Southern Appalachians with Professors Pumpelly, Willis, Holmes ; Montana, with Dr. AC Peale: [specimens] 18594-18708. No. 111 1891

Van Hise, Charles Richard, 1857-1918
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U. S. GEOLOGICAL SURVEY

FIELD SECTION BOOK

Book III.

Southern Appalachians with Profs.
Pumpelly, Willis, Holmes.
Montana, with Dr. A C Peale

C. R. Van Hise, 1891

18594 – 18708.

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 page is also arranged so that, if desirable, a smaller scale can be used, two inches, one inch, or even 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, for instance 4025, 250 *N.*, 300 *W.*, *Strike*, *N.* 6° *E.*, *Dip*, 50° *E.* Then follow with as full a description of the ledge as possible. 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, but chips of them must be taken. 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. In all cases collect chips for slicing. 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. It is desirable that specimens 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.

18594 – 18708

III

From Raleigh to Hillsborough North Carolina
Trip of Pumpelly, Willis, Holmes
and Van Hise in Southern Appalachains
Notes by C. R. Van Hise.

April 16 1891.

From Raleigh to Hillsborough N.C.

18594. Raleigh granite cut by pegmatite vein.
18595. Raleigh granite.
18596. Quartz schist about 5-8 miles from Goldsborough.

The Raleigh granite was found to be solid only in places where quarried that is at a considerable distance below the surface.

The disintegration in this region extends to a depth of 5-0 feet. As we approach the outer part of the Raleigh granite area the rock becomes very schistose but appears to be no more than a granite like rock in a disintegrated condition.

The only rock found in Kerr's first Huronian belt is a thick
18596. ridge of quartz-schist 18596 which has been subjected to the various dynamic movements of the region as shown by the structure exhibited by the specimens.

The numerous quartz veins which are more abundant towards the edge of the granite area are much later than the granite itself. As the quartz is coarse and the veins generally follow the schistose structure of the granite they themselves show no evidence of dynamic action.

At 58½ miles from Goldsborough we found the contact of the disintegrated pre-Triassic schist and the Triassic conglomerate.

While the crystallines are disintegrated up to the point of contact the vertical foliation is still discoverable and immediately upon this appears the basal conglomerate of the Trias. The Triassic is for the most part well consolidated and shows its bedding by the alternation of coarse and fine materials often in beds several feet in thickness. It is cut by frequent

3 1/2

T. R.

Photo. 1079. Triassic basal conglomerate on the Western North Carolina Railroad.

Photo. 1080. Dike so decomposed as to give disintegration cores cutting Triassic.

basic dikes which even when not fresh enough to outcrop are discoverable by the dark color of the disintegrated dike material.

18597. Knob of granite-porphyry in the Triassic area.

18598. Are from pebbles in the
18599. Triassic from this same porphyry.

The pebbles are partly disintegrated and as a result of weathering show a stronger lamination than the original rock. It is probable that the finely laminated schist is the same rock in a much more disintegrated condition.

18600. Dike in the disintegrated schist just before the Triassic is reached.

At the passage from the Triassic to Kerr's broad area of central Huronian but little was seen. The first rock here appearing is granitic in character then appears various phases of green semi-massive basic rocks which have the appearance of surface volcanoes

18601. } Specimens taken some distance
18602. } apart.

18603. Two phases of rock from one
18604. exposure containing various amygdaloidal looking areas of quartz

18605. Are exceptionally granitic phases
18606. of rock taken from one cut.

At Hillsborough the green disintegrated rock with solid cores formed by disintegration
18607. }
18608. } vary into fissile green and white phases
18609. }
18610. } as is well shown in railroad cut and on ridge. The fissile phases appear to be but the sheared portions of the green massive rock.

When University Station is reached the green rock again appears and continues for the whole distance to Hillsborough with the various phases of alternation above described. It is possible that the white phases of rock were of a different original character injected along the schistose structure of the green rocks.

During the day not one particle of evidence was seen that any of the rocks are of clastic character unless the quartz schist 18596 be such. As a whole the series has ~~none~~ more of an Archean than an Algonkian aspect although it is possible that the green schist area is composed of surface eruptive material.

Photo. 1081. Dikes cutting the green schists along the Western North Carolina railroad. "Kerr's large area of Huronian."

April 17, 1891
From Hillsborough to Greensborough.

18611. Schist about 6 miles west of Hillsborough.
18612 Whitish schist apparently the same as 18611 in a more decomposed condition.

About 2½ miles beyond Hillsborough the slate has a nearly vertical cleavage. The schists continue for a long way. After a time there appears in the schists granitic veins and about 5 miles east of Burlington
18613. appears solid granite 18613 in a cut.

In passing on, the next cut shows a large exposure in which is found both the altered schist
18614. and also granite 18614.

18615. Fine diabase. } The first is from
18616. Coarse grain diabase. } the outer part of diabase and the other from the interior.

18617. Three phases of diabase one granular and coarse, the second fine grained and the third schistose. The two last are parts of the same mass and pass into one another with minute gradations, the difference between them being due to shearing. The coarsest grain phase is in veins in the others, and it has the appearance of a later injection.

18618. Specimens showing gradation from coarse grain diabase into finely laminated schistose phase.

18619.
18620. } Burlington granite.

18621. Material from a partly disintegrated dike. It varies into finely fissile slaty material as it becomes disintegrated. About 9 miles west of Burlington.

(G.P.) U.S. 142 L 37

18622. Typical Greensborough granite.
The specimen is like the great mass of the granite on the way to Greensborough. It is cut by numerous dikes of basic character.

T. R.

Photos. 1082, 1083, 1084. Granite bowlders
of disintegration; top of Dunn Mountain,
near Salisbury, N.C.
Photo. 1085. Looking across at face
of quarry opened at Dunn Mountain

Salisbury N.C. April 18, 1891.

18629. Salisbury granite.

The large dome of granite known as Dunn mountain was visited. As a consequence of disintegration the exposures on the mountain are in the forms of gigantic bowlders and large knobs very like those which occur in Missouri. The granite has a horizontal rift and also another north and south. that is it has rifts in two directions nearly at right angles which make it very easy to quarry.

In passing from the granite mountain to the valley there appears the schists, which are cut by dikes of green material.

It is conjectured that the granite occupies but a small part of the area of the country.

Old Fort, N.C. April 19, 1891.

18624. Augen gneiss large cut at Old Fort

18625. Feldspathic schist which varies into decomposed fissile schist with coarse pegmatitic veins parallel to the structure.

18626. Purplish brown mica-schist at first tunnel about 1½ miles west of Old Fort. The schist and augen-gneiss vary into each other, all stages being seen from rocks which contain well rounded unaltered feldspar to the fine grained fissile schist.

18627. Specimen showing upon one side the fine grained schist upon the other a coarser phase in which the augen are drawn out.

18628. A less finely laminated phase of schist.

18629. Specimens showing the feldspar-augen in a practically unsheared condition. Two miles from Old Fort.

18630. Another phase of gneiss

11½

T. R.

Photo. 1086. Showing apparent bedded character of the rock at this point and the joints cutting across the bedding.

alternating with the other phase just beyond the two mile point from Old Fort.

The rock is here very regularly laminated with layers of different color and different degree of coarseness. The rock contains roundish areas of granite which may be regarded as residual pebbles or far more likely as residual cores of granite which have not become fissile as a consequence of shearing.

18631. Hornblende-gneiss a little farther on.

18632. Mica-schist appears at about 3 miles from Old Fort.

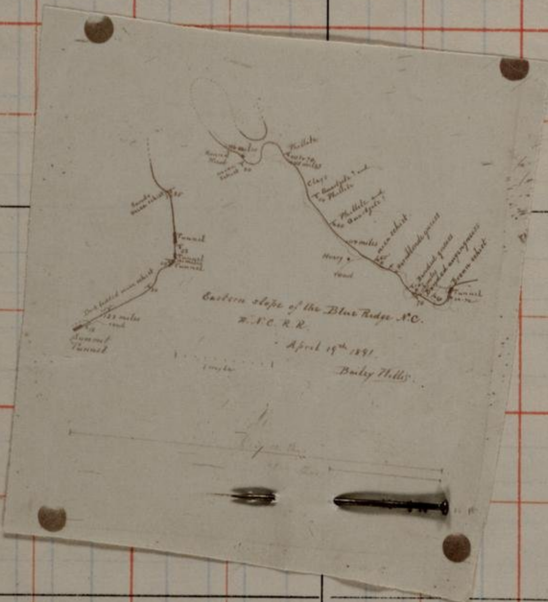
18633. Schist.

18634. Quartzite. These begin at the 114 mile post from A ? (5'); 145 (1,37)

They alternate with layers of quartzose material which have a strong appearance of bedding.

18635-36. Four phases of mica-schist. In order
18637-38. from where railroad is struck after

T. R.


Eastern slope of the Blue Ridge N.C.
W. N. C. R. R.
April 19th 1891.
Bailey Willis
Summit
Tunnel
Tunnel
Phillite
Clays
Tunnel

crossing loop to point where rail-road crosses wagon road. insert map.

In starting out at Old Fort we had no doubt that we were in the granite-gneiss of Kerr's Laurentian, the rock being a coarse augen gneiss, 18624. When we had reached the finely fissile schist we were somewhat doubtful as to its character, but regarded it as a dynamic schist. At the first tunnel the rock had assumed an appearance more common in altered sedimentary rocks than in altered eruptives.

From this place to beyond the long tunnel the likeness to bedding which the structure of these rocks show is simply wonderful in rocks so crystalline as these. At the places in which the rock is very quartzose and becomes a quartz-schist a casual examination without considering texture would without doubt lead to the conclusion that the rock is really bedded. It has as strongly a bedded appearance as the unaltered shales of later times and often the apparent bedding is very flat lying.

How could a schistose structure like this be produced parallel to bedding? Could the rock if deeply buried have had such a differential movement towards areas of relief as to produce this crystalline character, or could it be produced without dynamic movement by metasomatic change?

Near Black Mountain the rocks have become more crystalline and gneissic.

We rode on the train from this point to Asheville.

April 20, 1891.
Asheville to Hot Springs, North Carolina

At Asheville the rocks appear to be somewhat more crystalline than at Black Mountain and contain parallel to the lamination coarse gneissic layers.

18639. The fine grained schist at
18640. this point; and, 18640, the coarse gneissic material interlaminated with 18639.

That there is a gradation from the laminated schist which constitutes the core of the Blue Ridge into the Asheville gneiss on the west and into the gneiss near Old Fort on the east there can hardly be a doubt.

At the "granite quarry" about 1½ miles below Asheville the gneiss is found as the chief rock and is cut in various directions by pegmatite veins

15½

T. R.

Photo 1087. Granite quarry about 1½ miles below Asheville; showing coarse dike on the right hand side near the middle and fine dike on the left hand side cutting diagonally across the figure. Below on the right is the Asheville gneiss from a fraction of an inch to nearly a foot in width. Most of them are parallel to the schistosity, but many cut across the lamination. This pegmatized rock is cut by a great granite dike which is the lowest rock seen at this point.

Another dike of smaller size, about two feet thick, also cuts the pegmatized gneiss.

This latter is finer grained than the larger dike and both cut across the schistosity of the gneiss.

18641. Asheville gneiss. Country rock.
18642. Pegmatite from one of the larger veins.
18643. Granite from lower larger dike.
18644. Granite from fine grained dike.

At another place in the quarry a coarse dike of granite was found to lie in and parallel to the fine grained dike, there being between the two a narrow zone of chill, showing the coarse grained granite to be the later rock.

18645. A contact specimen showing the zone of chill.

In passing down the French Broad the granitic character of the rock becomes more and more apparent. The pegmatite veins are more numerous and larger and the granite dikes of greater size.

At 8 miles below Asheville
18648. a large exposure is composed of 18646
banded and contorted gneiss
which is cut by great dikes
18647. of granite 18647 one of which
is 20 or 25 feet thick This
dike cuts across the banding of the gneiss and includes huge fragments of the same.

At Alexander the rock becomes
18648. a coarse hornblendic gneiss 18648
in places, and in passing along

17 1/2

T. R.

Photo. 1088. The well laminated hornblendic gneiss, cut by pegmatite veins near Alexander, N.C.

the country rock is genuine hornblendic and micaceous-gneiss
18649-50. cut by fine pegmatite veins. From the banded and contorted granite-gneiss the rock varies into a variety which has a very regular lamination as a whole and which simulates bedding in a remarkable manner.

If the schists of the summit seen on the previous day are bedded then this hornblende-gneiss is also bedded.

18651. A light colored phase of gneiss 18651 is interlaminated with the darker somewhat hornblendic phases of 18649 and 18650.

This folded series of rocks in repeated anticlines and synclines continues to Marshall and a little way beyond.

Here a side ravine comes
18652. down to the road which shows 18652 the same hornblendic and biotitic gneiss. A little farther

18653. on is found 18653 and two specimens of typical augen gneiss of the French Broad described in the notes of the previous year. The feldspars are mostly simply twinned, and if the rock is the same as before the augen of feldspar must be secondary developments.

In places the augen gneiss has granitic layers and the augen appear to be of a granitic character. Pumpelly is inclined to regard the whole as a sheared granite.

(For contact between the augen gneiss and the fragmental rocks near Barnard's, see note book of previous year.)

18654. } Conglomerate from the farther
18655. } (northern) side of the small interval which separates the augen gneiss from the plainly fragmental rock. The previous year we felt uncertain as to the

character of this contact, the conglomerate not being found, but we all had no doubt that the fragmental rocks represent recomposed material derived from the augen gneiss and that the latter is an older series.

18656. Granite gneiss at Stack House. Remarkably like the augen gneiss in certain particulars at its border zone at Barnard's. The clastics appear at the Stack House.

April 21, 1891.

By horseback from Hot Springs North Carolina to Greenville Tennessee
18657 we saw a conglomerate 18657 which has a siliceous and calcareous matrix, the pebbles of which are hard blue lime-stone, the whole resting as a thin layer upon a steeply dipping limestone, the Knox dolomite, said by Willis to be the Calciferous. In a synclinal and according to him, upon the other side of the synclinal, is also found a conglomerate. The most of the pebbles are from the Knox but pebbles of another character are also seen.

The conglomerate is regarded by Willis as the Lower Nashville probably post-Trenton. The Nashville according to Willis runs from this horizon through the Hudson way up into the Medina.

Wednesday, April 22, 1891.

On horseback from Jonesboro, Tenn, to Erwin, N.C. and up the Nolichucky to Unaka Spring, and through the gorge on foot

On the way to Erwin we passed a synclinal of limestone
18658. called Knox by Willis, and
18659. upon this rests quartzite, three
18660. phases of which are shown by 18658-59-60.
This is called the Chilowee quartzite by Safford and is by Willis believed to be post-Trenton although regarded by certain geologists to be Cambrian overlying the Knox by faulting. These specimens are from the Gates of the Nolichucky
The Nolichucky gorge was found to be in places over a thousand
18661-62. feet deep. The quartzite 18661-62 is in heavy beds and appears to have a monoclinar structure.
Occasionally it is interlaminated
18663. with slaty phases 18663 which shows a parting, the beginning of slaty

cleavage. It also contains in
18664. places conglomeratic beds 18664–65
18665. the pebbles of which in one place
were as much as two inches in
diameter. Among the white
quartz pebbles which are predominant
are seen a few granite pebbles.

Layers of fine grained
conglomerate contain very
abundant crystals of feldspar
18665. Oftentimes the rock is
coarse and shows cross bedding,
while many layers are gray
from feldspar and pass into a
18666. coarse graywacke 18666.

Willis and Holmes went
farther than I and found beyond
18667. the quartzite and granite gneiss 18667.

Notes taken in Montana on the Three Forks sheet under the guidance of Dr. A. C. Peale.

Monday June 29, 1891.

We drove from Bozeman Montana to the Gallatin river at Shedd Bridge and examined the gneiss near this place. It was found to be a heavily laminated
18668. coarsely crystalline gneissoid granite.
The laminated structure reminded me of the apparently bedded gabbro west of Duluth.

June 30, 1891.

We drove from the Gallatin west to the Madison thence up the Madison canyon for some distance and thence to the Revenue mine on Richmond Flat.

From the Gallatin to the Madison Lake beds (Neocene) were seen most of the way. At places here and there in the ravines the gneiss appeared.

Upon reaching the Madison the road was through a solid gneiss country in which the Madison has cut a deep canyon. The rock here exposed is coarsely laminated, is much contorted and often folded into anticlines and synclines. It contains various interlaminated or cutting areas of black hornblendic rocks which often terminate abruptly.

It is cut by granite veins in many directions. The gneiss varies from coarse to rather fine grained. In short the whole is a typical area of a foliated completely crystalline complex almost precisely like the Lake Superior Archean. The lamination is not at all regular nor in any one direction but it appears to have a more frequent dip to the north than in any other direction. The rocks were not sufficiently examined to determine this point.

Photo. 1089. View of granite gneiss; showing structure; looking across the Madison.

Photo. 1090. Another view of same at a nearer distance.

Photo. 1091. Another view of granite gneiss looking across the Madison at another place and showing numerous granite dikes which cut the gneiss.

Photo 1092. More general view of the Madison canyon granite-gneiss.

Photo 1093. A nearer view of same point seen on right of 1092 ~~at a greater distance.~~ All of above from Madison canyon.

Photos. 1094 and 1095. An anticline of coarse granite gneiss interlaminated with black hornblendic layers. Up side of Hot Springs creek, going towards Red Bluff from the canyon.

In passing from Red Bluff to the Revenue mine the gneissoid granite becomes more massive, contains less hornblendic layers, and after a time appears coarse massive granite of Richmond Flat.

The impression is strongly that of a gradation between the gneissoid granite and the coarse grained massive granite.

In the latter are found no hornblendic layers.

Wednesday July 1, 1891.

From the Revenue mine we followed a road south to Ennis.

18669. The granite of Richmond Flat. It is here a coarse porphyritic rock showing cleavage planes in different directions as the result of weathering.

Photos 1096, 1097 and 1098.
Three views of Ward's Peak in passing from Richmond Flat down to valley below. The first well up on Richmond Flat, the latter from the valley.

From Ennis we drove west across the crystalline rocks which begin about two miles west of Ennis.
The rocks which here occur are found to be contorted and crumpled in every respect like those of the Madison canyon.

18670. 18671. 18672. Specimens of the gneissoid granite, which however has a more strongly laminated appearance as seen in the exposure than is shown by the hand specimen.

18673-74. Hornblende gneiss.

18675-76. Granitiferous hornblende gneiss.

18677. 18678. Phases of the more finely laminated hornblende gneiss.

These hornblendic rocks are rather more resistant than the granite gneiss 18670 and 18672 in which they occur and are seen as detached knobs which however are generally arranged in rows parallel to the lamination of the gneiss, and I have little doubt that they represent exceedingly ancient dikes which have been intruded parallel to the lamination and have been subsequently profoundly altered.

These hornblendic gneiss layers are exactly similar to those seen in dike-like form in the Madison Canyon

1867-9 Diabase dike (?) which cuts across the structure to the granite rocks almost at right angles and may be seen for a long way.

This dike is about 20 or 30 feet across. Other narrower ones are seen. These diabase dikes are readily followed because more resistant than the country rock and they extend above the soil and even if disintegrated they show their position by numerous angular blocks of the partly decomposed dike.

Thursday July 2, 1891.

We drove from Ennis south to Cherry Creek and then turning about we drove by a more westerly route north over ridges to Wigwam Creek.

On the outward trip we remained in the Meadow valley

18680. and the only rock seen was 18680 crystalline limestone the strike of which is N 25° E dip 55° to 60° NW.

The ridge or mountain beyond Cherry Creek is limestone of various kinds.

18681. Grey limestone.

18682. Pink limestone.

18683. Limestone showing the characteristic weathering. All from point of ridge south of Cherry Creek. The limestone is interlaminated with shaly layers.

18684. Calcareous mica-schist found

in passing north before Cherry Creek was reached.

The limestone must have a very considerable thickness.

18685. Hornblendic mica-schist found just north of Cherry Creek.

18686. Two phases of mica-schist
18687. which shortly appear and extend to first gulley, that is from a half to 3/4 of a mile.

18688. Quartzose mica-schist which occurs interstratified with 18686-87.

18689. Limestone which appears on a ridge just south of Morgan Creek.

On crossing Morgan Creek
18690. there appears granite gneiss 18690. This is banded and contorted and continues to the head of a branch of Wigwam Creek.

At Wigwam Creek again
18691. appears marble 18691.

North of this belt of limestone
18692. is found gneiss 18692. This soon
18693. passes into coarse granite gneiss 18693
which Dr. Peale says continues
to the northwest with no
reappearance of limestone.

General.

In this section the dips
are by no means universally
to the southeast but in places
reverse dips are seen.

This is particularly the case
with the last limestone and the
schists and gneisses to the north.

Instead of explaining the
section as one monoclinal deposite
as suggested by Dr. Peale I
should be inclined to explain
the structure as an overturned

anticlinal and a synclinal the bed of limestone being the same in all cases. The wider outcrop of limestone at the south end could be explained by regarding it as a crown of an anticline or a base of a syncline. All this is on the supposition that schistose structure is bedding and for this there is plainly no warrant.

The granite gneiss in the section appears to be like the Archean granite-gneiss of the Madison and of the area west of Ennis. Between this rock complex and the series of schists and limestone there is not improbably an unconformity.

Between the schist-limestone-gneiss series and the nearly horizontal Cambrian limestone exposed to the westward there is a beautiful unconformity exposed on a grand scale.

Friday July 3, 1891.

From Ennis we drove by the direct road to Norris.

After passing Meadow Creek
18694. we came upon granite gneiss 18694
having the usual strike somewhat east of north but the dip being to the southwest instead of to the northeast — the more common dip of the rocks of the country according to Peale. In the gneiss were found hornblendic layers and masses which have a strongly eruptive appearance.

18695. Two phases of these hornblendic
18696. rocks. The former is quite massive and the latter has a structure of coarse gneiss.

For a long way just to the left of the line of travel was seen the Richmond Flat granite. At one place it cuts across
18697. the road and is represented by 18697

coarse gneissoid granite.

This is more hornblendic than that part of the Richmond mass seen on the south traverse.

Is this more basic character due to the absorption of basic eruptive material such as that represented by 18695 and 18696?

Manhattan, Montana, July 4, 1891.

We crossed the Gallatin and East Gallatin and then went north over Peale's Algonkian section. Also saw his lower quartzite, middle Cambrian, upper Cambrian, Silurian, Devonian and Carboniferous. The whole series is inclined to the north at an angle of about 30°.

The lower series (Algonkian)
18698. is one of graywacke 18698, impure
18699. limestones 18699 and 18700, and
18700. shales.

The lower Cambrian quartzite is rather well indurated and shows on the surface a vitreous character such as occurs in the Potsdam of Wisconsin and other places due to atmospheric action.

18701. White quartzite showing this surface induration.

18702. Red quartzite.

18703. Red sandstones.

18704. Conglomeratic quartzite.

A beautiful fault was seen in a ravine. On one side of this ravine the Cambrian quartzite is seen resting against the lower Algonkian slates, while upon the opposite side of the ravine the lower quartzite is against the middle Cambrian.

The throw of the fault is about 400 feet.

July 5, 1891

From Sappington we went to Butte by rail.

In passing up the Butte road from Sappington the canyon of the Jefferson is followed for some distance, perhaps 15 miles. Here are beautifully exposed the same rocks as seen yesterday except the Algonkian is thicker and the faulting and folding is more intricate. A valley is passed and the road begins to climb the mountains towards the valley of Butte.

For some distance slates were seen which Peale thought to be the Algonkian. These were followed for a considerable distance after leaving the canyon, when suddenly appears about two or three miles beyond this place the massive Butte granite almost or quite in contact with the supposed slates. This rock when once struck was followed continuously to Butte. The many sections freshly cut by the rail-road gave an admirable chance to see the rock.

It is a coarse grained hornblendic and biotitic granite with little quartz. It weathers in huge round bowlders.

In many places the disintegration has extended to a depth of 10 to 30 or more feet leaving huge cores before the solid part is reached. In other places where not weathered the granite has a stratified appearance resembling heavy beds of limestone. These are sometimes horizontal and at other times inclined somewhat and at others vertical.

Do they represent the direction of lamination of mineral constituents or are they due to atmospheric heating or cooling or are they the result of folding.

For a long way after the granite was entered no other kind of rock was seen.

After a time near the summit of the ridge acidic dikes began to appear. As Butte is neared these greatly increase in number. Is it not possible that they introduce the mineral material and did the movements which resulted in the fractures through which the acid dikes found their way also produce other fissues for the concentration of the ore bodies.

The Butte mines are in two rows as described by Emmons and in a lower disintegrated and more deeply eroded part of the granite than the mountains, on the intermediate slope or foothills between the mountains and valley.

The same is true of the mines of Richmond Flat.

18705. Hornblendic granite near the summit of the mountains at side of track.

18706. Acid dike in same, showing contact with the granite.

18707.
18708. } Two phases of Butte granite from slope of hill between copper and silver lodes.

Photos. 1099 and 1100 View of lava flow on the stage road after having passed the (Mark) Gate on road between Hot Springs Hotel and Obsidian cliff.

Taken because this volcanic rock so closely resembles a sedimentary rock in its general appearance.