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Survey of the Pre-Cambrian rocks of the North West: record of lithological work: 3208-6556. Book I 1882/1883

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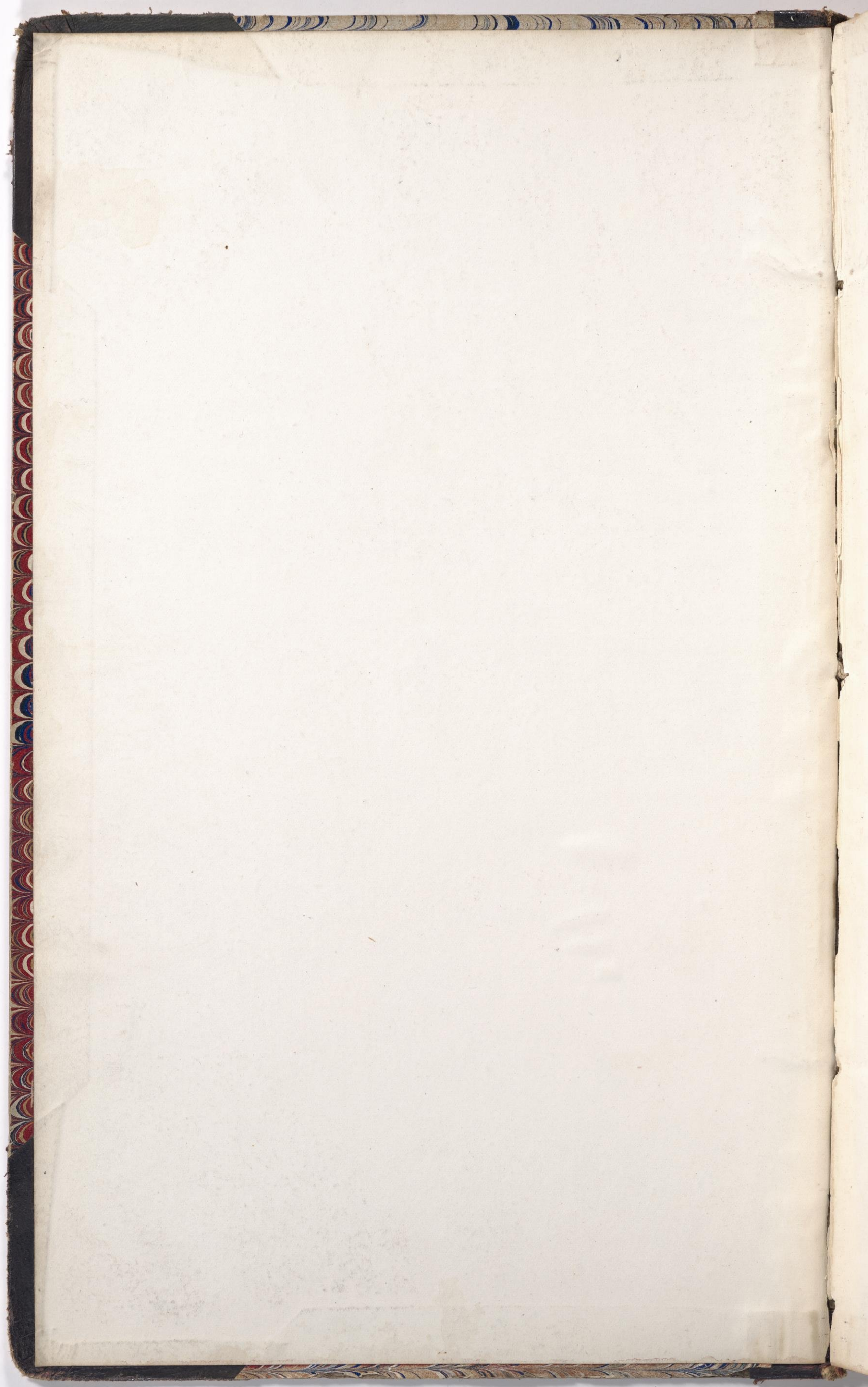
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United States Geological Survey.

Lithological Descriptions.

Book. I.



U.S. Geological Survey.

Survey of the Pre-Cambrian Rocks
of the
North West.

Record of Lithological Work.

3208

Quartzite.

Caledonia

C. R. Vanhise. 1882.

Columbia
Co., WisMacroscopic Description

= 753^{Wis} Grayish white; subconchoidal fracture; large grains of opalescent quartz (some of them being more than a fourth inch across) compose the larger part of the rock. The interstices between these grains are filled with a finely granular uniform looking mass of the same material. Upon the weathered surface the large quartz grains stand prominently out, because of the more rapid disintegration of the finer material.

Microscopic Description.

Composed mostly of large irregular, angular, often rounded grains of quartz, which most frequently come in contact with each other, at but few points, leaving spaces between them. But often these grains dovetail together in a perfect manner, as though they had formed in their present positions. Rutile is an abundant inclusion in one or two grains but is totally absent in all the others. Here and there are seen small opatite inclusions.

The interspaces are chiefly filled with a much smaller set of quartz grains, whose outlines fit each other, and the larger grains perfectly cementing the whole mass in a compact whole. Nowhere in these smaller grains is to be found rutile, and they are also much freer from cavities than the large grains. There is a wide variation in the size of each set of grains, but rarely if ever do any of the filling grains become so large as to be confused with the smallest of the larger set: this difference is so plain, as to at once suggest that the two sets were formed or placed in their present

Quartzite (con.)

position under different conditions.

Mingled with the smaller set of quartz grains is a little muscovite and ferrite.

Additional notes by R. D. Irving 1882.

Irregular, angular, jagged-edged grains, as seen in polarized light, make up the rock.

In ordinary light do not see any difference between the fine matter and the large grains.

Vanhise's description is all true. There seems to be no doubt about the muscovite.

I take it that the large grains are elastic material, coated and concealed by deposited quartz. Is this true of the fine material also?

Minute muscovite-like scales are very abundant in the fine material; these are in addition to the above larger ones.

Further study does bring out distinctly some outlines to the grains, beyond which the quartz is similarly oriented.

Macroscopically this rock is plainly conglomeratic. It appears as if of quartz pebbles or grains in a deposited, vitreous quartz matrix.

There is kaolinic matter present, so possibly the above bright scales, supposed to be muscovite, may be of this nature.

I take most of the fine material to be deposited.

3207

Gibraltar
Bluff
= 735' high
Sunny Coll.

St. Peter's Sandstone.

C. R. Vanhise. Dec. 1882.

Microscopic Description.

Everywhere where the quartz individuals interlock. The curved lines of inclusions, which separate the old rolled grains and the new deposition are present. These rows of inclusions are mostly cavities either air-filled, or partially liquid filled, and particles of iron oxide. The particles of iron oxide are usually much more numerous than the air-filled cavities, although in one crystal the latter appeared to be, as numerous, as the former. The mass of the quartz is very full of these cavities either gas or liquid, and many of those which, at first appeared to be at the line of division, are not upon it, only quite near. The line is rarely cut at right angles in the section; so that its position changes as the microscope is focused at different depths.

In one individual which polarizes uniformly and in which the line of division above spoken of is present, very numerous rutile needles were observed penetrating the original grain in every direction. Some of these run directly against the bounding ^{line} of the inner grain, but nowhere is one to be seen outside of this division line.

Additional notes by R. D. Irving.

See American
Journal of
Science
for June, 1883
p.

This section is of the very greatest interest and importance because while from the St. Peter's sandstone it yet shows all the important characters, i.e. interlocking grains of quartz, all of which have a nucleus of rolled quartz; no x line outlines; also inter-deposited quartz independent of the original grains. Figure to be made from this.

3209

Caledonia

Columbia Co.

= 755 Mts.

Surrey Coll.

Quartzite.

C. R. Vanhise. 1882.

Macroscopic Description.Light pinkish gray, uniformly granular;
sub-conchoidal.Microscopic Description.

In no particular different from 3208

Additional notes by R. D. Irving. Dec. 1882

Differs from 3208 chiefly in having elongated schist-like quartzes. For the most part no trace of original outlines of grains, but here and there one can see them faintly.

3210

Packwaukee

Marquette Co.

= 760 Wis

Survey Coll.

Potdam Sandstone.

R. D. Irving. Dec. 1882.

Macroscopic Description.Microscopic Description.

The siliceous cement here must be a mere film to the grains.

3211

B. R. Falls
 Depot.
 Jackson Co.
 = 1012 W.
 Survey Coll.

See Am.
 Journal of
 Science
 June 1883
 p. 406

Potsdam Sandstone.

3212

Lower Narrows

Sault Co.

= 1234 Wis

Sunnybell.

Quartz-Schist.

C. R. Vanhise. 1882.

Macroscopic Description.

Yellowish white; finely granular; somewhat friable; clayey odor.

Microscopic Description.

Fragmental. Composed in about equal proportions of comparatively coarse-grained, rounded fragments, and a fine confused substance; the two being everywhere mingled. The coarse grains differ from those of the sections previously described, in the following particulars: (1) Instead of quartz being the only mineral, orthoclase is present in some quantity; (2) they nowhere dovetail together, excluding the cementing material; (3) And lastly these grains are frequently not in contact with each other at all, they being held separate by the fine matrix-like material. This proves that the fine material could not as a whole have been deposited subsequent to the coarse grains. This filling substance is chiefly clayey, much the most important constituents being small grains of quartz and flakes of kaolinite. Ferrite and epidote occur.

3213

Lower Harrow

Sank Co.

= 1239215

Survey Coll.

Potsdam Sandstone.

R. D. Irving. Dec. 1882.

Macroscopic Description.

Potsdam sandstone with pebbles in it
of quartzite. Indurated; sparkling

Microscopic Description.

Two slides, one a slice - a bad one; the
other crumbled grains. The former looks
much like the Packwaukee rock; there
being no extensive interlocking. The latter
shows beautifully the clear quartz around
the grains. This shows a stage between
the crystal faceted sand, and those
cases where there is complete inter-
locking.

3215

Peck's Prairie

Sank Co. Wis.

= 1247 Wis

Sunny Coll.

Quartzite.

C. R. Vanhise 1882.

Macroscopic Description.

Dirty gray; large translucent grains of quartz buried in a finer ground mass.

Microscopic Description.

Resembles closely 3212. The most important differences are as follows: The coarse grains are all quartz and have wider variations in size, some of them being much larger than those of 3212.

The matrix-like material composes rather less than one-third the mass of the rock. Its composition is essentially the same as 3212, the only difference noted being that in one or two places the fine quartz grains exclude the kaolinite, in which cases the individuals appear to fit each other perfectly. (To be studied again with higher power.)

Additional notes by A. H. Irving Aug. 1882.

To be likened also to 3208, but it is more plainly fragmental and much more clayey. Some of the grains appear to show deposited quartz. These clayey kinds are the ones that give rise to muscovite.

3216

Beck's Prairie

Sank Co. Wis

= 1248 A

Wis. Survey
colly.Quartzite.

C. A. Vanhise. 1882.

Macroscopic Description.

Like 3215

Microscopic Description.

Same as 3215. The only additional thing noticed is the presence of larger patches, each composed of very numerous specks of a brown oxide of iron.

3217

Lower Navajo

Sank les

= 1250 Wils

Sunny Coll.

Quartz Schist

C. R. Vanhise. 1882

Macroscopic Description.

Light pinkish drab, has a soft, soapy feeling; finely laminated; emits a clayey odor.

Microscopic Description.

Composed almost entirely of a confused mass of very fine quartz grains, clayey material, and partly decomposed feldspar particles. In places are quartz areas the grains of which are sharply irregular and which dovetail together. The clayey substance is largely kaolinite; mingled with this is a considerable quantity of brown oxide of iron and a little hematite.

3218

Lower Harrow

Sank Co

= 1256711a

Surrey Coll.

Potsdam Sandstone.

R. D. Irving.

Dec. 1882

Macroscopic Description.

Much indurated, fine-grained sandstone, with quartzite pebbles. Close externally to Gibraltar Bluff rock.

Microscopic Description.

Like the Gibraltar Bluff rock, shows most beautifully both deposited quartz oriented with the original grains, and that which is not so. Here the new quartz contains numerous greyish, opaque particles. (See further with a higher power.)

3219

= 1257 M.

Survey Coll.

White Quartz.

H. R. Vanhise. 1882

Macroscopic Description.

White, in places faintly tinged with yellow; brittle; very compact; hard; of a conchoidal fracture. The rock is a typical white quartz.

Microscopic Description.

Composed almost entirely of quartz grains, which vary from very large to quite small. However the grains whether large or small join each other by perfectly fitting lines. In one or two places, small areas of the clayey substance before described, are present. Ferrite is present.

Note by R. H. Irving. Dec. 1882.

These grains interlock far more thoroughly than in the true quartzites; they even interpenetrate.

3220

Freedom

Sankb.

= 1271 Mis.

Sunnybell.

Quartzite.

C. R. Vanhise. 1882.

Macroscopic Description.

Varies in color from almost milky-white, to dark pinkish white; otherwise like 3219.

Microscopic Description.

Like 3219. The only differences noted are the presence of rutile and apatite; greater uniformity in the size of the quartz grains; and fewer inclusions of ferrite.

Note by R. L. Irving. Dec. 1882.Macroscopic Description.

Not ^{at} all like 3219 - for 3219 is white vein quartz, while this ^{is} a light-colored quartzite.

Microscopic Description.

Fine grained; highly interlocked; Study with higher power.

3221

Quartzite.

Upper Narrows

Sault Co.

= 1274 Wis

Surrey Coll.

3220.

C. A. Vanhise 1882.

Macroscopic Description.

Dark drab in color; otherwise like

Microscopic Description.

Shows distinctly a fragmental origin; The grains are usually rounded, and while they occupy most of the space, their outlines fitting quite closely, yet everywhere is material which fills up the narrow spaces between the larger grains. This filling substance is mostly fine quartz; the second mineral in importance is brown ferrite. As heretofore a little clayey substance is seen.

Notes by R. D. Irving. Dec. 1882.

Dark purple, vitreous, close granular quartzite. Above is all true, as to the filling substance, which is only rarely fine quartz, but is commonly quartz oriented with grains; a very admirable instance of this peculiarity. The original grains are often beautifully outlined with oxide of iron, and the new quartzes have the usual interlocking jagged edges. One of the most satisfactory I have yet found showing this peculiarity. The borders of the original grains are plainly made by oxide of iron.

3222

Upper Narrows

Sank Co.

= 1277 Wis

Sunny bdl.

Pink Quartzite

C. R. Vanhise 1882

Macroscopic Description.

Brownish pink; has a clayey odor; uniformly fine grain.

Microscopic Description.

Differs from 3215 only in carrying no very large quartz individuals and in containing no areas in the filling substance, composed entirely of quartz.

Note by R. D. Irving Dec. 1882.

The above is correct. These are very interesting cases because one can see here no trace of secondary quartz, and because the grains are elongated in a common direction.

3223

Ableman's

Sank Co.

= 1282 Ws

Sunny Coll.

Pink Quartzite.

C. R. Vanhise. 1882.

Macroscopic Description.

Light pink; somewhat friable; shows ~~no~~ appearance of conchoidal fracture; is more like a compact sandstone than a quartzite.

Microscopic Description.

Two thirds of the section is composed of small rounded grains. These are largely of quartz, but a good proportion of feldspar is present, this being divided among the three species, orthoclase, microcline, and oligoclase. This feldspar is often much decomposed, the outlines of the crystals being marked by iron oxide. The other third of the rock is of fine filling material, which is chiefly of interlocking grains of quartz and clayey substance and ferrite with little epidote or augite make up the remainder.

3224

Abbe's

Sank Co

= 1283 Wia

Survey Coll.

Quartzite.

C. R. Vanhise. 1882.

Macroscopic Description.

Like 3221.

Microscopic Description

Differs from 3221 only in having the quartz fragments somewhat smaller and in containing more clayey material.

Note by R. D. Irving.

Not much like 3221. The grains are elongated in a common direction and there is much fine quartz. An admirable case of transition toward the clayey rocks.

Are not the grains shored around so their longer axes run in one direction and then this elongation increased by added quartz?

A good deal nearer to 3222 than to 3221.

3225

Roche

Ecrit Bluff

Adamsko

= 1881 No

Surrey Coll

Potsdam Sandstone.

R. D. Irving. Dec. 1882.

Macroscopic Description.

Much indurated in places; dark purplish; very quartzite-like.

Microscopic Description.

Midway between the Gibraltar rock and those cases where the added quartz has crystalline faces. The quartzes are interlocked but there is not so much secondary quartz as in the Gibraltar rock.

3226

Silver Bluff
Jackson Co.

=

Potsdam Sandstone.

R. D. Irving. Dec. 1882.

Macroscopic Description.

Almost a vitreous quartzite; sugary; ringing; very hard; carries palaeozoic fossils.

Microscopic Description

Everywhere through the slice is a cementing quartz oriented with the nucleal grains; but the quantity is small. To the naked eye no fragmental appearance is presented but under microscope a pronounced one is seen. The corners are often filled with oxide of iron. The grains are much rounded. Often empty spaces are left between the grains.

Very fine grained. This has something to do with the great hardness and compactness.

The deposited quartz is very sharply outlined from original grains.

3249

= 1233 No

Jenny coll.

Quartzite.

C. R. Vanhise

1882.

Macroscopic Description.

Pale pink; shows a rather perfect conchoidal fracture with vitreous luster; very hard and brittle.

Microscopic Description.

Composed, like 3208 and 3209, chiefly of two sets of quartz grains of different sizes. It however differs from both of them in that the large set of grains in much of the section excludes the smaller set. In these areas the larger grains often fit each other to the minutest curve, while in other places there is a slight filling of the finer grains. However the relation between the two sets of grains is much the same as in 3208 and 3209. Like those before described, here and there a large grain is penetrated in every direction by rutile needles while this mineral is totally absent in the majority of them. Apatite occurs sparsely. Ferrite and muscovite occur in some quantity in small specks and flakes. A little hematite is present. In one grain unusually large cavities, filled with liquid with bubbles, were noticed.

Note by R. D. Irving. Dec. 1882.

Not so much clayey matter as 3208 and 3209 but otherwise much the same.

4069

Devils

Lake.

Wis.

Arenaceous Quartzite.

R. D. Irving. Dec. 1882.

Macroscopic Description.Microscopic Description.

Slide is crumbled sand, mounted in balsam. The facing can often be seen of secondary quartz. This is sure as compared with the nuclei. The original grains are much rounded.

None of this secondary quartz has crystalline edges. Plainly it has interfered.

4069A

Devils Lake

2 ft from 4069

Quartzite.

C. R. Vanhise.

1882

Macroscopic Description.Microscopic Description.

Same as 3207 except that no rutile needles were seen. One individual gives an unusually sharp line of division between the deposited and the nuclear quartz and the inclusions are apparently in very large part iron oxide.

4074
Devils Lake
Wis.

Arenaceous Quartzite.
R. D. Irving Dec. 1882
Macroscopic Description.

Microscopic Description.

1st Mounting — crumbled sand in balsam. Secondary quartz is very distinct; sometimes it is quite wide, always with jagged edges. The different areas must have interfered. The original grains are dirty surfaced and are ^{very} distinctly defined.

2nd Mounting — a section. Here too one can see the secondary quartz though often not so readily as in the first mounting. All the secondary quartz interferes, often with jagged interlocking edges.

4078

Devils Lake

Wis.

Quartzite

C. R. Vanhise.

1882

Macroscopic Description.Microscopic Description.

Has one individual of quartz, in which the division line between the nucleus and deposited quartz makes a complete circuit of the grain, which shows the following peculiarity. A portion of the quartz outside the line polarizes uniformly with the original kernel, but the remainder polarizes as three or four distinct individuals.

Note by R. D. Irving. 1882.

Mostly composed of very intricately interlocked coarse quartz as in vein quartz, but here and there one can see the outlines of the original grains.

4080
Devils Lake
Wis.

Quartzite.

R. D. Irving. Dec. 1882.

Macroscopic Description.

Hard; compact; light purple banded with dark purple.

Microscopic Description.

Resembles 3208. Large angular grains of quartz are imbedded in a fine matrix. Some of the bands are much colored with oxide of iron and have finer quartz than the rest. Some of the particles of interstitial quartz interpenetrate one another and hence are certainly of secondary origin. Quartz particles show a tendency to have their greatest lengths in a common direction. We can only occasionally distinguish between the quartz of the original grains and the secondary quartz which is oriented with those grains. Some clayey matter is contained.

4081

Devils Lake

Wis.

Arenaceous Quartzite.

R. D. Irving Dec. 1882.

Macroscopic Description.

A light colored, indurated sandstone which can be crumbled with the fingers.

Microscopic Description.

First mounting — crumbled sand. Clear secondary quartz facing the grains is very distinct. No crystalline outlines.

Second mounting — section. The same is true here. The section a good deal like that of the Gibraltar rock, the fragmental nature of the original rock being very pronounced, even in the polarized light. Not nearly so interlocked as the Gibraltar rock.

4081A

Devils Lake

Gra des into

4081

Quartzite.

R. D. Irving. Dec. 1882.

Macroscopic Description.

More indurated than 4081 and somewhat deeper colored.

Microscopic Description.

A step beyond 4081, the fragmental nature being much less evident especially in polarized light. In the ordinary light however the outlines of the original grains may often be more or less distinctly seen.

4081 B

Devils Lake

grades into

4081 or 4081g.

Quartzite.

R. D. Irving. Dec. 1882.

Macroscopic Description.

Complete quartzite; hard; vitreous; light purple.

Microscopic Description.

In the ordinary light the outlines of the original grains may be often quite distinctly seen; the coarser grains being embedded in a matrix of finer particles. In the polarized light much of the section shows no trace of a fragmental origin the grains being completely interlocked. There is evidence in this section that in addition to the secondary quartz that is oriented with the original grains, there is much that is not so.

4082 A

Devils Lake

Wis.

Quartzite.

C. R. Vanhise & R. D. Irving Dec. 1882.

Macroscopic Description.

Completely vitrified; dark purple.

Microscopic Description.

Contains a quartz grain in which the line of division between the original kernel and newer material is very sharp. In the older part rutile needles are quite numerous, ~~some~~ ^{several} of them being very close to the division line and one which runs directly against that line. Upon the other hand the added quartz which has a considerable area, contains no rutile. The original fragmental nature is very evident in ordinary light; on account of the large quantity of iron oxide, to which the dark color of the rock is evidently due.

4086

Devils Lake

Wis.

Quartzite.

R. D. Irving. Dec. 1882.

Macroscopic Description.

Very fine-grained, very dark gray, completely vitrified quartzite.

Microscopic Description.

There is much iron oxide which is red in reflected, black in transmitted light, and which marks very distinctly the outlines of the original grains.

4087a.
Devils Lake.

Quartzite.
F. D. Irving Dec. 1882.
Macroscopic Description.

Microscopic Description.

Section much like that of 4086. The secondary quartz is in part fine and interlocking, and in part coordinated with the original grains.

1116

St. Louis River

Minnesota

Slate.

C. A. Van Lise. Jan. 1883

Macroscopic Description.

Color dark gray to black; has a rough fracture; in an aphanitic mass are small fragments of crystals; shows a strongly marked stately cleavage. Cutting through this cleavage at an angle of about 60° , are parallel fractures upon one end of the specimen at intervals of little more than an eighth of an inch.

Microscopic Description.

Plainly of fragmental origin, scattered everywhere through a finely granular ground mass are worn fragments of quartz, orthoclase, and oligoclase. These pieces are in size from above one millimeter across to those so small as to be indistinguishable from the fine ground mass. This ground mass is composed, in part at least, of smaller fragments of the same material as the larger ones mingled with much ferrite, kaolinite, and pale-green fibrous chlorite. Sericite is present in quite numerous scales and fibres. The magnetite is mostly concentrated along certain lines.

It is possible that a part of the fine grained material crystallized in position

1129

Mission Creek

Minn.

Slate.

C. R. Vanhise Jan. 1883

Macroscopic Description.

Black; aphanitic; has a subconchoidal fracture, and well developed slaty cleavage. Like 1116 this rock shows running across the surface fine parallel lines, due to sedimentation, at intervals of less than one-eighth of an inch. Since fracture takes place along these lines, each of them represents a plane of weakness at an angle of 60° to the slaty cleavage.

Running at an angle of 80° to these lines there to be a less perfect second direction of weakness, as shown by faint lines upon the cleavage face, and by fracture.

Microscopic Description.

First section, parallel cleavage. Fragmental. Differs from 1116 in the absence of quartz in the ground mass (the only quartz present being packed in minute grains along a few lines of fissure, and evidently of secondary origin;) in the smaller sized, more decomposed and fewer feldspar fragments; in the different arrangement of the ferrite particles, and in the greatly increased fineness of the groundmass.

This groundmass apparently consists of clayey material, chlorite, ferrite and mica. The planes of weakness as seen macroscopically are not discoverable in the thin section unless the quartz-filled fissures represent actual fractures along their planes. (To be studied with new instrument.)

Second section Transverse to cleavage.

A section cut transverse to the cleavage gets dark when the direction of foliation is parallel to the cross-hairs; hence the

1129

Missouri

Migmatite

Slate. (con.)

C. R. Vanhise. Jan 1883

Microscopic Description (con.)

very numerous chlorite, sericite, or biotite flakes are similarly arranged crystallographically

About some large fragmental individuals, the fine material has arranged itself, trying to keep up the uniformity above spoken of, exactly as if the rock has been in a plastic state and flowage had taken place. This uniformity and appearance, as explained by Sorby, is, however, due to the foliation induced by pressure.

4000

Near Fond du

Lac, Minn.

Lake Superior Sandstone.

C. R. Vanhise. 1883

Macroscopic Description.

Reddish brown, friable; of a rather fine uniform grain. With the lens may be seen rounded grains of quartz coated with iron oxide.

Microscopic Description.

Quartz in uniformly-sized, worn grains is the most important constituent. Some orthoclase is present. The interstices are completely filled with ferrite which is the cementing material.

4004

St. Louis River

near Thompson.

Altered Diabase.

C. R. Vanhise. 1882.

Macroscopic Description.

Black; of a uniform texture; very fine grained; of a rough subconchoidal fracture. Labradorite fresh in small crystals; original

Microscopic Description.

Constituents:— labradorite, fresh in small crystals; original magnetite in individuals of some size, also in very numerous minute specks scattered through the chlorite; a few small remnants of the original augite, this mineral being almost entirely altered to pale green, feebly dichroic chlorite through which the small specks of magnetite above noted is scattered; ferrite; apatite.

4007

St. Louis River
near ThompsonArgillaceous Schist.

C. R. Vanhise. 1882.

Macroscopic Description.

Light gray; compact; fine grained; yellow ochre stains; schistose.

Microscopic Description.

Clastic. Composed largely of fragments of quartz, orthoclase, and oligoclase, the first being predominant and orthoclase being much more abundant than oligoclase. The grains are all small, none of them being more than one millimeter across, and from this maximum the fragments grade to those so small as only to be distinguishable with a high power. The quartz contains as inclusions, rutile and apatite. A good deal of chlorite and limonite are present, the former of a pale green fibrous variety. Magnetite and kaolin also occur.

The chief difference which separates this rock from 1116 is that it contains much less of a fine-grained, fragmental groundmass.

4011

St. Louis

near Thompson

Slate.

C. R. Vanhise.

1882.

Macroscopic Description.

Dark gray, aphanitic; hard; has a conchoidal fracture, and well developed slaty cleavage; the bedding direction is indicated by parallel bands of slightly different shade, running across the cleavage.

Microscopic Description.

First section parallel to cleavage.

Exceedingly fine grained, but like the other slaty rocks of the series is clearly of clastic origin. With high power it is seen to consist chiefly of biotite, sericite, chlorite, and perhaps clayey matter, mingled with quite numerous larger rounded fragments of quartz, some of them complex and felspar. Vaguely outlined patches and many minute specks of magnetite are seen. (To be studied with better instrument.)

Second section transverse to cleavage.

Shows uniformity of polarization, and has flowage appearance, in section cut transverse to the slaty cleavage, exactly as spoken of in 1129.

4017

Next to 4016

S. R. D. R. R.

Altered Diabase. (?)

C. R. Vanhise 1883.

Macroscopic Description.

Black; medium grained; presents the appearance of a diabase but when placed in acid it all dissolves with effervescence, except a skeleton which crumbles to pieces readily between the fingers, showing the rock to be largely composed of calcite.

Microscopic Description.

Consists very largely of calcite. This mineral includes many small worn fragments of orthoclase, plagioclase, and quartz, with few of augite and moscovite. Ferrite scattered through the rock.

4018

St. P. & D. R. R.

near Mahtowah

Minn

Argillaceous Schist.

C. R. Vanhise 1882.

Macroscopic Description.

Like 4007

Microscopic Description.

Identical with 4007, the one unimportant distinction being, that 4007 is slightly finer grained.

4023

L.P. & D.R. R.

near Barnum

Minn.

Biotite Muscovite Schist.

C. R. Vanhise 1883.

Macroscopic Description.

Dark drab in color; lustrous; finely laminated; the thin, much folded and contorted folia being easily separable.

Microscopic Description.

First section parallel to cleavage. The ground mass is mostly composed of numerous closely interlocking quartz grains averaging less than two millimeters across. The remaining portion of the matrix is chiefly orthoclase, in grains of about the same size as those of the quartz; oligoclase; Biotite very abundant in rather small individuals, averaging less than one millimeter, mostly lying with the greatest length, and basal cleavage parallel to the schistose direction. Muscovite ^{is} quite plenty, occurring like the biotite. Very numerous specks of magnetite; also few larger grains, they all being mostly concentrated along lines parallel to the mica.

Second section transverse to cleavage. The usual similar arrangement crystallographically of the mica particles. In addition to this the section shows most perfect horizontal segregation.

The contortions spoken of macroscopically, are followed by the parallel mica flakes. As a result, many of the flakes are curved. This appearance suggests that the folding must have been subsequent to the formation of the mineral constituents.

4024

St. P. & D. R. R.

near Moss

Lake, Minn.

Biotitic Schist.

C. A. Vanhise. 1882

Macroscopic Description.

Of a dark drab color; lustrous; finely laminated; differs from 4023 in being harder and in not having a foliated structure.

Microscopic Description.

Matrix the same as 4023, except that no oligoclase was noticed. Pale green biotite is the most abundant mineral. Calcite occurs almost completely excluding the other minerals in several large areas, but is totally absent in other parts of the section. Litanic iron occurs with its ^{usual} gray decomposition product. Quite numerous crystals of tourmaline are to be seen often with both prismatic edges and rhombohedral terminations. Epidote and apatite are both present.

The biotite is arranged crystallographically as in 4023.

4027

near Moose

Lake, Minn.

Biotite Hornblende Schist.

C. A. Vanhise. 1882.

Macroscopic Description.

Differs from 4024 in being of a lighter color and in having a less brilliant lustre.

Microscopic Description.

Resembles 4024. The section is cut parallel, or nearly so, to the planes of lamination. Differs from 4024 in that the biotite is more abundant than hornblende and in the absence of calcite.

4028

layer in

4027

Diotitic Hornblende Gneiss.

C. A. Vanlier. 1882.

Of Macroscopic Description.

Of a light gray color mottled with black; compact; medium-grained; schistose. Black hornblende, milky feldspar, and pellucid quartz are recognizable.

Microscopic Description.

The most abundant mineral is quartz; many of the individuals being vaguely outlined, making the section present a peculiarly confused appearance. Orthoclase in abundance; much green hornblende; biotite; magnetite; hematite; apatite, are the other ingredients recognized.

4032

West branch of
Kettle River
Minn.

Biotitic Hornblende Schist.

C. R. Vanhise.

Macroscopic Description.

Like 4027 except that 4032 has layers of calcite parallel to the plane of lamination.

Microscopic Description.

Hornblende, calcite and biotite are the most abundant minerals, their relative abundance being directly in the order mentioned. The hornblende is as in 4024 and 4027, except that much more is cut in a direction which shows the prismatic cleavage and dichroism. The calcite is often in large areas. Quartz and orthoclase, both in quantity, magnetite and limonite are the other ingredients.

3204

Arlington
Columbia Co. N.Y.

= 725 Wier

Surry Coll.

St. Peters Sandstone.

R. H. Irving. Dec. 1882.

Macroscopic Description.

Most of the specimen shows a fine grained, very loose, saccharoidal sandstone, without trace of induration, but in which numerous flashing points indicate the presence of crystal coatings to the grains. About one-fourth inch, however, on the weathered side of the specimen, presents the appearance of a completely vitreous quartzite.

Microscopic Description.

The section is from the above mentioned vitreous crust. It shows plainly the original rounded grains of the sandstone, but everywhere between them a deposited quartz which is divided off into areas coordinating optically with the original grains. The interference between the different areas of this deposited quartz has nearly always been too great to allow of the formation of crystalline outlines. See illustrations of this section in Am. J. Sci. June 1883. p 407.

4033

Biotite-Gneiss or Biotite Granite.

C. R. Vanhise. 1882.

Macroscopic Description.

Schistose; medium grained. Recognizable constituents:— clear quartz; white feldspar; black mica. A vein of feldspar cuts at an acute angle across the laminae.

Microscopic Description.

Chief constituents:— quartz; orthoclase; oligoclase; biotite; ferrite.

The quartz contains many liquid-filled and gas-filled cavities. The feldspar is somewhat decomposed, and while some single individuals include each a quartz grain, often several feldspars surround a quartz particle. In such cases the quartz grains are rounded and their edges somewhat indefinite. This rounding is however nowhere seen when the quartz grains are not in contact with the feldspar.

Numerous long needles of apatite occur, most plentifully in the orthoclase, though some are seen in the quartz. The latter mineral also includes a few particles which appear to be a portion of the feldspar.

4034

Hornblende Biotite- Granite.

C. A. Vanhise. 1882

Macroscopic Description.

Except that the specimen is slightly finer grained than 4033, it does not differ from it macroscopically.

Microscopic Description.

Chief constituents:— quartz; orthoclase; oligoclase; biotite; hornblende; apatite.

Resembles 3433 very closely. Small individuals of biotite and hornblende, the latter often showing sections of perfect crystals, are included in both quartz and orthoclase. The feldspars include quartz, the quartz includes feldspars, and the hornblende sometimes includes quartz grains of some size.

4035

Biotitic Hornblende-Gneiss

C. R. Van Lise 1882

Macroscopic Description.

Coarse grained; very compact; schistose. Recognizable constituents: quartz somewhat smoky; feldspar, white to pink; black lustrous hornblende. One thick layer of quartz occurs almost free from feldspar and hornblende.

Microscopic Description

Quartz, orthoclase, oligoclase, hornblende, The latter very abundant and in individuals of large size, are the main constituents. A little biotite is present, also a few large worn crystals of apatite. This rock does not present the confused appearance characteristic of the two preceding.

4036

Chloritic Biotite Slate.

C. R. Vanhise Feb. 1883.

Macroscopic Description.

Shows a fairly well developed slaty cleavage. The grains are small and uniform in size; the color a light drab. Quartz and mica are recognizable.

Microscopic Description.

First section parallel to cleavage. The ground mass is chiefly of small interlocking grains of quartz, the remainder being feldspar. Biotite and pale-green weakly dichroic chlorite, the former in large quantities, are present. Many biotites have growths upon one or both sides of chlorite (Penninite). In the center is the unchanged biotite, while at the sides, the line of division, being definite and usually straight, is seen the chlorite. A very considerable portion of the biotite is thus partly surrounded, the amount of chlorite varying from a narrow edging to a large part of the grain. The minor ingredients are quite numerous folia of sericite; magnetic or titanic iron, in irregular grains of some size; and ferrite in minute specks scattered abundantly through the rock.

Second section cut transversely to the slaty cleavage. This shows but little segregation of the mica. While in certain bands it appears rather more abundant than in others, upon the whole it is quite uniformly distributed.

4037Chloritic Biotite Slate.

C. R. Vanhise. Feb. 1882.

Macroscopic Description.

Resembles 4036.

Microscopic Description.

Rather finer grained than 4036, but resembles it very closely. The only difference of note is that this rock, in a section cut perpendicular to the slaty cleavage, distinctly shows at one side a strip of some width in which mica is concentrated to the almost entire exclusion of the quartz. Through the remainder of the section the mica is very uniformly scattered.

4038

Chloritic Biotite-Slate.

C. A. Vanhise Feb. 1883.

Macroscopic Description.

Of a uniform light gray color; fine grained; showing a perfect slaty cleavage. Besides the slaty cleavage, the specimen shows alternate zones of light and dark which cut across the cleavage at an angle of about 60° and doubtless represent true bedding.

Microscopic Description.

Very much like 4036, and 4037. Sericite is more abundant.

The section shows very little or no traces of segregation of the mica folia in the plane of cleavage, but these folia, instead of lying as in common very uniformly with their greatest dimensions parallel to the cleavage, show a perceptible contraction along lines at an angle to the cleavage about equal to that mentioned in the macroscopic description. This explains the light and dark bands, and is taken to represent the stratification foliation mentioned by Sorby.

4039Piotitic Chlorite-Slate.

C. P. Vanhise, Feb. 1883

Macroscopic Description.

Of a drab color; aphanitic; very finely schistose. As in 4038, the hard specimen shows alternate bands of different hues cutting at an acute angle the planes of cleavage.

Microscopic Description.

Excessively fine grained. As near as could be determined the minerals of the rock are the same as those present in 4036, 4037, and 4038. The only additional peculiarities beside fineness of grain, are the increased proportion of chlorite, and the intrusion of a large irregular area of coarse grained perfectly interlocked quartz (a quartz-vein.)

4040

Porphyritic Diabase.

C. A. Vanhise Jan. 1883.

Macroscopic Description.

Dark gray to black, spotted with yellow, fine grained, massive.

Microscopic Description.

The ground mass is composed of an intimate mixture of minute, nearly round grains of augite and tabular crystals of feldspar. The matrix is considerably altered, most of the feldspar being almost entirely decomposed, leaving behind gray kaolinite. Some crystals, however, are quite fresh showing distinct striation.

Porphyritic ingredients: Large crystals of augite are plenty, some of them perfect six or eight-sided sections, often twinned; some of these are fresh, others decomposed upon the outside or along cleavage lines, the resultant materials being magnetite and chlorite or serpentine. Olivine also occurs in porphyritic crystals which are in part or wholly decomposed to serpentine and ferrite. There are a few porphyritic crystals of feldspar, either labradorite or anorthite. Numerous irregular patches of biotite occur and also small ones of magnetite.

4041Chloritic Biotite-Slate.

C. R. Vanhise. Feb. 1883.

Macroscopic Description.

Resembles 4038.

Microscopic Description.

Resembles 4038. The section cut perpendicular to the slaty cleavage shows in one part of the section heavy lines cutting across this cleavage at an angle of about 60° which are doubtless the original bedding lines.

4042

Garnetiferous Hornblende Schist.

C. R. Vanhise. Jan. 1883.

Macroscopic Description.

The mass of the rock is composed of a dark drab, varying to black, aphanitic material, with a subconchoidal fracture. This material is everywhere studded with regular do. decahedral garnets, and in one place is even nearly excluded by a layer of dark lustrous needles of hornblende. The latter mineral is seen less abundantly in other portions of the rock. Upon one side the specimen varies into a garnetiferous biotite schist.

Microscopic Description.

The ground mass spoken of above is entirely composed of small uniformly sized interlocking grains of quartz, the average breadth of each grain not being above .05 m.m. This complex structure is only recognizable in polarized light. The dark color is given to the quartz by very numerous minute specks of ferrite; small apatites are also included in the quartz. Many beautiful regular sections of garnet are seen. This mineral includes a good deal of quartz, and some individuals are partly altered to chlorite. Large crystals and irregular patches of a light green hornblende occur and often include much quartz. A few large grains of magnetite are present.

4043Diorite.

C. R. Vanhise. Jan. 1883.

Macroscopic Description.

Massive; coarse grained; composed of black hornblende and white feldspar, the former much predominant.

Microscopic Description.

Basaltic hornblende is the chief constituent, being in places somewhat decomposed, but mostly fresh. The feldspar is much decomposed; it appears, however, to have been mostly plagioclase, although orthoclase is certainly present. The large hornblendes often include many of the smaller feldspars. Very little ferrite and few grains of quartz are present.

4044Diorite.

C. R. Vanhise Jan. 1883

Macroscopic Description.

Contains less hornblende and more feldspar than 4043; otherwise like it.

Microscopic Description.

Hornblende and plagioclase in about equal proportion make up the rock. The hornblende is of the green variety. There is no quartz and no orthoclase. In other particulars the same as 4043.

4045

Staurolitiferous and Garnetiferous Mica-Schist.

C. R. Vanhise. Feb. 1883.

Macroscopic Description.

Finely schistose in structure. A quartz-mica mass everywhere studded with small dodecahedral crystals of garnet. Very numerous regular, often twinned, crystals of staurolite, some of them over an inch long, penetrate the rock, their greatest length generally conforming approximately to the schistose direction.

Microscopic Description.

The ground mass is composed of small uniform-sized interlocking grains of quartz. Biotite is the next mineral in abundance, occurring in long blades, the crystals having the flat sides of the thin blades lying with great uniformity parallel to the plane of lamination, so that a section cut parallel to this plane shows nearly all the individuals in basal section. Besides uniformity in this direction this section, and especially a second one cut transverse to the lamination, shows that the cleavage directions of the mica and consequently the direction of greatest length of the fragments lie with equal regularity in another plane perpendicular to the first. As a result of this regularity of arrangement in two directions, the individuals are, with few exceptions, crystallographically similarly arranged. Hence a whole section cut transverse to the lamination acts the same with reference to light as it would if it were cut from a single large biotite mass containing many inclusions. Magnetite and ferrite also occur in the ground mass.

The garnet crystals are all in sections of the dodecahedron. Each crystal contains as inclusions many minute grains of quartz and a few large pieces of chlorite (penninite).

4045

Staurolitiferous and Garnetiferous Mica-Schist.

C. R. Vanhise Feb. 1883

Microscopic Description. (con.)

The sections of staurolite are pale yellow, dichroic and fresh. A large part of the space in each crystal is occupied by inclusions. The inclusions in the staurolites are chiefly quartz, and with this quite numerous, large garnets, the latter having their own inclusions precisely (when occurring independently) as described above. Magnetite is the remaining inclusion of importance in the staurolite.

Magnetite; ferrite.

4046

Staurolitic Biotite Schist.

C. R. Vanhise. Feb 1883

Macroscopic Description.

Like 4045 except that no garnets are seen.

Microscopic Description.

The quartz is coarser grained than in 4045. The biotite shows a decided tendency to arrange as described under 4045, a much greater proportion of the grains, are, however, irregularly disposed.

Sections of staurolite occur as in 4045. The chief inclusion is quartz some magnetite and a good deal of muscovite, and perhaps a little chlorite. Muscovite also occurs at the edges of the staurolite crystals, but is nowhere found except in connection with staurolite, while curiously enough biotite though so abundant in the section is nowhere found as an inclusion of the staurolite.

With the above differences the description of 4045 is applicable to this rock also.

4047Garnetiferous Mica Schist.

C. P. Vanhies. Feb 1883.

Macroscopic Description.

Like 4045, except that the garnets are fewer and smaller, and that no staurolite is seen.

Microscopic Description.

As to the arrangement and occurrence of the quartz and mica in the ground mass this rock does not differ from 4036, except that it is finer grained. Small garnets with irregular outlines are quite numerous, the grains including much quartz.

Surrounded by the finely crystalline mass of mica and quartz and several large rounded areas of pure quartz, which is in some cases a single grain and in others is complex. But in all cases these quartz areas are rounded and have the appearance of being of prior origin to the remaining portions of the rock.

4048

Porphyritic Olivine Diabase.

C. P. Vanhise. Feb. 1883.

Macroscopic Description.

Black; massive; consisting of an aphanitic ground mass, in which numerous medium sized porphyritic crystals are seen.

Microscopic Description.

The ground mass is composed of numerous small tabular crystals of feldspar and round grains of augite.

The porphyritic crystals occupy a considerable portion of the space, from one-third to one-half of the whole. They are large grains of olivine and of fresh augite, the latter often twinned and showing crystalline outlines. The olivine is largely decomposed into serpentine and biotite, the former in larger quantity. These two minerals are present in such quantity as to be quite important constituents of the rock. Magnetite is also present.

About each porphyritic crystal the small augite grains concentrate themselves, so that very close to the border of these crystals the feldspar is almost excluded. A grain near them the feldspars are largely arranged with their greatest lengths parallel to the sides of these large grains.

4049Porphyritic Olivine Diabase.

C. R. Vanhise. Feb. 1883.

Macroscopic Description.

Black; massive; containing less of a fine ground mass than does 4048. The porphyritic grains, besides being more numerous, are also much larger than in 4048. Very large areas of brassy augite occur. The weathered surfaces are green from the presence of serpentine.

Microscopic Description.

Differs from 4048 chiefly in containing much less serpentine, and more biotite. In 4048, from the relation of the olivine and biotite it seems probable that all of the latter mineral was derived from the alteration of the first, but in 4049 there is much more biotite, sometimes in large areas, and while it seems certain that a portion of this mineral results from the alteration of olivine, it is possible that a portion of it is of independent origin. Chlorite or an alteration product occurs.

4048 and 4049 differ from 4040 in being coarser grained, and in containing olivine. They all differ from ordinary diabases in that the augites, instead of being large compared with the feldspars, and completely filling up the spaces between them, and perhaps inclosing feldspars, are small and round and hence do not fill up the spaces left by the feldspars.

4050Biotitic Hornblende Granite.

C. P. Vanhise. Feb. 1883.

Macroscopic Description.

Massive; medium grained; Hornblende, black mica, white quartz, and feldspar are recognizable.

Microscopic Description.

Hornblende, biotite, orthoclase, oligoclase, quartz, ferrite, and abundant long needles of apatite are the constituents.

4051

Altered Augitic Biotite Gneiss.

C. R. Vanhise. Feb. 1883.

Macroscopic Description.

Of a mottled gray color; apparently schistose; medium-grained; showing black glittering flakes of mica.

Microscopic Description.

Augite with its alteration products, hornblende, uralite, and chlorite; feldspar and biotite are the more important constituents. These are all mingled together in a confused manner. The feldspar is chiefly labradorite but orthoclase occurs. A portion of the former mineral is in very large pieces, many times the size of the individuals of the other minerals and of the remaining crystals of labradorite. These large grains include many augites with their alteration products and biotite. The augite is largely altered into the minerals before mentioned. A few small grains of quartz were observed, also a little magnetite and apatite.

The small quantity of quartz, the basic nature of a portion of the feldspar, and the large amount of altered augite place this rock close to a diabase.

4052.Mica Schist.

C. R. Vanhise Feb. 1883.

Macroscopic Description.

Schistose; black; medium-grained; flakes of mica.

Microscopic Description.

Ground mass, quartz and feldspar, the orthoclase and oligoclase in about equal parts. Biotite very abundant, occurring as heretofore described in schists. Chlorite; very numerous small crystals of apatite everywhere penetrate the quartz and feldspar; pyrite; ferrite.

A few large porphyritic crystals of feldspar.

4053Mica-Bearing Diabase.

C. R. Vanhise. Feb. 1883.

Macroscopic Description.

Massive; medium grained; of a mottled gray and black color. Very abundant black flakes of mica, augite, and feldspar are visible.

Microscopic Description.

Similar to 4051. The rock does not however present so confused an appearance, the grains being clearly defined.

The augite is often completely changed to hornblende. The section shows very well, all the stages from an almost intact augite to a complete hornblende. Large, long needles of apatite occur. A few areas of quartz are present.

Note by R. D. Irving. Jan. 15. 1884.

This rock is very plainly a mica bearing greenstone.

4054

Granite.

C. R. Vanhise. Feb. 1883

Macroscopic Description.

Medium to coarse grained. Pale pinkish feldspar, smoky quartz and black biotite are recognizable.

Microscopic Description

Mainly composed of quartz and feldspar in large interlocking grains. The feldspars are orthoclase and oligoclase. The quartz shows nicely its crystallization subsequent to the feldspars, sometimes a single grain of quartz nearly surrounding a large feldspar. Biotite occurs in coarse flakes; also apatite and a little ferrite.

4055

Granite.

C. R. Vanhise, Feb. 1883

Macroscopic Description.

Massive; medium grained. Greenish black hornblende and pink feldspar are recognizable.

Microscopic Description.

Hornblende and feldspar, mingled together in a confused manner, occupy most of the space. The feldspars are orthoclase and oligoclase, both much decomposed. A few large grains of quartz occur, also some needles of apatite.

4056Diorite

C. P. Vanhise Feb. 1883

Macroscopic Description.

Massive; fine grained; black. A vein of pink feldspar cuts through the specimen.

Microscopic Description.

Consists almost entirely of intimately mingled particles of hornblende and plagioclase, the latter much decomposed. Apatite, a little biotite and ferrite are also present. A few large porphyritic crystals of feldspar occur, including many minute grains of hornblende.

4057Granitel.

C. P. Vanhise. Feb. 1883.

Macroscopic Description.

Massive; medium grained; bright pinkish; Quartz and feldspar are both recognizable.

Microscopic Description.

Consists of large interlocking grains of quartz and feldspar. This feldspar is somewhat kaolinized, and though chiefly orthoclase is in small part microcline. The pink color is due to stains of ferrite.

4058Altered Diabase.

C. R. Vanhise. Feb. 1883.

Macroscopic Description.

Massive; very fine grained; dark gray.
Small grains pyrite are visible.

Microscopic Description.

Made up almost entirely of augite or its
alteration product, chlorite and labradorite.
A little magnetite and ferrite and a few
grains of pyrite are seen in the section.

4059

Altered Biotitic Diabase.

C. R. Vanhise. Apr. 1883.

Macroscopic Description.

White and gray, to black; mottled; massive, coarser grained than 4051, and 4053. Black mica, grayish augite and hornblende, and white feldspar are recognizable.

Microscopic Description.

The rock is essentially the same as 4053. The arrangements of the minerals is that of a typical diabase, large single crystals of augite, inclosing several crystals of the plagioclase (labradorite). Orthoclase and quartz occur, as in 4051 and 4053.

This section shows beautifully the two extremes of unchanged and completely altered augite. In one part of the section is a large grain of augite which has no trace of alteration and has distinctly the two coarse cleavages nearly at right angles, while in other parts of the section is yellow basaltic hornblende with its distinct cleavages at an angle of about 124° . Most of the augite is partly or wholly altered to hornblende. Chlorite however is present as an alteration product of the augite.

4060

Porphyritic Granite.

C. R. Vanhise Mar. 1883.

Macroscopic Description.

Fine grained; massive. Black hornblende or mica, pink feldspar and quartz are recognizable. Buried in this mass are very numerous large pink porphyritic crystals feldspar.

Microscopic Description.

The ground mass is composed chiefly of orthoclase, microcline, and quartz. Mingled with these as ingredients of some importance are hornblende, biotite, and ferrite.

The large porphyritic crystals are orthoclase, often twinned according to the Carlsbad law, and oligoclase, the former the more abundant of the two.

4061Porphyritic Granite.

C. R. Vanhise, Mar. 1883

Macroscopic Description.

Like 4060 except that that rock is coarser. Porphyritic crystals of quartz as well as those of feldspar appear to be present. Some of the porphyritic feldspars are very large reaching nearly an inch in their greatest lengths.

Microscopic Description.

The section is too small to be satisfactory. The ground mass is as coarse as an ordinary granite, and consists of quartz, feldspar, large grains of hornblende and biotite, with a little ferrite and apatite.

In the section only a fragment of each of the porphyritic ingredients, quartz and feldspar, is seen. The portion of the quartz grain is large, over an eighth of an inch across, and is a fragment of a single grain. The feldspar is orthoclase.

4062Hornblende - Granite.

C. R. Vanhise. Mar. 1883.

Macroscopic Description.

Massive; medium-grained; dirty white feldspar; black hornblende; quartz.

Microscopic Description.

Oligoclase, orthoclase, hornblende and quartz are the principal constituents; the accessories are magnetite, biotite, apatite and sphene in a few small brown grains.

Some large hornblendes show cores (in one case a very large one) of augite, and it is possible that is all an alteration product of that mineral.

4063

Hornblende-Granite.

C. P. Vanlise, Mar. 1883

Macroscopic Description.

Massive; coarse grained. Pink feldspar, black hornblende and a little quartz are recognizable.

Microscopic Description.

Oligoclase, orthoclase, hornblende, quartz, are the chief constituents. The accessories are apatite and ferrite.

4064

Porphyritic Olivine Diabase.

C. R. Vanhise. Mar. 1883.

Macroscopic Description.

Dull black; aphanitic; rather soft. Buried in the ground mass are numerous porphyritic crystals.

Microscopic Description.

The porphyritic crystals are very numerous varying from those of large size to those so small as to be indistinguishable from the ground mass. The feldspar are most numerous. These are anorthite, which is usually very fresh, though in some cases largely kaolinized. The other porphyritic ingredients appear to have been augite and olivine. However, at present no unchanged olivine is seen, and augite only in a few cases. The alteration products of these minerals are serpentine, magnetite, and chlorite.

The ground mass is cryptocrystalline with apparently some amorphous matter. With a high power this ground mass appears to consist largely of the same minerals as those of which the porphyritic grains are now composed i. e. feldspar, magnetite, serpentine and chlorite.

4065Altered Biotitic Diabase. (?)

C. R. Vanhise. Mar. 1883.

Macroscopic Description.

Shows more quartz and feldspar than 4053; otherwise like it.

Microscopic Description.

Resembles 4053 very closely. The chief differences are as follows. The change from augite to hornblende is so very nearly complete as to leave remaining but a few insignificant cores of the original mineral. Quartz and orthoclase, particularly the former, are present in larger quantity, so that in this rock quartz becomes quite an important constituent.

4066Diabase.

C. R. Vanhise. Mar. 1883.

Macroscopic Description.

Massive; medium grained; of a uniform gray color.

Microscopic Description.

A typical diabase.

Anorthite, in fresh well developed crystals, and augite, are the main constituents. The latter is in large grains, filling up the spaces between the anorthites and often enclosing them, composing perhaps two-thirds of the rock. In places this mineral is altered to chlorite and magnetite. Magnetite and ferrite also occur independently.

4067

Hornblende-Biotite-Granite.

C. R. Vanhise, Mch. 1883.

Macroscopic Description.

Massive; coarse. Dirty white feldspars and quartz, black hornblende, and mica are recognizable.

Microscopic Description.

Orthoclase, oligoclase, quartz, hornblende, and biotite are all abundant in large grains. Many hornblendes have cores of augite from which mineral it is all doubtless derived, although much of it is of the basaltic variety. Magnetite, a few independent round grains of augite, fragments of crystals of sphene, and many very large blunt apatites, especially abundant in the hornblende, — are the remaining ingredients.

Separation of feld-
spars of rocks from
other minerals and
from each other by the
methods given by
Fouqué and Lévy, viz

- (1) By pulverizing and separating by means of solution of mercuric iodide in potassium iodide (Thoulet's method.)
- (2) By measuring angles of maximum extinction in zones: $\bar{\alpha} - \bar{\alpha}$
- (3) By analysis.

C. R. Vanhise
 April and May 1883.

1961

"The Greenstone"

Phoenix Mine

Newman

Point, Mich.

Melaphyr.

Separation by Thoulet's method.

Material passed through 80 mesh sieve. Dust washed out with water. Powder so finely divided that the separation took place very slowly. At specific gravity of 2.80 the material which had fallen was drawn off.

After this the specific gravity of the liquid was lowered very slowly the material falling gradually as the density was lessened. The material which fell at densities 2.75, 2.69 respectively and the remainder which floated at 2.69 were drawn off separately.

Separation of feldspar.

1961

Melaphyre (con.)

Upon examining with the microscope it was seen that the feldspar had not, even at the last, been separated completely from the other portions of the rock; hence that there was no separation of the feldspar among themselves.

1103

Clognet

River, Minn.

Olivine Gabbro.

Separations by Thoullet apparatus.

At specific gravity 2.80 most of the olivine and diallage were down.

On lowering from specific gravity 2.80 a few grains fell. These grains appeared mostly to be complex, being in part feldspar and in part diallage or olivine.

As the specific gravity was lowered from 2.70 to 2.68 the great mass of the remainder fell. Under the microscope this was seen to be all feldspar. Of this the grains were used for analysis which passed through a sixty mesh sieve but would not pass through an eighty mesh sieve. They yield to Prof. W. W. Daniels on analysis 52.40 percent of SiO_2 .

3

Duluth

Minn.

Orthoclase - Gabbro.

Separation by Thoullet's apparatus.

Sieves 40 - 60 mesh.

Before specific gravity 2.70 was reached all the material except the feldspar was down.

Portions of this feldspar fell at 2.70, 2.685, 2.67, 2.655, 2.627 and even then a small portion still floated, which was drawn off without farther lowering the density of the liquid.

Separation of feldspars.

169

There appeared to be no sharp separation indicating different feldspars at any definite point but a continuous fall of material as the specific gravity was lowered.

1752

Olivine- Gabbro.

Red Rock

Mission Bay

Lake Superior

Separation by Thoulet's apparatus.

All the minerals except the feldspars and the feldspars combined with other minerals fell at once, the specific gravity of the liquid being at beginning 2.80.

As the density was gradually lowered to 2.74 a few complex grains fell and were drawn off.

The liquid was now reduced to 2.72 when the whole mass of the feldspars fell together.

Sieves 60 - 80 mesh.

The separated portions yielded 49.28 Si O₂ to Daniells analysis.

822

Anorthite Rock

North Shore

L. Superior

Minn.

Thoulet.

Specific gravity of liquid 2.80

Sieves 40 - 60 mesh.

Until the specific gravity 2.72 was reached, absolutely no material came down, when a half dozen or more grains fell.

At specific gravity 2.70 the great mass was down. This is 822 A.

At specific gravity 2.69 perhaps two-thirds of small remainder fell. This is 822 B.

The density now gradually lowered to 2.46, the small portion left in tube gradually sinking to the bottom until at 2.46 three-fourths was down. This is 822 C.

All below 2.69 was drawn off together and found to weigh one-thirtieth of the portion which fell at 2.70.

Estimated relative quartzites of the

Separation of feldspars (con.)
 separated materials: 822b = 1; 822B
 = 3; 822A = 30

Portions of 822A when digested with hot HCl for two or three hours showed under microscope, both with and without polarized light, evident decomposition, and the solution gave with NH₄HO an abundant precipitate of Al₂(OH)₆.

Two new thin sections of 822 were now made and the three thin sections measured carefully for extinction angles with the following results viz:-

822 (1)			822 (2)			822 (3)		
Single Angles	Double Angles		Single Angles	Double Angles		Single Angles	Double Angles	
18	27	45	24	25	49	23	24	47
						25	19	44
32	35	67	33	36	69	33	20	53
						29	23	52
17	14	31	30	29	59	23	25	48
						40	41	81
33	29	62				28	28	56
						33	38	71
						37	32	69

Analysis of 822 by W. W. Daniells yielded, Si O₂, 46.54% (not picked by R. D. Irving.)

822A (see above) yielded 47.41% Si O₂.

Complete analysis of 822 by W. W. Daniells (picked carefully.)

Si O ₂	47.25
Al ₂ O ₃	31.56
Fe ₂ O ₃	2.29
Ca O	15.39
Mg O	0.27
K ₂ O	0.37
Na ₂ O	2.52
H ₂ O	0.40
	100.05

Separation of feldspars (con.)

"The powder heated turned red indicating Fe to be present as Fe₂O₃". W. W. Daniells.

A special determination gave 2.18% of Fe₂O₃.

Analysis by W. W. Daniells of single crystal of 822 yielded 46.56% SiO₂.

748
North Shore
Lake Superior
Minnesota

A northite Rock

Thoulet.

Specific gravity of the liquid 2.808
Sieves 40 - 60 mesh.

None fell until density 2.695 was reached, when a little less than one-fourth came down. This 748 A.

At specific gravity 2.682 rather more than one-third fell. This is 748 B.

The portion which floated at 2.65 (only a small quantity) was now drawn off.

Portions of 748 A and 748 B treated with acid gave same results as 822 A.

Extinction angles of two sections of 748.

748(1)			748(2)		
Single Angles	Double Angles		Single Angles	Double Angles	
24	26	50	10	11	21
26	22	48			
27	26	53			
25	25	50			
9½	10½	20			

Duplicate analyses of 748 yielded W. W. Daniells 50.22% SiO₂ and 50.30% SiO₂.

748 A yielded 49.73% SiO₂.

748 B yielded 51.78% SiO₂.

A single crystal of 748 yielded 51.57% SiO₂.

Separation of feldspars. (con.)

729

Northern shore
Lake Superior
Minn.Arorthite Rock.

Thoulet.

Specific gravity of liquid, 2.808
Sieves, 40-60 mesh.At specific gravity 2.713 a few grains fell.
At specific gravity 2.691 two-thirds was
down. This is 729 A.At specific gravity 2.663 the larger
part of the remainder fell. This is 729 B.The density of the liquid was
gradually reduced between 2.713 and
2.691 with a gradual falling of sus-
pended matter as the specific gravity
was lowered. As in 748 after the grains
commence to fall the action is con-
tinuous, as the density of the liquid
is lessened, until the larger portion
of the rock is down.Extinction angles of two sections.

729(1)			729(2)		
Single Angles	Double Angles		Single Angles	Double Angles	
33	38	71	22	15	37
31	36	67	8	20	28
31	28	59	21	18	39
33	25	58	26	12	38
			24	29	53
			39	38	77
			32	34	66

Analyses by W. W. Daniells :-729, Si O₂ 47.505 %729 A, Si O₂ 48.91 %729 B, Si O₂ 48.19 %

Separation of feldspar (con.)

Silica contents of typical Newer-
nawan eruptives - W. W. Daniells. 1883.

729	_____	47.505
✓ 748	_____	50.30 , 50.22 (duplicates)
822	_____	46.54
✓ 884	_____	47.90
✓ 876	_____	71.10
✓ 902	_____	73.87
✓ 906	_____	50.76
✓ 907	_____	52.56
✓ 908	_____	57.87
(?) ✓ 1045	_____	59.75
1315	_____	53.40
✓ 1542	_____	45.88
1543	_____	66.62
3240	_____	50.29
547	_____	52.79
718	_____	53.61

4069

Devils Lake,

Wis.

Quartzite.

R. D. Irving. Dec. 1882.

Macroscopic Description.Arenaceous quartzite.Microscopic Description.

First mounting a thin section. Shows secondary quartz interfering without crystalline outlines, very distinctly, and polarizing with original grains.

Second mounting. The rock is crumbled into sand and mounted in balsam. The edgings are very distinct and sharp but none show any crystalline outlines.

3218Sandstone.

R. D. Irving. Dec. 1882.

Laurie's

Baraboo River

Sauk Co.

= 1256 Wis

Laurie Coll.

Microscopic Description.

The section is of peculiar interest, since it shows a case of numerous inclusions in the secondary quartz, and because the rock is a sandstone and shows closely fitting quartzes in the polarized light. Worthy of further study as to inclusions in the added quartz.

4202

Norway Mine
Mich.Potsdam Sandstone.

C. R. Vanhise, Sep. 1883

Macroscopic Description.

White; vitreous; shows a conchoidal fracture.

Microscopic Description.

Composed almost entirely of interlocking quartz areas, nearly all of which show as kernels the worn rounded original grains of sandstone. The interlocking though pronounced is not so intricate and perfect as is usual in granite. In one kernel very numerous rutile needles run directly against the line between the original rolled grain and the later deposited quartz. Brown oxide of iron is quite plentiful as a filling material. A few grains of orthoclase, and plagioclase are present as also several larger areas occupied by an aggregate of small interlocking grains of quartz mingled with ferrite.

4206

Cyclops Mine
Mich.Potsdam Sandstone.

C. R. Vanhise Sep. 1883.

Macroscopic Description

Flesh colored. A little coarser than and not quite so hard as 4202.

Microscopic Description.

Resembles 4202. The differences are as follows:— (1) 4206 is coarser grained; (2) ferrite is more plentiful in it as a cementing material; (3) a rather smaller proportion of the grains of quartz in it show enlargements by secondary deposition; and (4) feldspar is not seen in it.

4229

Saginaw
Mine, Mich.Quartz Conglomerate.

C. P. Vanhise Sep. 1883.

Macroscopic Description.

Conglomeratic, the pebbles being of a dark red color and all appearing to be of a jaspery material. These pebbles vary in size from those as small as the grains of quartz in the matrix to those three-fourths of an inch across. The matrix is mottled and medium-grained, and is composed of pellucid quartz particles, garnet-colored jaspery fragments, and iron oxide. The different ingredients are strongly cemented; so strongly that when the rock is fractured the hard pebbles and quartz grains break across, making an approximately regular surface.

Microscopic Description.

Plainly clastic. Quartz is the most important mineral, occurring in pure rounded grains. In a few cases only is secondarily deposited quartz polarizing with the original rounded grains, observable. Scattered about are rounded or oval areas of small interlocking quartzes, which are taken to represent the jaspery pebbles spoken of above. Magnetite is the next mineral in abundance to the quartz. Small grains of quartz, perhaps some partly amorphous silica, and minute flakes of muscovite (?) or kaolin (?) or both, intimately mingled fill up the interspaces.

It seems probable that in all cases when oxide of iron, kaolin, or muscovite are so abundant as in this section, that they were, in part at least, laid down as original fragmental material mixed with the quartz. Of course this does not imply that these or other minerals have not crystallized in situ.

4230

Saginaw Mine

Mich.

Conglomeratic Quartzite.

C.R. Vanhise, Sep. 1883

Macroscopic Description.

The pebbles rather smaller than in 4229, but otherwise like that rock.

Microscopic Description.

The section shows a few rounded quartz areas, much larger than any in 4229, some of which are complex. Otherwise like 4229.

4231Saginaw Mine
MichConglomeratic Quartzite.

C. P. Vanhise Sep. 1883

Macroscopic Description

Like 4230.

Microscopic Description.

Resembles closely 4233. Differs from it (1) in that no grains show enlargements; (2) in that it contains large "jasper" pebbles which are composed of minute interlocking quartzes mingled with fine particles of magnetite; and (3) in the prominence of magnetite, both as large grains and as filling material.

4233

Saginaw Mine
Mich.Conglomeratic Quartzite.

C. R. Vanhise / Sept. 1883

Macroscopic Description.

With the exception that the pebbles are smaller the rock is exactly like 4229.

Microscopic Description.

Resembles closely 4229. As in 4229, only a few grains have uniformly polarizing secondary quartz deposited about them. These rounded grains compose the greater part of the rock.

Brown oxide of iron and magnetite are quite abundant as cementing materials. One of the noticeable things about the rock is the abundance of quartz, scales of kaolin, and perhaps flakes of muscovite as filling and cementing substances.

Some grains of quartz polarize uniformly, for a considerable area, and then gradually change to aggregates. The appearance is as if a grain while forming was able to build itself up regularly for a certain time, and by some changing condition it gradually lost this power, of course continuing as an individual in some directions farther than in others. The depositing silica, instead of all uniting crystallographically with the original grains, now formed independent grains. As the process went on more and more of the silica was deposited as separate grains, and the result is a quartz grain with a vague irregular outline fading into an aggregate.

As with 4229 much of the filling material was probably deposited in the original mud.

4232

Saginaw Mfne

Mich.

Conglomeratic Quartzite.

C. R. Vanhise Sept. 1883

Macroscopic Description.

Like 4233.

Microscopic Description.

Resembles 4233. However, a larger proportion of the grains show enlargement but secondary deposition, but this process has not continued until the grains have doctailed or even until they have become angular. But the chief part of the filling material as in 4233, except that more of the iron oxide is magnetic.

4235

Road between

Saginaw & Westland

Mines, Mich.

Quartzite.

C. R. Vanhise Sept. 1883.

Macroscopic Description.

Of a light gray color; hard; shows a conchoidal. In the mass of gray material are seen small garnet-colored grains, which are taken to be of a jaspery material as in 4229 & 4223

Microscopic Description.

Essentially like 4229 and 4233, the chief difference being that the perite as a filling material falls into insignificance. The worn grains which have secondary quartz as parts of themselves are few in number and the amount of material in each grain is small. Rounded grains composed of numerous minute interlocking quartzes occur. The filling material is also almost entirely composed of quartz of this nature with kaolin and mica (muscovite).

4243 A

Palmer Mine

Mich.

Quartzite.

C. R. Vanhise. Sep. 1883.

Macroscopic Description

Hard; of a conchoidal fracture; coarse-grained; almost conglomerate in character, some of the pebbles of quartz and jasper being nearly half an inch across.

Microscopic Description.

Large rounded grains of quartz compose about one-half the rock. While all are distinctly worn the process has often not continued until the grains became rounded or oval, many of them being somewhat angular. There is no evidence that this angular appearance is due to secondary deposition. Large rounded areas occur which are of small interlocking quartz grains. The abundant filling material is both individualized and cryptocrystalline silica, mingled with much muscovite and kaolin in small flakes. In some places the partly amorphous silica is predominant, in others the mica and kaolin. (Compare 4505, 4508, 4511.) Ferrite is the next mineral in importance. A good deal of chlorite and some epidote are seen. One large individual of partly decomposed orthoclase was observed.

4256

North of
Gordrich Mine
Mich.

Quartzite.

C. R. Vanhise. Sep. 1883.

Macroscopic Description.

With the exception that it is of a uniform granular appearance, containing no pebbles, and upon the weathered surface shows numerous white specks, this rock resembles 4243.

Microscopic Description.

Quartz is the most abundant constituent. While the rock is clearly clastic, much of the quartz is quite angular, and often an area is composed of several perfectly dovetailing grains of quartz with no indication that this a result of secondary deposition. Nor can this be explained by supposing the areas to have been deposited as complex ones, for they are not, considered as wholes, at all rounded, and are most irregular in shape. Farther, nowhere in the section is seen any trace of a division line between the original kernel and the angular boundaries, although it is probable that the shapes of the grains, as now seen, and the interlocking spoken of above, are both due to this cause.

The spaces between the quartzes, when these do not interlock, are often filled with secondary silica, which has deposited as small perfectly fitting granules of quartz. Sometimes in ordinary light these interspaces present the same appearance that they would have if this secondary quartz polarized with the original grains. The other important filling constituents are as usual Kaolin or mica, or both.

Rounded grains of orthoclase, microcline and plagioclase are so plenty, as to compose a considerable portion of the rock. In some cases the feldspars have completely decomposed to a dull gray non-polarizing mass. There are all grades from the almost

4256North of
Goodrich Mine

Mich

Quartzite. (con.)

C. R. Vanlue, Sep. 1883.

Microscopic Description.

unchangeable feldspar to those in which the kaolinization is complete. Brown oxide of iron, especially as an impurity, of the feldspar is quite abundant. This rock is noteworthy as approaching so nearly to a clastic rock, and for the relatively small amount of apparent secondary silica about the original quartzes.

4274

West end of
Teal Lake
Mich.Quartzite.

C. R. Vanhise. Sep. 1883.

Macroscopic Description.

Gray in part, and again in other parts red-brown, the lines between the colors being sharp but very irregular; of a fine uniform grain; vitreous; shows a conchoidal fracture.

Microscopic Description.

Everywhere are seen the rims of inclusions, which separate the original loose clastic grains from their secondary additions. This addition is as perfectly marked as observed in any specimen. However the depositing silica has not all united with the original grains to form the present strongly interlocking quartzite, quite a large portion of it having crystallized into small independent particles. This section illustrates beautifully the gradual variation from a single grain, fully described under 4233, to an aggregate caused by a part of the depositing silica forming separate grains instead of all uniting to the cores. The variation in color seen macroscopically are due to brown ferrite.

4278

Deal Lake

Mich.

Quartzite.

C. R. Vanhise. Sep. 1883

Macroscopic Description.

Hard; of uniform medium grain; having a banded appearance, one part of the hard specimen showing a greenish tint, while the other half is of a decided reddish cast.

Microscopic Description.

Rounded grains of quartz make up most of the rock. A few small rounded grains of magnetite and fewer still of hematite and feldspar are seen. Also a few rounded areas of aggregated quartz some of which include amorphous silica. The filling material consists almost exclusively of partly individualized silica and minute quartz grains with kaolin and muscovite. (Compare 4505, 4508, and 4511). Nowhere is there any appearance of quartz deposited as parts of the original grains; nor is it necessary to suppose that any has thus deposited, for none of the grains are especially angular or interlock with each other.

4279

North side of
Seal Lake
Mich.

Quartzite

C. A. Vanhise Sep. 1883

Macroscopic Description.

A pebble from the schist. Black; vitreous; of a conchoidal fracture.

Microscopic Description.

Except that the ferruginous material is mostly magnetite, the rock looks exactly like an ordinary sandstone. The quartz-grains are perfectly rounded. A few show secondary deposition, but this has never extended far enough to make any of them angular. The filling material is chiefly magnetite, and small interlocking quartzes. The remainder is kaolin, and chlorite. The iron oxide is mostly concentrated, about the rounded quartzes, as if it had adhered to them when deposited. The fact that they rarely get so close together as to exclude the oxide, suggests this idea. On the other hand, the small interlocking quartzes are found in the interspaces and are evidently a secondary deposition.

4341

Quartzite Range

near Marquette

Mich

Quartzite.

G. R. Vanhise. Sep. 1883

Macroscopic Description.

Hard; gray; vitreous; of a conchoidal fracture.

Microscopic Description.

Rounded grains of quartz compose the major portion of the rock. On one of these grains is apparently an addition due to secondary deposition, but nowhere else was it observed. Silica is the most important cementing material, all of it being individualized. Brown oxide of iron occurs. Some of the grains of quartz vary into the finer material, as described in 4233. A few grains of muscovite and some chlorite are present.

4340

Quartzite Range

New Marquette

Mich.

Dolomitic Quartzite or Quartzose Dolomite.

C. R. Vanhise. Sep. 1883

Macroscopic Description.

Red; schistose; of a fine uniform grain.

Microscopic Description.

Composed of rounded grains of quartz in a matrix of dolomite mingled with small quartzes. Some of these ^{large} quartzes show ^{decided} enlargements by secondary deposition. The dolomite composes about two-thirds of the rock, the quartz grains rarely coming into contact with each other. It fills up the interspaces closely. Some brown iron oxide is present.

A fragment treated with cold HCl gives a slight effervescence, but when heated the effervescence becomes vigorous, and the piece is largely dissolved. The skeleton of quartz left is about the size of the original fragment, but is so honeycombed that it crumbles to sand between the fingers. The filtrate from the HCl solution precipitated with NH_4OH and $(NH_4)_2CO_3$ gives an abundant crystalline precipitate with Na_2HPO_4 , indicating magnesium.

4342

Near Marquette
Mich.Red Quartzite.

C. R. Vanhise Sep. 1883.

Macroscopic Description.

Bright red; compact; of a uniform grain; vitreous.

Microscopic Description.

Mostly composed of interlocking grains of quartz, but the lines between the grains are usually of a less intricate character than would be the case in granite. Rounded cores indicating secondary deposition, are only occasionally recognizable, but doubtless the non-clastic appearance of the rock is due to the intrusion of secondary quartz. Fibres of red oxide of iron, to which the bright color of the rock is evidently due, are everywhere present between the grains. Comparatively little secondary silica has been deposited as an independent material. A little muscovite (?) is seen.

4353

Ganister quarry

Carp River

near Marquette

Mich.

Quartzite.

W. R. Vanhise. Oct. 1883.

Macroscopic Description.

Light gray; of a uniformly fine grain; vitreous; shows a conchoidal fracture.

Microscopic Description.

Rounded and angular grains of quartz compose nearly all of the rock, the angular grains often interlocking. However, in such cases, there is often a core of rounded quartz, about which the secondary material has deposited, making the grain angular. The very little cementing material is of quartz and kaolin. A few grains are penetrated with many rutile needles. Very little iron oxide is present.

4354

Lanister Quarry
near Carp River
Mich.

Quartzite.

C. R. Vanhise Oct. 1883.

Macroscopic Description.

Like 4353.

Microscopic Description.

Composed of almost perfectly interlocking grains of quartz which everywhere, however, show rounded nuclei. This rock is as good an illustration of this peculiar relation between fragmental and deposited as any I have seen. Small independent interlocking quartzes, and flakes of muscovite, though present, are at a minimum. Most of the quartz grains are quite pure, but oxide of iron is an abundant inclusion in a few of them.

4355

Near to uncon-
formably junc-
tion with
Potsdam Sand-
stone, Marquette
Mich.

Quartzite.

W. P. Vanhise. Oct. 1883

Macroscopic Description.

Except that the bedding is distinct, and that the rock is somewhat less vitreous, it does not differ from 4354 and 4355.

Microscopic Description.

The rounded grains of quartz lie closely together, but do not interlock. The only exception to this statement is that the section is cut by a vein which is composed of grains which do interlock in the most complicated manner. Nowhere are seen enlargements by secondary deposition. Small interlocking quartzes mingled with more or less kaolinic material make up the cementing material.

4395

East Nubish

Island, St. Mary's

River, Canada.

Quartzite.

G. R. Vanhise Oct. 1883

Macroscopic Description.

Stained more with iron oxide and less vitreous than 4353 and 4354; otherwise like them.

Microscopic Description.

Contains more brown oxide of iron than 4354; otherwise not different from it.

4396

East Nishish
Island, St Mary's
River, Canada

Quartzite.

C. R. Vanhise Oct. 1883.

Macroscopic Description.

Less vitreous than 4354, but close to it.

Microscopic Description.

Like 4354.

4400

East Nabich
Island, St. Mary's
River, Canada.

Quartzite.

C. R. Vanhise Oct. 1883

Macroscopic Description.

Less vitreous than 4354, otherwise like it.

Microscopic Description.

The only points of importance to note are: (1) that interlocking minute quartzes are very plentiful, occupying as they do areas of some size, and also scattered in narrow rows between the larger grains; (2) that while many of the larger interlocking grains show the original rounded kernel by a line of inclusions, in others the line is not seen. It is believed, however, that the angularity in the latter grains is due to the same cause as in the first, but the union between the old and new quartzes is so perfect, the exterior surface of the old grains having been clean, that it is not now discoverable. The graduation from large quartzes to minute interlocking ones is seen as described in 4233.

4406

McGowan's

Landing

Lake Huron

Canada

Red Quartzite.

C. P. Vanhise. Oct. 1883

Macroscopic Description.

Flesh red; composed of medium sized grains of quartz mingled with fine material.

Microscopic Description.

Quartz in rounded grains set in a fine matrix, is the most important constituent. In some cases the rounded areas, instead of being a single individual, are composed of several interlocking quartzes. Some of the grains have had a second growth, added to them, but the greater portion of the new silica is present as a filling substance in the form both of individualized grains and cryptocrystalline material. Mingled with this silica is much kaolin or muscovite or both. The newly deposited material is everywhere faintly stained with oxide of iron, which gives the rock its red color. A few small grains of magnetite were observed.

4407

Nearbampement

d'Orval

Lake Huron

Canada.

Quartzite

C. R. Vanhise Oct 1883.

Macroscopic Description.

Gray; of a medium, uniform grain; firm; showing a conchoidal fracture.

Microscopic Description.

Resembles closely 4233. Contains rounded areas which are aggregates in some cases wholly of individualized and in others partly of individualized and partly of amorphous silica. These areas are without doubt worn grains of "jasper." This section shows nicely the gradual variation of a single grain of quartz to that of an interlocking aggregate spoken of in 4233, and in this section in places the process has gone on until a part of the silica is amorphous. Silica both in its flinty (compare 4508 and 4511) and in its individualized forms, with kaolin and muscovite compose the abundant cementing material.

4408

Island S.E.

of Hurlish

Island

Lake Huron

Canada.

Quartzite.

C. R. Vanhise. Oct. 1883.

Macroscopic Description.

Like 4400.

Microscopic Description.

Like 4400 except that it contains rather more iron oxide, and also numerous muscovites, some of them of considerable size.

This mineral becomes here much more important as a filling material than the interlocking grains of quartz the reverse of which is true in 4400.

4409
Island S.E. of
Neelish Island
Lake Huron
Canada.

Quartzite.

C. R. Vanhise. Oct. 1883.

Macroscopic Description.

Light gray, weathers to a pale yellow; the fragmental grains of quartz are distinguishable from the finer matrix.

Microscopic Description.

The chief constituent is quartz in rounded grains, which average larger than in most of the quartzites heretofore described. Several complex areas — one of them very large — which, as wholes are rounded, are seen. The interspaces between the quartzes are unusually large, occupying more than a third of the section, and are mostly filled with very numerous brilliantly polarizing flakes of Kaolin with some quartz and perhaps muscovite. The grains of quartz are often not in contact, and it seems certain that some and perhaps all of the clayey material and large quartzes were deposited or clastic substances at the same time.

The gradual change from single quartzes to aggregates, as spoken of in 4233 and 4244, is to be seen here also.

4434

Near Blind

River, E. Huron

Canada

(Laurentian

according to

Logan)

Quartzite.

C. R. Vanhise Oct. 1883.

Macroscopic Description.

Yellowish-gray; vitreous; of a fine uniform grain; consisting apparently of quartz mingled with some brown oxide. Showing plainly a schistose structure. Aside from the above points the rock has quite a different appearance from any quartzite heretofore described in that it has a decidedly gneissic look.

Microscopic Description.

Quartz in rounded grains with no appearance of secondary quartz additions is the most prominent of the original constituents. Rounded fragments of orthoclase, microcline, and plagioclase are also quite abundant. The filling material which is in large quantity, although not so plentiful as in 4409, is composed of kaolin mingled with much quartz, the latter mostly in small interlocking grains. Brown iron oxide is present. Many of the quartz grains have ragged edges with gradually and irregularly fading colors in polarized light which probably is due to the process previously described (vide 4233 etc.) but may be caused by corrosion of the quartzites by some agent.

4435

Near Blind

River

Lake Huron

Canada.

Quartzite.

O. P. Vanhise. Oct. 1883.

Macroscopic Description.

Like 4434

Microscopic Description.

Like 4434.

4436

Logan's Laurentian area
North Shore
Lake Huron
Canada.

Quartzite.

C. R. Vanhise Oct. 1883

Macroscopic Description.

Composed of clear vitreous quartz, through which are scattered grains of a dull, opaque, white kaolin-like material.

Microscopic Description.

Quartz in interlocking — often intricately — grains composes nearly all of the rock. They are supposed, however, to have become thus by secondary enlargement from rolled grains, from the fact that what appears to be a division line between the old and new quartz is visible in a few grains. The chief part of the remainder of the rock is made up of interlocking small quartzes and flakes of kaolin, with a little iron oxide.

On second examination the proof of enlargement of rolled grains does not appear altogether satisfactory though the indications are that way.

4437Quartzite

C. R. Vanhise Oct 1883.

Macroscopic Description.

Like 4434.

Microscopic Description.

Essentially like 4434. Rutile needles were noted in some of the quartz grains. In one group of interlocking grains the division lines between old and new quartz seem quite satisfactory.

Logan's

Laurentian area

North Shore of

Lake Huron.

Canada.

4438

Logan's
Laurentian area
North Shore
Lake Huron
Canada

Quartzite.

C. R. Vanhise. Oct. 1883.

Macroscopic Description.

Colored more of a greenish yellow than
is 4334; otherwise like it.

Microscopic Description.

Has rounded quartz areas which
are complex; otherwise not different from
4434.

4442

Logan's

Laurentian area

North shore

Lake Huron

Canada.

Quartzite.

C. R. Vanhise Oct. 1883.

Macroscopic Description.

Hard; vitreous; of a conchoidal fracture. Differs from any before described in containing flesh-colored feldspars, which give the rock a gneissic appearance.

Microscopic Description.

Clearly fragmental. Quartz in rounded grains is as heretofore the most important constituent. Rounded areas which are quartz aggregates are also quite abundant. Feldspar including orthoclase, microcline, and oligoclase, all in rounded grains, is plentiful. The filling material is chiefly finely crystallized quartz. Kaolinic material, however, appears to be present. A number of patches of chlorite occur. While many quartzes seem to shade gradually into a fine interstitial material nowhere are seen what might be division lines between the old rolled quartz and that which has been deposited on it.

4472

From two
miles east of
Thucaline Point
North Shore
Lake Huron
Canada

Granite.

C. P. Vanhise. Oct. 1883.

Macroscopic Description.

Dark gray; of a massive, medium grain.
Feldspar and quartz are both recognizable.

Microscopic Description.

Constituents:- Orthoclase, and oligoclase,
both largely kaolinized; quartz; biotite,
mostly altered to chlorite and iron oxide.

4473

Boulder of
conglomerate

Island near

Base of Huronian

2 miles east of

Thessalon Point

North Shore

Lake Huron

Canada.

Altered Greenstone.

C. P. Vanhise Oct. 1883.

Microscopic Description.

Has apparently been some sort of a basic rock, perhaps a diorite or diabase, but is now so badly altered as to make it impossible to certainly say. The section now mostly consists of badly decomposed plagioclase, calcite, and pale green chlorite.

A few small grains of quartz and quite plentiful kaolin, are noticed, as also, a gray material which may be calcium titanate, a result of the decomposition of titaniferous iron.

11474

From an island
near base of
Huronian
2 miles east of
Theriot Point
north shore
Lake Huron
Canada

Feldspathic Quartzite.

C. P. Vanhise Oct. 1883

Macroscopic Description.

Grayish drab; fine grained; compact;
hard, with conchoidal fracture.

Microscopic Description.

Quartz in rounded, and sometimes somewhat angular grains is the most important constituent. Many of these grains show enlargements but the quantity newly deposited is always small, and the resultant grains never interlock. Orthoclase and oligoclase in rounded and angular fragments are quite plentiful. The unusual angularity of the grains suggests that the material composing the rock had but little way to travel after being broken down. The fragments vary greatly in size, running from medium sized grains to those so small as to be indistinguishable from the matrix. This matrix contains much kaolin but it is probable that the strength of the rock is largely due to secondary silica which has deposited in quantity as material crystallographically independent of the original grains. Iron oxide is present and also more or less infiltrated calcite.

4475

From island
near base of
Huronian
2 miles east of
Theodore Pt.
North shore
Lake Huron
Canada

Feldspathic Quartzite.

C. R. Pauliser. Oct. 1883

Macroscopic Description.

Like 4474.

Microscopic Description.

Like 4474 but finer grained.

4476

From island
near base of theHuronian
2 miles east of
Thessalon PointLake Huron
Canada.Quartzite

C. R. Vanhise Oct 1883.

Macroscopic Description.

Intermediate in look between the gray rather dull quartzite 4474 and the vitreous gneiss-like quartzite 4442.

Microscopic Description.

With two minor modifications the description of 4442 answers sufficiently for this section also. 4476 has more chlorite and less feldspar. Like 4442 it differs materially from 4474 and 4475 in showing no grains of quartz with apparent enlargements; in having very much less kaolin, and much more quartz deposited as interlocking grains crystallographically independent of the coarser quartz.

4477

From island
near base of
Huronian
2 miles east of
Theriot's Point
Lake Huron
Canada.

Conglomerate.

C. A. Vanlise. Oct. 1883.

Microscopic Description

First section matrix. Differs from 4476 in that clayey matter is more plentiful and fine interlocking quartz in the interspaces less plentiful.

Second section a pebble. A section of a granite pebble in 4477 shows a large amount of calcite and epidote with some chlorite, beside the essential minerals of such a rock, oligoclase, orthoclase, and quartz.

4478}

4483}

From island
near the base
of the Huronian
north shore
Lake Huron,
Canada

Conglomeratic Quartzites.

C. R. Vanhise Oct. 1883

Macroscopic Description.

Both have matrices which are not different from 4476. In these matrices are granite pebbles which resemble 4472.

Microscopic Description.

The sections are from the granite pebbles and the description of 4472 answers for these with the exception that 4478 carries a little augite.

Commence here new count of folios.

4480

From island

near base of

Huronian

north shore

Lake Huron,

Canada

Conglomeratic Feldspathic Quartzite.

G. A. Vanhise Oct. 1883

Macroscopic Description.

Consists of granite pebbles set in a rather sparse cement which resembles 4474. The granitic fragments are in sizes from several inches across to those so minute as to render impossible their separation from the matrix.

Microscopic Description.

The matrix resembles very closely 4474, the only difference of note being the absence of enlarged quartz grains. The granite pebbles are evidently parts of the rock 4472. They are scattered indiscriminately through the matrix in all forms from a single grain of quartz or feldspar, through complex ores, or unions of the two to those so large as to be capable of being chipped and furnishing entire sections.

4481

Conglomeratic Quartzite.

From island

C. R. Vanhise Oct. 1883.

near base of

Macroscopic Description.

Huronian

north shore

Lake Huron

Canada.

Granite pebbles set in an exceedingly fine, almost aphanitic, dull red, hard matrix, with conchoidal fracture, very different from that of the rock at the other end of the island.

Microscopic Description.

The matrix is very fine, and entirely different from either 4474 or 4476. Small, slightly rounded, or sub-angular quartz grains which often interlock more or less perfectly, largely compose it. Quite numerous feldspars, both orthoclase and oligoclase as also plenty of brown oxide of iron, and chlorite both in fragments of all shapes. Nowhere are to be seen any quartz grains enlarged by secondary deposition.

The granite pebbles have more iron oxide than 4472, but do not materially differ from it.

4482

From island

near base of

Huronian

north shore

Lake Huron

Canada.

Hornblende Biotite Gneiss.

C. R. Vanhise Oct. 1883

Badly decomposed, but showing distinctly
orthoclase, oligoclase, quartz, biotite, hornblende.
 Abundant long apatite needles are included
 in the quartz and feldspar. Chlorite and
ferrite are present.

Feldspathic Quartzites.

C. R. Vanhise, Oct 1883

6501 }
6502 }

Island 3 1/2

miles north-

west of

Three alone Point

north shore

Lake Huron

Canada

Microscopic Description.

Quite feldspathic. The quartz grains interlock often quite intricately, but the outlines of the old rounded grains are generally very faint and often are not to be seen at all. There is much quartz also which has been deposited independently, sometimes in large very irregular areas, so minutely crystallized as to leave it doubtful if a portion of it is not amorphous. In this case is it possible that a rounded complex nucleus was originally present, and that the depositing silica has continued to go on in the same manner, just as it does when it has a single grain about which to form? Pyrite and muscovite are present.

6503 }
 6504 }
 6505 }

Feldspathic Quartzites.

C. R. Vanhise, Oct. 1883

Microscopic Description.

The feldspar grains are rounded. The quartz grains never interlock, and are often at quite a distance from each other. They show no enlargements. Quite numerous rounded complex "jasper" grains are present. Also a large amount of clayey material and chlorite flakes. Silica also occurs as a very minutely crystallized interstitial material. Pyrite and muscovite are present.

6506

Conglomeratic Quartzite.

West of

L. P. Vanluse Oct. 1883

Thessalon Point

north shore

Lake Huron

Canada.

Microscopic Description.

Feldspathic; no enlargement in the grains of the matrix; chiefly clay as an interstitial material. The pebbles are of two classes: 1st those which are built of large intricately interlocking grains; and 2nd those which are of minute ones. The second class again subdivides itself into those which are mostly free from impurities, and those which have mingled with the grains a vast number of minute specks of magnetite. Doubtless the black pebbles seen macroscopically are of this kind. The existence of enlargements of complex pebbles spoken of in 6502 is farther confirmed by this section, for one must believe in the power of depositing silica to continue this form of growth or else that a pebble which is for the most part smooth surfaced and oval in shape may have a large very irregular angular protuberance.

6509

East Point

Bruce Mine

Bay

Lake Huron

Canada.

Feldspathic Quartzite.

C. R. Vanhise Oct. 1883

Microscopic Description.

A few interlocking quartzes occur, and in one or two places division lines marking off secondary enlargements are discoverable. Silica and ferrite are the filling materials. One large crystal of pyrite was noted.

6513

From island
on the east side of
Bruce Mine
Bay
Lake Huron
Canada.

Feldspathic Quartzite.

C. R. Vanhise Oct. 1883

Microscopic Description.

Differs from 6525, 6526, 6529 only in
containing more chlorite than they.

6513 }
 to
 6529 }

Bruce Mine

Bay

North shore

Lake Huron

Canada

Feldspathic Quartzites.

C. R. Vanhise Oct. 1883

Microscopic Description.

In places the feldspars interlock quite intricately with each other as well as with the quartz grains. This sometimes gives the rock a decided granitic appearance. Enlargements of the quartz grains were sought for and some indication of their existence was found with a fine ^{objective} in 6519. Enlargements of feldspars were also looked for but their existence not proved. If these two enlargements have taken place they have left behind little trace.

6514 }
 6516 }
 6519 }

Feldspathic Quartzites.

C. R. Vanhise Oct. 1883

Macroscopic Description.

From an island east side of Bruce Mines Bay
 Vitreous, reddish, feldspathic quartzites.
 These rocks have a decided granitic look.

Microscopic Description.

Lake Huron Canada.
 (In contact with a greenstone dyke.)
 While many of the quartz grains interlock, although searched for carefully, nowhere is there any evidence obtainable of secondary enlargements so far as lines of division are concerned. Interstitial minutely interlocking quartz occurs. The query naturally arises whether the contact of these rocks with the eruptive greenstones has obliterated such lines of division by "fusion" or by dissolving in superheated water the impurities which usually indicate the line which separates the old from the added quartz. A good deal of orthoclase stained with iron oxide is present. Also some chlorite and a little muscovite.

These quartzites remind one of the granitic quartzites of the Laurentian area (4434 - 4442.)

6520

Framvickland
from east side

Bruce Mine

Bay;

north shore

Lake Huron

Canada
(Ten feet from
contact with
the dyke.)Feldspathic Quartzite.

C. R. Vanhise Oct. 1883

Macroscopic Description.

Like 6514.

Microscopic Description.

Contains larger grains of quartz and orthoclase than 6515, 6516, 6519, some of the grains of the former of which minerals interlock very intricately. A fine interlocking, interstitial quartz occurs sometimes in large areas. In such cases there were probably original complex nuclei. A little calcite is present.

6524

From same

place as

6520.

filling the
entire space

between two

dykes.

Feldspathic Quartzite

C. R. Vanhise Oct. 1883

Macroscopic Description.

Even more feldspathic and granitic looking than the preceding from this locality.

Microscopic Description.

While the rock is clearly fragmental, the interlocking of the grains is as common as in 6520 and there is a smaller proportion of minute interstitial quartz. Then there is a much greater quantity of chlorite than in the preceding quartzes; so that the appearance of the whole is quite a close approach to that of a chloritic granite. Complex quartz grains and very abundant ferrite inclusions occur.

6525 }
 6526 }
 6529 }

Feldspathic Quartzites

C. R. Vanhise Oct. 1883.

Macroscopic Description.

Like 6524.

Microscopic Description.

From an island on the east side of Bruce Mine Bay Lake Huron Canada Between two dykes. Not essentially different from 6514, 6515, 6519, 6520. In one case even the feldspars interlock. They include microcline and plagioclase which have not been before noted. One has a crack filled with chlorite mixed with some hornblende. The gradation from single large quartzes to minute interlocking ones is nicely illustrated. Nowhere is any line of division observed to prove secondary enlargements. The amount of interstitial quartz, and the degree of interlocking varies in the different sections as it does in a less degree in different parts of the same section. There are many complex areas of fine quartz.

6553

Campement

d'Ours

Island

Lake Huron.

Feldspathic Quartzite.

C. R. Vanhise Oct. 1883

Microscopic Description.

Orthoclase and plagioclase compose fully one-half of the section. The quartz in a few cases shows division lines of enlargement; however the quartz and feldspar fit each other closely and often interlock. Comparatively little interstitial quartz and kaolinite are present but there is some chlorite, limonite and pyrite.

6555

Carapement

d'Ors

Island

Lake Huron

Feldspathic Quartzite.

C. R. Vanhise Oct. 1883

Microscopic Description.

Orthoclase and oligoclase are quite plentiful but not nearly so abundant as in 6553. The quartz is correspondingly plentiful, and often intricately interlocking; however, nowhere are seen satisfactory division lines of enlargement. There is comparative little fine interstitial quartz.

6556

St. Joseph's

Island

Lake Huron

Argillaceous Quartzite

C. R. Vanhise Oct. 1883

Microscopic Description.

But little feldspar is present. The quartz grains interlock and frequently show enlargements. A good deal of kaolin and interstitial fine quartz are present, as also a little limonite.

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