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Geological Survey (U.S.); Van Hise, Charles Richard, 1857-1918
[s.l.]: [s.n.], 1883/1884

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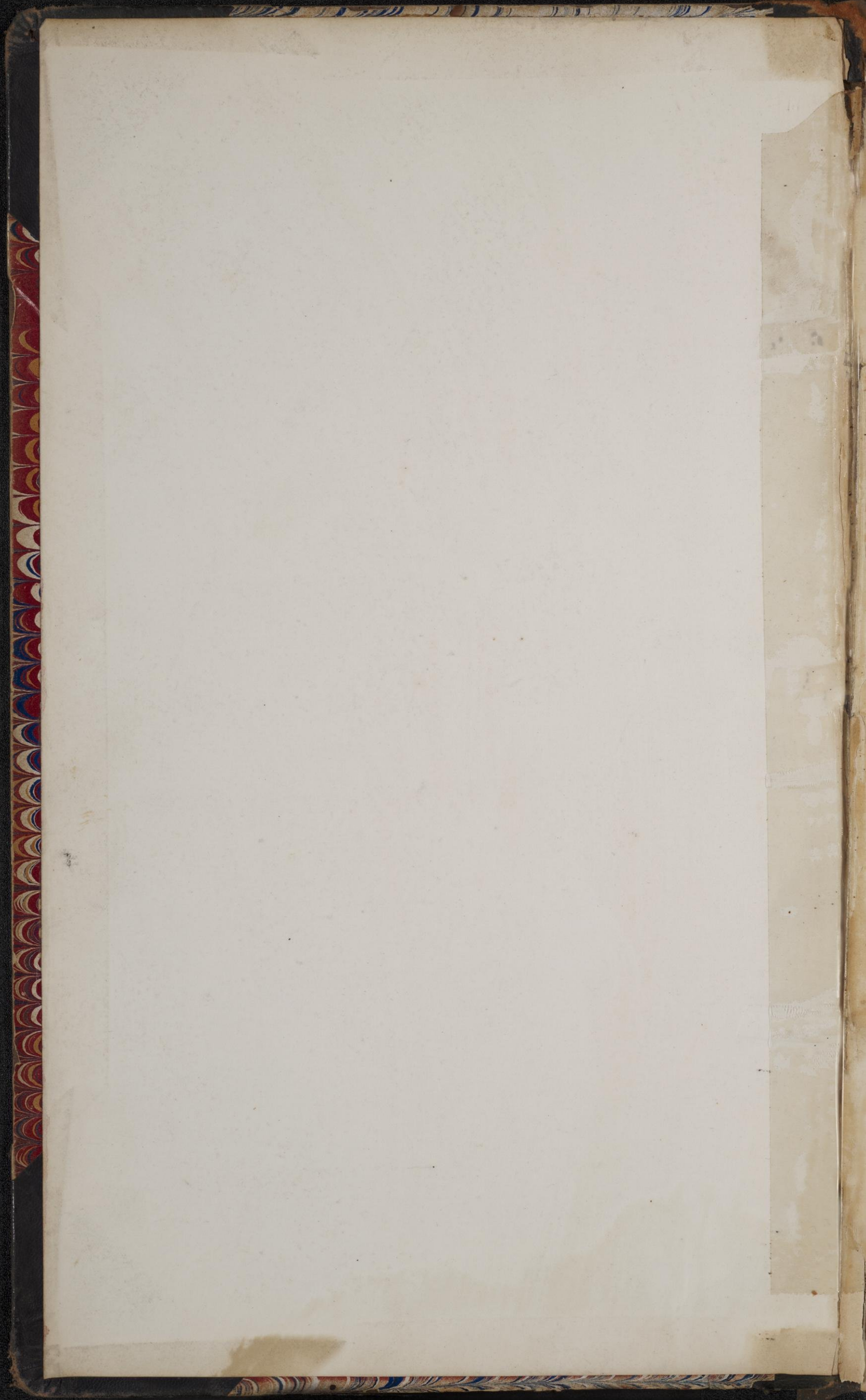
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United States Geological Survey.

Lithological Descriptions.

Book III.



6543

Greywacke.

C. R. Vanhise, Dec. 1883.

West of
French Is.Macroscopic Description.lands, Lake
Superior.

Dark grayish-green; of a medium uniform grain; compact. At first look might be taken for a greenstone.

From the

Slate Con-

glomerate

of Logan.

Microscopic Description.

Composed mostly of rounded grains of quartz and feldspar, of varieties of orthoclase and plagioclase in about equal proportion. Both of these minerals distinctly show enlargement. The amount is not usually large and, as a result, the grains do not commonly interlock. The points indicating feldspar enlargement are as follows: ^{the} orthoclase shows rounded nuclei which are considerably decomposed, and about these there are rims of more or less angular fresh feldspar which polarize with these centers; again, in some cases, besides the center being more decomposed, there are distinct lines between the core and the secondary matter; lastly, the same things are to be found in the plagioclases, and in such cases the new material is twinned uniformly with the old. Chlorite is the principal mineral between the grains, and often the feldspars are partly changed to this substance. Some clay and complex areas of fine quartz are present.

Note by R. W. Irving. Jan. 1884.

Quartz enlargements plain; feldspar enlargements doubtful. Is any of the fine interstitial material of a chalcedonic ~~origin~~ nature? One crystal is noted of a fresh brightly polarizing material. Is it augite sphere or what? The relation of the chlorite to the quartz and feldspar grains is worthy of further study. It polarizes very feebly or not at all, in some areas being completely without polarization. Query — has all of the chlorite

6543.Greywacke (con.)

come from the alteration of the feldspathic material. ? Some of it has undoubtedly had that origin. This is also without polarization. However this may be, the chlorite is plainly of a secondary nature and cannot, I think, be regarded as of metamorphic origin. The rock is typically a "recomposed" one and while very markedly of a fragmental nature, has by enlargements of the quartzes and perhaps also of the feldspars, and by the addition of chlorite been brought so close to a crystalline rock that a very little continuation of the process would be needed to give us a true crystalline schist of a chloritic gneiss.

6544

West of
French Islands
Lake Huron
"Slate Con-
glomerates"
of Logan.

Greywacke.

C. R. Vanhise Dec. 1883.

Macroscopic Description.

Much finer than 6543.

Microscopic Description.

The chief difference between this rock and 6543 is that the former is finer grained. Enlargements of quartz and feldspar with No. 5 objective were quite satisfactorily seen though not so completely as in 6543. Carries more chlorite and clay than 6543.

6546

West of French

Islands

Lake Huron

Logan's

"slate Con-

glomerate."

Greywacke.

C. R. Vanhise Dec. 1883.

Macroscopic Description.

Same as 6544 except that it contains large pebbles of granite and felsite.

Microscopic Description.

The general appearance is the same as that of 6544. The enlargements of quartz and feldspar were not seen.

6547

Greynacke slate.

West of the
French Islands

C. R. Vanhise Dec. 1883.

Lake Huron

Logan's

slate con-
glomerate.

Macroscopic Description.

Finer than 6544. Almost aphanitic.

Microscopic Description.

Apparently not much different from 6544.
The only points of difference noted are that
scales of kaolin are quite abundant here
while there is less chlorite.

6548West of
French Islands

Lake Huron.

Slate Con-
glomerate
of Logan.Greywacke.

C. R. Vanhise Dec. 1883.

Macroscopic Description.

Like 6543.

Microscopic Description.

Like 6543. One flagioclase shows an enlargement nicely. Contains felsite pebbles.

6550West of the
French Is-lands, Lake
Huron."Slate Con-
glomerates"
of Logan.Greywackes.

C. A. Vanhise Dec. 1883.

Macroscopic Description.Matrix like 6544. Contains large
pink feldspars.Microscopic Description.

The rock teaches nothing new. There is more clay than before and the feldspar fragments vary widely in size, running from those which are minute to those which are very large. There are large felsitic fragments. Enlargements are not found.

6015

West end of
Copper Lake
Minn.Magnetitic Augite Schist.

C. R. Vanhise Dec. 1883.

Macroscopic Description.

A very fine grained rock which is apparently composed of ~~more and~~ alternate bands of more and less ferruginous quartz; the bands containing most iron are black, while those containing little are gray.

Microscopic Description.

A ground mass of fine perfectly fitting grains of quartz. The individuals of this mineral must have crystallized in place; for a single one of the very numerous rutile needles which are included in it, often extend beyond a single grain. Augite composes perhaps one-fourth of the rock and is found both in small grains and in large ones which are often cut into several parts by the quartz and often include many grains of that mineral; hence the augite is subsequent to the quartz. Magnetite is more abundant than augite, occurring in minute specks included by the quartz and in large irregular grains. Also a portion of it is concretionary and this portion has formed about complex nuclei of quartz, about magnetite grains, about augite grains, or about two or more of these minerals combined in one grain.

The order of crystallization has then been as follows, viz:—(1) rutile; (2) magnetite in part; (3) quartz; (4) augite; (5) magnetite, concretionary.

That concretionary action could come in at so late a time in the formation of a (but for this) perfectly crystalline rock, would seem to indicate that to the very last the rock was more or less plastic and that the magnetite was able to force passages about the old material where it is deposited in a concretionary form.

6018

Sec. 7, T. 64

R & W,

Miner

Augitic Quartz Schist

C. A. Vanhise Dec. 1883.

Macroscopic Description.

Upon a fresh fracture, ^{it} looks to be a black-banded quartz schist. Upon the weathered surface it is yellow from peroxidization of iron.

Microscopic Description.

Consists mostly of large intricately interlocking ~~quartz~~ grains of quartz. This mineral was evidently the last to crystallize, for in some parts of the section, grains of it include all of the minerals to follow. These are augite, olivine, magnetite in crystals, biotite, chlorite, chrysotile or fibrolite or both. (To be farther studied.)

(6820) Slaty Feldspathic Quartzites or Slaty Greywackes
 (6822) C. R. Vanhise Dec. 1883.
 (6828) Macroscopic Description.

From the "Annickie Group" of the National Boundaryline
 Fine grained; uniform compact texture; the color is bright gray to dark grayish drab; conchoidal fracture.

Microscopic Description.

(6820-2) N.E. 1/4 Sec 28 T. 65, R. 1 E. High Bluff Minn. (6828) from cliff on south side of east end of Mount Lake.
 Quartz is in each the mineral in greatest quantity ~~is~~ and is in (1) simple fragmental grains; in (2) complex ones composed of minute interlocking quartzes; and in (3) in interstitial interlocking areas the simple grains are certainly and the complex ones probably often enlarged while the interstitial is regarded as secondary in large part at least. Thus ~~the~~ the quartzes interlocking with each other and at times with the feldspars. Orthoclase and plagioclase are the next minerals in importance. Often the grains fit closely with each other and sometimes dovetail somewhat. Enlargements may have taken place but no proof of this was seen. Some clayey material was found between the grains.

These rocks are comparable with the slates 6544-6-7 of Lake Huron. There are however points of difference among which are these: the latter are finer grained, more chloritic and the quartz grains of quartz are less angular, this probably being due to the fact that enlargements have not been so common, and less interstitial quartz has been deposited. In short 6544-6-7 are nearer true slates than 6820-2-8.

The resemblance to the Marshall Hill rocks (930 Wis., 932 Wis., 3583 Wis.) is also noticeable. Here however there are important differences. In the Marshall Hills specimens no quartz enlargements are seen. The larger fragments of quartz and feldspar are usually not in contact with each other;

{ 6820 Slaty Feldspathic Quartzites or Slaty Graywackes. (con.)
6822 thus a ~~fine~~ matrix composes about one-half
6828 of the rock. This matrix is very fine grained
 and consists of quartz, chlorite and clay in
 which are ^{numerous} flakes of Kaolin. Another notice-
 able thing is that the grains of quartz and
 feldspar instead of showing sharp definitions
 appear to gradually fade into the matrix. The
 probable cause, as it appears to me, is that
 the individuals of those minerals commenced
 to enlarge and in so doing enclosed a
 portion of the plastic clay about them. As
 they continue to grow, they enclosed more and
 more of this matrix until finally the power
 to continue growth died. This would seem
 to explain the phenomenon. (Compare 4233,
 4274, 4341, 4407, 4400, 4434, and more
 important 6604.) It seems probable that
 the better explanation of the gradual variation
 of a quartz grain into finely complex quartz
 would include that given in the description
 of 4233 and 6604. In one rock it may be
 due to one of these causes, in a different one to
 the other, while again both explanations may
 apply. It is likely however that the expla-
 nation applied to No. 930 must always be true
 of the enlargements of feldspar. We are to
 6820, -2, -8 than either the Lake Huron slates
 or Marshall Hill schists, are 1111 and 1113. The
 latter rocks contain rather larger fragments of
 quartz and feldspar than these rocks which
 are not quite so angular, nor do they so fre-
 quently interlock. Other ^{minor} ~~main~~ points of differ-
 ence are the presence of microcline, kaolin
 and calcite.

6162Slaty Feldspathic Quartzite

Near center

~~Macroscopic~~ C. R. Vanhise Dec 1883

Sec. 27, T 65

Macroscopic Description.

R. & E. Minn.

The rock is like 6820, -2, -8 except that it is finer.

Microscopic Description.

The rock differs from 6820, -2, -8 only in being finer grained

6040

S. W. J. E.

Sec. 3, T. 65

R. 6 W., Minn.

Feldspathic Quartzite.

C. R. Vanhise Dec. 1883

Macroscopic Description.

The rock is coarser ~~than~~ grained than 6820-2-8. Otherwise it is like them.

Microscopic Description.

The rock is coarser than the rock in 6820-2-8. Otherwise, taken as a whole, it is not different. Upon one side of a section is a long area which with a low power looks like a much kaolinized feldspar. With a high power, while the flakes of kaolin remain, the area seems to be composed largely of very minute interlocking grains of quartz, perhaps mingled with amorphous silica.

{ 6176
 { 6766

Partridge Falls

Pigeon River

Minn.

Feldspathic Quartzite.

C. R. Vanhise Dec 1883.

Macroscopic Description.

The rock is very like 6820-2-8. The proof of quartz enlargements is complete. The grains of quartz differ from those found in 6820-2-8 in being finer grained, in that the quartz and feldspar fragments lie closer together and more often interlock; consequently there is much less room for interstitial quartz.

6845From first
rapids below

end of Grand

Portage trail

Oregon River

Minn.

Clayey Feldspathic Quartzite.

C. R. Vanhise Dec 1883.

Macroscopic Description.

The rock is not so compact as 6820-2-8.

It is of a clay blue color with a decided clayey odor.

Microscopic Description.

The section does not differ greatly from those of 6820-2-8. The quartz enlargements are plainly visible. The chief point of difference between this rock and those mentioned is the presence of a larger quantity of clayey material with kaolin flakes.

6038

Conglomeratic Slate or Quartzite.

S W 1/4, S E 1/4

C. R. Vanhise, Jan. 1, 1884.

Sec 23, T 65

Macroscopic Description.

R. 6 W

Minn.

Large granitic pebbles and debris are scattered through a dark drab colored clayey matrix. This matrix is much finer in some parts than in others.

Microscopic Description.

A section from the matrix includes portions of both coarse and fine parts. The coarser part is composed of fragments of quartz and feldspar in sizes from several m. m. across, to those of minute dimensions. The rounded grains of quartz are usually simple with no enlargements, but many are composed of finely complex grains which in one case are so fine as to leave it doubtful if a portion of it is not amorphous. The orthoclase and plagioclase are usually much decomposed. Yellow feebly dichroic chlorite is seen which somewhat resembles biotite. Pulverized granite which is so plentiful in the rock, probably furnished the biotite as it also doubtless did feldspar and quartz to build up the matrix. Sometimes the grains of quartz and feldspar interlock with each other or among themselves but in such cases the wholes appear to be complex granitic fragments. The coarser portions of the section have a dirty illly defined look due to decomposition and perhaps to original mud. The finer portions of the section are much decomposed but the section appears to be a portion of a crystalline rock. The only minerals to be discerned in these parts are (1) little centers of feldspar, the outsides of which are completely decomposed; and (2) large chlorite areas. In the interstices of these minerals is a dirty mass of clayey material.

6053Pyritiferous Clay Slate.

C. R. Vanhise, Jan 1. 1884

Macroscopic Description.

The rock is fine grained, gray and black banded, compact, and has a conchoidal fracture.

Microscopic Description.

Rounded grains of quartz and feldspar with no enlargements, fragments of pyrite and magnetite are scattered through a fine ground mass which appears to consist mostly of clay, chlorite and perhaps ~~of~~ quartz. These minerals do not interlock, there is much matrix; This rock is a true slate and while different from the Marshall Hill schists is yet allied to them.

6071

Sec. 1, T 64

R 9 N.

Minn.

Epidiotic
Augitic Hornblende Schist.

C. R. Vanhise Jan 1. 1884

Macroscopic Description.

A dark-green, fibrous schist.

Microscopic Description.

Augite (Epidote?), hornblende, quartz and feldspar scattered through a matrix of quartz and feldspar make up the rock. The augite is quite plentiful and often altered in part to hornblende. Hornblende is the most important mineral in the section. Enlargements of augite and hornblende were sought but none which were satisfactory were found. However there are a few lines which might be supposed to be lines of division between new and old hornblende. The quartz grains are mostly rounded but often quite angular and sometimes intricately interlocking. While there are indications of enlargements, the lines of division are not definite enough to warrant positive statement. Feldspar is plentiful but mostly so much ^{de-}composed as to make the species uncertain. The matrix is composed of quartz and badly decomposed feldspar. The quartz has a decided fragmental look and I am inclined to regard the rock as partly clastic at least, although the ^{epidiotic} augite and hornblende may have developed in place.

1943

Ferruginous Feldspathic Sandstone.

N. E. 1/4 Sec 36

C. R. Vanhise Jan 5. 1884

T-8, R 30 W

Macroscopic Description.

Mich.

A red uniform sandstone. A magnifying glass shows no quartz and the feldspars are stained with iron oxide. Heated hydrochloric acid gives a slight effervescence with the powdered rock, though no calcite was found in the thin section.

Microscopic Description.

The section is mostly composed of grains of feldspar. The next constituent in abundance is granitic porphyry fragments i.e. feldspar traversed with saturating quartz. Next comes fragments of basic rocks and finally a few grains of quartz. All the above except the quartz are stained with brown iron oxide.

The feldspars are frequently more or less kaolinized, but nearly all are fresh enough to give mostly uniform light and dark shades in polarized light, and, when triclinic, banding. Nearly every grain is enlarged by secondary deposition. The nuclei are all rounded, their boundaries being marked by broad lines of ferrite. By enlargement the feldspars everywhere extend beyond these boundaries. These extensions as compared with the original grains are different in that they show no trace of decomposition, and are free from ferrite. When the growth has been uninterrupted, as often it has in the interstices of the original rounded grains, the new feldspar has usually a nearly uniform width with sharp serrate edges. When the enlargements from different feldspar grains have grown enough to come in contact, they form a jagged, nicely fitting junction, like to the sutures of a skull. While this dovetailing is perfect, one grain does not usually cut deep into the other as is sometimes seen in quartz. This is explained by the uniform growth of the feldspars. The proof that the added material is feldspar

1943

Ferruginous Feldspathic Sandstone (con.)

is based upon grounds similar to those given to show that the ordinary enlargements of quartz are that mineral. First the added material has the general appearance of feldspar; second, in orthoclase the deposited substance polarizes uniformly with the nucleus; and third, when triclinic feldspars are enlarged the new material twins uniformly with the old; so that twinning bands run across the cores and borders. This conclusive point is of course not possible in the case of quartz.

Again the granitic porphyry fragments are enlarged and the added portion resembles and polarizes with the feldspars instead of with the quartz as it ought, if with either, were it a silica deposit of any kind. The feldspar crystallizing force has been so strong that the exteriors are all feldspar while frequently a half or more of the outside of the cores, and in some places for a considerable space continuously is quartz. The conditions which were so favorable to the second growth of feldspar has not appeared to be so favorable for a second growth of quartz; for nowhere, upon the few grains seen are enlargements found. Finally the complex basic fragments also have feldspar enlargements. Here, however, instead of a single individual of feldspar being about a nucleus, the enlargement consists of several or many grains of feldspar. These basic grains are very feldspathic, the individuals being small. The feldspars at the outside of the cores have controlled the new growths. These polarize with the old interior grains but have often extended upon each side beyond them and thus they ~~overlap~~ ^{overlap} other interior feldspars or other minerals if they chance to be in contact with the division lines.

A little new feldspar was found about the complex nuclei and the granitic porphyry fragments, which appears to be independent

1943

Ferruginous Feldspathic Sandstone (con.)
of any part of the cores.

In one case an orthoclase grain has been broken into three pieces and here new material polarizing with and continuous in two pieces with the outside enlargement has cemented it. (See 1225.)

Jan. 8 — A second thin section was prepared which contained calcite and also shows quartz enlargements. The feldspar enlargements of two sections without covers were examined as to hardness with a needle and with hydrochloric acid. As nearly as could be determined the hardness corresponds to feldspar and the acid gave no effervescence.

1944

N.B. 14

Sec 36

T 58

R 30 W

Minn.

Ferruginous Feldspathic Sandstone.

C. A. Vanhise Jan. 8. 1884

Macroscopic Description.

The rock is like 1943.

Microscopic Description.

The fragmental materials are of the same kinds as seen in 1943. However quartz is in greater quantity and quite frequently shows enlargements. The feldspar enlargements, although unmistakable, are not so common as in 1943 nor so wide nor do they illustrate the methods of formation nicely. Epidote is found.

1937

Sec 15

T 58

R 30 W

Mich.

Quartzose Feldspathic Sandstone.

C. A. Vanhise Jan 8. 1884

Macroscopic Description.

The rock is composed of red feldspar mingled with quartz and metallic copper.

Microscopic Description.

Feldspars, porphyritic matrix, granitic porphyry fragments and quartz with a little magnetite make up the section. The quartz grains are often much enlarged and often interlock among themselves or with the feldspars. The feldspar grains show a few rather narrow enlargements.

2524

Sec 35

T 51

R 43 W

Mich.

Feldspathic Sandstone.

C. A. Vanhise Jan 10. 1884.

Macroscopic Description.

A fine grained sandstone.

Microscopic Description.

The constituents of this rock are elastic fragments of feldspar, quartz, basic rocks and porphyries. The grains of quartz and feldspar are often enlarged. Calcite is an abundant indurating material. Often a grain of this mineral is seen which contains a closed loop of ferrite. The appearance is precisely that which would be given by an enlarged, ferrite-stained, elastic grain of calcite. However grains are found in which the calcite only occupies one side of the nucleus and extends beyond the line of ferrite in that direction, while the remainder of the interior is feldspar. Different proportions of these minerals are found in different nuclei. The calcite then is a replacing material and gives the appearance described above when has replaced entirely an iron stained feldspar grain, and then continued its growth beyond the old feldspar limits, replacing adjoining grains.

375 N.H.Quartzite.

C. R. Vanhise Jan. 23. 1884

Microscopic Description.

The section is mostly composed of quartz. The grains are roughly rounded and while often closely fitting are never deeply interlocking. This close fitting is invariably due to enlargements which though commonly of small extent in each grain has affected nearly every one in the section. In a few grains the enlargements are of some width. Calcite is quite an abundant filling material, a few complex areas of this mineral being quite large. The quartz is quite free from impurity, little flakes of ferrite being the only inclusion of importance.

377 A.H.Quartzite.

C. R. Vanhise Jan 23. 1884.

Microscopic Description.

The section is composed chiefly of small rounded grains of quartz. It is at once noticeable from the fact that nearly all the grains are so much rounded that the great mass of them approach a circular form. Only a few grains are to be found whose lengths are twice their breadths. The grains are loosely packed, the interstitial material being quite abundant. Some of the grains are slightly enlarged. As a result at times the individuals fit each other quite closely. Many grains of the quartz are not sharply defined. The appearance is that which would be given by the quartz grains commencing a second growth, and, as they enlarged, including interstitial material as described fully under 6820-2-8. The filling material consists kaolin, quartz and possibly amorphous silica. The general appearance of the section is like that of 4355. The differences are that 4355 is coarser grained, these grains are not so nearly circular and it contains large interlocking grains the like of which are not found in 377.

377.

381 A.H.Quartzite.

C. R. Vanhise Jan 23. 1884

Microscopic Description.

While the rock is plainly clastic and the grains of quartz are rounded and never deeply interlocking, they are almost everywhere closely fitting; so that quartz composes the mass of the section. Enlargements were seen in a few grains but probably the present close fitting of the quartz grains throughout the entire section is due to the same cause. The very little interstitial material appears to be kaolin. The observation in regard to the nearly circular form of each grain (taking the section as a whole) noted in 377 is applicable to this rock. Rutile needles are common in the quartz grains. Minute specks of ferrite is the only impurity of account present.

383A.N.Quartzite.

C. R. Vanhise Jan 23. 1884

Microscopic Description.

The section only differs from 381 in
being a trifle more kaolinitic.

385 N. N.Quartzite.

C. R. Vanhise Jan. 23. 1884.

Microscopic Description.

The section from 381 and 383 in being
rather more kaolinitic than either.

387 A. N.Quartzite.

C. R. Vanhise Jan. 23. 1884

Microscopic Description.

The section is composed almost entirely of grains of quartz which while not deeply interlocking dovetail much more than in 381. The grains are comparatively free from ferrite, yet enlargements are seen in many of them. Kaolin and ferrite although found in a few interstices are at a minimum. Needles of rutile are found in a few grains of quartz. Although there are minor irregularities in the grains as they now exist (and these are doubtless due to enlargements) their general contour is circular or nearly so.

389a.N.Quartzite

C. R. Vanhise, Jan. 23. 1884.

Microscopic Description.

The grains of quartz are more irregular in shape and their interlocking more intricate than in any of the preceding Hague sections. Proofs of enlargement although noted in one or two places are more difficult to find than heretofore. However this section differs chiefly from the other Hague sections in the presence of a large amount of interstitial interlocking fine quartz, and the broken appearances in places of the large grains of this mineral. The section looks as if the rock bed had the following history.

The quartzite, after enlargements have been completed, has been badly fractured, leaving fissures through it which were often filled with broken fragments of varying sizes of the then interlocking grains. After this fracturing of the rock, again it has been penetrated by siliceous waters which have deposited finely crystalline quartz about the broken pieces and has finally completely filled all the spaces in these fissures with this form of quartz.

391 A. N.Quartzite.

C. R. Vanhise Jan 23. 1884.

Microscopic Description.

This section differs from 387 A. N. only in the points that fewer enlargements are discernible and in the presence of a few narrow veins of interstitial quartz.

501 A.H.

Conglomerate.

C. A. Vanhise Jan. 23. 1884.

Macroscopic Description.Microscopic Description.

The section is composed of rounded fragments of completely amorphous silica, of silica in which small grains of quartz have crystallized in a non-polarizing groundmass, of chalcedonic silica with its characteristic radial fibrous brilliant polarization, of finely complex completely interlocking quartz of 1 and of large simple grains of quartz. The latter show enlargements very nicely, sometimes a complete circuit being made by the line of division between the old and new material. The finely complex and the half-crystalline grains mentioned above have also sometimes taken a new growth, the added material bringing in one case clearly of a chalcedonic nature. This material in such cases is distinguished from the original grains by its freeness from brown iron oxide which is particularly abundant in the original half-amorphous, chalcedonic or opaline grains. I saw no reason to believe that the completely amorphous silica had anywhere taken a second growth. A part of the new quartz has formed as independent material. This in places is very finely crystalline and sometimes hardly amorphous. One original amorphous grain is traversed by peculiar stringers which resemble calcite somewhat, but are probably a peculiar form of imperfectly crystallized silica[?]. Needles of rutile are found in some of the grains of quartz.

6866

Arenaceous Quartzite.

Grand Cañon

C. R. Vanhise Jan 24. 1884

Group

Macroscopic Description.

Colorado Riv.

This is a white, granular, sugary looking rock of medium grain and so friable that the thin edges can be crumbled with the fingers.

Microscopic Description.

Grains of quartz are the only constituent of importance. Nearly all the grains have rounded nuclei which are now enlarged and consequently more or less irregular in shape. This growth has extended so far that the outlines fit each other well, leaving little and often no space between the enlarged grains. Numerous rutile needles are in the nuclei of some of the grains of quartz. The section has rather a dirty appearance due to numerous specks of iron oxide (emery dirt?).

6867Arenaceous Quartzite.

Grand

C. R. Vanhise Jan. 24, 1884.

Canon

Macroscopic Description.

Group

Colorado

River

The rock differs from 6866 only in being rather more indurated.

Microscopic Description.

The section is the same as that of 6866 except that the nuclei are free from ferrite, while more of this material is found in the interstices than in it. Lines of division between the old and added quartz are very plain.

6868

Semi-Vitreous Quartzite.

Grand

C. R. Vanhise Jan. 24. 1884.

Canon

Macroscopic Description

Group

The rock is like 6867 only that it is more

Colorado indurated than it.

River.

Microscopic Description.

The rock is free from ferrite than 6867. The little of this mineral present is of a much lighter brown color than in either 6866 or 6867. The section contains a few grains of finely complex quartz and one composed of partly amorphous silica. One grain is present which somewhat resembles to calcite. A very few flakes of interstitial ~~of interstitial~~ are found. Aside from these minor points the rock is not different from 6867.

6869

Grand

Canon

Group

Colorado

River.

Quartzite.

C. R. Vanhise Jan. 24. 1884.

Macroscopic Description.

A white, medium-grained, vitreous quartzite.

Microscopic Description.

The points in which this rock differs from 6866, 6867, and 6868 are as follows: the grains of quartz do not tail more perfectly than this mineral in them; however the original kernels are everywhere discernible. Finely complex grains of quartz are present. One simple ^{grain of} quartz shows very nicely (perhaps the best anywhere seen) the gradual change from an individual to a finely complex aggregate. Dark brown grains of iron oxide are more plentiful than in 6868.

6870

Sandstone.Henry
Mts.

C. R. Vanhise Jan. 24. 1884.

Macroscopic Description.

Utah.

This rock is of a light gray to flesh red color with a chalky appearance and is fine grained and somewhat friable.

Microscopic Description.

Small rounded grains of quartz compose the larger part of the rock. These grains are often enlarged and consequently fit closely. Here and there are seen grains of orthoclase and plagioclase. Calcite is found between the grains of quartz. The interstitial material is partly fine fragmental and partly fine interlocking quartzes mingled with some clayey substance. Iron oxide stains are also found between the grains of quartz.

6667

N. W. 1/4

Sec 20

T 40

R 38 W

Mich

Biotite Quartz Schist

C. R. Vanhise March 29. 1884

Macroscopic Description.Microscopic Description.

Portions of the section are composed mainly of worn grains of quartz. These grains are often slightly enlarged and sometimes quite deeply interlocking. Scattered between these grains is very fine interstitial material composed of quartz, biotite and kaolin. In bands through the section this interstitial material becomes so greatly predominant as to almost exclude the large grains of fragmental quartz. A little chlorite and iron oxide are found.

4410

Palladream

Islands

North shore

L. Huron.

Greywacke Slate.

C. R. Vanhise March. 28. 1884.

Macroscopic Description.

A dark green finely-grained compact rock. Scattered through the fine mass of the rock, are grains of some size both of quartz and feldspar.

Microscopic Description.

Fine fragments of quartz and feldspar — ^{the} latter in part orthoclase, in part plagioclase — compose a large part of the rock. The quartz fragments in a few cases show division lines of enlargements and frequently a gradual fading into the matrix. The feldspars are often quite badly decomposed the resultant products being chlorite and kaolin. The abundant matrix is composed very largely of chlorite. Mingled with this mineral are very fine particles of feldspar and quartz. Probably a portion of the latter at least is secondarily deposited. Quite numerous fragments of iron oxide — both brown and magnetic — are seen.

4500

Quartzite.

C. R. Vanhise Feb. 8. 1884.

Prairie

River

Macroscopic Description.

Falls A red vitreous quartzite resembling much of the red
 Minn. quartzite of northern Minnesota.

Sec. 24

T. 56

Microscopic Description.

R 25 W.

The rock is composed almost entirely of grains of quartz which in polarized light are seen to make nicely fitting junctions and sometimes to interlock quite deeply. In ordinary light the grains all however show prominent lines of ferrite inclusions which mark the boundaries of the worn clastic grains. This section illustrates the secondary enlargement of fragmental quartz grains unusually well. Quite a number of the nuclei are penetrated in every direction by rutile needles. These again show the history of the rock, for while so numerous in these nuclei and while they quite often abut sharply against the edge of the old grains, none are seen to penetrate the new material which has co-ordinated with the clastic fragments. The quartz nuclei contain a few needles of apatite, numerous specks of oxide of iron, and very numerous gas or liquid filled cavities, many of the latter with a gas bubble which is quite frequently in rapid motion. The newly deposited quartz is commonly free from impurities and cavities. The only other mineral of importance in the section is ferrite. This is concentrated upon the cores of the old grains. Here it is ordinarily a mere film but quite frequently little areas are complex. Here the enlargements are also complex; each of the several parts polarizing with the part adjacent to it in the nuclei.

4501

Biotite Gneiss.

C. A. Vanhise Feb. 8. 1884

Upper

Falls

Prairie

River

Minn.

Macroscopic Description.Microscopic Description.

Orthoclase is the mineral present in greatest quantity. Oligoclase is also abundant. These feldspars are mostly in large grains. They are often so much decomposed as to give no characteristic polarization effects. The first grains are comparatively free from inclusions a few small apatites being the only ones of note. Greenish brown biotite occurs in bands many of them of large size. This mineral is somewhat decomposed and as a result is almost opaque in places and perhaps has become lepidomelanite. Deeply interlocking quartzes fill up the spaces left by the feldspars and mica. Some grains are quite free from iron oxide, inclusions, and cavities and again others contain many of each.

6901

Jasper.

C. A. Vanhise Feb. 15. 1884.

S. W. 1/4

Sec. 27

T. 110

R. 30 W

Winn

Near

New

Macroscopic Description.

A bright red aphanitic rock with conchoidal fracture.

Microscopic Description.

The rock mostly consists of an intimate mixture of minute specks of red oxide of iron mingled with minute interlocking quartzes and partly amorphous silica. These substances certainly were simultaneous in their deposition and probably were formed as chemical sediments. The ground for this belief is that everywhere through the section are traces of concretionary action and in many places distinct small concretions. In places there have evidently been geodic cavities and in these the quartz has deposited in two stages. The cavity has first been partly filled with grains of quartz where the water bearing the silica also contained considerable iron oxide and the two have deposited together. In the second stage the water was mostly free from ferrite and the grains before commenced are now carried on until often they completely interlock. Some of these geodic cavities also contain magnetite which unlike the ferrite has crystallized separately between the crystalline grains of quartz. Magnetite is found in but ^{a few} small grains outside from those former geode cavities and evidently was the last mineral to crystallize filling up completely the little remaining space left by the last non-ferruginous silicated waters.

6902Jasper.

C. R. Vanhise. Feb. 15. 1884

S. W. '4

Sec 27

Macroscopic Description

T. 110

R. 30 W

Of a darker red color than 6901; otherwise not different from it.

Minn

Near

New

Microscopic Description.

Ulm.

The rock consists largely of half crystallized silica carrying a great amount of red or brown oxide of iron in minute specks. The only other mineral present is magnetite which is seen in very numerous irregular grains of small size scattered uniformly through the mixture of silica and iron oxide in one half of the section. In the other half of the section magnetite is very sparse.

6903

Coarse Jasper.

S. N. 14

C. A. Vanhise Feb. 15. 1884

Dec 27

Macroscopic Description.

T. 110

R30 W

Minn

Near

New

Ulm.

This rock differs from 6901 and 6902 in that its color instead of being uniform is mottled with red and white. The white spots are perhaps due to the fact that the silica here deposited is free from ferrite.

Microscopic Description.

The materials which compose this rock are of the same nature as those in 6901 and 6902 but the manner of deposition has been different. The silica is, as before, partly amorphous but it has also crystallized in coarser grains in places than are found anywhere in 6901 or 6902 except the filled geodic cavities of the former. Again a large portion of the silica is practically free from iron oxide while other numerous round or oval areas are very full of ferrite. The siliceous waters have at times been free from iron oxide and at other times heavily charged with it and in this latter case concretionary action has caused the deposition of ^{the} iron oxide mingled with the silica in the forms spoken of above. In certain places the iron has been present for a short time and then ceased. Grains which were forming before the iron appeared are, for a short distance, full of iron oxide and then again free from it. The appearance is as if a rounded clastic grain had been coated with a broad band of iron oxide, then deposited in a rock, and finally new silica bearing waters had appeared to build up again these grains. However, in this rock this appearance is evidently due to the causes given before, concretionary action and periodic presence of ferrite. As in 6901 there have been apparently geodic cavities present. There are none however filled with comparatively coarsely crystalline quartz or magnetite or the two combined with also brown or red iron oxide. A single long slender broken needle of what is taken

to be
apatite
was seen

6904Black Hornstone.

C. R. Vanhise Feb. 15. 1884.

S. N. 4

Sec 27

Macroscopic Description.

T110

R 30 W fracture,

Miner

Near

Microscopic Description.

New

Ulm.

The thin section is composed almost wholly of minute intricately interlocking grains of quartz. These grains are mingled with a small amount of amorphous silica. The rock differs greatly from 6901, 6902, and 6903 in that it carries very little iron oxide. This small amount consists however of the three forms heretofore seen — brown, red, and black or magnetic oxide. The small amount of impurities present however shows that concretionsary action has played the same important part in the arrangement of the material that it has done in 6901, 6902, and 6903. A few grains of iron oxide are seen each grain being composed partly of hematite and partly of magnetite which have crystallized independently of the quartz.

6907

Quartzite.

SW 1/4

C. R. Vanhise Feb. 15. 1884.

Sec 27

Macroscopic Description.

T110

A medium grained, white, vitreous quartzite.

R 30 W The rock has a speckled appearance due to the
 Minn particles of brown iron oxide.

Near

New

Microscopic Description.

Ulin.

The outlines of all the original clastic grains of quartz are strongly marked by lines of ferrite. Now each grain has enlarged until the individuals completely fit each other. This section is among the best that I have seen to represent such second growth of quartz grains. Brown iron oxide is included in the nuclei and more plentifully in the added quartz. One finely complex grain has a slight enlargement having the same structure as the nucleus.

6908

Conglomeratic Quartzite.

S. W. 14

C. R. Vanhise Feb. 16. 1884

Sec. 27

Macroscopic Description.

T 110 The rock consists of small, white, vitreous quartzite
 R. 30 W pebbles mingled with a few black hornstone ones
 Minn set in a flesh colored matrix which has a strong
 clayey odor.

New

Urb.

Microscopic Description.

Each of the pebbles spoken of above usually consists of numerous deeply and intricately interlocking grains of quartz. Nowhere among these grains is there any sign that any of the individuals have been enlarged and thus caused the interlocking. On the contrary the appearance is like that of rolled complex masses of veined or granitic quartz. But few of the clastic fragments are enlarged and these but slightly. The filling material consists of kaolin, ferrite and fine quartz. The iron oxide colors the interspaces red and gives between them and the fragments of quartz a sharp contrast.

6909

Biotite Granite.

SW 14

C. A. Vanhise Feb. 16. 1884.

Sec 27

Macroscopic Description.

T 110

A coarse massive rock. Very coarse grains of bright red feldspar, some of them an inch long, Miner compose two thirds of the rock. Large grains of translucent quartz make up the larger part of the remainder. Mingled with these two minerals are many small greenish black grains.

Microscopic Description.

Large grains of orthoclase and oligoclase, many of them much kaolinized and all stained with brown iron oxide are the most abundant minerals. Quartz in large intricately interlocking grains, also a few small quartz grains, are seen included by the feldspars. A little greenish brown biotite is found in the feldspars.

6910

Ferruginous Indurated Sandstone.S. E. $\frac{1}{4}$ & B. $\frac{1}{4}$

C. A. Vanhise Feb. 16. 1884.

Sec 34

Macroscopic Description.

T 110

R 30 W

Minn

A fine uniformly grained rock of deep brownish red color with strong clayey odor and schistose structure.

Redstone

Minn.

Microscopic Description.

The section consists of clastic² fragments of quartz most of them simple but some finely complex set in a fine matrix composed of ferrite, clay, and fine interlocking quartz. Many of the simple quartz grains are enlarged but the added material has not usually extended so far as to cause interlocking.

6912

Quartzite.

C. R. Vanhise Feb. 16. 1884.

S. E., S. E.

Sec 34

Macroscopic Description.T₁₁₀

A pinkish gray, hard, vitreous quartzite.

R. 30 W

Microscopic Description.

Redstone

Minn.

Like 6907 the original boundaries of the grains of quartz are all marked by ferrite but often these grains are composed of purely con-
 files quartz. However they have all taken second
 growths each after its kind but very frequently
 this has not continued until the enlarged grains
 interlock. The quite numerous and large inter-
 spaces thus left are filled with fine interlock-
 ing secondary quartz mingled with enough red-
 dish brown iron oxide to give these parts of the
 section a red tint in reflected light. Parts of
 this deposited silica are non-polarizing.

6913 A

J. E. S. E.

Sec 34

T₁₁₀

R 30 24

Redstone

Minn.

Quartzite.

C. R. Vanhise Feb. 16. 1884

Macroscopic Description.

A pinkish gray, vitreous quartzite with conchoidal fracture.

Microscopic Description.

The rounded grains of quartz are quite often complex. They nearly all show secondary enlargements which have often extended so far that the grains interlock. However, much fine interlocking quartz mingled with considerable ferrite has filled perfectly the remaining interspaces and given the rock its strength. Ferrite is more abundant than in 6912; otherwise the two rocks are very similar.

6913 B

S.E. S.E.

Sec. 34

T₁₁₀

R 30 W

Redstone

Missouri

Quartzite

C. A. Vanhise Feb. 16. 1884.

Macroscopic Description.

The rock is simply a less indurated portion of 6913 A. In consequence of this it is friable and not vitreous.

Microscopic Description.

In the thin section, one is not able to distinguish this rock from 6913 A.

6916

N. W. 1/4

Sec. 9

T107

R. 3524

Delton

Cottonwood Co.

Minn.

Indurated Sandstone.

C. R. Vanhise Feb. 16. 1884

Macroscopic Description.

The rock has a stratiform appearance, is not so deeply colored with ferrite as 6910 and has not so strong an odor of clay. In other points it resembles 6910.

Microscopic Description.

This rock is finer grained than any of the preceding Minnesota quartzites except 6910. The description of the vitreous quartzite 6912, however, gives the description of the section, with the minor exception that ferrite and interstitial and fine interlocking quartz are rather more plentiful than in 6912. This interstitial silica also seems to be partly amorphous in places.

6917

N. W. 1/4

Sec. 9

T 107

R. 35 24

Delton

Cottonwood Co

Mizou.

Quartzite.

G. R. Vanhise Feb. 18. 1884

Macroscopic Description.

A brownish-pink, vitreous quartzite with conchoidal fracture.

Microscopic Description.

This rock is quite like 6912. The chief points of difference are as follows:— the enlargements of the quartz grains both simple and complex have mostly extended until they came in contact, leaving little spaces for fine interstitial quartz; iron oxide too is more abundant in the secondary quartz than in 6912. Finally the rock is a little finer grained.

6920Quartzite.

S. W.

O. R. Vanhise Feb. 18. 1884.

Sec. 9

Macroscopic Description.

T. 107

Like 6912.

R. 35 21

Delton

Microscopic Description.

Cottonwood Co

Mign.

The section resembles that of 6912; yet there are quite a number of points of difference. The fine, complex, clastic grains of quartz, while quite as plentiful as in 6912 have not ordinarily been enlarged although some of them certainly have been. As in 6912 and in most other sections having this form of fragment these finely complex quartz grains are noticeable on account of the amount of ferrite which they carry. In ordinary light these grains can be picked out by this property. There are present in the interstices several areas of unmistakable chalcedonic silica. It is possible that some of these areas are fragmental grains although they in part at least, were certainly deposited in place. There are also seen in this rock a few very brilliantly polarizing grains which may be epidote although it hardly appears like the mineral. Brown iron oxide is more abundant in the interstices than in 6912.

6921

Quartzite.

S W 1/4

C. R. Vanhise Feb. 18. 1884

Sec 9

Macroscopic Description.

T107.

R 35 W

Delton

Minn.

A coarse grained, almost conglomeratic quartzite. Some of the larger fragments are white quartz and some of flinty or jaspery silica. The matrix is of a light pink color.

Microscopic Description.

Except that some of the quartz grains are much coarser than any found in 6920 there is little difference between the two quartzites. Here again about some of the finely complex grains of quartz is deposited unmistakable radially fibrous chalcedonic silica.

6922

N. E. N. E.

Sec. 36

T 108

R 36 W

Germantown 6920.

Miss.

Quartzite.

O. R. Vanhise Feb. 18. 1884.

Macroscopic Description.

The rock is somewhat sandy and has a

laminated structure. In color it is like 6912 and

Microscopic Description

The fragmental quartz grains are smaller than the average in the preceding rocks of the same region although coarser than in 6910 and 6916. These grains are often enlarged, but commonly have not grown until interlocking has occurred. Complex quartz grains are present. The abundant filling material is fine interlocking quartz mingled with much brown iron oxide.

6924

Calcareous Sandstone.

Sec 16

C. R. Vanhise Feb. 18. 1884.

T 109

Macroscopic Description.

R 29 W

Minn.

The rock is light gray in color and may be called a compact sandy limestone or calcareous sandstone.

Microscopical Description.

Fragmental quartz grains, many of them quite angular, and a few enlarged, are seen in a continuous matrix of interlocking calcite. The quartz grains commonly are not closely in contact with each other and very often they are quite isolated from other grains of the same mineral. A few of them are complex. The quantity of quartz is about equal to that of the calcite. Quite numerous specks of brown iron oxide are seen scattered through the calcite or concentrated in rows along the edges of the quartz grains. One fragment of tourmaline is present. This is of interest because it has a core which does not extinguish quite at the same time as the outer part. The core also in ordinary light has a little deeper brown tint than this outer part. Has the nucleus been enlarged?

53 Wis.
Basswood
Island
Lake
Superior.

Sandstone.

C. R. Vanhise Feb. 20. 1884

Microscopic Description.

The section is very thick and unsatisfactory. However it is made up chiefly of grains of quartz both simple and complex. Mingled with this quartz is some orthoclase and some plagioclase. The simple grains of quartz are often enlarged, and in some places the enlargement presents distinct crystal faces. The section is so bad that it is impossible to say whether the complex quartz grains are enlarged or not. The feldspars are often quite badly decomposed. Ferrite is found in the interstices.

55 Wis

Wilson's

Island

Lake

Superior.

Ferruginous Sandstone.

C. R. Vanhise Feb. 20. 1884.

Microscopic Description.

Quartz in grains both simple and complex is the most important constituent. Orthoclase and oligoclase grains are present. In the interstices is much ferrite. The section is bad so that details can not well be made out but it seems certain that the simple grains of quartz, at least, are, in some cases, enlarged.

3204Sandstone or Quartzite.

C. R. Vanhise Feb 20. 1884

Microscopic Description.

Arlington
Columbia Co
Wis.

The section is composed of grains of quartz with some brown iron oxide in the interspaces. Nearly all these quartz grains are enlarged and these enlargements have often extended until the different grains have formed nicely fitting junctions. However the enlarged grains very often have formed crystal outlines, which in some cases are very perfect. These crystals are more numerous, I think, than in any section heretofore examined.

32083209Quartzites.

C. R. Vanhise Feb. 21. 1884.

Microscopic Description.

753 Wis These sections are composed of large grains of
 755 Wis quartz (which have a fragmental appearance)
 Caledonia set in a fine intricately interlocking matrix. En-
 Wis. largements, although sought, were not found.

1251 Wis

1260 Wis.

Magnesian Limestones.

C. R. Vanhise Feb. 23. 1884.

Macroscopic Description.

A finely crystalline buff and purple limestone. The powder is almost completely soluble in hydrochloric acid. After the calcium is precipitated with ammonium carbonate and oxalate sodium phosphate gives a precipitate. This reaction and the fact that the rock is insoluble in cold dilute hydrochloric acid both show that magnesium ^{is} ~~are~~ present.

Microscopic Description.

The sections are composed almost wholly of finely crystalline, cherty dolomite. There are present however small scattering grains of quartz and often these are enlarged. A few small grains of green chlorite are seen and the dolomite is stained with brown iron oxide.

754 Wis877 "923 "927 "935 "946 "Quartzites.

C. R. Vanhise Feb. 21. 1884.

Microscopic Description.

All of the sections of these rocks are composed of large intricately interlocking grains of quartz with no sign of enlargement in any case. They are rocks like vein quartz.

1253 Wis.

Lower Marrows

Jank Co.

Wis.

Ferruginous Sandstone.

C. R. Vanhise Feb. 22. 1884

Microscopic Description.

The section is composed chiefly of rounded grains of quartz of various sizes. These are frequently enlarged but ordinarily not sufficiently to interlock. The filling material is abundant and is made up of brown iron oxide mingled with fine quartz.

1271 Wis
Freedom
Sank Co.

Quartzite.

C. R. Vanhise Feb. 22. 1884.

Microscopic Description.

Wis.

The section is composed of rather small uniform quite deeply and intricately interlocking grains of quartz. Division lines are however quite often seen between rounded nuclei and the enlarged irregular grains. In the interstices is a little fine interlocking quartz.

1273 Wis

Upper Narrows

Sank Co

Wis.

Quartzite.

C. R. Vanhise Feb. 22. 1884.

Microscopic Description.

The section differs from that of 1271 Wis. in being medium grained, in that the quartz does not so deeply interlock, in the presence of more interstitial quartz and in the presence of a little Kaolin.

1275 Wis1322 "

Upper

Narrows

Sault Co

Wis.

Quartzites.

C. C. Vanhise Feb. 22. 1884.

Microscopic Description.

The section differs from that of 1273 Wis. in the presence of quite an amount of brown iron oxide. As a consequence the nuclei of the enlarged grains of quartz are easily discernible in each individual. The section also differs in that Kaolin is absent and a few finely complex quartz grains are present.

1277 Wis
 upper Narrows
 Sauk Co.

Quartzite.

C. A. Vanhise Feb. 22. 1884.

Microscopic Description.

Wis.

Quartz grains many of them enlarged and sometimes nicely fitting, are set in an abundant fine matrix composed of fine interlocking quartz, kaolin, and brown iron oxide.

1307 Wis
Madison/
Wis.

Sandstone or Quartzite.

C. R. Vanhise Feb. 22. 1884.

Microscopic Description.

The quartz grains are small and are often enlarged. There are present quite numerous grains of feldspar. These two classes of grains with the enlargements of the former make quite a compact whole. There are, however, interspaces and these are filled with clay and iron oxides.

1331 Wis.
Sank Co.

Chert.

G. A. Vanhise. Feb. 22. 1884.

Microscopic Description.

The section is composed almost wholly of very fine interlocking grains of quartz mingled with amorphous silica. Numerous spherical concretions of this cryptocrystalline material are seen all through the section. Evidently all the above substance was deposited at the same time and probably judging from the numerous, as a chemical sediment. However imbedded in the above as a ground mass are a few fragmental of grains of quartz (which have served usually as cores for concretions) and many of these have taken a second growth.

1349 Wis
Sank Co.

C. A. Vanhise Feb. 22. 1884.

Microscopic Description.

The section is essentially like that of 1331 Wis. However, mingled with the finely crystalline quartz and amorphous silica is also chalcedonic silica. The enlarged fragmental grains of quartz which, as before, are cores of concretions, have often changed gradually from an individual to the finely crystalline material by which they are surrounded. There are seen quite numerous holes in the section due to cavities in the rock and which are lined by brown iron oxide.

1321 Wis.
Westfield
Sank Co.

Chert

C. R. Vanhise Feb. 23. 1884.

Macroscopic Description.

An aphanitic light gray rock containing many cavities. These cavities vary in size from those more than half of an inch in diameter to those so minute as to be invisible. They become more numerous as the size decreases and all are stained brown by iron oxide.

Microscopic Description.

The section is not materially different from that of 1349 Wis. However the fragmental grains of quartz are much more numerous than in 1331 Wis. of 1349 Wis. The larger portion of these grains are enlarged. The gradual variation from a simple quartz grain to finely complex or amorphous silica by more and more of the infiltrating substance depositing as independent material as explained elsewhere, is shown as nicely in this section as seen anywhere. As in 1331 Wis. and 1349 Wis. there are numerous oval or circular holes in the section lined with brown iron oxide. These of course correspond to the cavities seen macroscopically.

1330 Wis.
Juneau Co.

Flint or Chert.

C. R. Vanhise Feb. 23. 1884.

Macroscopic Description.

This rock as a whole has a flinty look and brecciated character. The different pieces of the breccia vary in appearance from the amorphous look of hornstone to that of a finely crystalline quartzite. Whether this nodular and broken appearance is due to concretionary action, to fragmental origin or actual breaking it is impossible from this specimen to say.

Microscopic Description.

The section is composed mainly of interlocking finely crystalline grains of quartz and chalcedonic silica. Concretions although present are not nearly so plentiful as in 1331 Wis. and 1349 Wis. A few fragmental grains of quartz are present, which are, with few exceptions, enlarged.

1354 Wis

Quartzites.

1355 1/2 "

C. A. Vanhise Feb. 23. 1884.

1357 "

Microscopic Description.

1358 "

Neudah
Wis.

Quartz in large grains often deeply interlocking composes the greater portion of the rocks. Quartz enlargements were sought but no satisfactory proof of their existence was seen, although the grains often have a distinct fragmental appearance. In the interstices in all the sections are flakes of brilliantly polarizing muscovite and also fine interlocking quartz. In different ones of these sections there is also seen brown iron oxide, magnetite, and kaolin.

140.0713.Greywacke.

C. R. Vanhise Feb. 27. 1884.

Microscopic Description.

A fine grained rock. Quartz in small worn grains is the most plentiful constituent. Many of these grains are enlarged and are consequently unusually close fitting. Small worn grains of fresh orthoclase and plagioclase are abundant and the evidences of enlargement of quite a proportion of these are quite satisfactory. Microcline is also present. Grains of chlorite are sparsely scattered through the rock. In the inter-spaces of the above minerals quite a quantity of iron oxide is seen. This rock is quite noteworthy in that it contains all the materials necessary to make a chloritic gneiss, yet the feldspars and nuclei of quartz are distinctly fragmental and both are now enlarged.

442044214423442544274429Quartzites and Schists.

C. R. Vanhise Mar. 4. 1884.

Microscopic Description.

Sections of all these rocks were examined carefully
for quartz enlargements and none were found.

6 1/2 W. of
mouth of
Serpent River.
Canada

4299Mica Schist.

Island in

G. A. Vanhise Mar. 4. 1884.

Michigan

Microscopic Description.

Lake

Sec 34

T 48

R 30 W

Mich.

The section was examined for quartz enlarge-
ments but although a few grains showed lines
which may be due to this cause, satisfactory proof
of enlargements was not found.

6647

Friable Sandstone.

Spurr

C. R. Vanhise Mar. 4. 1883.

Mountain

Macroscopic Description.

Mich.

N. W. S. W.

Sec

T 48

R 31 W.

The rock is so friable that the grains can easily be broken apart between the fingers. Running through the quartz sand are layers bearing magnetite and these thin laminae are much harder.

Microscopic Description.

An examination was made with dry grains broken apart. Many of the grains of quartz are enlarged and often these enlargements have crystal faces which quite frequently give pyramidal terminations. Magnetite is mingled with the quartz but whether any of it is due to secondary deposition it is impossible to say owing to the method of examination used.

3552 Wis3563 "3572 "Argillaceous Schists.

C. R. Vanhise Mar. 4. 1884

Microscopic Description

The fragmental quartz particles which are abundant in each of the above sections were examined for quartz enlargements but none were certainly found. The only indication of anything of the kind is that some of the quartz grains have interiors which are much fuller of inclusions than their borders.

For 930 Wis., 932 Wis and 3583 Wis see p. 19

4520

= 17 Wis.

Formation 2

Plover Gap

Ashland Co.

Wis.

Semi-Vitreous Quartzite.

C. R. Vanhise Mar 7. 1884

Macroscopic Description.

White, compact semi-vitreous quartzite.

Microscopic Description.

The section is composed almost wholly of rather small, always closely fitting and often quite deeply interlocking grains, of quartz. Many of the grains distinctly show enlargements and all are believed to have had additions of quartz. The only mineral present beside quartz is brown ferrite which is found in small specks between the grains.

4522

Quartz Schist.

= 176 Wis.

C. R. Vanhise Mar. 8. 1884.

Formation 3

Macroscopic Description.

Gorge of \$

Tyler Forks

The rock is vitreous with conchoidal fracture. Mingled with the quartz is some greenish black Ashland Co. material. This with a schistose structure gives Wis. the rock a gneissic appearance.

N. E. 1/4

Sec. 33

Microscopic Description.

T. 45

R. 1 W.

Quartz composes fully three-fourths of the rock. This section is a very nice instance of secondary enlargement. All of the original cores are easily seen. The enlargements are often very wide and the interlocking at times quite deep. A few grains of finely complex quartz are scattered through the section. This form of quartz has also helped to fill the interspaces of the grains. The remaining mineral of importance is chlorite. This is found in large rounded areas (probably a decomposition product of feldspar) in films and patches around and between the quartz grains and also in films between the old and new quartz of an enlarged grain here taking the place usually occupied by iron oxide. A few grains of magnetite are present. Brown iron oxide is found between the enlarged grains of quartz and in films about the nuclei of this mineral.

4526
 = 1572 A. Wis.
 F. 2 A

Semi-Vitreous Quartzite.

C. R. Vanhise Mar. 8. 1884.

Pemokee

Macroscopic Description.

The larger portion of the rock is like 17 Wis.
 It has, however, a brecciated character and mingled
 with this white part are broken fragments of a
 greenish color.

Microscopic Description.

The section is like that of 17 Wis. The lines
 of division in the enlarged grains of quartz
 are not so distinct.

4527

= 1443 Wis

Formation 19

near

Penokee Gap

Ashland Co.

Wis.

Biotitic Quartzite.

C. P. Vanhise Mar. 8. 1884.

Macroscopic Description.

Very fine-grained, black, vitreous quartzite.

Microscopic Description.

Quartz is by far the most important constituent. None of the grains are large. They vary however, much in size a large proportion of the quartz being in very small grains. A part of this mineral is clearly clastic and is quite often distinctly enlarged. Orthoclase and oligoclase are sparingly found. The mineral of greatest abundance, next to the quartz, is biotite. This substance occurs in very numerous small brown scales between the quartz grains. Pyrite is present in quite numerous small grains. Brown stains of iron oxide everywhere stain the section, between the quartz grains and give the mineral a dirty confused appearance.

4528= 14462 *Wis.**Form. 4 B.**Penokee Gp.**Ashland Co.**Wis.*Magnetitic Schist.*C. R. Vanhise Mar 8. 1884.*Microscopic Description.*No enlargements were found. To be examined in another connection.*

Biotitic Quartz Schist.

C. R. Vanhise Mar. 10. 1884

4529

= 1450 Wis.

Formation 3

Macroscopic Description.

Pewee Gap

Ashland Co

Wis.

A finely schistose rock. Mingled with the predominant small grains of quartz is much finer dark gray and black material.

Microscopic Description.

Quartz is the chief constituent. Many of the larger grains of this mineral are plainly fragmental, and some of them seem to be enlarged although the proof of this is not conclusive. Very numerous flakes of chlorite, biotite, scales of kaolin, muscovite or sericite, and grains of magnetite — many of them crystals — are the other minerals of importance.

4530

= 1451 Wis.

Form. 4 A.

Penokee Gap

Ashland Co

Wis.

Chloritic Quartzite.

O. R. Vanhise Mar. 10. 1884

Macroscopic Description.

A coarse grained massive rock. Mingled with the quartz is quite an amount of greenish black material.

Microscopic Description.

The section is chiefly composed of large well rounded fragmental grains of quartz with no enlargements. A few of them are simple but most are complex. The individuals of each grain deeply interlock. The interstitial quartz is in grains of about the same size as the ones in the complex fragments and the two sets fit so closely that in polarized light it is difficult to distinguished one set of the grains from the other and consequently the rock does not show its clastic origin in polarized light. Its fragmental nature is however at once seen in ordinary light by the borders of chlorite and ferrite which surround the clastic grains. With the chlorite in the interstices in the interstices are mingled a few small grains of biotite. Magnetite is the mineral in most abundance next to the quartz. The grains are often sections of crystals, and are most abundant in the interstitial quartz. At times a single grain of this mineral is partly in a fragmental grain and partly in the interstitial material, while in several places a grain runs across a layer of interstitial material between two clastic grains and penetrates both of the latter. It is not easy to understand how the magnetite got into this position. Two or three small brilliantly polarizing grains of some mineral which looks like augite ^{were} ~~was~~ seen.

4531

Chloritic Gneiss.

-1461 Wies

C. R. Vanhise Mar. 12. 1884.

Pensacola Gap

Ashland Co

Wis

Macroscopic Description.

Fine grained, and finely schistose rock. Mungled with feldspar and quartz is some dark mineral which gives the rock a mottled black and white color.

Macroscopic Description.

Feldspar of the species orthoclase and oligo-
clase quite badly kaolinized is the most abund-
ant constituent. The larger part of the remaining
space is filled with grains of quartz. In one
important particular this rock differs from all
gneisses which I remember. The feldspar and
quartz grains have no sharp angles and never
doortail with each other or among themselves. Some-
times a large feldspar includes one or more grains
of quartz but the feldspar grain and each of the
grains of quartz included have a decided elastic
appearance. If it were not for this inclusion of
quartz by feldspar, one would be inclined to believe
that the quartz and feldspar are fragmental.
It is possible that a portion of these minerals
are of this nature. Chlorite is the only remain-
ing mineral of importance. This is found in the
spaces between the roundish grains of quartz
and feldspar. A few small grains of magnetite
is mungled with the chlorite.

1496 Wis.

Formation 15

near

Penokee Gap

Ashland Co

Wis.

Feldspathic Quartzite

C. R. Vanhise Mar. 12. 1884.

Microscopic Description

Fragmental grains of quartz, some of them complex, are the most plentiful constituent. Many of these are slightly enlarged. Horn grains of feldspar are quite plentiful. They are mostly badly kaolinized. The interspaces are filled with fine interlocking quartz mingled with very numerous specks of magnetite with a little brown iron oxide and some clayey material.

2104 Wis

Frontier 17

Tyler's Forks

Ashland Co.

Wis.

Feldspathic Quartzite (Graywacke.)

C. R. Vanhise Mar. 12. 1884.

Macroscopic Description.

A dark-gray, fine grained schistose rock, showing crystals of pyrite in the uniform background.

Microscopic Description.

~~Fragmental grains of quartz, some of them complex, is the most plentiful constituent. Many of these are slightly enlarged. Horn grains of feldspar are quite plentiful. They are mostly badly kaolinized. The interspaces are filled with fine interlocking quartz mingled with very numerous specks of magnetite with a little brown iron oxide, and some clayey material.~~

Microscopic Description.

Small fragmental grains of quartz and feldspar are scattered through a matrix which composes perhaps one half of the rock. Many of the quartz grains are slightly enlarged. In a few grains the enlargement has extended further in their growths and they have included finely complex quartz and matrix. The feldspars are considerably decomposed but often there is a narrow border of perfectly fresh feldspar about these partly altered nuclei. In such cases it seems probable that the unchanged feldspar is due to second growth. The matrix consists of a mixture of fine quartz, flakes of kaolin, specks of magnetite and clayey material.

4532

Clay Slate.

C. R. Vanhise Mar. 12. 1884.

- 2055 Wis

Form. 3

Macroscopic Description.

Mt. Whittelsey

A compact drab-colored, aphanitic slate.

Ashland Co

Wis

Microscopic Description.

N. W. N. W.

Sec 16

T 44

R. 2 W.

The section consists of fine fragments of quartz and less plentiful scales of biotite and muscovite mingled with clay in which many brilliantly polarizing flakes of kaolin are seen. Here and there are grains of magnetite, and brown ferrite stains are common. Many of the minute clastic grains of quartz are seen, with a high power, to be enlarged.

Feldspathic Quartzite.

C. R. Vanhise, Mar. 13. 1884.

Microscopic Description.

3164 Wis.

Tanner 21

South line.

Sec 27

T 45

R 2 N

Ashland Co.

Wis.

Fragments of quartz and feldspar, the latter less plentiful than the former, are mingled with much clayey material. The grains of quartz are often enlarged. In the clay or mud are fine interlocking quartz, flakes of kaolin, muscovite, chlorite, magnetite, and brown iron oxide.

C. P. Vanhise Mar. 13. 1884.

73 Wis.

A fine grained biotite schist.

1493 Wis.

A clayey magnetitic quartzite. The section is so thick that nothing can be determined as to enlargements.

2005 Wis.

A hornblende schist or gneiss.

2006 Wis.

A quartzite. The section is good for nothing.

2007 Wis.

A biotite schist. The section is thick and whether there are any quartz enlargements it is impossible to say.

2008 Wis.

A hornblende schist.

2017 Wis.

A decomposed biotite gneiss or granite.

2098 Wis.

An aphanitic slate or argillite.

3172 Wis.

A biotite schist.

2039 Wis.

A muscovite biotite schist.

1424A Wis.

Magnetitic Quartzite.

C. R. Vanhise Mar. 14. 1884.

Microscopic Description.

About one half of the section consists of large well rounded grains of quartz, some simple and others complex. Nowhere is there any indication of any enlargement. These grains often are not in contact or even near to each other. The large interspaces are filled with abundant intimately mingled magnetite, quartz and chlorite. The quartz is fine and intricately interlocking. The magnetite is in grains varying in size from minute to quite large, and some of them crystals. The appearance is as if the magnetite and interstitial quartz had been deposited as a chemical sediment and the worn fragmental quartzes had been brought in simultaneously by some extraneous force. The rock is allied to 4530 (1451 Wis.)

1455 Niss.Magnetitic Quartzite.

C. R. Vanhise Mar. 14. 1884.

Microscopic Description.

The section resembles very closely that of 1424 A Niss. The points of difference are that it contains many more crystals of magnetite, a very considerable portion of this mineral being in that form, and also more brown iron oxide.

4523

= 1401 A Wis

Magnetitic Quartzite.

C. R. Vanhise Mar. 18. 1884.

Macroscopic Description.

A fine uniformly-grained quartzite, heavily charged with iron oxide.

Microscopic Description.

Small grains of perfectly fitting quartz is the most abundant constituent. There is no trace of enlargement. Upon the other hand there seems to be positive proof that all the quartz deposited at one time; for there are very numerous needles of apatite in the rock, and these give no heed to the quartz individuals very often a single needle of apatite penetrating in a straight line as many as three individuals of quartz. The magnetite is in part in small grains, and in part in very large areas. Actinolite or tremolite in blades, and needles, the latter penetrating often several quartz grains, is the remaining mineral of note. The order of crystallization appears to have been, first, magnetite, apatite or tremolite; second and third, (which is prior it is impossible to say), and then the quartz. Of course this crystallization may have been partly simultaneous.

2090 WisClayey Quartzite.

C. R. Vanhise Mar. 19. 1884.

Macroscopic Description.

A very fine grained almost aphanitic rock of gray color.

Microscopic Description.

The section is composed mostly of quartz, feldspar, and clay, the two former in very fine grains. Few crystals of magnetite are seen. No enlargements were discovered.

2094 Miss.

Chloritic Quartzite.

C. R. Vanhise Mar. 19. 1884.

Macroscopic Description.

The rock is a vitreous quartzite of medium grain and greenish color.

Microscopic Description.

Quartz composes the larger part of the rock. The rounded clastic grains are all enlarged some of them greatly. There is present quite a quantity of fine interstitial quartz and the enlarged grains of this mineral in conjunction with the interstitial quartz make a compact whole. Chlorite is found in a few large areas and in films between the old and new quartz. Brown ^{iron} oxide is found in positions similar to the chlorite.

C. R. Vanhise Mar. 15. 1884.

4420 Micaceous quartzite. No enlargements are present.
4421 } Fine grained, chloritic and micaceous schists.
4423 } No enlargements were found.
4425 }

4426 A medium grained sericitic quartzite. The grains of quartz fit perfectly, but do not interlock intricately. No enlargements are visible. The quartz is very clear and free from inclusions.

4427 Except that the grains of quartz deeply interlock and ferrite is present this rock is like 4426.

C. P. Vanhise Mar. 19. 1884.

4767

Chert, mingled with some clay.

4726

Chert containing a few fragmental grains of quartz, some of which are enlarged.

4768

Gneiss or micaceous quartzite. No enlargements were found.

4769

Magnetitic Quartzite

Microscopic Description.

All the quartz is original. The grains of this mineral and also the magnetite grains are almost uniformly elongated, so that each individual is two or three times as long as broad. This phenomenon taken in connection with the parallelisms of all the grains gives the section quite a remarkable appearance. It is difficult to understand what force could compel individuals of minerals to thus become so uniform and exceptional in their shape.

6030

N. W., A. C.

G. R. Vanhise Mar. 19. 1884.

Sec. 13

Macroscopic Description.

T 65

R. 6 W

Minn.

N. E. corner

Microscopic Description.

Ojibwa Muncie

Lake.

The rock is clastic. The fragments consist of simple quartzes (some of them very large), finely complex grains of quartz (chert), orthoclase, plagioclase and porphyry matrix all worn and jumbled together. The cementing substances are cherty quartz, clay, calcite, and iron oxide. No enlargements were found.

6036

N. W. N. E.

Sec 26

T 65

R 6 W.

Minn.

Greywacke.

C. R. Vanhise Mar. 19. 1884.

Macroscopic Description.

A gray fine-grained, massive rock, showing quartz and feldspar grains.

Microscopic Description.

The rock is almost wholly composed of fragments of feldspar and quartz. The former is of the two species orthoclase and plagioclase — the first more abundant, and both often much decomposed. The grains of quartz are in a few cases plainly enlarged. In the interstices are found finely interlocking quartz and often partly amorphous silica and quite numerous small grains of magnetite and brown iron oxide. The decomposition product of the feldspars has often been chlorite into which whole grains have frequently changed.

6050

Cherty Feldspathic Quartzite.

N. W., S. E.

C. P. Vanhise Mar. 19. 1884.

Sec 17

Macroscopic Description.

T 65

R 6 W.

Minn.

A fine grained, dark gray, vitreous, compact quartzite

Microscopic Description.

Fragments of quartz and feldspar (orthoclase and plagioclase) compose about one half of the rock. A few grains of the former are distinctly enlarged. The matrix is almost wholly composed of cryptocrystalline silica (chert). In some places most of it is individualized, in others most of it is amorphous. A few grains of magnetite are scattered through the matrix. The main difference between this rock and 6036 is that it contains a much greater proportion of interstitial silica.

6077East end of
small lake at

the center of

Sec 24

T 66

R. 6 W

Minn.

Greywacke.

C. R. Vanhise Mar. 19. 1884.

Macroscopic Description.

A very light colored rock - almost white. With this difference the specimen is like 6036.

Microscopic Description.

Like 6036. Feldspar and quartz compose most of the section. The feldspar is quite fresh the plagioclase showing sharply defined bands in polarized light. No satisfactory proof of enlargement was seen. A few grains of biotite, muscovite and pyrite are found. The interstitial material appears to be clay and iron oxide.

4296Mica Schist.4299

C. R. Vanhise Mar. 20. 1884

Michigan

Microscopic Description.

S W 1/4

These rocks were examined closely for enlargements but no indications of any were found

Sec 28

T 48

R 38 W

Mich.

St. Louis & Mississippi Slates & Schists.

C. R. Vanhise Mar. 20. 1884.

Sec 14

Microscopic Description.

T 49

Many of the small fragmental grains of quartz are distinctly enlarged. (See p. 75 Book I). Distinct

R 17 W

enlargements of quartz are found as in 4007 (See p. 81

Minw

4018

Book I)

S. W. 1/4

Sec 17

T 48

R 17 W.

Minw.

4402

Thin sections

No. 1026

No. 1393

Narrow belt of
islets below

East Keesbich,

Canada.

Altered Orthoclase Diabase.

C. A. Vanhise.

Macroscopic Description.

A medium grained, massive, dark grayish green rock.

Microscopic Description.

The feldspar appears to be in part orthoclase although the greater portion of this mineral is plagioclase. They are very badly decomposed so that in a few places only is banding seen in the plagioclase and then indistinctly. The alteration has usually been a kaolinic one but in a few grains of feldspar, pale, yellow, feebly dichroic areas of epidote have developed. The feldspars are also often dotted with rather numerous small irregular patches of hematite. Numerous characteristically irregular areas of magnetic iron are seen. This mineral is in most cases entirely unaltered but some few of the smaller grains are bordered with hematite. Augite was originally fully as abundant as either feldspar or magnetite but now it has mostly decomposed or altered to other minerals. In one slide however quite large areas of comparatively fresh augite is found which shows nicely its 87° angles & cleavages. In many cases the augite has simply decomposed into a grayish aggregate of fine non polarizing material; however more of the augite has altered into green, feebly dichroic chlorite. A third product of the alteration of the augite is green hornblende and while in part a mere aggregate (uralite) another part of the hornblende is found in areas of some size, each of which is a single individual.

4404

Thin section

No. 1027

Narrow belt

of islets below

East Neebuh,

Canada.

Altered Orthoclase Diabase.

C. P. Vanhise Jan 17 + May 20. 1884.

Macroscopic Description.

The rock is massive and coarser-grained than 4402. It is composed in about equal proportions of reddish brown feldspar and of dark olive green material.

Microscopic Description.

The feldspars, their alteration products, and inclusions are precisely as in 4402. Epidote and hematite as alteration products are more abundant than in 4402. Magnetite is found as in 4402. Scattering cores of augite are all that remain of that mineral. Much of it has changed to a gray aggregate and to chlorite as spoken of in the description of 4402. However, much more of it has altered to hornblende than in 4402. This hornblende is sometimes found in large areas surrounding what has been an augite individual. This material has a 124° angle cleavage, a brown color, and very strong dichroism. That these large brown hornblendes are secondary is shown by their forms and positions. In places in the chlorite aggregates give brilliant violet and purple polarization colors. Secondary quartz has sometimes replaced quite large areas of feldspar. This rock was evidently originally like 4402 and even now differs from it only in minor points.

4414

Thin Section

No. 1033

Three and a half
east of west
mouth of
Mississagui
River, North
Shore of Lake
Huron.

C. R. Vanhise Jan 18th May 20. 1884Macroscopic Description.

A massive medium grained rock of uniform olive green color.

Microscopic Description.

The slide is composed of a confused mass of much kaolinized feldspar gray decomposition product of titaniferous iron (leucocene), almost colorless or pale green hornblende, epidote, and chlorite. Mingled with these minerals is a little quartz and biotite. The hornblende with a single nicol becomes green by dichroism and with crossed nicols gives brilliant polarization colors. The areas of this mineral are the best defined of any in the section with the exception of the epidote. A part of the chlorite seems to have resulted from the alteration of the hornblende. If the original rock has been augitic it is possible that both the hornblende and chlorite in their first source are results of alterations of this mineral. The epidote in the main seems to have resulted from change in the feldspars. The quartz is all doubtless a secondary replacing material.

4415

Thin section

No. 1034

3 1/2 miles

E. of N. mouth

of Mississagui

River, north

shore of

Lake Huron.

Altered Diorite.C. R. Vanhise Jan 18th May 20. 1884.Macroscopic Description.

The rock is somewhat lighter colored than 4414; otherwise it is like it.

Microscopic Description.

The rock is not so badly decomposed as 4414 although it originally must have been much like it. Many of the feldspars distinctly show twinning in polarized light. When altered into or replaced by other minerals these are the same as in 4414, epidote and quartz, the amount of the former being much less and of the latter quite a good deal greater than in 4414. Titanic^{iron} is again known to be present only by its gray alteration product, leucosene. The hornblendes are not so fragmentary as in 4414. It is however of the same variety and often the blades are several times as long as broad. Quite frequently individuals of the mineral are twinned. The chlorite appears mostly to be an alteration product of the hornblende. A little biotite in small grains is scattered through the chlorite.

4428

Sec. 1480
 6 miles east
 of mouth of

Blind River,
 Canada.

Norite.

C. R. Vanhise, Jan 19th May 21, 1884.

Macroscopic Description.

A massive medium grained rock of dark gray color. Its general appearance is that of a gray gabbro.

Microscopic Description.

The section is composed almost wholly of anorthite, hypersthene, or enstatite, and hornblende. The anorthite composes rather less than one-third of the rock, and has evidently been the first of the more abundant minerals to crystallize. Quite numerous small crystals of apatite and grains of magnetite are included by this mineral. In many small round or oval areas the anorthite has altered to epidote. The hypersthene individuals are often large with a continuous fibrous cleavage across their entire areas. Others are much broken. Some individuals which in ordinary light show a single fibrous cleavage, in polarized light give bands of color in two directions at an obtuse angle. The appearance is like that of brilliantly polarizing hornblende which has strongly developed its two cleavages. This phenomenon may be due to an incipient alteration of the hypersthene to hornblende. The inclusions in the hypersthene are chiefly specks of magnetite. Often it has considerably altered, the resultant products being hornblende and chlorite. The hornblende is mostly white, or pale brown or blue, feebly dichroic, brilliantly polarizing and often having its characteristic cleavages. (Tremolite?) The remainder of the hornblende gives strong dichroism. One or two small grains of pyrite are seen. In many respects resembles 3366. W. C. Compare Foggé, Plate ~~F 130~~ L. x x 3.

4431

Section

1147

Island 1 1/2

miles east
mouth of
of Blind

River, Canada.

Altered DiabaseC. P. Vanhise, Jan 19th and May 22, 1884.Macroscopic Description.

A dark olive-green colored, fine grained, fibrous structured rock.

Microscopic Description.

The section is composed almost entirely of plagioclase and hornblende with the alteration products of the latter. The plagioclase is tolerably fresh, showing distinctly almost everywhere banding in polarized light. Some areas of feldspar have the appearance of orthoclase but they are so small and uncommon that they might well be sections of plagioclase which did not chance to cut across the lines of twinning. The only inclusions of note found in the feldspar are numerous small crystals of apatite and round granules of epidote. The latter is probably an alteration product.

The hornblende with its alteration product, actinolite, is the most abundant material in the section. The hornblende is light brown, very often has its characteristic cleavages, and is quite strongly dichroic. However it is rare to find an area which has not altered in part to actinolite. In many grains a mere film of actinolite surrounds the hornblende and from this all phases of the change are seen up to the point where entire grains are actinolite. This actinolite is perfectly colorless, and non-dichroic, has a fine fibrous or needle-like structure, never shows the 124° cleavage of hornblende and is brilliantly polarizing. There are quite numerous areas, some of them of large size, of very pale green ~~and~~ nearly colorless chlorite. With crossed nicols the light is extinguished almost perfectly, more perfectly than in any chlorite heretofore seen. It is very possible that this mineral is all due to alteration in the

4431Altered Diabase (con.)

alteration product, actinolite. In many cases the alteration has gone on beyond the chlorite to epidote quite large areas of the latter mineral being found included by the chlorite.

The epidote while most abundant as above stated in the feldspar and chlorite is also found in the hornblende and actinolite. A few small specks of magnetite and hematite are found throughout the section.

4430

C. R. Vanhise Jan 19th and May 22/84.Macroscopic Description.

Sec. 1046

Island 1 1/2

miles east of

mouth of

Blind River,

Canada.

The rock differs from 4431 only in being finer grained and more compact.

Microscopic Description.

This rock from its ~~position~~ location and appearance is taken to have been like 4431, but it is illustrative of the extreme of poverty. If hornblende were once present it has entirely disappeared. However, actinolite like that ~~of~~ in 4431 yet remains, although less abundant, while epidote and chlorite are ~~se~~ very plentiful. The section taken by itself could only be described as a confused mass of decomposed feldspar, actinolite, epidote, and chlorite with some ferrite.

4432

Altered Diorite.

C. R. Vanhise May 2. 1884

Sec. 1048

Macroscopic Description.

Island 1 1/2 miles east of mouth of Blind River, Canada. A massive, medium grained rock of mottled pink, white, and dark olive green colors, the pinkish white grains being the feldspars. The specimen is much coarser grained than those of 4430, and 4431.

Microscopic Description.

The feldspar appears to be in part orthoclase although most of it is plagioclase. It is all more or less decomposed and much of it is altered to epidote which mineral is found everywhere through the feldspar grains in small roundish grains or clusters of grains. Another large portion of the feldspars has been replaced by saturating quartz. Quite often many separate areas of this quartz are seen in the polarized light to be parts of a single individual showing that large areas of feldspar are honeycombed by a single quartz unit. This saturating quartz resembles closely that of 6009.

The second of the original minerals is titanite iron and its gray decomposition product leucosene which is present in large areas.

Hornblende and actinolite bear the same relation to each other in this rock that they do in 4430, except that ordinarily the actinolite alteration of the hornblende has proceeded from the center of the ground outward instead from the outside toward the center, and that latter is commonly the change has been complete. The areas much finer of these two minerals are much larger than grained in 4431, but the hornblende and actinolites are very similar in appearance and structure of it. In spots through out the section the hornblende and actinolite have altered to chlorite. In the main there seems originally to have been little difference between this rock and 4443 except that the (see margin)

4439

Sec. 1052

Altered Orthoclase Gabbro.

C. A. Vanhise, May 3, 1884

Macroscopic Description.

East bank of
Mississagui River just
above the
forks. A massive medium grained rock, mostly
having an olive-green color, showing however,
a mottled appearance given by whitish and
pinkish feldspar.

Microscopic Description.

Feldspar is much the most abundant
constituent. While it is always badly kaolinized
it is usually fresh enough to give twinning
bands, when trichitic, as it usually is, the
amount of orthoclase being small. In a
few small areas the feldspar has altered
to epidote, while a saturating quartz has
often replaced portions of grains.

Magnetic or titanite iron is rather
sparsely scattered through the section in
grains of medium size.

The abundant large areas of
diabase are always badly decomposed gener-
ally the alteration products being gray zeolite
aggregations. However in places chlorite
and, less commonly hornblende have resulted
from alteration of the diabase.

4440

Sec. 1053

East bank of
Mississagui
River, just
above the
forks.

C. R. Van Hise, May 23. 1884
Macroscopic Description.

This rock is like 4439.

Microscopic Description.

The once abundant feldspars are so badly decomposed and altered that in but one or two places is any trace of banding seen in polarized light. The resultant products of this decomposition are kaolin, chlorite, epidote, and some zeolite. The epidote is perhaps the most abundant of these alteration products the areas being aggregates of small roundish grains. The brilliant violet and purple colors spoken of in 4404 are seen in this section in polarized light. It seems most probable that this material is chlorite. In places saturating quartz has replaced feldspar as in 4439.

A few small areas of titanic iron are seen, which in some places have altered to leucosine.

Actinolite is found in large areas. In some places it is altered to chlorite, and one or two of them show twinning across the actinolite fibres, as if the area had once been a hornblende one. If all or much of the actinolite is of this origin, this rock must once have been very like 4432.

Of course it is possible that this rock and 4440 were both originally gabbros and that since then the diagenesis has altered to hornblende which has undergone another change in 4440 producing actinolite.

4455

C. R. Van Hise, Jan. 19th and May 23. 1884

Slide 1060

Macroscopic Description.

Near end of point about 5 miles west of N. mouth of the others.

Mississauga River.

Microscopic Description.

The plagioclase is so badly decomposed that in but few places is twinning still visible. The alteration products consist largely of epidote which is found everywhere through the feldspar. A portion of this product may also be zeolite.

No original titanite iron is found, all that remains of this mineral being its gray decomposition product.

Numerous large areas of actinolite are seen, which in places are more or less altered to chlorite. In one or two grains large cores of hornblende with its dichroism and 124° angle cleavage was found; however, the actinolite outside of these cores, showed neither of these properties in the least. It is probable that all the actinolite of the section is of this origin.

Aside from the epidote spoken of above very large complex areas of epidote are found. In these areas the grains are large, fit closely so as to exclude all other minerals. This form of the mineral is so abundant as to compose one-third of the rock.

4458

Altered Greenstone.

C. R. Van Hise, May 8. 1884.

Macroscopic Description.

Slide 1061

Near end of
point 5 miles rock.

Fine grained, massive, dark green colored

west of West
mouth of
Mississauga
River.Microscopic Description.

This rock is so badly decomposed that it is impossible to say what may ~~have~~ ^{be} of the constituents are. Feldspar, badly decomposed but sometimes showing banding in polarized light, is abundant. The decomposition products are kaolin and chlorite.

Branching areas, or areas made up of many small separate grains of its titaniferous iron and its decomposition product — leucocoxene, are plentiful.

Next to feldspar, chlorite is the most abundant constituent. A portion of this mineral as before stated is a secondary product of the feldspar, but it is probable that much of it has resulted from the alteration of augite or an augite like mineral.

Saturating quartz ~~the~~ is found throughout the section. However the greater portion of it replaces feldspar. Numerous small specks of calcite are scattered through the section.

4460

Altered Greenstone - Diabase?

C. R. Van Hise, May 10/84.

slide 1063

Macroscopic Description.

" 1064. The rock differs from 4459 in that the
 near end of feldspar is of a bright brownish red color.
 point 5 miles Calcite is also more abundant, being seen
 west of West in veins cutting through the rock.
 mouth of
 Mississagui
 River.

Microscopic Description.

The sections are essentially like that
 of 4459, the only noticeable difference
 being that the feldspars are tinted with
 brown iron oxide. One of the sections is
 cut by a vein of quartz and the other by a
 vein composed in about equal propor-
 tions of quartz grains and irregular
 small grains of magnetite.

4459

Altered Greenstone - Diabase?

C. F. Van Hise, May 8. 1884.

Slide 1052.

Macroscopic Description

Same locality

as 4460

The rock is a little coarser grained than 4458; otherwise it is like it.

(p. 241)

Microscopic Description.

The rock is much altered but still retains the general appearance of a diabase. It appears to differ from 4458 only in that the alteration has not proceeded much farther so far.

The feldspar quite frequently shows distinct banding. The alteration products are kaolin and chlorite as in 4458.

Titanic iron and leucosene are found as in 4458.

Chlorite is very abundant and much of it is in well defined areas which are situated relatively to the feldspars as augite is in diabase. No saturating quartz is seen. Calcite is found as in 4458.

4443

Altered Diorite.

C. R. Van Hise, May 26. 1884

Slide 1055

Macroscopic Description.

Large island
on south
side of
Mississagui
Bay.

A fine grained, massive, dark gray colored rock, with veins of brownish-green epidote cutting it.

Microscopic Description.

The plagioclase is very largely altered into epidote and chlorite or replaced by saturating quartz. The epidote is very abundant and is often seen in quite large areas. The saturating quartz has replaced the feldspar in minute spots; nowhere are areas of any considerable size found, yet grains of feldspar often have two-thirds or more of their substance replaced by this mineral.

Numerous small grains of titanic iron and its decomposition product leucoxene are found throughout the section.

Actinolite or hornblende, often having a 124° angle cleavage, either colorless or pale green, and at times feebly dichroic is one of the most abundant minerals of the rock. This mineral has quite often partly or wholly altered into chlorite, which again has frequently changed to epidote.

The origin of the epidote is nicely shown in this section. Frequently a large individual of it is found entirely surrounded by feldspar or chlorite.

4445Altered Greenstone.

C. R. Van Hise, May 27, 1884

slide 1056.

Macroscopic Description.

North side

of Muskegon

Bay.

A finely schistose aphanitic rock of a dark green color.

Microscopic Description.

The section is made up of a very fine indiscriminate mixture of chlorite, decomposed feldspar, titanic iron, leucocoxene, quartz, and chlorite epidote. Nothing can be said as to the nature of the original minerals.

4446Altered Greenstone

C. A. Van Hise, May 27, 1884

Slide 1057

Macroscopic Description.

Same locality

as 4445

(p. 247)

The rock differs from 4445 in being massive and not quite so fine grained.

Macroscopic Description.

The minerals which compose this rock are mainly the same as mentioned in the description of 4445, of which it appears to be a simply a coarser phase. Epidote is far more abundant than in 4445 and numerous grains of pyrite are scattered through the section.

4469

Altered Greenstone - Diabase?

C. A. Van Hise, May 10. 1884.

Slide 1066

Macroscopic Description.

4 miles

east of Pt.

Thessalon

at "Les

Grande Sablon."

A very fine grained massive, dark gray colored rock.

Microscopic Description.

The section is very fine grained. The plagioclase is largely altered to epidote. The remainder is much decomposed, although fresh enough to show banding in places.

Titanic iron and leucoxene is present in numerous small areas.

Plentiful chlorite occupies the position relative to the feldspars usually taken by an augitic ingredient in diabases. In a few grains of chlorite, badly decomposed cores of what appear to be augite are found and it is probable that all the chlorite is due to the alteration of augite.

4485Altered Diorite.

G. R. Van Hise, May 12. 1884.

Slide 1082

Macroscopic Description.Between $\frac{1}{4}$
and $1\frac{1}{2}$ miles
of Thesalon
Point.

A dark gray colored, massive, aphanitic rock having a sub-conchoidal fracture.

Microscopic Description.

The section is exceedingly fine grained and much altered.

Very small tabular feldspars are very abundant. They are mostly much kaolinized.Numerous small vaguely outlined areas of leucoxene are present.Many small areas of hornblende ^{or ura~~l~~ite} are fresh enough to show distinctly their optical properties. However they are largely altered to chlorite.Quartz has penetrated the rock and is quite plentiful in veins and complex small areas.This rock has a close resemblance to the so called "ash-bed" diabases and it may originally have been such a rock the ura~~l~~ite coming from alteration of augite.

4486

Altered Diorite.

G. R. Van Hise, May 12. 1884.

Slides 1082 x

1461

Macroscopic Description.

This rock is like 4485.

Between $\frac{1}{4}$
and $1\frac{1}{2}$ miles
of Thesalon
Point.

Microscopic Description.

The rock was probably in one phase of its alteration like 4485, but the process has proceeded much further.

Little tabular areas of gray kaolinic material is all that remain of the feldspars.

No hornblende is found and much even of the secondary product of the hornblende, chlorite, as well as a large part of the feldspar has been replaced by irregularly outlined areas of calcite of greatly varying sizes.

Quartz besides being found in complex areas of some size as in 4485 is scattered through the section in single small individuals.

4487Altered Diorite.

C. R. Van Hise, May 13, 1884

Slide 1397

Macroscopic Description

Between 1/4

and 1 1/2 miles east of Point Threelock. A very fine grained, massive, dark gray colored rock. Although so fine grained its texture is much coarser than in 4485 and 4486 from which it appears to differ only in this particular.

Microscopic Description.

The section differs from that of 4485 chiefly in being coarser grained.

The feldspars are often fresh enough to show banding in polarized light. The decomposition is a kaolinic one.

All the titanic iron has been ^{altered to} leucocoxene.

Uralitic looking hornblende is abundant. Much of it however has altered to chlorite.

Fine quartz replacing the feldspars as noted in 4485 is present.

4488Altered Diorite.

C. R. Van Hise, May 13. 1884.

Slide 1398

Macroscopic DescriptionBetween $\frac{1}{4}$
and $1\frac{1}{4}$ miles

The rock is like 4487.

east of
Thermal
Point.Microscopic Description

The rock is finer grained than 4487 but is essentially like it. The few points of difference are as follows:-

The feldspar areas are fresher in places than any of the preceding sections from the same locality. Also in a few places some of the plagioclases are very large which gives the rock a somewhat porphyritic appearance.

A few unaltered specks of titanic iron are found amongst the leucoxene.

The uraltic looking hornblende has mostly altered to chlorite. A few grains of epidote are present. Quite numerous small individuals of titanite some of them in the characteristic wedge-shaped crystals are found.

4489

Altered Diorite.

C. R. Van Hise, May 16. 1884.

Macroscopic Description.

The rock is like 4487.

Microscopic Description

This rock is one of the more badly altered ones of the series.

In only a few places is banding seen in the feldspars.

Nearly all of the titanic iron has decomposed leaving behind, leucoxene.

Traces only of the original hornblende are found, it having nearly all been changed to chlorite.

Epidote is quite plentiful mostly in minute particles, but sometimes in grains of some size.

The amount of finely crystalline replacing quartz is quite large.

A few areas of chlorite which in ordinary light are strongly dichroic, in polarized light give brilliant violet and purple colors.

Aside from the above points this rock does not differ from those previously described from the same locality.

Slide 1462
Between 1/4
and 1 1/4 miles
east of Point
Thessalon.

4490

Altered Diorite.

C. R. Van Hise, May 29. 1884

slide 1399

Macroscopic Description.

Bellevue 1/4

and 1/4 miles

east of Point

Thessalon

A rather coarse grained, massive dark-green colored rock.

Microscopic Description.

The plagioclase grains are quite large and sometimes distinctly show banding although the larger part of this mineral has altered to chlorite or epidote or has been replaced by saturating quartz. The chlorite into which the feldspar has altered is of the brilliantly polarizing variety mentioned in the preceding description. At times this secondary mineral chlorite has farther altered into epidote. The section looks however as though much of the epidote had developed directly from the feldspar. Saturating quartz is abundant in large areas, and frequently many detached grains are portions of a single individual.

Large areas of titanic iron and leucoxene in their characteristic forms are found. The abundant large hornblendes are of the green variety and they sometimes show traces of the 124° angle cleavages. Many of the grains are partly and some of them wholly altered to chlorite.

This rock is very like 4432 the chief difference being that none of the hornblende is brown and that the actinolite alteration is not seen. It is of course possible that in this section the hornblende has ^{already} gone through the changes which are now in progress in 4432.

4492

Biotite Muscovite Granite.

C. R. Van Hise, May 29, 1884

Slide 1400

Macroscopic Description.

Between 1/4

and 1/2 miles east of Point Thessalon. A very fine grained, compact, massive, dark-gray rock, in which porphyritic crystals of feldspar are seen, and having conchoidal fracture. The rock has the appearance of a felsite.

Microscopic Description.

The rock has all the characteristics of a fine grained granite.

The fine feldspar grains are mostly orthoclase although quite a portion of oligoclase is present. The larger porphyritic feldspars spoken of above are of the same species. These minerals are commonly much decomposed and often include crystals of apatite.

Greenish brown biotite is the mineral next to the feldspars in abundance. It occurs scattered uniformly through the section in irregular grains ordinarily with somewhat ragged edges.

Muscovite is much less plentiful, the individuals averaging smaller than those of the biotite.

Small tolerably plentiful grains of quartz are scattered through the section, which often includes needles of rutile.

Chlorite as an alteration product of biotite, brown iron stains upon the feldspars, and a little epidote are found.

4493Biotite Muscovite Granite.

C. R. Van Hise May 29. 1884.

Slide 1083.

Macroscopic Description.

Between 1/4

A very fine grained, compact, dull black and 1 1/2 miles rock with a conchoidal fracture and shows east of Point traces of a schistose structure. The general appearance of the rock is somewhat like that of a fine grained mica schist.

Microscopic Description.

The rock in all essential points is like 4492. The feldspar and biotite are more decomposed, no porphyritic feldspar are seen, and epidote is abundant. Aside from above points no difference is seen between it and 4492.

4494

Altered Porphyritic Diorite.

C. R. Van Hise, May 30. 1884.

Slide 1084.

Macroscopic Description.

Between 1/4

and 1 1/2 miles

east of Pt.

Thessalon.

An aphanitic, dark gray colored rock with conchoidal fracture and containing many small porphyritic crystals

Microscopic Description.

The ground mass is excessively fine grained. It appears originally to have consisted mostly of feldspar and hornblende with perhaps titanic iron, but now the minerals are badly altered; so that the ground mass consists largely of epidote, chlorite and leucoxene.

The porphyritic crystals were part hornblende of the actinotite variety and in part feldspar. The hornblende is largely altered to chlorite and the plagioclase to epidote and kaolin.

Epidote beside being found as above spoken of is also seen in quite large complex areas.

Quartz also is present in small grains which have been an abundant replacing material throughout the rock, and some areas are composed almost wholly of this mineral.

4495

Altered Porphyritic Diorite.

C. R. Van Hise, May 29, 1884.

Slide 1085

Macroscopic Description.

Between 1/4

and 1/2 miles

east of Point

Thessalon.

A fine-grained massive dark green colored rock containing porphyritic crystals of feldspar.

Microscopic Description.

Much of the plagioclase is quite well preserved, so well that extinction angles were obtained which show it to be albite or oligoclase. However in places this mineral has altered to epidote.

Leucoxene is all that remains of the titanite iron.

The hornblende is of the green variety and is now largely altered to chlorite, which in turn has often further altered to epidote.

Epidote from the two sources above is abundant.

The areas of the different minerals in this section are more satisfactorily defined than in any of the preceding rocks from the same locality. The different areas lie with respect to each other as is common in diabases and it is very probable that the hornblende itself is due to alteration of an original augite.

4496

Altered Greenstone.

C. R. Van Nise, May 30. 1884.

Section 1086.

Macroscopic Description.

Between 1/4

and 1 1/2 miles

east of Point

Theraplow.

A fine-grained, almost aphanitic, dark-grayish-green colored rock which contains numerous porphyritic crystals. These crystals are now however largely altered into or replaced by green epidote, pink zeolite, or calcite, the first being greatly preponderant. The epidotic alteration has commenced upon the outer surfaces of the crystals and has extended toward their centers. Ordinarily the change has not been completed so that we have the porphyritic areas with light yellowish-green exteriors, containing cores of a black mineral.

Microscopic Description.

The rock is so badly altered that little can be made out as to its original character.

The ground mass now consists of feldspar in all stages of decomposition, the resultant minerals being chlorite, epidote and kaolin. The former mineral is by far the most abundant of the three and has sometimes taken a spherulitic form.

Most of the porphyritic areas spoken of above are composed mainly of epidote and green fibrous chlorite, the former mineral being on the exterior of the areas while the chlorite occupies the interiors. In many cases however these minerals have altered into or been replaced by calcite, quartz, or ^{gray} zeolite. As the quartz has crystallized, it has caught numerous rounded specks of the chlorite which it has replaced, and these give the quartz a peculiar spotted appearance.

4497Altered Diorite.

C. R. Van Hise, May. 30. 1884.

Macroscopic Description.

The rock is like 4485.

Microscopic Description.

This rock in the minerals it contains and in the fineness of its grain is very like 4485, 4486, and 4487.

It does not have the appearance of an "ash-bed diabase" spoken of as characteristic of 4485, and perhaps is nearest like 4487, the description of which would almost perfectly apply in this case, except that 4497 is more decomposed and epidotic than 4487.

Slide 1087
 Return 1/4
 and 1 1/2 miles
 east of Pt.
 Thessalon.

4499

Altered Diorite.

C. A. Van Hise, May 30, 1884.

Macroscopic Description.

Slide 1401

East side
of Point
Shesalon
midway of
its length

A rather fine grained, massive, very dark gray, almost black colored rock. The appearance of the specimen is that of a diabase.

Microscopic Description.

A portion of the plagioclase is unusually fresh for a specimen from the region from which it comes, it giving very nice continuous polarization colors. Most of it however is much kaolinized and in part altered to chlorite or epidote.

The titanic iron is altered to leucosene in but few places.

Hornblende is present in abundant large grains in most cases more or less decomposed and altered to chlorite, but the mass of the mineral distinctly shows the characteristics of hornblende.

The epidote here as before described has often resulted from alterations of the feldspars with chlorite as an intermediate step.

That the feldspars in the alterations which produce the epidote, in all cases pass through the mineral chlorite is not at all certain, the change often appearing to be direct.

The chlorite is often of the variety which gives the brilliant violet and purple colors ^{before} ~~above~~ spoken of.

This rock has the general appearance of a diabase and the uraltic looking hornblende individuals are of the ordinary forms of augite. It seems probable that the hornblende is of this source and consequently that the rock was originally a diabase.

6002

Olivine Gabbro.

C. R. Van Hise, Feb. 2, 1884.

Slide

Macroscopic Description.

Sec. 23, T. 63

R. 1 W, Minn.

1800 paces

800 " W.

A coarse grained massive rock. Light gray and yellow iron stained feldspar, magnetite, and black augite are visible.

Microscopic Description.

Mentioning the minerals in order of crystallization, olivine appears to come first. It is found in few large rounded grains, as a whole quite fresh, yet upon the edges and along cracks of the grains it is altered ~~and~~ to serpentine and hematite. Magnetite is abundant in large grains. Labradorite is the mineral seen in largest quantity. It is in large grains an quite fresh although along cleavage lines it is stained with brown iron oxide. Pyroxene is found in abundant large individuals in the two forms diallage and augite in about equal quantity. While much of the pyroxene is quite fresh, much of it is altered to hornblende and chlorite. The former mineral is of the brown basaltic variety. Included in one large individual of diallage are several brown very strongly dichroic grains which are taken to be tourmaline.

6003

Olivine Gabbro.

Sec. 15,

C. R. Van Hise, Feb. 2. 1884.

T. 63,

Macroscopic Description.

Q. 1 W.

1020 ft. N

1500 ft. W.

The feldspar is not stained with iron oxide as in 6002, consequently the rock looks fresher than does 6002. Otherwise there is little difference between the two rocks.

Microscopic Description.

Olivine is more abundant and usually fresher than in 6002. Along edges of grains and along fissures it is somewhat altered the resultant minerals being serpentine and ferrite and sometimes a grain is entirely thus changed.

The magnetite grains are often bordered by biotite. The labradorite is very fresh. The diplage and augite grains while quite frequently partly or wholly altered to chlorite do not show a basaltic hornblende alteration as seen in 6002. Uralite decomposition is however noted. Many grains of magnetite are included by the pyroxene. The biotite spoken of above is evidently a secondary product and from its position it seems quite certain that the magnetite has furnished in part at least the necessary iron for the formation of that mineral, while the augite and feldspar have furnished the remainder of the elements.

6004

Olivine Gabbro

C. R. Van Hise, May. 3. 1884.

Slides 1120

Macroscopic Description.

1121

A very coarsely crystalline, perfectly black, massive rock.

Sec. 16,

D. 63

Q. 1 W.

Microscopic Description.

1400 faces N

1400 faces W

Minn.

Olivine is seen in fresh large brilliantly polarizing areas containing many minute black inclusions which are taken to be magnetite.

The feldspar is of the anorthite species it like the olivine often contains fine parallel lines of minute black magnetites. The pyroxene is of the two varieties diallage and augite. The former shows nicely the characteristic fine cleavage and is usually much fuller of the magnetite inclusions than either the olivine or feldspar. In fact it is often so full of this fine magnetite that with a low power entire areas are almost black. The augite is in large clear grains almost free from magnetite and frequently exhibits its two cleavages at right angles. Magnetite beside being present in the form spoken of above is found in grains of some size. Films of chlorite and iron oxide as decomposition products are scattered through the section.

Feldspar Porphyry

C. R. Van Hise Feb. 5. 1884.

Macroscopic Description.

6005

Sec. 32

T. 64

R. 1 W.

850 paces N

1000 " W.

Mgmn.

The rock is reddish brown to black in color; massive; red crystals of feldspar in an aphanitic ground mass.

Microscopic Description.

Porphyritic crystals ~~x~~ of orthoclase and oligoclase are set in a partially non-polarizing, spherulitic groundmass, which is penetrated in every direction by curved often feather-like black microliths. The porphyritic feldspars vary greatly in size, are numerous and badly decomposed. A few small grains of magnetite, some of them crystals, are seen in the matrix. Also small grains of chlorite which have crystal outlines, and are evidently pseudomorphs after some other mineral are found. The originally mostly amorphous ground mass has ^{heavy} largely devitrified. The section is everywhere deeply stained with brown iron oxide. A little secondary replacing quartz is scattered through the section.

6006

Olivine Orthoclase Diabase.

C. A. Vanhise, Feb. 6. 1884.

South side
of Cross LakeMacroscopic Description.

T. 64

R. 1 W.

Minn.

A coarse grained, massive rock. Brownish red feldspar is the only ^{recognizable} mineral which is mingled with black material.

Microscopic Description.

A single grain of olivine which is partly altered to oxide of iron is found. Other roundish grains now composed of brown iron oxide are doubtless decomposition products of olivine.

Magnetite is present in rather small grains. It is often included by feldspar and hence crystallized later than that mineral. The feldspar is partly orthoclase and partly plagioclase which so far as they remain are quite fresh. Most of the grains of these minerals have been penetrated throughout by a saturating quartz. In each grain the intruding quartz is arranged with some regularity in parallel lines in either a single direction or in two sets of parallel lines which cut each other at an angle. The directions of these lines doubtless correspond to planes of cleavage in the feldspars. Many little granules of the saturating quartz in a single feldspar polarize together, showing that although separate in section they together compose a single irregular individual with the parts of the feldspar grains as inclusions. The augite is quite fresh. The outsides of a few grains are however changed to hornblende and brown ferrite is seen along the cleavage lines. Brown iron oxide stains all the above minerals. Large long needles of apatite are included in the feldspars.

6007

South side
of Cross Lake

T. 64

R. 1 W.

Minn.

Gabbro.

C. R. Van Hise, May 3. 1884.

Macroscopic Description.

A rather coarse grained massive rock.

White feldspar and black magnetite are visible.

Microscopic Description.

If the rock originally contained olivine it is now altered to serpentine and chlorite.

The feldspar is apparently all triclinic but is too much altered to determine extinction angles.

Pyrroxene in large grains of the two varieties augite and diallage are present both kinds showing ^{their} respectively cleavages.Magnetite is found in large abundant grains some of them with crystalline outlines. Also small grains are quite frequently included by pyroxene. The alteration products present are serpentine, chlorite, and brown oxide ^{of iron}. The former two are often found in grains which resemble those of olivine and they are here probably the result of alteration of that mineral. This rock is very like 6004 the most important difference being the absence in the former of the great numbers of minute specks of magnetite which are found in parallel lines in the olivine feldspar, and diallage of 6004. Saturating quartz is found in this rock of the same nature as shown by 6006 but it is not abundant.

C. R. Van Hise, March. 1885

The grains of diallage are often partly decomposed, the products being chlorite, and biotite. Both of these minerals are found upon the exteriors of the areas of diallage and also inclosed by them.

6009

South shore
of "Key" Lake
just west
of Cross Lake

Orthoclase Gabbro

C. R. Van Hise, Feb. 9. 1884.

Macroscopic Description.

A very coarse grained massive rock. Some of the cleavage faces of the black diallage and white or iron stained feldspar are fully half an inch across.

Microscopic Description.

Very large irregular grains of magnetite are abundant. Orthoclase and plagioclase are in very large grains, the latter being more plentiful than the former. These feldspars when fresh are tolerably free from inclusions. They are however frequently kaolinized and very large areas of them have been replaced by secondary quartz. The amount of this saturating quartz is not perhaps greater than that found in 6006 but a continuous area is often large and often many of these areas extinguish together showing that a single individual of this mineral is of great size. The diallage grains are also very large. They have a very well developed cleavage and along these lines the mineral is everywhere stained with iron oxide resulting from decomposition and in one case a large portion of a grain has altered to chlorite and biotite. These two secondary min^{er}als here show a somewhat complex intergrowth, but ^{that} they both are due to alteration of the diallage there is little doubt. Biotite is also found in small grains, apparently independent of the diallage; but here it is very possible that entire individuals of diallage have altered to that mineral.

6011

Olivine Gabbro.

In. T 64

C. A. Van Hise. Feb. 9. 1884.

R. 3 W

Macroscopic Description.

Minn.

A medium grained massive rock; white feldspar mingled with black minerals giving the rock a mottled appearance.

Microscopic Description.

The olivine occurs in abundant six or eight sided, very fresh crystals. In the individuals which are the most decomposed only a narrow film of serpentine or chlorite is seen along their outer edges or in the larger fissures. The amount of magnetite present is very small. It is seen in a few independent grains but is mostly found as an inclusion in the olivine and diallage.

Anorthite is* the most

30	33	63
33	33	66

 plentiful mineral in the section. It is scarcely decomposed at all. It contains numerous cavities and quite numerous inclusions of iron oxide and crystals of apatite, with a few small dark brown zircon needles. The diallage is not very plentiful, is fresh, has a strongly marked cleavage, and contains as inclusions very numerous minute specks of magnetite which give it a black and white spotted appearance.

6013

N.W. side of
Copper
Lake

Sec. 9

T. 64

R. 4 W.

Minn.

Olivine Gabbro.

C. R. Van Hise, Feb. 9. 1884.

Macroscopic Description.

The rock is ~~no~~ more feldspathic than 6011 and the pyroxene ingredient is of a dark brown color instead of black.

Microscopic Description.

The olivine is as abundant as in 6011, but it is not nearly so fresh. Some of the grains have so much decomposed as to give feeble or no characteristic colors in polarized light. The resultant product is chiefly brown iron oxide. The magnetite is again not plentiful. The outside of the grains are often oxydized to hematite. Plagioclase is abundant as in 6011. The diallage has a deep, pinkish brown color, otherwise it is not different from that in 6011.

C. R. Van Hise, March. 1885

About the grains of magnetite and from them at times extending for some distance into the feldspar or augite are areas of secondary biotite. This association of the biotite and magnetite is so frequent as to lead to the conclusion that it has had something to do with the formation of the secondary mineral. The magnetite is buried in the feldspar or augite and nowhere, except about the magnetite, is the biotite found; it appears then that the magnetite has furnished, in part, at least, the iron oxide necessary for its formation, while the feldspar or augite has furnished the remaining necessary chemical constituents.

6018 (?)

S 1129

Sec. 7

T. 64

Q. 4 W.

Minn.

Olivine Orthoclase Gabbro.

C. R. Van Hise, Feb. 12. 1884.

Macroscopic Description.

Rather fine grained, black, massive rock.

Microscopic Description.

Olivine occurs in rather fresh mostly oval grains. Around the edges of the grains and along lines of fissure this mineral is altered to chlorite.

Magnetite is found in numerous medium sized grains, some of them sections of crystals. This mineral ought to have been mentioned before the olivine for it is prior to it in crystallization as well as to the feldspar and diallage, grains of it being included by all of these minerals. The grains of magnetite often contain cores of pyrite. In such cases the magnetite is apparently a secondary product resulting from the oxydation of the pyrite. Whether all of the magnetite of the section is of this origin is uncertain, but it is possible that such is the case.

Orthoclase and labradorite ^{24 25 49}_{26 23 49}_{6 7 13} are apparently both plentiful in medium sized fresh grains.

Pyroxene is abundant both as diallage and augite. It is usually fresh although the cleavage lines and outside surfaces have given an opportunity for the formation of a little chlorite.

A few apatite crystals, some of them of considerable size, are found in the feldspars.

6044

N. W. 1/4 of

N. W. 1/4

Sec. 27

T. 65

R. 6 W.

Mason

Hornblende Porphyrite.

C. R. Van Dine Feb. 12. 1884.

Macroscopic Description.

Many flesh colored feldspars with fewer black hornblendes are buried in an olive green matrix.

Microscopic Description.

Porphyritic grains (many of them crystals) of feldspar and hornblende are very abundant. The feldspar crystals are often more or less rounded at the corners, and vary in size from grains several m.m. across to those so small as to be lost in the fine matrix. This feldspar is in part orthoclase and in part oligoclase. Only two porphyritic grains of quartz were found. With high power the ground mass, which composes perhaps one fifth of the rock, appears to be made up of quartz and feldspar with some kaolin and perhaps cryptocrystalline silica. There is here certainly more feldspar than quartz and, as clear small orthoclases are difficult to distinguish from quartz, the latter mineral may be little in quantity and possibly wanting.

6500

Altered Gabbro.

C. R. Van Hise, May 30. 1884.

Macroscopic Description

slide 1418

Island

A coarse grained massive rock, composed of colorless to pink feldspar, and a black of Thessalon coarse grained mineral.

Point, Can.

Microscopic Description.

The plagioclase is of the anorthite species being the least decomposed of any feldspar yet found in any of the greenstones of the north shore of Lake Huron. The section exhibits very nice interpenetrating feldspar twins. The last two of the above measurements are then from the different parts of one of these twins. The decomposition products of the feldspar, so far as it has changed, are kaolin and the ordinary gray material to which it commonly changes. Sometimes large areas of the anorthite have been honey combed by saturating quartz. Often times in these areas a single quartz individual is very large, perhaps a hundred (estimated) or more detached quartz areas are seen in the section, all being parts of one unit.

27	30	57
23	25	48
28	25	53
21	26	47
38	37	75
36	37	73
34	30	64

Magnetic or titanitic iron is found in large areas. Associated with most of the individuals of this mineral, oftentimes completely surrounding, biotite is found. When the titanitic iron ramifies as it frequently does biotite fills the interspaces. This constant association of the two minerals suggests the idea that the biotite is secondary, the magnetite having furnished iron oxide for the formation of this mineral while the other constituents of the rock perhaps furnished the remaining essential elements. This same association has been

6500

Altered Gabbro, (continued)

noted in 6003,

The diallage is in large areas and shows finely its characteristic cleavages. The larger part of this mineral however has altered to amphibole. The amphibole is of the varieties uraite, green hornblende, actinolite, and brown hornblende. The fibres of the actinolite correspond exactly to the original diallage cleavages and have evidently been governed by it. This actinolite is precisely like that described in specimens 4430, -31, -32, -44, -55 and others. There it was considered as being due to an alteration of hornblende, but when compared with this section it seems possible that in all these cases the actinolite is directly due to the alteration of pyroxene. This is particularly true in the case of 4432 where the hornblende is described as altering to actinolite in the centers, leaving the outside hornblende; for in 6500 exactly the same relation between these two varieties of amphibole is found and here the alteration from diallage to each of them is a direct one. It is also likely enough that the actinolite of 4443 is due to the direct alteration of pyroxene.

The brown hornblende is often in large individuals showing its 124° angle cleavages.

One very large wedge shaped crystal of sphene is present.

This section indicates more strongly than any of the preceding that the "diorites" described upon the preceding pages are altered diabases or gabbros.

In many respects this rock suggests the Wausau, Wis., hornblende granites. The quartz in these rocks is scarcely more abundant than in 6500.

6500Altered Gabbro. (con.)

Diabase and hornblende bear the same relation to each other there as here. The points of difference are that in the hornblende granites no quartz is found in detached areas partly replacing feldspar individuals. More important than this however is the difference in the feldspar species. The Wausau rocks contain oligoclase, microcline, and orthoclase while in 6500 but a single basic feldspar is found. Yet it seems possible or perhaps probable when compared with this rock that the Wausau granites are altered greenstones.

6507Altered Greenstone.

Slide 1419

C. R. Van Hise, May 31. 1884.

Mainland

Macroscopic Description.

4 1/2 miles

N. W. by N.

from Pt.

Theriot

Canada

A badly decayed, dark-gray colored, medium grained, weakly schistose rock.

Microscopic Description.

The mass of the rock consists of badly decomposed feldspar, of titanic or magnetic iron and of chlorite. A little saturating quartz has replaced the plagioclase in places.

6508

Gabbro.

C. R. Van Dine May 31. 1884.

Macroscopic Description.

Slide 1420.

Mainland

4 1/2 miles

N.W. by W.

Thessalon

Point, Can

A rather coarse grained, massive black rock having a mottled appearance due to light pinkish colored feldspars.

Microscopic Description.

Many of the labradorites are very fresh while others are at most completely decomposed. The

alteration products are epidote, chlorite, and kaolin. The epidote is usually in small clear aggregates entirely free from chlorite, when the change from the feldspar appears to be a direct one.

The chlorite ordinarily gives lively violet and purple colors in the polarized light.

Large areas of magnetite or titanite iron, having biotite associated with it are found as in 6500.

Unaltered pyroxene is abundant in large areas, most of it having the 87° angle cleavages, while often ^{over} these the diallage cleavage is ^{also} found. Much of the pyroxene has altered to chlorite and amphibole. The varieties of the latter mineral are the same as in 6500 although none of them are so plentiful.

6510

Altered Diorite.

Slide 1190.

C. A. Van Hise, May 31. 1884.

Mainland

Macroscopic Description.S. side of E
point of
Bruce Mine
Bay.A medium grained, massive, mottled
black and white rock.Microscopic Description.The plagioclase is largely altered to
epidote, chlorite, or kaolin or replaced by
saturating quartz.Titanic iron and its decomposition
product leucoxene, associated with biotite,
are abundant.Actinolite, green hornblende, and
brown hornblende and uralitic looking
hornblende are all found in rather
small quantities, the major part of the
amphibole having altered to chlorite.Although this rock is so badly
altered and ought by the ordinary
rules of nomenclature to be called a
diorite it is in every essential particular
what 6500 and 6508 would be if altera-
tion had proceeded farther and there
seems but little doubt that it was
originally a diabase or gabbro.

6511.Altered Diorite.

Slide 1427

C. P. Van Hise May 31. 1884.

Eagle Pt.

Macroscopic Description.

near Bruce

Mines

A coarse grained, massive, black rock, cut by veins and nests of zeolite and calcite.

Microscopic Description.

The greater portion of the large plagioclase individuals are largely altered into aggregates of chlorite and gray zeolite with some epidote. They include numerous long large crystals of apatite.

Pitamic iron and leucoxene in large areas are present.

The amphibole is of the varieties mentioned in 6500, 6508 and 6510. It has largely as in those altered to chlorite.

6512

slide 14 & 21.

Eagle Pt.
near Bruce
Mines.Altered Diorite.

C. R. Van Hise May 31. 1884.

Macroscopic Description.

The rock is like 6510.

Microscopic Description.The section is like that of 6510 except that little or no saturating quartz is found.

6515

Slide 1193.

Eagle Pt.

near Bruce

Mines.

Much Altered Porphyritic Diorite.

C. P. Van Hise, June 2. 1884.

Macroscopic Description.

A fine grained, massive dark greenish gray rock, containing numerous grains of pyrite and showing porphyritic feldspars.

Microscopic Description.

The plagioclase has largely altered to zeolite, kaolin and chlorite.

All the titanic iron has decomposed leaving leucoxene behind.

The amphibole remaining is of the variety actinolite, but nearly all of it has changed to chlorite.

Calcite occurs in small specks scattered throughout the section.

About one-half of the bulk of the rock is composed of tolerable sized grains of the above materials, while the remaining half is made up of the same constituents in very fine grains. It is then a basic porphyry.

6517

Slide 1423.

Eagle Pt.
near Buca
Mexico.Altered Diorite.

C. P. Van Hise, June 3. 1884.

Macroscopic Description.

The rock is exactly like 6512.

Microscopic Description.

The section differs in no particular from that of 6512.

6518.

Much-Altered Porphyritic Diorite.

Slide 1193.

C. R. Van Hise, June 3/84.

Macroscopic Description.West end of
islet off
Eagle Pt.

near Bruce

Mines.

The rock is like 6515 except that the porphyritic character is not so marked, and pyrite is absent.

Microscopic Description.

The section is essentially like 6515. The only points of note are that the proportion of porphyritic material is greater in 6515. The plagioclase in its alteration has produced, besides the minerals mentioned in 6515 quite abundant epidote.

By reference to map note book 4, p. 35 it will be seen that 6515 and 6518 are at the edge of dykes, very close to the quartzites, while 6512 and 6517 are in the middles of dykes. The only difference between the two sets is that those close to the quartzites have taken a porphyritic appearance while those in the middles of the dykes show nothing of the kind. Apparently a rapid cooling tends in some cases to give a rock a porphyritic character.

It is also noticeable that none of these rocks contain saturating quartz. They are near to or in contact with quartzites and much decomposed — conditions very favorable as one would suppose for this replacement. Many basic rocks less decomposed and not in proximity to any quartzose rock frequently have the feldspars largely replaced by quartz.

6521

S. 1198

Altered Porphyritic Diorite

C. A. Van Hise, June 5. 1884.

Macroscopic Description.Dike on
islet offExcept that 6521 contains no pyrite
it is precisely like 6515

Eagle Point

near Bruce

Mines.

Microscopic Description.

The section is essentially like that of 6515. The porphyritic crystals have mainly been feldspar but now they are entirely decomposed the resultant products being brightly polarizing zeolite, kaolin, epidote, and chlorite.

7562Tremolitic Schist.

C. R. Van Stise, Sept. 29, 1884

Sec. 19

Macroscopic Description.

T. 47

A fine-grained, dark gray strongly schistose rock.

R. 46 N.

Mich.

675 steps S.

Microscopic Description.

675 " E

The schist has a strong fragmental appearance of N. N. corance. The minerals quartz and tremolite compose the larger part of the rock, although orthoclase and magnetite are present in some quantity. The tremolite is in small blades which sometimes show a faint green color and feeble dichroism. The orthoclase is somewhat kaolinized. The grains are oval or roundish. The quartz also occurs in grains which are very regularly outlined and the quartz and orthoclase grains, while fitting closely, do not deeply interlock. In several places, with a moderately high power, grains of quartz were seen which appear to be enlarged, although the division lines are not frequent and continuous enough to make this certain.

7563.Hornblende Schist.

C. R. Van Hise. Sept. 29. 1884

575 steps E.

Macroscopic Description.

N. W. cor.

Sec. 19

T. 47

R. 46 W.

Mich.

This rock differs but little from 7562, the chief difference being that the former is finer grained.

Microscopic Description.

The mineral constituents are seen to be the same as those which make up 7562. The proportions are different from it in that the orthoclase is as abundant as the quartz and very little magnetite is contained. The rock has the same general fragmental appearance presented by 7562. In quite a number of places there are indications of the enlargements of quartzes and also orthoclases, but the division lines are not sufficiently clear and continuous to prove this decisively. Quite a number of doubly terminated quartz crystals are found, while many grains of this mineral have one or more crystalline faces.

7529Biotite Schist.

C. R. Van Stise, Sept. 29. 1884

Macroscopic Description.

300 steps N.
 of E. $\frac{1}{4}$ post
 Sec. 18
 T. 47
 R. 45 N.
 Mich.

Fine grained, light gray, highly schistose rock having a sheeny lustre upon the freshly broken surface.

Microscopic Description.

The rock is seen to be a typical mica schist the ground-mass being composed of quartz and orthoclase in which numerous brown flakes of biotite are present.

7519

Chloritic Schist.C. R. Van Hise, Sept. 30th. 1884.

545 steps S.

Macroscopic Description.

25 " N. The rock is an excessively fine grained,
 of N.C. cor. highly schistose, greenish gray colored rock,
 Sec. 16 containing numerous small grains of pyrite.
 T. 47.

R. 45 N.
 Mich.

Microscopic Description.

The fine mass of the rock appears to consist mainly of quartz, chlorite, and sericite or some other hydromica with perhaps some kaolin. It is also possible that some of the small grains which are taken for quartz may be fresh orthoclase. In this fine ground mass are scattered sparse grains of considerable size of quartz, orthoclase, and plagioclase. The presence of these large roundish grains is taken by Sorby in mica schists to indicate a fragmental origin of the rock, or, at least, he states the belief that such large grains must have been fragments unaffected by subsequent alterations of the rock, or, if affected, at least not sufficiently so as to entirely obliterate their original exteriors.

7520

Chloritic Hornblende Schist.C. R. Van Hise, Sept. 30th, 1884.

750 steps

Macroscopic Description.

of E. 1/4 part

A rather fine grained dark greenish gray schistose rock.

Sec. 16

T. 47

R. 45 N.

Microscopic Description.

Mich.

The rock is seen to be composed of quartz, orthoclase, plagioclase, hornblende, and chlorite with some calcite, titanite, iron, and epidote. The feldspar is very fresh and the whole section shows all the minerals sharply defined with none of the mussy appearance characteristic of a highly altered eruptive greenstone. Yet the minerals of the rock interlock rather intricately, showing no trace of fragmental origin.

7633Biotite Schist.

C. R. Van Hise, Sept. 30. 1884.

500 steps N.
of W.C. cor.
Sec. 28Macroscopic Description.

A highly schistose rock very much like 7529.

P.T. 47

Microscopic Description.

R. 45 N.

The rock is, like 7529, a typical mica
Mich. schist. As in it the minerals, biotite, quartz,
and orthoclase compose the mass of the rock.
The grains of the two latter while closely fitting
never deeply interlock. The grains of both of
them are roundish or oblong. Quite a number
of quartz grains were found which are believ-
ed to have narrow enlargements.

7634Hornblende Schist.C. R. Van Hise, Sept. 30th. 1884.

35 steps S.

Macroscopic Description.

of N. E. cor.

Sec. 28

T. 47

R. 45 W.

Mich.

The rock very closely resembles 7633, except that grains of black hornblende and glittering specks of pyrite are seen.

Microscopic Description.

The rock is found to be quite different from 7633. In place of biotite we have abundant green hornblende and pyrite in numerous grains; and the ground mass instead of consisting of clearly defined roundish grains of quartz and orthoclase has the two minerals jumbled together somewhat confusedly. Chlorite, magnetic iron, and numerous grains of kaolin or some hydro-mica are contained. While the rock may be fragmental little trace of such an origin is now discoverable.

7636.Hornblende Schist.

C. R. Van Hise, Oct. 1. 1884.

135 steps N.

Macroscopic Description.

80 " E

The rock differs from 7634 only in being of S.W. cor. finer grained.

Sec. 22

T. 47

Microscopic Description.

R. 45 N.

Mich.

The section of the rock is composed mainly of hornblende, quartz, feldspar, and clayey material. The hornblende is in grains of varying sizes, the larger ones being concentrated along planes at irregular intervals. However, the large and small grains of hornblende (the latter being scattered uniformly through the matrix) have their greatest lengths in a common direction. The orthoclase is not fresh. Both it and the quartz in many places have a fragmental look. In the ground-mass of quartz and feldspar there is much clayey material, which is taken to be iron oxide, kaolin, with perhaps hydro-micas.

7637

Hornblende Schist.C. R. Van Hise, ^{Oct. 1}~~April 22~~. 1884.

1500 steps N.

75 . E.

of St. cor.

Sec. 22

T. 47

R. 45 N.

Mich.

Macroscopic Description.

The rock is dark gray to black and rather massive although a schistose structure is plainly perceptible.

Microscopic Description.

While the section is highly hornblende, the individuals do not have their cleavages in a common direction and hence the slide does not present the appearance of a schist. The hornblende is in quite large individuals, some of them being of the yellow variety with cleavages in two directions. This mineral composes one-third of the rock. The larger part of the remainder is composed of somewhat decomposed orthoclase. Mingled with this chlorite is some quartz, kaolin, and magnetite. The section does not have the slightest clastic appearance. In fact, from the section alone, one would be inclined to call the rock a syenite.

7498.

Hornblende Schist.

O. R. Van Hise, Oct. 1. 1884.

925 steps S.

Macroscopic Description.

of 7th cor.

Sec. 23

T. 47

R. 45 N.

Mich.

The rock is a rather coarse-grained, almost gneissic looking, dark-colored hornblende schist.

Microscopic Description.

The hornblendes show but traces of a schistose plane. Chlorite is quite plentiful. The ground-mass is mainly quartz and orthoclase the latter mostly somewhat decomposed, the former, at times, in very fine and close fitting grains. There is little or no fragmental appearance.

7500 Amphibolitic Chlorite Schist or Alt. Greenstone.

C. R. Van Hise, Oct. 1. 1884.

330 steps S.

of E. 1/4 post

Sec. 23

T. 47

R. 45 W.

Mich.

Macroscopic Description.

The rock is grayish green and somewhat massive looking, although something of a schistose structure is seen.

Microscopic Description

The schist looks like a highly altered greenstone, being composed largely of decomposed feldspars, chlorite, hornblendes, and radial fibrous actinolite. Titanic iron, its decomposition product leucoxene, quartz and epidote are all sparsely found.

7490

Chlorite Schist.C. K. Van Hise, Apr. Oct. 1st. 1884.

600 steps N.

Macroscopic Description.

of SW. cor.

Sec. 18

T. 47

R. 44 W.

Mich.

An exceedingly fine grained, light green schist including large grains of calcite

Microscopic Description.

The rock is seen to be very fine grained and is composed mainly of chlorite, very fine grained quartz, and perhaps feldspar. Ragged areas of leucoxene are seen and calcite grains are scattered irregularly through the section.

7488Epidotic Chlorite Schist

C. R. Van Hise, Oct. 1. 1884.

435 steps S.

Macroscopic Description.

75 " W. A fine grained, dark green, massive looking
of W. 1/4 part rock.

Sec. 20

T. 47

R. 44 W.

Mich.

Microscopic Description.

The section is seen to be composed of a confused mass of fine individuals of decomposed feldspar, chlorite, epidote, titanic iron, leucosene, and quartz. The rock might be either a highly altered eruptive or of fragmental origin.

7489

Epidotic Chlorite Schist.

C. R. Van Nise, Oct. 1. 1884.

100 steps N.

Macroscopic Description.

of N. 1/4 post

Sec. 29

The rock is of a grayish green color, very fine grained, and highly schistose.

T. 47

R. 44 N.

Mich.

Microscopic Description.

A confused mass of epidote, chlorite, feldspar, and its decomposition product kaolin, quartz, titanic iron, and leucoxene make up the rock. The feldspar is in part orthoclase in part plagioclase. The individuals are at times quite large, giving the section a porphyritic appearance, although commonly they are quite small. The quartz is commonly concentrated in finely complex areas of considerable size excluding other minerals. The epidote is often so related to the chlorite as to prove that it has resulted from alteration of that mineral. The two together at times make up large areas. One would conclude from the section that the rock is a highly altered eruptive.

747H.Calcareous Schist.

C. R. Van Hise, Oct. 2, 1884.

660 steps N.

Macroscopic Description.

75 " N.

The rock is very finely schistose, of a dark greenish gray color, and having a sub-conchoidal fracture.

J. 47

R. 44 N.

Microscopic Description.

Mich.

The section is seen to be made up of an intimate mixture of excessively fine quartz, calcite, chlorite, ~~and perhaps~~ iron oxide, and perhaps kaolin and other clayey materials.

7651.Chloritic Mica Schist.

C. R. Van Hise, Oct. 2, 1884.

880 steps E.

Macroscopic Description.

of SW. cor.

Light gray, finely schistose rock.

Sec. 34

T. 47

Microscopic Description.

R. 44 W.

Mich.

The rock is seen to be composed of a matrix of quartz and feldspar in which is buried much fine grained biotite with chlorite in some quantity. The matrix is less fragmental looking than any of the typical mica schists heretofore described. In one place in the section a vein cuts it which is composed of large deeply interlocking grains of quartz.

7652

Biotitic Hornblende Schist

C. R. Van Hise, Oct. 3. 1884.

100 steps N.

Macroscopic Description.

of S. E. cor.

A coarsely schistose, gray to black rock.

Sec. 34

T. 47

Microscopic Description.

Q. 44 N.

Mich.

The thin section shows the rock to be a typical hornblende schist. Quartz and fresh orthoclase with little plagioclase compose the rather sparse ground mass. Green hornblende individuals with their axes commonly lying in the same direction make up a good portion of the rock. Biotite is quite abundant. Also plentiful black grains surrounded by peculiar looking crystalline aggregates are plentiful. These are taken to be titanic iron and leucoxene; but the gray aggregates, which are evidently a decomposition or alteration product of the black grains, in part at least, give unusually bright colors in polarized light for leucoxene. Apatite crystals are plentiful. While no decisive proof of enlargement or fragmental origin is found, yet the inclusions in the quartz are found upon their outer margins as if they had been caught in by the depositing silica. These inclusions are mainly small hornblende individuals.

7655Epidotic Hornblende Schist

C. R. Van Hise, Oct. 3. 1884.

200 steps E.

of St. cor.

Sec. 35

T. 47

R. 44 W.

Mich.

Macroscopic Description.

This rock differs from 7652 only in being finer grained.

Microscopic Description.

The rather sparse ground mass of quartz and orthoclase interlocks quite intricately. If of fragmental origin no trace is now left of its original condition. The hornblende is as in 7652 only it is finer grained. A few small crystals of magnetite are present. Epidote is found in scattering grains, and also in veins. Titanic iron with gray material about it is seen as in 7652.

7656

Hornblende Schist.

G. R. Van Hise, Oct. 3. 1884.

58 steps. E

Macroscopic Description.

of S. 1/4 post

Sec. 35

T. 47

R. 44 W.

A fine grained, strongly schistose, black rock. The rock is a typical fine-grained, hornblende schist.

Microscopic Description.

The section is made up of fine green hornblende, quartz, and orthoclase, the former mineral being very abundant. A little epidote and some calcite are present. The rock appears to be thoroughly crystalline. Black grains are present with leucoxene surrounding them as in 7652 and 7655.

7657Epidotic Hornblende Schist.

C. R. Van Hise, Oct. 4, 1884.

290 steps S.

Macroscopic Description.of N. $\frac{1}{4}$ foot

Sec. 2

T. 46

R. 44 N.

Michs.

This rock is coarser grained than 7655 and of a somewhat lighter color. Otherwise it is like it.

Microscopic Description.

This rock differs from 7655 only in being slightly coarser grained.

7658

Chloritic Hornblende Schist

C. R. Van Hise, Oct. 4, 1884.

800 steps S.

of N. 1/4 part

Sec. 7

T. 46

R. 44 W.

Mich.

Macroscopic Description.

The rock differs from 7656 only in being coarser grained and in being of a grayish green color instead of black.

Microscopic Description.

The rock differs from the previous typical hornblende schists described in but few details. The hornblende is more abundant, and some few individuals are much larger than their fellows. A portion of this mineral has altered to chlorite. Upon account of ^{the great amount} of hornblende, quartz, and orthoclase are somewhat sparse.

7661

Epidotic Hornblende Schist

C. R. Van Hise, Oct. 4, 1884.

500 steps E.

Macroscopic Description.

of S. 1/4 post

Sec. 35

A light gray colored, compact, schistose rock with sub-conchoidal fracture.

T. 47

R. 44 W.

Michr.

Microscopic Description.

This rock differs from the others just described in that quartz and orthoclase are more plentiful and in the consequent decrease of the amount of hornblende. Titanic iron, leucoxene, and epidote are found as in the schists heretofore described.

7659

Epidotic Chlorite Schist.

C. R. Van Hise, Oct. 4, 1884.

Macroscopic Description.

500 steps E.

1380 " N.

of S.W. cor.

Sec. 1

T. 46

R. 44 N.

Mich.

This rock is of a light gray color, having the general appearance of a fine gray quartz schist. It is everywhere more or less stained with green epidote. Quite numerous small grains of pyrite are scattered uniformly through the rock.

Microscopic Description.

The rock is now composed of an intimate mixture of quartz, orthoclase, and its decomposition products chlorite and epidote with a little hornblende. The quartz is not different in its occurrence from that in the previous rock. The orthoclase is badly decomposed the resultant products being chlorite, kaolin, and epidote. If the rock has originally been hornblende most of that mineral too has changed, the first product doubtless being chlorite, and by the alteration of that mineral epidote has resulted.

7429

Epidotic Chlorite Gneiss.

C. R. Van Hise, Oct. 6. 1884.

660 steps S.

of N.E. cor.

Sec. 31

T. 47

R. 43 N.

Mich.

Macroscopic Description.

The rock is a compact, light gray colored, regularly banded, fine grained gneiss.

Microscopic Description.

The rather fine grained ground-mass is composed chiefly of quartz although orthoclase is present. Pale green non-polarizing chlorite is quite abundant. Epidote, too, is very plentifully scattered everywhere through the section both in small and large grains. The rock has a completely crystalline appearance.

7431.

Syrinitiferous Epidotic Chlorite Schist

C. R. Van Hise, Oct. 6. 1884.

840 steps S.

Macroscopic Description.

of N.E. cor.

Sec. 31

T. 47

R. 43 N.

Mich.

The rock is a dark green and finely schistose one in which are seen numerous glittering flakes of pyrite.

Microscopic Description.

The ground-mass is composed of orthoclase and quartz as in the schists previously described. However, the former mineral is comparatively abundant and much kaolinized. The green non-polarizing chlorite seems to be concentrated in the interstices of the quartz and orthoclase grains and may be largely a result of the alteration of the feldspars. Epidote and pyrite are plentiful. The latter is often altered upon its outer border to hematite or limonite. The arrangement of the chlorite about the feldspar grains is the only thing which suggests a fragmental origin.

7422

Chlorite Schist.C. R. Van Hise, Oct. 6th. 1884.Macroscopic Description.

1040 steps. J.

230 " E.

The rock is dark green, finely schistose, of N. $\frac{1}{4}$ Portland, when broken parallel to the structure, Sec. 29 gives a sheeny surface.

T. 47

R. 43 N.

Mich.

Microscopic Description.

The fine ground-mass is seen in the thin section to be mainly composed of quartz, although orthoclase appears to be present in small quantity. These quartz grains are all roundish and usually are not interlocking and, very frequently, are not in contact at all. Their interspaces are filled with chlorite, epidote, kaolin, titanic iron, ^{in small grains} with leucosene about them. The chlorite, epidote and titanic iron are found in the larger interstices, while the flakes of kaolin are everywhere present in great numbers close to a between the quartz grains.

The rock thus has a decided fragmental appearance seems to represent the true origin of the rock; for several quartz grains were found in which enlargements have, without much doubt, taken place. The idea of the enlargements of the quartz grains is further favored by the fact of the inclusion in the outer border of many grains and flakes of kaolin.

7425

Hornblende Schist.

C. R. Van Hise, Oct. 11. 1884.

Macroscopic Description.

1525 steps S.

190 " N.

of N. 1/4 post schistose, dark green ones.

Sec. 29

T. 47

R. 43 N.

Mich.

Microscopic Description

The thin section shows the ground mass to be composed of small grains of quartz and much kaolinized feldspar. In this ground mass are abundant green hornblende individuals and numerous small roundish grains of titanic iron, which are ordinarily surrounded by leucoxene. The secondary minerals, chlorite and epidote, are quite plentiful.

7421

Altered Greenstone.

C. R. Van Hise, Oct. 11. 1884.

125 steps S.

Macroscopic Description.

400 " E.

The rock is very fine grained, massive, and of N. 1/4 part of a greenish black color.

Sec. 29

T. 47

Microscopic Description.

R. 43 N.

Mich.

In the section the rock is seen to be composed chiefly of a confused mixture of badly altered feldspar, chlorite, and epidote. Scattered through this mixture are grains of titanic iron, and leucosene in their ordinary characteristic relative positions.

7410

Biotite ~~Gneiss~~ Schist.

C. R. Van Hise, Oct. 11, 1884.

Macroscopic Description.

The rock is a light gray, medium grained, typical mica schist.

Microscopic Description.

The rock consists of numerous flakes of biotite buried in a ground mass of quartz and orthoclase; the former being much the more plentiful. The larger number of the individuals of these minerals are of medium and rather uniform size. However, there is present quite a large quantity of fine-grained, interlocking quartz which has helped to fill the interstices of the larger grains. This quartz is believed to be secondary. The larger grains of quartz never interlock intricately, and in quite numerous ones unmistakable ~~are~~ proofs of enlargements are seen. Epidote and hornblende are the two important accessories. It would seem that there is little doubt but this is a clastic rock.

600 steps S.

of N. 1/4 port

Sec. 28

T. 47

R. 43 N.

Mich.

7674.

Chloritic Biotite Schist.

C. R. Van Kise, Oct. 11. 1884.

250 steps N.

10 " W.

of S.E. cor.

Sec. 29

T. 47

R. 43 W.

Mich.

Macroscopic Description.

The rock is a black, medium grained, typical mica schist.

Microscopic Descriptions.

In the thin section the ground mass is composed chiefly of rather small grains of quartz mingled with a considerable quantity of orthoclase. The grains of quartz interlock at times somewhat deeply and are always closely fitting. There is no fine interstitial quartz as in 7410. The biotite and chlorite are both abundant the latter evidently being in part an alteration product of the former. Titanic iron and epidote are present in small quantities.

Indications of quartz enlargements were found in several grains but they are not so decisive as to prove this supposition beyond doubt.

7403

Chlorite Schist.

C. R. Van Hise, Oct. 11. 1884

50 steps N.

Macroscopic Description.

of S. 1/4 post)

The rock is dark green in color and so
finely laminated as to appear almost aph-

T. 47 anitic.

R. 43 N.

Mich.

Microscopic Description.

In the thin section, quartz in roundish grains is seen to be the most plentiful constituent. The grains are of quite uniform size and rarely interlock. Ordinarily they are in contact with each other only at one or two points and very frequently grains are entirely isolated from other grains of quartz. The interspaces are largely filled with chlorite although kaolin is abundant here also. Oxide of iron is scattered about in these interstices.

While no other proof of quartz enlargements is found than a fading away of numerous grains into the matrix, it is believed that the rock is fragmental.

One large grain of tourmaline, including patches of chlorite and small quartz grains and having detached areas which are all parts of a single individual, is contained.

7404

Epidotic Chlorite Schist

C. R. Van Hise, Oct. 11. 1884.

10 steps N.

of S. 1/4 post

Sec. 21

T. 47

R. 43 N.

Mich.

Macroscopic Description.

This rock differs from 7403 only in being of a gray instead of a dark green color.

Microscopic Description.

In the thin section quartz is found in about the same way as in 7403. However, the interspaces here seem to be largely filled with ^{badly} decomposed feldspar. In addition to the minerals mentioned as filling substances in 7403, epidote and titanic iron, with its decomposition product, leucoxene, are found in quantity.

It is possible that this rock might originally have been chiefly a quartz-orthoclase rock, and that the latter mineral fitted the ^{small} quartzes perfectly entirely filling the spaces between the quartz grains. In the decomposition of the rock the feldspar may have furnished the materials for the formation of the chlorite, epidote, kaolin, etc. As the decomposition went on the quartz grains might slightly enlarge and include some of the matrix now composed of mineral aggregates. Thus might it not be possible for a completely crystalline rock, especially if it were fine-grained (as in such rocks the minerals rarely interlock deeply) by decomposition and subsequent enlargements of quartz grains to take on a fragmental appearance?

7381.

Hornblende Schist.

C. R. Van Hise, Oct. 11. 1884.

400 steps N.

Macroscopic Description.

135 " S.

A black, medium-grained hornblende of N.E. cor schist.

Sec. 28

T. 47

Microscopic Description.

R. 43 N.

Mich. The ground mass which composes almost one-half of the mass of the rock is made up almost entirely of somewhat kaolinized orthoclase. Through the orthoclase are sparsely scattered grains of quartz. Brownish green hornblende in medium sized flakes composes the major part of the other half of the rock. Magnetic or titanic iron is the only important accessory. A little epidote is present.

7362

Quartzite.

C. R. Van Hise, Oct. 16. 1884.

Macroscopic Description.

580 steps N.

35 " S.

of N.E. cor. quartzite.

Sec. 23

T. 47

Microscopic Description

R. 43 N.

Mich.

In the thin section the rock is mainly composed of rounded grains of quartz of medium size, mingled with less numerous grains of feldspar of the same shape and size set in a fine ground mass composed chiefly of minute interlocking quartz grains. The feldspar comprises the three species orthoclase, oligoclase, and microcline. Oftentimes the individuals are very fresh while others are quite badly altered, the decomposition products being kaolin and chlorite. The large grains of quartz are often distinctly enlarged, and quite frequently they merge gradually into the matrix, this being due to their manner of second growth. Besides the medium sized grains of quartz and feldspar areas of some size composed of chlorite or chlorite and ferrite are present. Such areas may have resulted from the alteration of flakes of biotite. Again a few quite large rounded areas composed of interlocking grains of quartz, feldspar, and sometimes chlorite are found. These are taken to be complex, non-clastic fragments, probably of a granitic origin. The abundant cementing material, composed chiefly if not wholly of interlocking grains of fine quartz, composes fully one-third of the mass of the rock. Calcite is found in small quantity.

7363.

Coarse Greywacke.

C. R. Van Hise, Oct. 16. 1884.

580 steps N.

Macroscopic Description.

35 " S. The rock is of a medium grain and of a
 of N.E. cor. mottled pink and gray color which in every
 Sec. 23 way resembles a massive granite.

T. 47

R. 43 N.

Microscopic Description.

Mich.

Quartz, orthoclase, microcline and oligoclase occur in clastic grains exactly as described in 7362 except that they are here of a larger size. A few areas of green strongly dichroic biotite are also present. The thin section, however, differs from that of 7362 in several important respects. First, the rounded complex areas of granitic fragments are both much larger and more numerous, clearly showing the sources from which the material for the decomposed rock is drawn. Again the cementing material instead of being wholly quartz is fully half calcite. The individuals of this mineral are quite large and closely interlocking. A portion of the calcite too is a replacing rather than a cementing material as grains of feldspar are found which are penetrated through and through with calcite, the numerous areas of which, for a single grain of feldspar, are all parts of one individual just as the different areas of quartz when replacing a feldspar grain are all parts of a single individual.

Are these phenomena due to the fact that all of these disconnected areas, as seen in the thin section, are connected in fact, or is it possible that the feldspars control the directions of the optic axes in the replacing minerals and when the disconnected areas come together they are in accord? Quartz enlargements while less numerous and wide than in 7362 are, nevertheless, unmistakably present.

7364.

Conglomerate.

C. R. Van Hise, Oct. 16. 1884.

Macroscopic Description.

590 steps N.
45 " S.
N.E. cor.
Sec. 23
T. 47
Q. 43 N.
Mich.

The matrix of the rock is exactly like the mass of 7363 except that the former is more coarsely granular i. e. it resembles a medium grained granite. In this ground mass are large rounded granite pebbles.

Microscopic Description.

Upon a close examination one plainly sees that the rock is a re composed one. But the granite fragments which make up the rock are so large and closely packed together that one, at the first look, might mistake the rock for a massive granite. However, the rounded appearance of the complex quartz-feldspar-chlorite fragments, the presence of a few individual rounded grains of quartz and feldspar and of a sparse matrix show the clastic origin of the rock. Many of the feldspar grains are broken or distorted. ^{the latter phenomenon being beautifully shown} The section is the finest I have seen for distortions in triclinic feldspars. This has perhaps taken place when the fragments were broken down from the original non-clastic rock or it is possible that it may be caused by pressure applied after the grains were deposited in the re composed rock.

The matrix consists of finely interlocking quartz, kaolin, ferrite, ^{some carbonates} calcite, and some chlorite. One large area of chlorite is found, which looks as if it might have resulted from a very large flake of biotite, which mineral it closely resembles in some places and indeed it probably here is only partly altered.

7365

Biotitic Hornblende Gneiss.

C. R. Van Hise, Oct. 17, 1884

Macroscopic Description.

600 steps N.

135 " E

of N. E. cor.

Sec. 23

T. 47

R. 43 N.

Mich.

The rock is medium grained, strongly schistose and is apparently chiefly composed of black hornblende and flesh-colored feldspar.

Microscopic Description.

The ground mass is composed largely of partly kaolinized orthoclase. This mineral is mingled with a little plagioclase and considerable quartz. Green hornblende is the mineral next in abundance to the orthoclase. Biotite in large flakes is plentiful. Calcite and epidote are present in small quantity.

7367.Slate.

C. R. Van Hise. Oct. 17. 1884.

Macroscopic Description.

640 steps N.

157 " S.

of No. cor.

Sec. 23

T. 47

R. 43 N.

Mich.

The rock is a dark gray aphanitic slate, containing numerous segregations of ferrite which give it a mottled appearance.

Microscopic Description.

The thin section is mainly composed of abundant green flakes of chlorite, of plagioclase badly decomposed, of kaolin, and of ferrite with a little quartz. The yellow areas, as seen microscopically, appear to consist of limonite mingled with other minerals.

7358.

Greywacke Slate.

C. R. Van Hise, Oct. 17, 1884.

370 steps N.

of S. 1/4 post

Sec. 13

T. 47

R. 42 W.

Mich.

Macroscopic Description.

A fine grained, black, almost massive rock, having a subconchoidal fracture.

Microscopic Description.

The section is composed of rounded grains of quartz and feldspar of some size set in an exceedingly fine ^{grained} matrix.

While the worn grains show an unmistakable clastic origin, none of them, so far as observed, were found to be enlarged. The feldspar grains are much more plentiful than those of quartz; they are usually quite fresh, and comprise the species orthoclase and plagioclase, the latter including microcline.

The fine ground mass is composed of quartz, chlorite, kaolin, pyrite and ~~perhaps~~ probably feldspar and clayey material.

7368 Calcareous Quartzite or Quartzitic Limestone.
C. R. Van Hise, Oct. 18. 1884.

40 steps N.

Macroscopic Description.

14 " E The rock is massive, gray-colored, rather
of S.W. cor. fine grained and has the general appear-
Sec. 14 ance of a quartzite.

T. 47

R. 43 N.

Microscopic Description.

Mich.

The thin section is composed mainly of quartz and calcite in about equal proportions. The quartz grains are all rounded and much the larger proportion of them are simple, but many are finely complex. These latter are evidently derived from some "jaspery" or flinty rock. None of them, so far as observed, show enlargements. Calcite has been the cementing material and interlocking grains of this mineral everywhere fill the spaces left unoccupied by the quartz.

A few grains of orthoclase and plagioclase are with the quartz set in this calcite magma. The calcite is everywhere stained with numerous minute specks of ferrite.

7370Flint

C. R. Van Hise, Oct. 18. 1884.

Sec. 14

Macroscopic Description.

T. 47

R. 43 N.

Mich.

The rock is a light gray to smoke colored one, aphanitic in texture, and is traversed by alternating bands with different degrees of translucency.

Microscopic Description.

The rock is made up of exceedingly fine interlocking grains of quartz, mingled with a little ferrite. Evidently the rock is a non-clastic one. The rounded complex grains of quartz found in the clastic rocks 7368 and 7369 are precisely like the mass of this rock, and this is their probable source.

7371.Hornstone.

C. R. Van Hise. Oct. 18. 1884.

Sec. 14

Macroscopic Description.

T. 47

R. 437. The rock is of a smoky gray color, the mass of it aphanitic, and is traversed by Mich. veins of rather coarsely crystalline quartz and galena.

Microscopic Description.

The mass of the rock is composed of finely crystalline interlocking grains of quartz mingled with a little ferrite, just as in 7370. However, this material is cut by veins of coarsely crystalline quartz, which, like the mass, is stained with ferrite. All of the quartz is plainly non-fragmental.

7372Magnetitic Schist

C. R. Van Hise, Oct. 18. 1884.

Sec. 14

T. 47

R. 43 N.

Michr.

Macroscopic Description.

The rock is dark green in color, finely schistose, and is cut by veins of quartz.

Microscopic Description.

The thin section is composed mainly of a confused mass of very fine grains of magnetite mingled with small flakes of chlorite and kaolin, sericite or some other hydromicas. Within this fine mass of material, are a few grains of quartz which appear to be of fragmental origin. Cutting the above, are veins composed of coarsely crystalline interlocking quartz and calcite.

7375Chlorite Schist

C. R. Van Hise, Oct. 18. 1884

640 steps N

35 " S.

N. 1/4 foot

Sec. 14

T. 47

R. 43 N.

Mich.

Macroscopic Description.

The rock is a dark green, aphanitic, finely foliated schist.

Microscopic Description.

The thin section appears to be composed chiefly of exceedingly small flakes of chlorite mingled with a fine non-polarizing mass of material. Ferrite is mingled with these. This aggregate is separated into rounded areas by a concentration along their borders of a dull gray substance. The appearance is as if the rock had been composed of fragmental grains — perhaps of feldspar — and these grains had suffered total decomposition. However, this appearance may be due to concretionary action.

7373Magnetitic Slate.

C. R. Van Hise, Oct. 18. 1884

400 steps N.

30 " N.

of S. W. cor.

Sec. 14

T. 47

R. 43 N.

Mich.

Macroscopic Description.

The rock is a black aphannitic slate.

Microscopic Description.

The section is exceedingly fine-

grained and is composed of an intimate mixture of fine specks of magnetite, grains of quartz and probably feldspar, and flakes of kaolin and chlorite.

7376.Altered Greenstone.

C. R. Van Duse, Oct. 18. 1884.

640 steps N.

35 " S.

of S. 1/4 post ish green rock.

Sec. 14

T. 47

R. 43 N.

Mich.

Macroscopic Description.

A fine grained, massive, dark gray

Microscopic Description.

The rock is so badly altered that it is with difficulty that one can determine its nature, but it appears to be a much altered crystalline eruptive. It is now composed of a confused mixture of chlorite, partly decomposed feldspar, and leucoxene mingled with some calcite and ferrite.

7378. Magnetitic Calcareous Chlorite Schist.

C. R. Van Hise, Oct. 18. 1884.

500 steps N.

75 " N.

7 S.E. cor.

Sec. 15

T. 47

R. 43 N.

Mich.

Macroscopic Description.

A greenish black, finely schistose, aphanitic rock.

Microscopic Description.

The rock is very fine grained. Chlorite seems to be the mineral which chiefly makes up the ground mass. In this quartz and feldspar may be present, but it is difficult to say certainly as to this. In this ground mass of chlorite are quite plentiful irregular grains of magnetite, and much calcite, the latter being, doubtless, a secondary replacing product.

7379

Biotite Schist

C. R. Van Hise, Oct. 27, 1884.

480 steps N.

Macroscopic Descriptions.

1000 " S.

of N.E. cor.

Sec. 22

T. 47

R. 43 N.

Mich.

A fine grained, dark gray colored, highly schistose rock, which, when broken along the planes of lamination, shows a sheeny surface.

Microscopic Description.

The ground mass in a few places is composed of closely fitting grains of quartz and grains of somewhat kaolinized feldspar, mostly orthoclase. However, in the larger portion of the section, the feldspars have completely kaolinized, the ground mass here consisting of grains of quartz set in an aggregate of kaolin. This decomposition gives the rock a strongly fragmental appearance. Filling the spaces left by the quartz and feldspar ~~and apparently playing the same role that augite does in diabase, are~~ are numerous grains of dark brown biotite, ~~none of them have crystallized out~~ ~~lines~~. In a few places they are partly altered to chlorite. Each biotite grain includes very numerous small intersecting needles of some brilliantly polarizing mineral.

7383.

Greywacke.

C. R. Van Hise. Oct. 27. 1884.

Macroscopic Description.

A fine grained, light gray colored, massive rock.

Microscopic Description.

Fragmental grains of quartz and feldspar — the former much the more plentiful — of quite uniform size compose the larger part of the rock. These minerals are but loosely packed and the interspaces are filled by a fine matrix. The quartz grains quite often show enlargements. The feldspar is in part orthoclase and in part plagioclase, a portion of the latter being microcline. The filling material consists of finely divided quartz, of chlorite, and of kaolin. Ferrite is found in the matrix, also as stains in the feldspars.

7385

Quartzite.

C. R. Van Hise, Oct. 28. 1884.

Macroscopic Description.

A medium grained, compact, greenish gray colored, vitreous quartzite.

Microscopic Description.

Clastic grains of quartz, many of them enlarged, compose the greater mass of the rock. However, the induration is mostly produced by small interlocking interstitial quartzes. Frequently the large grains merge into this fine quartz. The section shows this merging of coarse fragmental quartz into finely divided interlocking quartz as well as any section that I have seen. Quite abundant ferrite and chlorite is found in the interstices of the fragmental quartz grains mingled with the deposited silica.

7387.Greywacke Slate.

C. R. Van Hise, Oct. 28. 1884.

230 steps N.

Macroscopic Description

150 " E.

of S.W. cor.

Sec. 21

T. 47

R. 43 N.

Mich.

A fine grained, dark gray, schistose or slaty rock, which weathers to a dull whitish yellow.

Microscopic Description.

Clastic particles of quartz, ortho-
clase and plagioclase of varying sizes, set in a fine matrix, make up the rock. The only indication of the enlargements of the quartz grains is a frequent gradual merging into the matrix. The larger grains of feldspar while sometimes kaolinized are most often very fresh. The small grains, upon the other hand are generally badly decomposed. The ground-mass is an intimate mixture of quartz, chlorite, kaolin and ferrite. This rock differs little from 7358.

7388.Clay Slate.

C.R. Van Hise, Oct. 28. 1884

Macroscopic Description.380 steps N.
20 " E
of SW. cor.
Sec. 16

A finely schistose, grayish green, aphanitic rock.

T. 47

Microscopic Description.R. 43 N.
Mich.

Many very small fragmental grains of quartz and feldspar set in an abundant fine matrix of clayey material, make up this rock. The grains of quartz fade into the matrix as described in 7387. The feldspars are, orthoclase and plagioclase, also as in 7387, and the matrix is composed of chlorite, quartz, ferrite and kaolin as in the same rock. The only points of difference between this rock and 7387 are, then, that the clastic particles of quartz and feldspar are smaller and less plentiful, the matrix being consequently much more abundant. The proportion of chlorite in the matrix of 7388 is also greater.

7389

Clay Slate.

C. R. Van Hise, Oct. 28. 1884.

84.

650 steps N.

Macroscopic Description.

50 - N.

of N.W. cor.

Sec. 16

T. 47

R. 43 N.

Minn.

The rock is a black, aphanitic, easily cleavable slate.

Microscopic Description.

In the thin section the rock appears to be composed of an excessively fine mixture of quartz, chlorite, ferrite and kaolin.

7398.Greywacke Slate.

C. R. Van Duse, Oct. 28. 1884.

Macroscopic Description.

The rock is precisely like 7387.

Microscopic Description.

In every particular the thin section is like that of 7387.

500 steps N.

of S. 1/4 p.

Sec. 16

T. 47

R. 43 N.

Mich.

6

92

Hx 92

302

