



# **Marquette Region ; Philadelphia, Pennsylvania ; Highlands of New Jersey and the Hudson ; Green Mountains in Massachusetts and Vermont: [specimens] 12459-12500, 18001-18143. No. 96 1890**

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

No. 96.

Marquette Region; Philadelphia, Penn.;  
Highlands of New Jersey and the Hudson;  
Green Mountains in Massachusetts & Vermont.

C. R. Van Hise, 1890.

12459-12500, 18081-18143

# SURVEY OF THE PRE-CAMBRIAN ROCKS OF THE N.W. STATES.

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## 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 figure attached, showing the amount and inclination of the dip. Denote slaty or other very plainly bedded rocks by lines running in the direction of the strike, with figures and a dip arrow attached as before. In all cases where there is the least doubt about the true bedding directions, 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 as 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.

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.

3. The ruling of the left hand page is also arranged so that a smaller scale can be used. Each one of the black lines may represent a section line and the red lines quarter sections and "forties." The scale of the maps may thus be reduced, if desirable, to two inches to the mile (the ordinary town plat scale.)

4. Collect a specimen from each separate ledge of rock, or wherever there is a change of rock on any one ledge. In case of trips made on foot or in canoes, for long distances, neighboring ledges, unquestionably of one kind of rock, need not be sampled, the position and extent of the ledge being marked on the map, with a note that it is of a rock identical with specimen so-and-so. Under the same conditions small sized samples, trimmed to a uniform size of  $2 \times 2\frac{1}{2} \times \frac{3}{8}$  inches will be allowed, but in all other cases *large sized specimens*, trimmed to a size of  $3 \times 4 \times 1$  inches, must be selected, in accordance with § 3, chapter IV, p. 44, Regulations of the U. S. Geological Survey. In all cases collect chips for slicing. All specimens are to have numbers painted on them, in white on a black background, in the field.

5. 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., etc.

12459-12472  
96

Ishpeming, Michigan, July 4, 1890.  
Mr. Channing and I drove to the  
Cambria Mine, thence to Agnewee  
visiting the Jackson Mine, thence to  
Ishpeming.

The Cambria open-pit was found to show a ferruginous slate regularly laminated and dipping to the south. This material is much different from the banded and contorted jasper of the hard ore formation. These slates resemble the red ferruginous slates above the ore horizon in the Penokee Series. The ore is certainly not at a single horizon in the slates, but is in two or three different positions.

In the simple dips of the row of mines south of Feal Lake, and in the character of the ore, this range resembles more closely the Penokee Series than any others in the Marquette region.

Photos. 1027 & 1028. Regularly dipping slates in large open pit of Cambria.

Upon again visiting the Jackson Mine  
the schistose dyke, which runs along  
several pits upon the south wall  
dipping nearly vertical, was seen.

Besides this dyke there was noted  
upon the north side of the same pit  
another mass of schistose rock running  
approximately east and west 6 or 8 feet  
thick, which cuts almost perpendicularly  
across the ore formation, the schistose  
structure being parallel to its sides.  
This is just what would be expected  
in a dyke-rock cutting through folded  
ridgy material like jasper, and con-  
sequently strongly squeezed. These  
two dykes seem to have for some  
distance outlined the boundaries  
of the zone of concentration of rich  
ore, although to the south of the  
smaller dyke are found other ore-  
bodies.

More interesting than the dykes  
was the discovery, above the hard banded  
and contorted jasper containing the  
ore, of a conglomerate which contains

3

fragments of ore and jasper, and with a matrix of the same material, but very largely also of ore. These fragments have their lamination in all directions, and consequently show that the jasper formation and the rich hard ore had formed before the deposition of the overlying conglomerate. While the pebbles are not as large as at the Goodrich, the evidence for a very considerable time break is here just as good as at that place.

12459 Piece of dyke from the one on the south side of pit about 3 feet thick. The rock while slaty has gray spots which suggest a residual granular structure.

12460} 12461} Conglomerate. From north wall of junction, showing pebbles of ore, jasper, etc. The conglomerate has been mixed in a small way for ore just as at the Goodrich.

From the Jackson Mine we went north to the greenstone ridge mapped

by Brooks. We found its south side flanked by a belt of Land jasper formation, which locally has been mixed as an ore. This occurrence suggests that the Land ore formation was here brought to the surface by the upwelling mass of greenstone; or it may be that we have here simply a synclinal structure in which folding the greenstone has partaken.

At the Lake Superior Mine the diamond drill has had at many places struck conglomerate made up of ore, jasper, etc., like those described at the Jackson, Goodrich, etc. Several belts of this material was struck in one hole according to Mr. Sturtevant.

12462

At 413 feet deep the conglomerate was but a short distance above the ore.

In the same drill hole, at a depth of 800 feet, was struck a gray material resembling carbonate of iron in part, which carries veins of siderite, the

analyses of which show a content of iron of 48%. The gray material effervesces with acids and I have no doubt contains siderite. It is compact, gray, and resembles the original siderite of the Penokee region.

The Hematite Mine of the Lake Superior had, in its upper workings, the ore near the adjacent greenstone mass dipping away from it. In going down, the ore-body became vertical and the jasper nodule under the greenstone, a considerable thickness of jasper coming in between the ore and the eruptive rock. The ore-bodies became smaller in depth. Numerous drill holes in the greenstones show a gradation from a schistose phase (soap-rock) on the outside to the massive greenstone of the large knob. There is always a sharp contact between the ore-formation and the schistose material, and a gradation between the latter and the massive greenstone, according to Mr. Sturtevant.

Dshkemming, Michigan, July 5, 1890.

I visited Mr. Mills, Superintendent of the Cleveland Mine.

The general strike of the formation is east and west. The ore was first found adjacent to a greenstone knob, which in the form of soap-rock constitutes the foot-wall of the ore-body. The lower levels of the mine are rather flat and much of the workings are now upon the other side of the synclinal trough. The ore trough pitches to the west so that it is necessary to go deeper for the ore-body in going west. We thus have here a combination of favorable conditions for percolation — a pitching synclinal, and a mass of greenstone diorite on one side of the ore body. Over the ore body is the ordinary vitreous-quartzite so common over the hard ore formation of the Marquette region, and the diamond drill shows that between this and

the ore is the jaspery iron conglomerate like that of the Goodrich. Perhaps the thing of greatest interest, however, at this mine is the fact that siderite becomes largely developed in its deeper workings, as indicated by a remark by Mr. Muller. He says it looks as though the jasper and ore were turning into siderite, so often has this material been struck in. In the deeper workings of the mine I would say rather the siderite in the deeper workings of the mine had failed to turn or be replaced by jasper and ore. The mine yields both hematite and magnetite, as well as martite. The siderite is associated with the magnetite. This fact suggests at once the known production of magnetite from siderite in the Atrimikie Series. The two minerals are most intimately associated. Between the mixture of siderite and magnetite and the diorite is a zone of almost pure siderite. In the lower workings of the mine

(500 & 530 feet levels) the ore is low grade from 40% to 50%. Its lack of richness is probably due to the fact that underground percolation has failed to concentrate the material at this depth as at the higher levels.

It is barely possible that the siderite is a secondary formation in the magnetite.

- 12463 Siderite and magnetite from rock pile. Taken out, according to Mr. Niles, from one of the deeper levels of the mine.
- 12464 Siderite and magnetite containing numerous veins of the former.
- 12465 Pure siderite. From diamond drill hole
- 12466 Overlying quartzite.
- 12467 Ore and jasper conglomerate.
- 12468 Siderite, magnetite and chert.

12469 Soapstone?

12470 Chert and siderite?

All of the above from the Cleveland Mine.

The Lake Angelus Cleveland makes a perfect synclinal through, as developed by workings and diamond drill holes under the lake.

Mr. Miller says that at the Feal Lake Cleveland the shaft has been put down to a considerable depth, about 800 feet. It has at this depth struck granular quartzite. A diamond drill hole was put down to cut this quartzite, but failed to get through. The quartzite is here under the ore because the shaft was in the jasper foot-wall, which dips to the south.

Is this quartzite the equivalent of the quartzite above the ore in the regions of hard ore jasper, that is, the Lake Superior, Jackson, etc., and the ore consequently at a higher horizon;

or is this the lower quartzite of the  
region, and the soft ore jasper horizon  
older than the hard ore jasper; or  
may it be an overture? If the  
second or third, how does it happen  
that the formation is so regular  
that one can hardly believe it  
received the folding to which the  
region was subjected before the ore  
jasper conglomerate was deposited?

July 6, 1890.

In company with Bayley and Thompson we drove again to the Goodrich Mine; thence to the Winthrop range.

Upon reaching the Winthrop, at the west end of the range the ore jasper-conglomerate exactly like that at the Goodrich was found. The Winthrop itself dips ~~to~~ north at a flat angle away from a diorite mass.

The Foster showed by its two open pits on opposite sides of a hill, and by exposure at its crown, to be on the two flanks of an anticlinal.

Driving back to Ghpemming, an examination of the Barnum flats showed that here as elsewhere the ore and jasper-conglomerate abundantly occurs above the ore formation.

In the afternoon we drove to Negarnee, across the strike of the rocks from the North Jackson towards the South Jackson, to the place where the hard or jasper changes to soft or jasper.

(These terms are used for convenience to designate the red brilliant banded and contorted jasper which contains a specular ore, from the light or white cherty material which contains the soft ore.)

There seems to be a ready distinction between these two classes. Thompson maintains his capacity to tell by the nature of the jasper or chert the kind of ore, whether hard or soft which will be found in it.)

In passing south from the North Jackson the dip continues to be to the north, and the soft or jasper appears to underlie the hard or jaspey material.

The section from Teal Lake to the South Jackson suggests a synclinal, the soft ore jasper at the base, the greenstone in the middle, and the hard ore formation at the top. This would make the Teal Lake range older than the hard ore jasper, and the quartzite struck in the Teal Lake Cleveland the lower quartzite.

Are these greenstones intrusions prior to the folding? If so, has the fact that they are below the hard ore jasper and formed the basement of percolation been the cause which has led to the more profound alteration of the hard ore jasper zone and the concentration of the ore here, while these same greenstone layers have protected against atmospheric agencies the soft ore jasper material and thus leaves it nearer its original condition?

The Jackson is the easternmost appearance of the hard ore jasper;

this fact being due according to Brooks to a plunging synclinal structure for the region as a whole which results in higher and higher members appearing toward the west, until at Michigamme the mica-schist is found.

We drove from Negaunee to the Cascade Range, the road for the most part running south. The rocks seen were the soft ore jasper and greenstone.

At the Cascade the wheat was first visited. This is in the soft ore jasper and the folding is most intricate as shown by the open pit, there being several sharp anticlines and synclines in this bed alone.

Photos 1029 & 1030 Photographs of the above.

In driving from the wheat to the old Cascade a diamond drill was found at work, which has penetrated the ore and jaspery conglomerate.

✓ 12471 Conglomerate.

12472 Conglomerate from a depth of 600 feet,  
bottom of hole at this time.

Visiting the old Cascade the strike  
was found to be about northwest and  
southeast. The ore is overlaid by a  
bed of heavy quartzite and conglomerate  
but in the latter were seen no fragments  
of ore and jasper. Also this overlying  
quartzite and the jasper formation  
appeared here to be in conformity,  
contrary to the observations at the  
Goodrich and elsewhere.

Philadelphia, Penn. July 16, 1890.

Work done in company with Prof. Pamphelly.

✓ 12473 Philadelphia gneiss. On bank of Schuylkill River, in the Park.

12474 } Hornblende-gneisses, a little farther

12475 } up the river. The rock contains quite wide layers of calcite. Not possible that this rock is derived from an impure limestone?

✓ 12476 Coarse gneiss from higher up the Schuylkill.

✓ 12477 Granite in the form of a great dyke, or else a mass of granite in the schists.

✓ 12478 A quartzitic phase of the gneiss above the granite.

The Schuylkill was followed to Tissahickon Creek, and from this point the creek was followed.

✓ 12479 } Gneisses, along the Tissahickon, about  
12480 }

the middle of the Manayunk mica-schist belt.

✓ 12481 Primal sandstone about one mile east of Barren Hill.

12482 Decayed gneiss. Obtained just before reaching Barren Hill.

12483 Primal sandstone at Spring Mill.

✓ 12484 } Different phases of banded and con-  
✓ 12485 } torted gneiss, south of Primal along  
✓ 12486 } railroad, upon bank of stream at  
Spring Mill. These rocks are exactly  
like the Philadelphia gneisses.

12487 Limestone and marble at West Conshohocken.

In the various belts of gneisses of Hall, his 1st, 2nd, & 3rd belts — that is, his Hudson River and Laurentian, very little difference was seen. The Philadelphia gneiss is banded, contorted, and contains a good deal of hornblende. A

considerable thickness of it at one place is hornblende-gneiss. This belt is cut by granite veins just as in the Laurentian. They may both be Hudson River, or both be Laurentian, but I have little doubt that one will turn out to be of the same age as the other. The whole of the rocks have a very old appearance. The only thing which at all suggests a younger age than Pre Cambrian is the presence of a considerable quantity of calcite in the hornblende-gneiss, suggesting (Pumpelly) that it may be a much altered impure limestone.

The Primal sandstone and the associated limestones (12487) was very much squeezed, and the latter very crystalline.

July 17, 1890.

From Philadelphia we went by rail to Willow Grove. We here visited the Primal conglomerate east of Willow Grove, described by Hall, and obtained specimens of it.

12488 ✓  
12489 ✓  
12490 ✓  
12491 ✓

This place is known as "The Rocks." Nowhere was a single fragment seen which could possibly be identified as coming from the syenite. ~~These~~ These fragments are said to be abundant by Hall. That fragments from the syenite could by any one possibly be distinguished from the schists of the first and second belts is incredible. The pebbles of the conglomerate are mostly white and blue quartz, which are so dark at times as to suggest that they have been mistaken for syenite, although such a mistake would be remarkable.

From Willow Grove we returned to Philadelphia, and then went to Trenton, N.J. and examined the section along the Delaware River.

12492 ✓ Laurentian

12493 ✓ Philadelphia gneiss

12494 ✓ Primal. Using Hall's maps as a guide.

Here the remarkable likeness between the so-called Laurentian and the Philadelphia gneiss already noted was still more prominent. That they are widely different in age would be so remarkable as to be discredited without the most positive evidence. The unconformable contacts between the Primal and the gneiss, described by Rogers, were not found.

The Highlands of New Jersey.  
July 18, 1890.

In the company of Frank Nason we visited the extreme southeast side of the New Jersey Highlands, in the vicinity of Boonton. The rock as found was a regularly banded gneiss cut by veins of granite, the most of the latter being parallel to the schistose structure.

12495 In the slaty phase is found a thin layer of limestone

12496 ✓ Specimen of freshest part of granite gneiss.

12497 Granite, deeper in mass, just southeast of Montville marble quarry. This rock sheared might readily produce one like 12496.

At the Montville marble quarry granite is found on both sides. Trap dykes also appear, and at one place is a schistose phase of rock said by

Stason to be graphitic schist. The limestone is the diopside-coccolite-pyroxene limestone altering into serpentine described by Merrill.

12498 Serpentine from this place.

12499 } Limestones (To be sent in by Stason.)  
12500 } never worn down. Lathe,

Stason describes along the southeast border of the Highlands a schistose series which he says comes in contact with his Mount Hope type, and in other places in contact with his Oxford type of rocks. These relations he takes as indicating an unconformity, regarding the schistose series as detrital. At one place limestone is found in this series. The limestones are, however, according to Stason, generally associated with granite, which he regards as eruptive; also frequently with trap dykes. The limestones by their detached outcroppings indicate, if this is the case, that the granite extends well along the southeast

border of the Highlands. So far as I could see, the schistose structure of the rocks, it seems to me that it might be produced by foliation on the outer border of the granite-gneiss mass. Compare 12496 and 12497.

This suggestion will explain the occurrence of the limestone in both the granite and the schists, the much foliated condition of the limestones in the latter, the fact that the schist series as a whole cuts across the older types of rock as well as giving a common origin to the granites and associated schists. Upon the outer part of the granite rocks dynamic movement has produced the crystalline schists.

July 19, 1890.

The day was spent in going from Newfoundland to Franklin.

- 18001 Hornblende granite or gneiss.
- 18002 Pegmatite. The two are intermingled in the most irregular fashion. They are banded and contorted. These rocks are found shortly after leaving Newfoundland.
- 18003 Magnetic granite, said by Nason to be a typical rock of his Mount Hope type.
- <sup>✓</sup> 18004 } Magnetic granite, Two phases of  
<sup>✓</sup> 18005 } same type from quarry on the railroad.
- ✓ 18006 Quartzite (so-called by Nason) in granite. This is really a white variety of the granite in which the bisilicate is absent, interlaminated with 18007, gneiss.
- ✓ 18007

- 18008 Another phase of the white granite like this, on the opposite side of the railroad cut.
- 18009 Granite from a little farther along the road. Said by Sason to be his Oxford type of rock
- 18010 Hornblende granite, being found in various irregular forms in the white granite.
- 18011 White epidotic granite between Stockholm and New Bridges.
- 18012 Granite ("Oxford type") some distance east of Hamburg.
- Sofar as I could see the granite in its most schistose form is a granite-gneiss. The distinct types expected from Sason's description were not found to be sharply defined from each other, but to grade off from one phase to another. Upon the whole, I was much surprised at the uniformity

of the granite. It is certainly much more uniform than most areas in the granites of the Lake Superior country. I saw no evidence of clastic character. The whole series seems to be an eruptive one affected by subsequent squeezing or by flowage in solidification, as well as by intrusions of a different kind from the ordinary rock, the intrusions taking place for the most part parallel to the lamination of the original rock.

Obs 18001-18012 give very well the types of rock between Newfoundland and Hardystonville.

18013 Blue and white limestone, Hardystonville. The limestone is here neither the ordinary blue limestone of the region referred to the Frenton nor the white limestone of the Laurentian, but has an intermediate character well-shown by the specimen.

St Hamburg occurs the end of the granite tongue of Pochumak Mountain

In a railroad cut it is in contact with the sandstone and the latter grades up into limestone. The latter has been supposed to be of Trenton age. The limestone is the ordinary blue type. The sandstone is welded to the granite. This may be taken to be due to contact action, regarding the granite to be the eruptive, or as due to subsequent cause by the cementation or by Pumkelly's disintegration theory.

The Trenton limestone dips away from the granite. There is an unmistakable transition between the limestone and sandstone. The quartzite next to the granite looks very granitic, but rapidly grades into the ordinary quartzite.

The following is a section from the blue limestone to the granite:

- 18014 Blue limestone
- 18015 Quartzose limestone
- ✓ 18016 Quartzite
- ✓ 18017 Quartzite in contact with the granite

- ✓ Sun
- 18018, Quartzite and granite  
 18019 Granite 15 to 20 feet from the contact.  
 18020 Vein pyroxene from the granite mass.

Near Handystownville, a short distance south of the road is found the following succession:

- 18021 White limestone.  
 ✓ 18022 Potsdam sandstone from lower slope of hill

On the west side of the hill, near its top, is found in contact 18023, limestone, and 18024, sandstone, the latter being lower down. The limestone is white and crystalline and the sandstone (18024) is clearly in an inferior position. The same facts are seen at Franklin Furnace.

These occurrences are taken by Jason to mean that the white limestone is geologically the equivalent of the blue limestone referred to the Fratton. He explains the more crystalline character of the belt here

referred to by the fact that it is along a line of eruptions, both granites and traps. The crystalline character and metamorphic minerals, such as chondrodite, he regards as due to metamorphic action. If the above is true, the Archean limestone of New Jersey and southeastern New York would be reduced to those on the southeastern border, and these would remain of uncertain age as they have been seen to be associated with the eruptions of undetermined ages.

18025 Chondroditic limestone from quarry at Franklin Furnace.

✓ 18026 From a great granite dyke in 18025.

18027 Coarse limestone in contact with the granite dykes.

This coarse white limestone, in containing chondrodite at Franklin Furnace cut by a dyke of granite,

bears in favor of Stacox's idea as to  
the cause of the crystalline charac-  
ter of the limestones. If he is  
right, it would be the case that  
in New Jersey we have granite  
dykes older than Trenton age.  
If this is true of the northwest  
border of the Highlands, it is not  
unlikely that the same phenomena  
occur on the southeastern border,  
and that this limestone is also  
Paleozoic.

July 21, 1890.

Work done in company with Prof.  
Pumpelly and Dr. Geo. A. Williams

Trip along the Highlands of the Hudson, on the West Shore Road, from Tompkins Cove to Cornwall.

At Tompkins Cove the little altered slates and limestones of the fossiliferous series were seen.

After an interval we pass into the crystalline rocks, the north-eastern extension of the southern half of the Highlands of New Jersey. The rocks were found to be coarse granitoid gneisses having alternating faces of white and pink coarse and fine materials with apparent layers of hornblende-gneiss, and the whole cut by pegmatitic veins of coarse granite and much altered basic eruptives. The resemblance to the Late Superior Fundamental Complex is very close.

18027A Granite-gneiss from near Tompkins

Cove. This phase continues for some distance along the track intermingled with coarser phases.

18028 White granite free from felsilicates. This belt is about 2 or 3 miles wide and in places is like 18027A. It resembles Stason's "Quartzite Blocks" in granite.

18029 Another phase of granite-gneiss farther on

18030 Basic dyke in granite about 2 miles above Tompkins Cove. Found before reaching Jones Point.

Photo. <sup>1031</sup> Photograph of basic dyke in the granite. Showing a cross-jointing of the dyke and something of a lamination parallel to its sides.

Photo. <sup>1032</sup> Another dyke in granite farther on,

Photo. <sup>1033</sup>  
1033 Showing the massive character of the granite. It has a coarse vertical lamination.

18031 Granite-gneiss between Jones Point and Iona Island.

18032 Hornblende-gneiss near Iona Island. This cuts across white and red granite-gneiss.

At Iona Island we boarded the cars and rode to Cornwall. From here we walked down the track through the Storm King granite cut to the quarry.

The rock is here chiefly a light-gray granite-gneiss with greenish tint, the rift of which is nearly vertical. The coarse phases of granite running into pegmatite veins before noted are here very distinctly seen to grade into the ordinary granite. In general they have a rough parallelism with the foliation of the ordinary

granite-gneiss, but here and elsewhere they often cut across the foliation. There are also found a series of hornblende-gneiss or diorite-gneiss dykes, which vary a few degrees — about 10° — from vertical. They are cut by the coarse pegmatite veins.

The history here seems to have been as follows: — The ordinary granite formed, and after solidifying the basic dykes cut the granite. After these had solidified, but while still hot, the whole mass was impregnated by the coarse granite, which in the case of the smaller veins generally followed the rift of the earlier granite-gneiss, but in its larger bodies broke across the rift. The likeness of composition of the granite-gneiss and the pegmatite has caused a merging together of the two kinds of rock.

✓  
18033 Storm King granite from Storm King. The Ordinary type.

✓  
18034 Intermediate phase of granite

18035 ✓ Coarse pegmatitic granite.  
18036 ✓

18037 Hornblende-gneiss dyke.

18038 Hornblende rock and ordinary granite  
together.

after passing above the station  
at Cornwall the rocks are found  
to be wholly different; that is, little  
altered slates and limestones.

18039 limestone

18040 slate.

North Adams, Mass., July 22, 1890.

He visited near the Stamford dyke near Stamford, on the southeast part of Clarksburgh Mountain, described by Pumppelly and Dale in their report. The relations were here found as described

The following specimens were taken as representatives of the locality.

- ✓ 18041 Granite.
- 18042 Piece of the dyke.
- 18043 Granite and dyke in contact.
- 18044 Conglomerate containing blue quartz fragments.
- 18045 Schist adjacent to 18044. The blue quartz contained in the pebbles is likely that in the granite gneiss. The dyke does not penetrate the quartzite. The latter contains detritus from the dyke. It has altered and foliated, the layers of quartzite thickened at the place at which the dyke has been weathered out. The schist (18045) shows much squeezed pebbles. The process of alteration has gone so

far as to destroy their integrity  
for the most part.

Photo <sup>1034</sup><sub>1034</sub> Quartzite layers overlying  
the dyke.

Following along the strike of the  
quartzite over the granite gneiss boss  
<sup>18046</sup>  
<sup>18047</sup> the conglomerate apparently changes  
into 18046 and 18047, quartz schist  
carrying feldspar.

This schist is interlayered with 18048  
18048 mica-schist or gneiss.

Going down the east side of the  
18049 moutain, 18049, albite gneiss or  
albite phyllite is found. This rock,  
according to Penncelly, is the equiva-  
lent of the marble or limestones  
west of the Hoosac River. The  
albite gneiss is above the quartzite.

Returning from Brantton to North  
Adams exposure of arenaceous,  
calcareous schist 18050, and quartzite

18051 are found interlaminated, and these interstratified with nearly pure limestone.

At quarries about half-way between Cranston and North Adams are 18052 and 18053, marble. These are nearly at the axis of the anticlinal but show nicely the folding of the beds.

The Hoosac River according to Pumelly is the old axis, upon the east side of which was deposited the sedimentary rocks from which the schists have been formed, while upon the other (west side) was deposited limestone.

North Adams, Mass., July 23, 1890.

We drove to the Hoosac Tunnel central dump and examined the east upper flank of the Hoosac Mountain; then west across the crest and down the west side; after which we climbed a spur near the middle of the main Pre-Cambrian mass.

At Hoosac dump there are shown the various phases of rock which are cut, the granite and gneissoid granite, albite gneiss, etc. Between the granite and conglomerate there appears to be a gradation. All are holocrystalline.

- 18054 Granite gneiss,
- 18055 Granite gneiss
- 18056 Granite gneiss or squeezed conglomerate.
- 18057 } Conglomerates.
- 18058 }
- 18059 Alternations of conglomerate and fine-grained schist;
- 18060 }
- 18061 Fine grained schist.

18062 } albite gneiss.

18063 }

18064 Garnetiferous albite gneiss.

All of the above from Hoosac dump.

Photos. 1035 & 1036. Conglomerate of central Hoosac dump; photographs of fragments.

18065 } Phases of schist from the east side of  
18066 }  
18067 ) Hoosac Mountain.

Walking up the spur on the west side was found the following succession:-

Albite gneiss

18068  
18069  
18071  
18072  
18073  
18074

Phases of the white gneiss, 18073-74 being very coarse-grained and containing feldspar crystals. These are the rocks which laterally are replaced by quartzite.

18075 Hornblende rock occurring in the above. Alterd dyke?

18076 Granite gneiss near the crest of the

spur.

- 18077 Calcareous gneiss at old quarry  
east of Adams
- 18078 Vitreous quartzite from a boulder  
supposed to be the Cambrian.
- 18079 White gneiss
- 18080 } Quartzose limestone
- 18081 } Quartzose limestone
- 18082 Blue limestone, interlaminated  
with white limestone.

The above, 18077 to 18082, are taken  
on the road from Adams to North  
Adams.

At the top of Hoosac, upon our  
trip across the crest, I found a  
coarse conglomerate containing  
little altered boulders of the  
coarse granite-gneiss and of a  
finer grained gneiss. The axis of  
the anticlinal pitches to the north,  
and about 10 feet to the south was  
found the typical granite at a lower  
level than the conglomerate. The

identity of the numerous boulders of the Conglomerate — some of them a foot and a half through — with the material of the underlying granite is plain, and leaves no doubt of the later age of the conglomerate.

The overthrust folding was beautifully shown on the west side of the mountains. The dips are usually to the east, but places are found where they are not — that is, at the axis of the folds. But these occupy but a small area, and they might altogether escape the notice of any one but a careful observer.

The albite gneiss and whitegneiss are so crystalline that at the Lake Superior region they would undoubtedly be placed with the fundamental series. The matrix of the conglomerate is just as crystalline as in the finer grained phases of the Laurentian rocks of this region.

The large massive fragments have been able to resist the pressure on the axis of the fold, and show in an unmistakable fashion the clastic character of the rock, which could not be easily discovered if it were not for these conglomerates.

July 26, 1890.

It drove from Rutland, Vt. to Mendon, Vt. and thence to North Sherburne. The last half of the drive took us over the Green Mountain Range.

- 18083 Limestone exposed for some distance before the crest of the range was reached.
- 18084 After passing the crest, appears coarse granite. This continues for a short distance only when there appeared laminated rocks of a chloritic character.
- 18085 } Two phases of quartz schists little  
18086 } farther on.
- 18087 Quartzite, in which 18083 & 18086 appear to grade.
- 18088 Gneiss which quickly appears and continues to North Sherburne.

18084 to 18088 are all taken within two miles of Sherburne and are believed by Pumpelly to be pre-Cambrian rocks.

East of North Sherburne is a conglomerate very much like the Black Hills conglomerate. The pebbles are bent and stretched, in some cases the distortions being of the most unusual sort. The bedding of the rock cuts the cleavage at a high angle. The fragments of the conglomerates are nearly pure quartz and a peculiar schistose rock, both of which are abundantly found, the first in veins, and the second in layers at a near point to the west, just across a narrow ravine. It looks as though a physical break is at this point, and that the fragments of the conglomerate are derived from this underlying massive series. Rocks containing the same variety of quartz and schistose phases of rock are also found west of North Sherburne.

Farther west, between these rocks and Sherburne, are found granitic phases of rock some of which are coarse and resemble the granite-gneiss of the Hoosac.

Williams suggests that the rock, which is above supposed to be the material from which the pebbles are derived, is but a more intensely squeezed phase of the conglomerate.

- 18089. conglomerate;
  - 18090. fine conglomerate;
  - <sup>18091</sup> { pebbles from conglomerate, showing the  
18092 } two phases;
  - 18093 "cement rock" showing cleavage and bedding cutting across each other at an angle. (Specimens in University Cabinet)
- All of the above are from the conglomerate described.

<sup>18094</sup> {  
<sup>18095</sup> {  
<sup>18096</sup> {  
<sup>18097</sup> {  
<sup>18098</sup> { Various gneisses taken from east to west, west of place at which the conglomerate is found.

Photo. 1037 Exposure showing vertical cleavage and cutting diagonally across this bedding as in exposure, near conglomerate a short distance east of North Sherburne.

Photos. 1038, 1039, 1040. Coarse conglomerate with elongated pebbles at North Sherburne.

Photos. 1041, 1042 Coarse conglomerate at North Sherburne, showing elongated character of the pebbles. The schistosity is more strongly developed than in 1038, 1039, 1040. The very irregular shapes of the pebbles, and the manner in which, by pressing against each other, their shapes are affected is to be noted.

Photos. 1043, 1044 Medium-grained conglomerate at North Sherburne. The

schistose character of the matrix is very well shown.

Photo. 1045 South Sherburne conglomerate, interstratified with a layer of less conglomeratic character.

Photo. 1046 Band of conglomerate in schists at South Sherburne. The conglomerate layer in the form of a litter shows the probable direction of bedding. The schistose structure is in a uniform direction.

Photo. 1047 South Sherburne conglomerate (?) From a distance

From what has been seen at South Sherburne, it is probable that the specimens collected the previous day, 18084, to 18088, represent a part of the series which belongs with the South Sherburne conglomerate.

July 27, 1890.  
From South Sherburne Vt., to Ludlow.

18099 White quartzite which is a  
layer in 18100, green cement rock  
schistose dike in the same.  
All found along road before  
getting  $1\frac{1}{2}$  miles south of  
South Sherburne.

18102, Another phase of gneiss a  
little farther on.

We then come to a con-  
glomerate like that east  
of Sherburne.

This was not specimenmed.

18103, Schist which alternates  
with conglomerate just as  
we came to a limestone  
at the north end of Plymouth  
Valley proper.

18104, Blue limestone; the two closely  
18105- White limestone. associated.

18106, Schist containing albite,  
adjacent to the limestone in  
the so-called "cement rock"  
of Pimpelly.

The above about one mile  
northwest of West Bridgewater.

18107, Albitic cement rock, one  
mile north of Plymouth  
Cinross.

18108 }  
18109 } Conglomerates one mile north  
18110 } of Tynson's Furnace, Plymouth  
18111 } Pond. (Hitchcock's Plymouth  
18112 } Pond locality.)

In the above the pebbles are  
very much distorted and  
grade almost into a  
schist.

18113 In 18113, another phase,  
no one would suspect that  
any pebbles are contained.  
It crops like a fine-grained  
gneiss, but in all essential  
respects is like the <sup>former</sup> conglome-  
rate of which it <sup>forms</sup> a part.

July 28, 1898.  
From Ludlow R. to Cuttingsville.

- 18114 "Cement rock" Lowest  
member of Pumppelly's pro-  
visional Cambrian; about  
2½ miles west of Ludlow.
- 18115} two phases of feldspathic  
18116} gneiss in rock series referred  
to pre-Cambrian near  
Hedville.
18117. Gneiss in railroad cut at  
Summit Station.
18118. schistose dyke in the gneiss;  
old and much altered.
18119. Comptonite dyke; fresh,  
from the interior of the dyke.
18120. Another specimen of the  
same dyke at its edge.
- 18117-18120. All from Summit rail-  
road cut.
18121. Gneiss, just north of Hollow-  
ville cheese factory.

- 18122} Serpentine and hemispheric  
18123} limestone about  $\frac{1}{4}$  mile north.
- 18124 Gneiss about 5-6 ft. north  
of Limestone; Whittle speaks  
of it as quartzite.  
The limestone appears to  
be in the gneiss and all  
are taken to be pre-Cambrian.
- 18125 Gneiss from top of Mount  
Holly; showing cleavage  
and bedding.
- 18126 Foliated and contorted  
18127 dyke material folding over  
quartzite, and the quartzite  
apparently interlaminated  
with the same.
18128. The quartzite associated  
with 18126 and 18127.

Photo. #<sup>1048.</sup> Foliated and  
contorted dyke interlaminated  
with quartzite, folded into  
an anticline near the  
crest of Mount Holly.

- 18129 Gneiss on the north slope.  
This gneiss appears to me to  
be not once whit more  
crystalline than the "white  
gneiss" of Hoosac.
- 18130 Garnetiferous fitted quartz  
schist; east slope, Mount Holly.
- 18131 Syenite from huge boulder  
on east flank of Mount Holly.
- 18132 Coarse gneiss containing  
much feldspar and little  
quartz; at base of northeast  
flank of Bear Mountain.
- 18133 "Cement rock", a fine-grained  
greenish schist. The first  
variety found above the  
coarse-grained gneiss in  
passing west from 18132.
18134. Typical cement rock. From  
crest of north end of Bear  
Mountain, west of 18133.  
This passes into a fine-

18135.

18136.

grained conglomerate of which  
18135 and 18136 are fine  
phases.

18137. Very coarse quartzite;

18138. Quartzite

18139. Fine grained quartzite west  
of above, in continuation  
of the same section farther  
to the south.

18140} are continuation of the

18141} same section.

In passing along grit they  
quartzite a great mass appears in  
a great mass on the west  
slope of the range.

The dip is  $80^{\circ}$  east, and  
the strike apparently about  
north and south.

This eastern dip is regarded  
by Rumphelly as an overturn.

The above set, from  
18132 to 18141, make the  
section from east to

went in passing from  
the base to the crest of Bear  
Mountains.

18142 Returning, 18142 green  
rocks containing feldspar  
crystals, at a bridge cliff at  
last crest near top of  
mountain. This is  
apparently a transition rock.

18143. Gneiss in the valley below.  
Taken to be a core rock found  
pre-Cambrian; it is strongly  
banded and contorted.  
The whole of the ~~Bear Mountain~~  
series is supposed to be pre-  
Cambrian and it is in this  
region that Pumpelly expects  
to be able to sub-divide the  
pre-Cambrian rocks into  
an Algongian and Archean.



