later at lower stages.

Aug. 7.

From Drain to Scottsburg by stage, 36 miles
Scottsburg to Gardiner down the Umpqua by foot, 20 miles.

After leaving Drain went almost immediately into the Coast Ranges. As described by Diller found the - - - - - - - formation to be a graywacke-like sandstone with shaly layers.

From Drain to near Scottsburg the dips were to the W at low angles. Near Scottsburg, rocks nearly flat. Down the Umpqua from

Scottsburg the dips were for some distance at low angles to the N. E. Dip in no case more than 15 or 20° and 8° to 10° more common.

This part of the mountains is thus a very gentle syncline. For some distance before reaching Gardner the rocks are either flat or have very slight dips to the west. This indicates slight western anticline

The horizontal shortening in the folding of the Coast Ranges in this region is very slight, indeed almost immeasurable. The rocks as usual in cases of slight folding are cut into parallelopiped blocks by the bedding, and 2 rectangular sets of joints at right angles to bedding - therefore tensile joints. These beautifully seen in bed of river.

It thus appears that in this region the formation of the Coast Range is mainly due to vertical movement. If this was contemporaneous with the formation of the Cascades these lavas might have been deposited at a lower level, and have been relatively uplifted at the same time with the Coast Ranges. The tangential movements were slight. The Coast Ranges, like the Cascades, are no more than a dissected plateau.

The Umpqua to Scottsburg is rapidly cutting. Below Scottsburg it is not, and by the time Gardiner is reached it is in an estuary a mile or so broad. This suggests at the present time depressions below Scottsburg, elevation above.

The Coast Ranges rising 500 to 800 or more ft above the Umqua estuary present a beautiful and grand scene. Where the river is $\frac{3}{4}$ mile wide, above Gardiner, and the cliffs are highest, the scenery is fully comparable to the better parts of the Hudson. Before Gardiner is reached, the hills become lower, and rise less abruptly from the water, and are therefore not so inspiring

Sunday, Aug. 8, at Gardiner.

Aug. 9.

Gardiner to Marshfield.

Aug. 10

Marshfield to ~~Myrtle Point.~~ Lighthouse Pt., via . . . . . and return

Aug. 11

Marshfield to Myrtle Pt.

On the way down the Umpqua River to the mouth from Gardiner, the dips are steadily seaward, the angles running up to 10° or 15°. It thus appears clear that the Coast Range proper is a syncline, and that the foothills to the W are an anticline. Thus the section from Drain to the mouth of the Umpqua consists of a great syncline followed by a great anticline, the dips of both being very moderate.

In driving down the beach at low tide from the mouth of the Umpqua to Coos Bay, saw a beautiful exhibition of sand dunes. For much of the way these billowy dunes stretch about 2 miles inland. They are still encroaching upward burying the forest and hills. Here and there ridges clothed with trees partly buried protrude through the sand. The surface of the dunes is everywhere beautifully wind ripplemarked. However the ripple-marks have more rounded upper ridges than do the ripple marks of water. Also lack the central ~~depressions in~~ crests in the depressions. In short the section of the ripplemarks of the wind is more symmetrical than that of water as ordinarily formed

To my surprise, the Eocene strata constituting the Mt. south of Coos head and the light show dip to the E, varying from 60° to 70°. In miles of distance observed by Diller and myself, no sign of duplication by folding was observed. So far as Diller has gone toward Cape .... the dips continue to the E; however, the ridge E. of the Seven Devils river marks the crest of an anticline.

About a mile E. of the Light House the Eocene is followed by the Miocene with a dip of 19° to the E. This dip, at this angle continues for some distance. From this fact, and the uniformity of the dip of the Eocene, for a long distance to the W., with no evidence of lessening dip, it appears probable that the two formations are unconformable.

The layers of the Eocene vary much in thickness and texture. At this Mt. it is a formation consisting of alternating layers of well compacted grit (near gray-wacke) and of shale, with various gradations. The layers vary from less than an inch in thickness to three feet. The latter are confined to the grit.

25906
25907
Specimens 25906 and 25907 show varieties of the more compact varieties of the grit. These are as well indurated as many of the rocks of the pre-Cambrian, although this statement could not be made of the Eocene as a whole.

The fracturing of the Eocene is typical for that of complex folding. The rocks are broken into rectangular blocks by two sets of rectangular fractures at right angles to bedding. In some of the lower layers this method of tensile fracture is perfect. The more massive the layers the wider the joints apart. In some places this may be a number of feet. In the shales on the contrary they are close together. In some cases the shales are in little blocks averaging an inch across, and these may not be less perfect than those of the stronger beds.

Of course the beds are not all fractured at right angles, - some are at rather acute angles, but that the tendency is toward right angles there can be no doubt. As already said, this in many cases, is as near as the eye can see, while in the more massive layers it does not often vary more than 10° to 15° from right angles.

The structure of this western mountain gives the west side of the next syn-~~chinorium~~ & following the anticline east of the mouth of the Umqua in all probability However the structure has not been traced south from the Umqua to this place,— and therefore this may not be the case

Friday, Aug. 13, 1897.

Rode on Southern Pacific from Roseburg, Oregon, to - - - - - -, Cal.

For much of the way saw folded rocks, little altered, & many similar to the Eocene of Coos Bay. The fracturing is in all respects like that already described at Coos Bay. The other abundant rocks are the volcanics. These were noted over large areas. Basalt with columnar structure was noted, also lighter-colored rocks which were supposed to be more acidic. These volcanic rocks were especially noticeable in the district adjacent to Shasta, but by no means confined to it.

In crossing the Siskiyou Mts. crystalline schists are seen which are cut in a

most complicated way by
coarse porphyritic granites.
Just before Siskiyou is
reached - perhaps a mile,-
near the summit, - the train
broke and I had an oppor-
tunity to see the rocks.
The rock cut by the granite
25908 here is dark mica-schist.
I understood from Diller
that this is of Carboniferous
age. In many respects this
schist, cut by dikes, bosses of
granite and interleaved with
parallel masses, resembles the
Basement Complex, but there
is not the same intricacy
of material or of folding

Saturday, Aug. 14.

Rode 5 mi the morning along the E. shore of San Francisco Bay to Oakland. At various points the rocks were seen. They are folded so as to have rather a steep inclination, and again I noted the fracturing in two systems at right angles to bedding so repeatedly noticed.

Sunday, Aug. 15.

Went to - - - then by Ry to Reed, in order to examine the contact metamorphism on the Peninsula above the station. At the cuts about ½ mi before reaching the station, the black igneous rock is noted. In a cut before reaching this point are the steeply inclined sedimentary rocks. These are thinly-bedded, practically unaltered, and they again show in a remarkable degree the two sets of fractures at right angles to the bedding. With these however, there are various other irregular fractures, one set of which has a marked tendency to follow the bedding. Besides these regular systems of fractures are others which cut these diagonally. One would perhaps make out sets of diagonal fractures, but the ledges were not so closely studied as to do this. While I am convinced of the regular systems of fractures above described, one who did not examine the rocks carefully might perfectly well ~~might~~ describe the rocks as broken into rubble, according to no regular system, as has been so frequently done.

The rocks adjacent to the intrusive at the N.W. end of the tunnel show a change in character, becoming somewhat silky, but still the metamorphism is not marked. However, following the ravine E. up from the R.R. just before the tunnel is reached, one finds first glaucophane schists, and the garnetiferous glaucophane schists, and after these, capping several hills, and making a large area at least a half mile long and 1/4 mile or more wide, is a black coarse eruptive rock, to which the metamorphism has been attributed. As there seems to be a gradation from the little altered rock to the crystalline schist, and the altered rock is peripheral to the eruptive, I see no reason to doubt the conclusion.

25909 25909 (Missing) 25910, 25911,
25910 25912 are phases of the more
25911 metamorphosed rock.
25912 25909 + 25910 are at some little distance from the eruptive.

25911 is in a ravine near the eruptive, and

25912 is in a mass along

a depression on either side of which is the eruptive. This is the most altered phase.

The foliation in places seems to dip toward the eruptive, and in other places away from it. I do not know the explanation of this unless the rock were folded after the intrusion.

These schists have wholly recrystallized. In every way they are like the dynamo-metamorphic sedimentary rocks. I do not for a moment think that the process has been one of baking as ordinarily used. It seems to me probable that it was in no way different from the dynamic process. The intrusions of the eruptive gave pressure and heat. The hot solutions under these conditions were active, and the material of the rock recrystallized.

The production of the glaucophane schist was probably mainly due to the character of the sediments. It is doubtful if the igneous rocks contributed largely to the material of the schist.

The grit character of the sediments of the Coast Ranges has been noted in the Coos Bay sheets, and the area to the northward. The same was noted along the S. P. Ry. between Roseburg and San Francisco. This basic character of the schists is doubtless due to extensive areas of basaltic lava which occur in the Coast region. These gave basic sediments or sediments in which feldspar, mica, pyroxene, and amphibole are important. Thus it appears that these rocks were not disintegrated. While the sand along the beach of the Pacific the present moment

appears to be largely quartz.
I suspect offshore mud in
the bays, such as San Fran-
cisco, that similar sediments
are now forming. I do not
mean by the above to imply
that no disintegration is
taking place or took place; for
I suppose the sediments are
much more acidic than
basalt, but only that the
alkalies and alkaline earths
were only partly abstracted
by solution, and that the
minerals mentioned were largely
deposited in detritus.

Aug. 16-20, inclusive.

Spent with Branner and Hoskins in study of Coast Ranges.

With Branner, went over his work adjacent to Stanford. He has mapped this area very carefully. Shows beyond all question that we have a case of complex folding - only less complex than in Marquette district of Lake Superior region. On account of this it was found impracticable to predict where given belt will be, much if any beyond where seen. The exposures on the foothills W. of Stanford very poor; hence mapping exceedingly difficult. Mapping by Branner only accomplished by most detailed work, following up all ravines. This work slow and laborious.

Branner finds as he thinks, three unconformable series, - a series (the oldest) bearing cherts, serpentines, and making the higher parts of the Mts. W. of Stanford. The dominant rock is a peculiar broken one of undetermined character, but probably sandstone. Above this is the Miocene which bears a lava bed. Over this is unconformably the gravels of the Bay. Immediately adjacent to the University these gravels are somewhat consolidated and incline at steep angles. Evidently these are very recent rocks - perhaps Pliocene or Pleistocene. They have been folded, and though truncated, have taken their parts in the mountain-making processes.

The fracturing of the foot-hills Miocene back of the University is exceedingly complex. In fact in many places it is so irregular that little or no system can be made out. This is even more marked with the

Golden Gate series. In fact the name ruffle is justified at many places.

In many of the Miocene sands the material is so uniform that it was exceedingly difficult to determine bedding. This is often determined by Branner by means of rows of concretions. In other places banding gave certain results.

The igneous rocks in places are andesite, in places basalt, and in places tuff. All are taken by Branner to belong to a single volcanic epoch.

In places the rocks belonging to the volcanics are
75913 indurated. Branner called this baking, but I took some to be cementation promoted by the presence of the volcanics.

At one place in the basalt are numerous cracks which have been filled with silt from above.

25914 25914 represents the entire width of one of these dikes.
Some are 25 or more feet high
25915 and but a few inches wide.
In places they die out above.

25916 } The serpentine, supposed to
25917 } belong to the Golden Gate
25918 } series, is overlain by a fragmen-
25919 } tal rock which appears to be largely derived from the serpentine. Recomposed rock. Miocene?
25919 similar to Beckers? Altered fragments - Diller?
Built largely from serpentine after it changed to serpentine, and if so marking an unconformity perhaps between the Golden Gate and Miocene

25920 At one place the volcanics have been bored into by bottom of sea animals, which gives positive evidence of a short interval, at least, between the volcanics and overlying sedimentary rocks.

Aug 19 and 20.

Drove across the Santa Clara valley to the Mts to the West. - went to Calaveras where Branner showed us a filled valley, dammed as he supposed, by faulting. The sediments appear to be thick. Terraces are cut in them. There is no rock floor. The material has not the appearance of a flood plain, all being fine, and therefore appears to demand damming in order to explain its existence. The structure too seems to indicate faulting.

In the stream below the valley is an igneous rock which shows all gradations from an ordinary broken igneous mass which might be called a breccia, to a glaucophane-schist. All gradations are seen from the breccia to the schist. In an intermediate stage cores of unmashed material lie in a schistose background. In a less altered stage the breccia fragments have a mere film of schist. In the completely altered phase we have a banded schist in which no unmashed fragments remain. The above suggests that rapid deformation may first shatter a rock to a breccia, and subsequent slower pressure molds the rock to an ordinary schist.

Driving North, before Niles Creek was reached, another valley was found, but this seemed to be largely and possibly wholly flood plain deposits.

In Nile Canyon the rocks are regularly ~~banded~~ bedded, and these show the typical fracturing in 2 right angled systems normal to bedding.

The structure of the range

was not clearly seen, but
enough was noticed to show
that there is no such
simplicity as in the main
Coast Ranges of Oregon.

Monday, Aug. 23.

Went by train with Hoskins from Palo Alto to end of Sierra Ry. above Oakdale. On the Sierra Ry, which began to climb the foothills of the Mt., volcanic rocks were seen. These were followed by green schists, which, almost directly on end protruded from the ground in many places in sharp jagged ledges, varying from a few inches to several or many feet. These ledges continue to Chinese Camp.

Aug. 24

By team from Chinese Camp to Sequoia.

From Chinese Camp to foot ~~hills~~ of hill below Priests the rocks are soft little metamorphosed beds of dark character, and vary from shales to grits. The harder beds have the usual fracturing at right angles to bedding in two systems. The softer beds have the usual complex fracturing. The beds are little metamorphosed, and are supposed by Turner to be Jura-Trias.

In ascending the hill to Priests, the rocks are green schist which is supposed to be an altered eruptive. This schist is much broken by later fracturing.

In ascending the creek above Priests, black slates are found, which show beautiful slaty cleavage. While the rocks are somewhat fractured, even in the clean exposures in the bed of the creek, the slaty structure is clearly the dominant one.
On the road, as a result

of weathering, the rock is fissile as a result of secondary fracturing along the cleavage! Turner regards these slates as Carboniferous. - The slates are generally black, and in places carbonaceous and pyritiferous, but in places they show other phases which give them a banded appearance. In places also they are injected by granite, and this rock has a tendency to follow the cleavage.

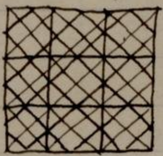
Aug. 25.

Road from Sequoia to Yosemite, and on mule back from Yosemite out of valley via Yosemite Falls to Turner's camp. at Porcupine Flat.

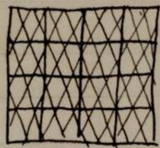
In going into the valley from Sequoia, saw beautiful illustration of the formation of soil by the disintegration of the granite; also of the formation of great bowlders by the disintegration. Many of them are as large as a good sized house. The bowlders and the rock surface both have the domed appearance due to weathering. The disintegration follows along the joints, and this produces the bowlders. Then the angles are rounded off. Bowlders thus formed are ready at once for transportation by water or ice. Also the rounded surfaces of disintegration have a great similarity to glacial surfaces in their general contours.

In the Valley saw the most magnificent illustration of the various systems of joints that I have ever seen. The dominating features of the valley are produced by parting along joint planes. This parting is the explanation of the stupendous cliffs there seen. These dominating joints are in a E-W. direction parallel to the valley, and in almost exactly vertical position. Another set is almost at right angles to this in a vertical position, and therefore transverse to the valley. The next most important set is almost horizontal, and therefore intersects the two previous sets at right angles. Along this set are very numerous narrow dikes of a later granite. These three sets of joints give the great cliff faces in an E-W and N-S direction which at several places intersect to form 2 right angled walls like a great building. The horizontal joints result in step like recessions of the peaks at many places, and thus produce the buttress forms so characteristic of landscape. The partings along all three joints give almost perfect walk.

Besides these sets of joints there are four more sets, or 2 double sets. The first double set has a strike parallel to the valley. One of the sets intersects the other diagonally and also the previous rectangular sets. Looking at the cliffs facing west, the one set is seen to incline to the right, the other to the left, with about equal angles. Thus:-



On the E-W. faces the diagram would be similar, except that the other set of vertical joints would be shown, and so far as I saw on my trip the diagonal joints are steeper, - thus:-



However, the day's observation was not extensive enough to show that this is a general law. However, there is a fundamental difference between the vertical and the inclined joints in that the fractures along the inclined joints, which may be beautifully seen in the upper part of the trail to the top of Yosemite Falls, - are curved thus indicating conical fractures. The question thus arises whether the apparent two sets of diagonal joints are not continuous conical joints, the same as in Daubrée's experiment. If so, these as seen in section would be inclined diagonal sets. If this be true, this suggests that the inclined joints are fractures in shearing planes, perhaps occasioned by differential vertical stresses in the uprise of the Sierra. If this be so, are not the vertical joints tensile ones, similar to tensile joints in sedimentary rocks, and the horizontal joints fractures made by the differential movements between the fractured masses, similar to the accomodations between beds? Then the further question arises as to how far the joints are simultaneous, and how far successive.

In coming up on the train and between the Valley and Porcupine, a distinct schistose structure was seen in the granite at various places. This structure is marked by the arrangement of the mineral particles, and is more distinctly seen in the flattened black inclusions so abundant in the granite. In places these are flattened into almost paper-like areas. Between this extreme and no flattening there are all gradations. This distinctly shows that the granite yielded here and did not there - or at least not to the same degree.

At one place also a flattening was seen transverse to the first, but this did not seem to be general. From this one can infer that the maximum compressive stresses when the schistosity was produced was normal to the N-S. directions of the same, - that the direction of mean stress was tangential - and normal to this, or a stress which produces cross folding, and in this case is parallel to the Sierra, - while the direction of least stress would be the vertical. More observations are needed to exactly determine the directions of the planes of flattening.

Also parallel to the most marked schistosity is a distinct sheeted structure of the two chief kinds of granite of the region - the light gray true granite and the darker colored granodiorite. Along the contact of the two there seems to be a complicated mingling. ?

These sheeted and schistose structures are believed to be deep-seated phenomena, formed prior to the jointing. Whether the schistose structure of one of the granites was formed before the introduction of the other did not appear from my yesterday's observations. I have little doubt that the sheeted and schistose structures were the controlling features in producing the vertical jointing and consequently, ~~the~~ as a secondary result, the horizontal jointing.

Aug. 26.

Rode from Porcupine Flat to Lake ~~of~~ Tenaya.

The systems of joints before observed were noted. At one place, east of the lake, the nearly horizontal jointing has resulted in the production of a short, nearly circular ~~tower~~ in fact two or three of them. The weathering forces have taken advantage of these planes, and cause the tower to shelve off on the E., S, and W., the surfaces having a conical appearance. However, on the N side, the layers break off vertically. A close examination convinced me that the controlling planes are the nearly horizontal system which here is more decidedly inclined to the S.

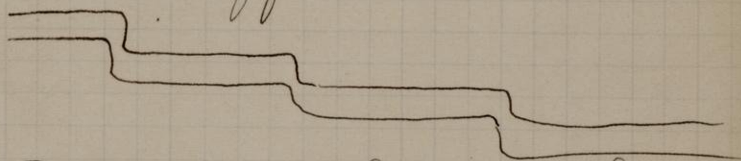
Lake Tenaya is a beautiful lake about the size of Devil's Lake - walled in on the E. by granite domes and peaks which rise probably about 1000 feet above the water. A single great dome rises from the water's edge on the W. A low glacial dome holds the water back and below the lake i.e., to the S. are beautiful meadows, furnishing fine grass. Altogether the place is a most charming one

Aug. 27

The party road N. from Lake Tenaya following an old trail instead of the road, to the Tuolomne river.

We then followed the river to the Meadows - through the Meadows - then on road again following Dana Creek.

The same systems of fracture were seen as on previous days, but there was a difference in direction, i.e., the vertical sets run approximately NE - SW and NW - SE. Corresponding with this change of direction the direction of the streams also changes to the same general directions. This tendency is especially marked in the smaller streams, and in the widened glacial valleys. Adjacent to some of the larger streams, the tendency to migrate from side to side to some extent obscures the decided tendency, although even in these cases if one looks at the walls of the canyon, instead of the stream itself, he sees the tendency controlling the topography i.e., the general direction perhaps diagonal to bedding is made by a series of steps at right angles to each other, the corners being rounded off. Thus.



But even in this case the rounded corners are made by rectangular steps of the individual joints or at small skips of joints.

Continued in Notebook 200