

Another variety (Sp. 953) is of a light brownish-red color, with the Mica flakes arranged in greenish-black parallel streaks; weathered surface reddish-white and even.

No. 282 (Sp. 952).—*Greenish Chloritic Gneiss*.

Laurentian.—From State Road L'Anse to Champion, T. 49—R. 33.

Grayish-green, with minute reddish-white, slightly glittering specks.

A hard, compact, tough, fine-grained, uniform, calcareous Gneiss, composed of grains, never over $\frac{1}{32}$ inch in diameter, of the following:—

a. About 5 parts of the rock, of reddish-white, often grayish-white, and smoky-gray Feldspar, minutely striated.

b. About 3 parts of the rock, of grayish-white Quartz, and

c. Minute soft olive-green scales of Chlorite, hardly distinguishable by the lens, whose frequently parallel arrangement produces the faintly-marked schistose structure. Small bunches occur of a coarse crystalline aggregate of the Feldspar and Quartz, in facets, $\frac{1}{16}$ to $\frac{1}{8}$ inch across, with a few minute particles of yellow Pyrite.

Fracture rather uneven. Streak greenish-white. Effervesces decidedly in acid. A few seams, covered with a film of the Chlorite, which appears under the lens to consist largely of minute glistening scales.

Weathers nearly $\frac{1}{2}$ inch deep, with an even surface, of grayish-white color, with a slight reddish tinge, the particles of Chlorite being more distinct on this lighter ground than on the fresh fracture.

No. 283 (Sp. 955).—*Coarse Chloritic Gneiss*.

Laurentian.—From State Road L'Anse to Champion, T. 49—R. 33.

Grayish-white, mottled with light brownish-red; glistening.

A coarse, hard Gneiss, composed of the same materials as No. 258, viz.:

a. About 6 parts of grayish-white crystalline Feldspar, partially decomposed into light brownish-red, in facets $\frac{1}{4}$ to $\frac{1}{2}$ inch across.

b. About 4 parts of grayish-white and smoky-gray glassy Quartz, in masses $\frac{1}{8}$ to $\frac{1}{4}$ inch across, but partially in tiny, flat, thin, lenticular, parallel masses. A blackish-green soft altered Mica or Chlorite, in minute glistening scales, with greenish-gray streak, is distributed throughout in small quantity, in parallel thin lenticular masses, $\frac{1}{4}$ to 1 inch long.

Fracture uneven. A few fissures, stained reddish-brown.

Weathers rather evenly, to a white or reddish-white, mottled with smoky gray.

No. 284 (Sp. 956).—*Fine-grained Chloritic Gneiss*.

Laurentian.—From State Road L'Anse to Champion, T. 49—R. 33.

Grayish-green; glittering.

A hard, tough, homogeneous, and very fine-grained, calcareous rock, made up of the same materials as No. 282, with the addition of minute scales of softened brown Mica. The scales of Chlorite help to produce the minutely glittering appearance, and the Feldspar occurs in thin flat crystals, which appear in section as exceedingly minute glistening lines, $\frac{1}{32}$ to $\frac{1}{8}$ inch long. A few yellow particles of Pyrite can be distinguished by the lens. The hand specimen does not reveal a schistose structure. A few thin seams occur, which are somewhat parallel and occupied by films of grayish-white Calcite.

Fracture sub-conchoidal. Streak grayish-white. Effervesces decidedly in acid. Fuses at 5 to a black glass.

By weathering, the color becomes a dirty greenish-gray, the edges are rounded, and the surface is covered with shallow cavities, slightly roughened by projecting particles of Feldspar and the edges of the Calcite-seams. Apparently a fine-grained variety of No. 282, in which no schistose structure can be distinguished in the hand specimen.

No. 285 (Sp. 1128).—*White Chloritic Gneiss*.

Laurentian.—Champion Mine.

Grayish-white, speckled with bluish and reddish-white; shining.

A compact, hard, brittle, coarse rock, which is made up of about equal parts of a grayish to bluish-white Feldspar, with good lustre and cleavage, and white streak, in facets $\frac{1}{16}$ to $\frac{1}{2}$ inch across, and of grayish to reddish-white and smoky Quartz, in tiny granules, which surround the grains of Feldspar, with a small quantity (much less than one-tenth) of a soft altered grayish-green Mica (Chlorite?), with greenish-gray streak, in tiny films, rarely over $\frac{1}{16}$ inch in length, made up of minute scales. The latter are irregular and sparsely distributed, and their slight predominance in one layer in the specimen faintly suggests a gneissoid structure.

Fracture uneven.

Weathers rather evenly and smoothly, to the depth of $\frac{1}{8}$ inch, to a dull grayish-white, speckled with dirty blackish-green.

No. 286 (S. 1367).—*Fine-grained Chloritic Gneiss.*

Laurentian.—S. W. part T. 47—R. 42, W. of Lake Gogebic.

Greenish-gray, minutely speckled with reddish-white.

A tough, compact, fine-grained Gneiss, consisting of Feldspar, Quartz, and Chlorite. No traces of stratification can be distinguished in the hand specimen. The Feldspar constitutes about 4 parts of the rock, and consists of minute granules of reddish-white or brownish-red color. The Quartz occurs in about equal quantity, in similar particles of a smoky-gray and grayish-white color. The Chlorite occurs in minute, soft, olive-green scales. Small bunches occur of coarse aggregations of these materials, the Chlorite traversing them in thin layers.

Fracture almost even. Streak greenish-white. A few fissures stained reddish-brown.

Weathers smoothly, to a dirty reddish-brown.

No. 287 (Sp. 1375).—*Banded Chloritic Gneiss.*

Laurentian.—N. E. $\frac{1}{4}$ of S. W. $\frac{1}{4}$ of Sect. 33—T. 47—R. 42.

Greenish-black, with minute specks and narrow bands of brownish-gray; glittering.

A compact, tough, hard, fine-grained, Chloritic Gneiss, made up of regular layers, which vary in thickness from a film up to $\frac{1}{3}$ inch, and in color in proportion to the amount of Chlorite in each layer. The Feldspar and Quartz resemble those of No. 269 (Sp. 1363), in grains rarely $\frac{1}{8}$ inch in diameter. The Chlorite consists of soft greenish-black scales, like those of No. 269, but never as large even as $\frac{1}{32}$ inch across. Several of the layers contain Pyrite in golden-yellow particles.

Fracture sub-conchoidal, but rough. Streak greenish and grayish-white.

Weathered surface even, and of a greenish-black color, with brownish tinge.

No. 288 (Sp. 1377).—*Chloritic Gneiss.*

Laurentian.—W. of Lake Gogebic, S. part of T. 47—R. 42.

Grayish-white, with blackish-green and white specks; slightly shining.

A compact, tough, hard, fine-grained Chloritic Gneiss, with its constituents uniformly distributed. The Feldspar constitutes about 6 parts of the rock, and differs slightly from the ordinary form, presenting a dead white appearance, slightly inclined to milky-white, often minutely striated, and occurs in tiny crystalline grains or perfect crystals, rarely exceeding $\frac{1}{32}$ inch in diameter, but in one case $\frac{1}{2}$ inch long. The Quartz occurs in tiny grains of smoky-gray, constituting 3 parts of the rock. The Chlorite occurs in minute scales, with almost as high lustre as those of No. 287. One layer occurs, chiefly feldspathic, and traversed by innumerable minute transverse films of a yellowish-green Epidote.

Fracture uneven.

Weathering even, but rough, and a reddish-white color, with white specks.

No. 289 (Sp. 1378).—*White Chloritic Gneiss.*

Laurentian.—In brook N. E. corner of Sect. 22—T. 46—R. 42.

Grayish-white, inclining to smoky, and with minute dark-green specks; glittering.

A compact, hard, tough, rather fine-grained, uniform, white Chloritic Gneiss, composed of Quartz and Feldspar. The Feldspar is grayish-white, with a smoky tinge, gives a white streak, and occurs coarsely crystallized; so that the section is covered with glittering facets, often minutely striated, about $\frac{1}{16}$ inch across. The Quartz occurs in about equal quantity, grayish-white in color, and in tiny masses uniformly distributed among the Feldspar. The micaceous scales are of two kinds: the one greenish-black, soft, glistening, fissile, and with greenish-gray streak—the other blackish-green, still softer, dull, particles of Chlorite, with greenish-white streak; the latter are the more abundant.

Fracture even.

Weathering smooth, and of a dirty olive-green, minutely speckled with black, and stains the rock with a light reddish-brown to the depth of $\frac{1}{8}$ to $\frac{1}{4}$ inch.

No. 290 (Sp. 1381).—*Banded Chloritic Gneiss.*

Laurentian.—Near N. W. $\frac{1}{4}$ of Sect. 29—T. 47—R. 42.

Olive-green, faintly banded with light flesh-red; slightly shining.

A hard, compact, tough, fine-grained, Chloritic Gneiss, made up of regular layers, faintly visible on a section, from a film up to $\frac{1}{8}$ inch in thickness. The Feldspar constitutes about 6 parts of the rock, and consists of flesh-red and reddish-white minute crystalline grains, very rarely exceeding $\frac{1}{32}$ inch in diameter; its predominance in certain layers imparts to them their reddish tint. The Chlorite is disseminated in thin films, mostly parallel, soft, olive-green, and slightly shining, because made up of very minute greenish-black, glistening scales, which can just be distinguished by the lens. Its predominance in films and layers produces the olive-green bands. Smoky-gray Quartz occurs in a very few minute grains, and a little yellowish-green crystalline Epidote in grains sometimes $\frac{1}{4}$ inch long. A little Pyrite is disseminated in minute golden-yellow particles.

Fracture uneven.

Weathers rather evenly, and without change of color.

Specimen 1383 is a layer from 1381, in which the proportion of the constituents is about 5 parts of Feldspar, 3 parts of Quartz, and 2 parts of Epidote, with only a very few scattered scales of Chlorite.

No. 291 (Sp. 1391).—*Decomposed Chloritic Gneiss.*

Laurentian.—N. $\frac{1}{4}$ of N. W. $\frac{1}{4}$ of Sect. 14—T. 47—R. 43.

Reddish-white and shining, with faint short lines of blackish-green and brownish-yellow.

A very hard, tough, compact, fine-grained, Chloritic Gneiss, made up chiefly of about equal quantities of reddish and grayish-white Feldspar, in tiny crystalline grains, often minutely striated, and of grayish-white and smoky-gray Quartz, with a very small amount of Chlorite, uniformly distributed in tiny parallel glistening blackish-green scales. Many of these have been decomposed, and their places are occupied by a brownish-yellow Ochre. Irregular seams occur, covered with soft bright brownish-yellow and reddish-brown Ochre.

Fracture almost even.

Weathers smoothly, to a dirty greenish-brown.

No. 292 (Sp. 1392).—*Decomposed Chloritic Gneiss.*

Laurentian.—N. $\frac{1}{4}$ of N. W. $\frac{1}{4}$ of Sect. 14—T. 47—R. 43.

Light flesh-red, mottled with reddish-brown and brownish-yellow.

A very hard, compact, tough, ochrey rock, made up of Feldspar and Quartz, like those of No. 291, the former predominating.

Fracture uneven. Streak white. It is traversed by many irregular fissures, by some of which a schistose structure is produced, and which are covered with soft films and folia of reddish-brown and brownish-yellow Ochre.

This is a variety of No. 291, in which the original Chlorite is entirely decomposed—the last stage in the decomposition of the Chlorite in a Chloritic Gneiss.

No. 293 (Sp. 1398).—*Banded Chloritic Gneiss*.

Laurentian.—N. W. corner of Sect. 29—T. 47—R. 42.

Apparently identical with No. 287, except in a lighter shade of green, and in the absence of Pyrite. (Hand specimen too small for any further distinctions.)

Specimen 1399 is lighter in color, the altered Mica constituting less than $\frac{1}{8}$ of the rock, and arranged in irregular but parallel thin seams, by which the section is covered with thin dark-green streaks, $\frac{1}{8}$ to $\frac{1}{4}$ inch apart.

No. 294 (Sp. 1400).—*Red Chloritic Gneiss*.Laurentian.—Near centre of N. W. $\frac{1}{4}$ of Sect. 29—T. 47—R. 42.

Brownish-red, streaked and speckled with smoky-gray, with broad flat surfaces speckled with blackish-green.

A compact, hard, tough, coarse Gneiss, with many seams, $\frac{1}{3}$ to $\frac{1}{2}$ inch apart, which produce a decidedly schistose structure. The Feldspar amounts to about 6 parts and is brownish-red, with reddish-white streak, and coarsely crystalline—the depth of its color being probably due to weathering. The Quartz amounts to about 3 parts, and is smoky-gray, and disseminated in bunches and seams, often $\frac{1}{4}$ inch thick. The seams are covered with thin films and tiny bunches of grayish-white Calcite and soft blackish-green Chlorite, with greenish-white streak, usually intermingled in the bunches. A few tiny geodes of Quartz crystals occur.

Fracture uneven.

Weathers smoothly and without change of color.

No. 295 (Sp. 1402).—*Chloritic Gneiss*.Laurentian.—Near centre of N. W. $\frac{1}{4}$ of Sect. 29—T. 47—R. 42.

Grayish- and blackish-green, speckled and mottled with reddish and grayish-white.

A hard, compact, tough, Chloritic Gneiss, of medium texture. It consists of about 6 parts of crystalline Feldspar, in tiny facets, rarely $\frac{1}{16}$ inch across, of a reddish and grayish-white and greenish-

gray color, of 3 parts of grayish-white and smoky-gray Quartz, and 1 part of soft blackish-green or bright grayish-green scales of Chlorite, with greenish-gray streak. The latter has a parallel arrangement which produces the schistose structure; and it is also somewhat irregularly disposed, so that small bunches and streaks in the rock are colored reddish-white by the predominance of the Feldspar.

Fracture uneven.

Weathers to the depth of about $\frac{1}{8}$ inch, with an uneven surface of a dirty cream color or reddish-white, with tiny crystalline grains of Feldspar projecting.

No. 296 (Sp. 1546).—*White Chloritic Gneiss*.

Laurentian.—From trail running N. Easterly from Ontonagon River in T. 46—R. 41.

Grayish-white, speckled with reddish-white and black.

A compact, tough, fine-grained, Chloritic Gneiss. The Feldspar constitutes about 6 parts of the bulk of the rock, and consists of tiny masses, rarely $\frac{1}{4}$ inch across, of grayish-white color, passing into reddish-white, and sometimes minutely striated. The Quartz is smoky-gray, and amounts to nearly 4 parts of the rock. The Chlorite is disseminated in minute soft olive-green scales, with somewhat parallel arrangement, and does not amount to 1 part of the rock. A few crystals of yellowish-green Epidote occur.

Fracture even.

Weathers rather evenly, to a gray color, dotted with white crystals of Feldspar.

Another variety, 1547, is a reddish-white Chloritic Gneiss, of still finer grain, and the weathered surface is of a reddish-white, speckled with white; contains no Epidote.

No. 297 (Sp. 940).—*Talc Chloritic Gneiss*.

Laurentian.—N. side of Sect. 16—T. 49—R. 33.

Resembles No. 290 (Sp. 1381), is not banded, but has a more decidedly and uniformly laminated structure from the arrangement of

the Feldspar, in parallel lenticular flakes, usually $\frac{1}{16}$ inch thick and $\frac{1}{8}$ to $\frac{1}{4}$ inch long. Contains no Pyrite, but many minute reddish-brown particles, as if from its decomposition. A little grayish-white Quartz is disseminated throughout in tiny granules, not easily distinguished by the eye. A little Talc seems to be associated with the Chlorite in minute greenish-gray or gray glistening scales.

No. 298 (Sp. 944).—*Talcy Chloritic Gneiss*.

Laurentian.—N. side of Sect. 16—T. 49—R. 33.

Light brownish-red, with specks and streaks of greenish-gray, grayish-white, and smoky gray; slightly shining.

A compact, hard, brittle, uniform, decidedly schistose Chloritic Gneiss, made up of about 4 parts of light brownish-red Feldspar, in tiny masses, rarely crystals, $\frac{1}{32}$ to $\frac{1}{16}$ inch across, of about 3 parts of grayish-white and smoky-gray Quartz, usually in still smaller grains, and of grayish-green Chlorite, with greenish-gray streak, and of greenish-gray Talc, with grayish-white streak, in greasy parallel films, which consist of minute glittering scales. The Feldspar grains are generally separated from each other by the Quartz and a somewhat porphyritic appearance is produced on a small scale.

Fracture uneven.

Weathers evenly, unchanged in color.

No. 299 (Sp. 945).—*Talcy Chloritic Gneiss*.

Laurentian.—N. side of Sect. 16—T. 49—R. 33.

Resembles No. 298 in general character, but is coarser. The Talc is present in much smaller quantity; the Feldspar predominates, occurring in crystalline masses, sometimes $\frac{1}{2}$ inch across, and the Quartz occurs in parallel, irregular, lenticular flakes. A seam occurs, stained reddish-brown.

Streak of the greenish films, sometimes greenish-gray, but generally greenish-white.

No. 300 (Sp. 1389).—*Brownish-gray Mica-Slate*.

Laurentian.—N. part of N. W. $\frac{1}{4}$ of S. 22—T. 46—R. 42.

Like No. 214, but the parallel films of brownish-gray Mica so predominate as to convert the rock into a Mica-Slate.

Effervesces decidedly in acid. Fuses before the blowpipe at 4.5, to a black glass.

Weathers rather evenly to a brownish-gray—the cleavage surfaces within being stained brown, often to the depth of an inch or more.

A transition rock from Feldspathic Argillyte into Mica-Slate.

No. 301 (See No. 61, Appendix B).—*Staurolitiferous Mica-Schist*.

Huronian.—Formation XIX.—Island in Michigamme Lake.

Brownish-black, minutely streaked with brownish-gray; glistening.

A rather hard, compact, fine-grained Mica-Schist, of a finely fibrous and somewhat nodular structure. It is made up of about 6 parts of grayish-white Quartz, in minute granules, and 4 parts of brown, blackish-brown, and black Mica, in minute narrow bladed scales, rarely over $\frac{1}{16}$ inch in length, the two materials being uniformly intermingled. Crystals of Staurolite, $\frac{1}{8}$ to $\frac{1}{4}$ inch long, and sometimes over $\frac{1}{16}$ inch broad, are dispersed through the rock, both in separate blades and in twins, associated with irregular masses, sometimes $\frac{1}{4}$ inch across, of a brownish-yellow mineral; the bending of the micaceous laminae around these minerals, sometimes in broad continuous films, and in separate scales, $\frac{1}{16}$ inch across, produces the nodular structure.

Fracture hackly. Streak white.

Weathers to a reddish-brown.

No. 302 (Sp. 743).—*Altered Porphyritic Dioryte*.

Huronian.—Sect. 3—T. 47—R. 30. South of Lake Michigamme.

Greenish-black and glittering, speckled with greenish-gray and reddish-white.

A hard, compact, tough, coarse Dioryte. The hornblende mineral amounts to nearly 6 parts, and occurs in irregular masses, scales, and long thin blades, usually $\frac{1}{16}$ to $\frac{1}{8}$ inch wide, and $\frac{1}{4}$ to $\frac{5}{8}$ inch long, of a high lustre, greenish-black color, sometimes iridescent, and with grayish-white and greenish-gray streak. These scales and blades have a feebly marked transverse striation, instead of the usual longitudinally-fibrous structure of Amphibole; and a minute dull line often runs down the middle of the long blade, like the midrib of a lanceolate leaf. Minute films of a light-green and of a grayish-white color sometimes cover these facets, and perhaps consist of Epidote and Calcite. The Feldspar amounts to about 4 parts, is generally greenish-gray, often reddish-, greenish-, and yellowish-white, gives a grayish-white streak, has generally a very feebly marked cleavage and dull lustre, and occurs in grains $\frac{1}{16}$ to $\frac{1}{8}$ inch across. A very few grains of smoky-gray Quartz and bronze-yellow Pyrite also occur, $\frac{1}{16}$ to $\frac{1}{8}$ inch across.

Fracture uneven. Effervesces but very slightly in acid. Not magnetic. Powder greenish-white. The magnet separates 5 per cent. in black particles.

Weathers unevenly to a reddish-brown, the crystals of Amphibole projecting and unchanged in color.

No. 303 (Sp. 1103).—*Black Dioryte*.

Huronian.—Bed VII. or IX.—Washington Mine.

Greenish-black and glistening.

A hard, compact, very tough, and rather coarse Dioryte, which consists of about, or over, 5 parts of greenish-black Amphibole, in fibrous facets, $\frac{1}{16}$ to $\frac{1}{8}$ inch long, of somewhat micaceous structure, greenish-gray streak, and glistening lustre—of nearly 4 parts of grayish-white Feldspar, in crystalline masses with very feebly marked cleavage—and about 1 part of smoky Quartz (?), yellow Pyrite, scales of blackish-green Chlorite, and particles of black Magnetite: which can all be distinguished by the lens, especially on the weathered surface.

Fracture uneven. Streak greenish-white. Fissures stained reddish-brown.

Weathers evenly but roughly, to a reddish-white (Feldspar), speckled with blackish-green (Amphibole). The flattened shape of the specimen and a few fissures suggest that it may be a Dioryte-Schist.

No. 304 (Sp. 1244).—*Green Dioryte*.

Huronian.—Grand Portage, Sect. 25—T. 43—R. 30.

Greenish-gray, minutely speckled with greenish-white; glittering.

A compact, tough, hard, rather fine-grained rock, consisting of about 6 parts of grayish-green fibrous facets of Amphibole, $\frac{1}{16}$ to $\frac{1}{8}$ inch long—3 parts of greenish-white Feldspar, in crystalline particles without cleavage—and nearly 1 part of minute yellow particles of Pyrite.

Fracture uneven, but approaching sub-conchoidal. Streak greenish-white.

Weathers rather evenly, to blackish-brown, mottled by yellowish-brown; the constituents appear to weather equally.

No. 305 (Sp. 1246).—*Green Altered Dioryte*.

Huronian.— $1\frac{1}{4}$ miles above Paint Portage.

Dark green, speckled with brown; glittering.

A hard, compact, tough, minutely porphyritic Dioryte, of medium grain, made up of about equal bulks of blackish-green Amphibole, in slightly fibrous blades, usually from $\frac{1}{16}$ to $\frac{1}{8}$ inch, sometimes $\frac{1}{4}$ inch in length—of a brown Feldspar in thin plates of the same size, with good cleavage—and of a crystalline light green paste, which seems to be made up of minute scales, perhaps of Chlorite. Much Pyrite is also disseminated in bright yellow crystals or particles, $\frac{1}{16}$ inch across.

Fracture uneven. Streak greenish-gray. A fissure occurs, covered with a film of brownish-white Calcite.

Weathers rather unevenly, to a yellowish-brown, mottled with reddish-brown.

No. 306 (Sp. 1409).—*Black Porphyritic Dioryte (Micaceous)*.

Boulder in Sect. 18—T. 47—R. 45.

Black, with reddish-white specks; glittering.

A very compact, hard, tough, coarse, calcareous Dioryte, composed of about equal parts of slightly altered black Amphibole, in fibrous facets about $\frac{1}{8}$ inch long, with greenish-gray streak, and of reddish or grayish-white Feldspar, in massive grains, rarely over $\frac{1}{16}$ inch across. Mica also is disseminated in brown scales, and yellow Pyrite in unusual quantity, in minute particles or strings, often crossing the facets of Amphibole.

Fracture rather uneven. Effervesces decidedly in acid.

Weathers unevenly to a light yellowish-gray, speckled with black and reddish-white. Resembles an Amphibole-Gneiss rather than any other Dioryte, on account of the slight alteration and bright lustre of its Amphibole, but I cannot distinguish any Quartz.

No. 307 (Sp. 1427).—*Black Dioryte*.

Huronian.—W. line of Sect. 18—T. 47—R. 45.

Black, minutely speckled with gray; decidedly glittering.

An unaltered, minutely porphyritic Dioryte, resembling No. 306, but of a fine texture, the crystals rarely exceeding $\frac{1}{16}$ inch in length. The Feldspar is usually grayish-white. Pyrite is disseminated in minute particles, and there is no Mica nor Calcite.

Fracture sub-conchoidal. Streak grayish-white. A thin seam of brownish-red Feldspar occurs. Very feebly magnetic. Powder ash-gray, inclining to greenish; the magnet separates $7\frac{1}{2}$ per cent. by weight in grayish-black particles.

Weathers unevenly, but smoothly, to a brownish-red enamel.

No. 308 (Sp. 1432).—*Altered Porphyritic Dioryte (Magnetic)*.

Copper Trap.—Just N. of S. E. corner of Sect. 7—T. 47—R. 44.

Blackish-green, with greenish-gray specks; decidedly glittering. A very hard, compact, heavy, tough rock, of medium texture,

made up of about 6 parts of greenish-gray and grayish-white translucent Feldspar, with good cleavage and high lustre, in sharply crystallized blades, usually $\frac{1}{8}$ inch, some $\frac{3}{8}$ inch, in length,—of 3 parts of a blackish-green, apparently amorphous mineral (altered Amphibole)—and nearly 1 part of irregular grains of black Magnetite. Much Pyrite is disseminated through the rock, being often enclosed in the crystals in minute bright yellow particles.

Fracture uneven. Streak greenish-white. Many irregular fissures, stained yellowish-brown. Decidedly magnetic, and polarity strongly marked. Powder greenish-gray. The magnet separates $8\frac{1}{2}$ per cent. by weight, in blackish-gray particles.

Weathers evenly to a light chocolate-brown, to the depth of $\frac{1}{4}$ to 1 inch; on the surface occurs a tiny geode of Quartz crystals, so that the whole rock may be quartzose.

No. 309 (Sp. 1454).—*Fine-grained Gray Dioryte*.

Laurentian.—S. side of Sect. 16—T. 47—R. 45.

Gray, inclining to greenish, minutely speckled with gray; glittering.

Resembles No. 256, but is a little finer-grained, and consists of about equal parts of brownish and greenish-black Amphibole, and grayish-, sometimes yellowish-white Feldspar, both with good cleavage and lustre. A little smoky Quartz may also be present. It contains no Mica and little Pyrite. Very feebly magnetic. Powder ash-gray, slightly inclining to greenish; the magnet separates 2.8 per cent. by weight, in grayish-black particles. Many fissures occur, stained blackish-brown.

Weathers evenly but roughly, to a dirty reddish-brown, to the depth of $\frac{1}{3}$ to $\frac{1}{8}$ inch, with a section of the same color, terminating in a dark brown band.

No. 310 (Sp. 1498).—*Fine-grained Blackish-green Dioryte*.

Huronian.—Sunday Lake Outlet.

Blackish-green, with very minute gray specks; glittering.

A very fine-grained, compact, hard, tough, homogeneous, mi-

nutely porphyritic, altered Dioryte, in which the crystals are rarely $\frac{1}{32}$ inch long. Under the lens it appears to consist of about 6 parts of fibrous facets and needles of blackish-green altered Amphibole, and 4 parts of minute plates of grayish-white Feldspar, with many bright yellow particles of Pyrite disseminated throughout.

Fracture sub-conchoidal. Streak greenish-gray.

Weathers unevenly, to a reddish-brown; the color may be due to disseminated Chlorite.

This specimen differs to the eye from all the other Diorytes in its extremely fine grain, its peculiar uniform green color, and the indistinct blending of its constituent minerals.

No. 311 (Sp. 1501).—*Fine-grained Black Dioryte.*

Huronian.—Sunday Lake Outlet.

A minutely porphyritic, unaltered Dioryte, resembling No. 310; but its texture is not so fine, the crystals being often $\frac{1}{16}$ inch long. The Amphibole also is of a black color. Many irregular fissures occur, stained yellowish, and reddish-brown.

Fracture uneven. Streak white, slightly grayish. Effervesces slightly in acid. Very feebly magnetic. Powder ash-gray, perhaps slightly greenish; the magnet separates 5 per cent. by weight, in grayish-black particles.

Weathers evenly, to shades of yellowish- and reddish-brown.

No. 312 (Sp. 1504).—*Greenish Altered Dioryte.*

Laurentian.—Near E. $\frac{1}{2}$ of Sect. 24—T. 47—R. 46.

Blackish-green and glittering, speckled with greenish-white.

A hard, compact, tough rock, of medium texture, made up of equal quantities of a blackish-green mineral (altered Amphibole?), in shining narrow facets, usually about $\frac{1}{8}$ inch long, and sometimes fibrous, and of greenish-gray Feldspar, partly massive and partly in tiny tabular crystals, with good cleavage.

Fracture uneven. Streak grayish-white.

Weathers evenly, to dirty shades of reddish-brown.

In another variety, 1505, bronze-yellow Pyrite is disseminated in tiny particles.

Weathers to the depth of $\frac{1}{16}$ inch, with an even surface of a reddish color, speckled with blackish-green, and roughened by the irregular weathering and slight projection of the harder crystals of the two minerals.

No. 313 (Sps. 1549, 1550, 1551).—*Fine-grained Black Dioryte.*

Laurentian.—Say N. E. $\frac{1}{4}$ of Sect. 22—T. 46—R. 41.

Black, speckled with grayish-white; glittering.

A compact, hard, tough, fine-grained rock, minutely porphyritic, and resembling No. 332, etc.; but is made up of about 6 parts of grayish-white Feldspar, in thin plates, with good cleavage and high lustre, and sometimes minutely striated, and of 4 parts of ill-defined short blades and facets of a black and blackish-green Amphibole, passing into blackish-green scales of Chlorite, which sometimes retain the bladed form.

Fracture uneven. Streak grayish-white.

Weathers evenly to a yellowish-brown, reddish-brown, and brick-red, to the depth sometimes of $\frac{1}{16}$ inch.

No. 314 (Sp. 1720).—*Quartzose Porphyritic Dioryte.*

Huronian.—Marquette Quarry near Cleveland Dock.

Blackish-green, speckled with brownish-red; glittering.

A compact, tough, heavy, coarse Dioryte, made up of about equal parts of green Amphibole, with good lustre, and greenish-white streak, in fibrous facets, usually $\frac{1}{16}$ to $\frac{1}{8}$ inch, sometimes $\frac{1}{4}$ inch, in length, and of a bright brownish-red to salmon-colored Feldspar, in facets rarely over $\frac{1}{16}$ inch across, generally with good cleavage and lustre, and grayish-white streak, but often showing alteration by dullness of lustre and color, and lack of good cleavage. The arrangement of these constituents varies at one end of the specimen, one or other of the constituent minerals predominating; and the extreme corner consists of a mixture of the same coarseness, of

equal parts of the Feldspar and of grayish-white to smoky Quartz, entirely free from Amphibole.

Fracture uneven. A few irregular fissures, covered with films of dull blackish-green Amphibole, or reddish to yellowish-brown Ochre.

Weathers rather evenly, to a dirty blackish-green, speckled with dull brownish-red.

Specimen 1721 is a larger specimen of the quartzose aggregate which occurs on a corner of 1720. The Quartz is occasionally gathered in bunches, $\frac{3}{16}$ inch across, and a few isolated crystals of greenish-black Amphibole are interspersed. A seam of greenish-gray material, $\frac{1}{8}$ inch thick, lines one face of the specimen, and is described under No. 315.

No. 315 (Sp. 1723).—*Quartzose Porphyritic Dioryte.*

Huronian.—Marquette Quarry near Cleveland Dock.

A coarser variety of No. 314, the blades of Amphibole often varying in length from $\frac{1}{4}$ to $\frac{1}{2}$ inch, and the facets of Feldspar from $\frac{1}{8}$ to $\frac{1}{4}$ inch, with rare evidence of cleavage and dull lustre and color, the two minerals being irregularly mingled in different parts of the specimen. It is traversed by a seam, apparently of segregation, from $\frac{1}{4}$ to $\frac{1}{2}$ inch thick, of a grayish-green material, almost impalpable in texture and resembling green Jasper. It gives a grayish-white streak, slightly metallic from the file, and may be a fine-grained aggregate of Quartz and greenish-gray Feldspar.

No. 316 (Sp. 1724).—*Epidotic Porphyritic Dioryte.*

Huronian.—Marquette Quarry near Cleveland Dock.

A variety of No. 314, with the coarseness of No. 315, consisting of about 7 parts of brownish-red Feldspar, with good cleavage and lustre, often in bunches $\frac{1}{8}$ to $\frac{1}{4}$ inch across, and 3 parts of greenish-black Amphibole, in fibrous shining facets, $\frac{1}{8}$ to $\frac{3}{8}$ inch long, the two minerals being somewhat irregularly mingled. A little yellowish-green translucent Epidote is interspersed in crystalline masses, with good lustre, sometimes $\frac{1}{8}$ to $\frac{1}{4}$ inch across, always

attached to, or surrounding, the blades of Amphibole. The coarseness of the rock, high lustre of the minerals, and fine contrast of the colors, render this the most beautiful and characteristic of the Diorytes.

Specimen 1725 is a seam, $\frac{1}{4}$ to $\frac{1}{2}$ inch thick, from the Dioryte represented by Specimens 1720 to 1724. It consists entirely of brownish-red Feldspar, with good cleavage and lustre, and apparently unaltered, in facets $\frac{1}{8}$ to $\frac{3}{8}$ inch across. Many tiny geodes occur, lined with small crystals of the Feldspar, the surface of the geodes and of the cleavages being mostly covered or mottled with brownish or brownish-black stains.

No. 317 (Sp. 1733).—*Porphyritic Dioryte.*

Huronian.—Pic Nic Rocks, Marquette.

Resembles No. 316, in general appearance and characteristics; but the Amphibole occurs in about equal quantity to the Feldspar. The latter is very much lighter in color; very little Epidote can be distinguished; and a very little Quartz is associated with the Feldspar grains.

The weathered appearance is striking: the crystals of Amphibole remaining undimmed in color and lustre, but more deeply worn than the Feldspar—while the latter projects in angular masses of a reddish-white color, without lustre, the surface being thus rendered rather uneven and very rough.

No. 318 (Sp. 1734).—*Quartzose Porphyritic Dioryte.*

Huronian.—Pic Nic Rocks, Marquette.

About half of this specimen consists of a very coarse Dioryte, like Nos. 316 and 317, containing a very little Epidote, Quartz, and bronze-yellow Pyrite, and in which the blades of Amphibole are often from $\frac{1}{8}$ to over $\frac{1}{2}$ inch long, and from $\frac{1}{8}$ to $\frac{1}{4}$ inch wide. This passes quite suddenly into very hard, fine-grained, compact, grayish-green rock, somewhat resembling the flinty seam in No. 315, but consists not only of Quartz and grayish-white and greenish-white Feldspar, but of microscopic blades of Amphibole. Much

Pyrite is disseminated through this fine-grained rock, in tiny particles and in thin films, sometimes $\frac{1}{4}$ inch across, and it is also crossed irregularly by thin seams of blackish-green Amphibole, and by others of greenish-gray color, from whose material the Amphibole seems to be absent. The specimen is traversed by a few fissures, covered with films of Ochre of a brownish-red and yellow color.

Weathers somewhat unevenly but smoothly, on the fine-grained rock, to a light shade of greenish-gray, striped by the seams with reddish-white, and mottled by the fissures with reddish-brown and yellowish-gray.

No. 319 (J).—*Coarse Green Amphibolyte.*

Huronian.—N. part of N. W. $\frac{1}{4}$ of S. W. $\frac{1}{4}$ of Sect. 11—T. 47—R. 27 (N. of Marquette Mine).

Blackish-green, speckled with grayish-green; shining.

A tough, compact, heavy Amphibolyte, made up of about 7 parts of blackish-green Amphibole, in rather soft, fibrous, thinly laminated facets, $\frac{1}{8}$ to $\frac{1}{4}$ inch across, which give a greenish-white streak, and of 3 parts of a minutely granulated Feldspar, of a greenish-gray, grayish-white, and yellowish-green color, in thin scales or in tiny granules.

Fracture uneven. Thin seams traverse this rock, containing a light-purple feldspathic mineral, in radiating groups, associated with green Quartz and a little Chlorite in minute scales.

No. 320 (Sp. 745).—*Coarse Green Amphibolyte.*

Boulder from S. 3—T. 47—R. 30, South of Lake Michigamme.

Blackish-green; shining.

A compact, tough, coarse Amphibolyte of medium hardness, made up of about equal bulks of Amphibole and a very fine-grained matrix of the same color. The former occurs in fibrous facets, about $\frac{1}{2}$ to $\frac{3}{4}$ inch square, inclined irregularly in all directions, and gives a greenish-gray streak. The matrix appears under the lens to consist of scales of silvery-white Mica, needles of Am-

phibole, and granules of grayish-white Feldspar, with a little yellowish-white Quartz.

Fracture very uneven. Many seams and films traverse the rock and the crystals of Amphibole, weathered to rusty shades of reddish-brown.

Weathers rather evenly and smoothly to a blackish-green, minutely speckled with reddish-white (Feldspar), the Amphibole crystals appearing as spots of a lighter shade of blackish-green than on a fresh fracture. In some parts of the weathered surface, minute yellowish-green spherules (of Epidote) appear under the lens.

No. 321 (Sp. 876).—*Black Serpentine.*

Dyke like Presqu'isle.—E. side of Presqu'isle.

Iron-black; slightly glittering.

A rather hard, compact, brittle, fine-grained rock, almost homogeneous to the eye, but which under the lens appears to consist of about 7 parts of tiny black angular masses, in a yellowish-green paste, probably Serpentine. The former is partly crypto-crystalline, but mostly granular, presenting many minute facets visible to the naked eye and traces of cleavage (altered Amphibole). A small quantity of scales of blackish-green Chlorite appears to be present, and a few particles of yellow Pyrite. Many irregular fissures, stained reddish-brown, or covered with films of a black enamel and of brownish-white Calcite.

Fracture very uneven. Streak gray.

Weathers very unevenly and roughly to a blackish-brown.

No. 322 (Sp. 1245).—*Green Magnesian Dioryte (Serpentine).*

Dyke like Michigamme River, Sect. 28 or 29—T. 42—R. 31.

Greenish-gray, mottled with black; dull.

A rather soft, compact, brittle, crypto-crystalline rock, whose appearance slightly resembles that of an Ophiolyte, consisting of about 7 parts of angular black masses, of irregular shapes, usually $\frac{1}{4}$ to $\frac{1}{2}$ inch long, in about 3 parts of a greenish-gray paste. The

latter presents many minute facets under the lens, sometimes slightly striated, and appears to consist of a Feldspar. The black masses seem to consist of about equal bulks of particles of the same greenish-gray Feldspar, and of black scales, sometimes fibrous, perhaps of altered Amphibole. Many irregular fissures in all directions, stained or mottled with reddish-brown.

Fracture uneven. Streak greenish-gray on the black masses and grayish-white on the paste.

Weathers unevenly to shades of reddish-brown. This rock contains much Lime and Magnesia, but no Chromium, and appears to show one of the last stages in the alteration of a Dioryte into Serpentine.

No. 323 (Sp. 1247).—*Black Magnesian Dioryte (Serpentine)*.

Huronian (?)—Sect. 22—T. 42—R. 31.

Iron-black and dull, speckled with greenish-gray, and glittering.

A brittle, coarse rock, resembling No. 322, made up of about 7 parts of black irregular angular masses, $\frac{1}{8}$ to $\frac{1}{4}$ inch across, in 3 parts of a greenish-gray paste. The former is generally dull, cryptocrystalline and homogeneous; but under the lens it sometimes shows an imperfect columnar structure (Amphibole). The greenish-gray paste consists of crystalline grains of a Feldspar, with good cleavage and lustre, passing into grains of the same color without cleavage, and possessing a greasy lustre, which may be Serpentine. A little brown Mica is also interspersed, sometimes in scales $\frac{1}{8}$ inch long; Pyrite occurs in a few yellow particles; Calcite, associated with red Ferric Oxide in grayish-white and reddish-brown films; and a translucent greenish-gray mineral, with grayish-white streak, apparently Serpentine, in a thin enamel-like seam.

Fracture uneven. Streak gray and grayish-white.

Weathers very unevenly, to reddish-brown, mottled with blackish-brown.

No. 324 (Sp. 1530).—*Chloritic Dioryte*.

Laurentian (?).—W. branch of Ontonagon River, Sect. 13—T. 46—R. 31.

Blackish-green, minutely speckled with brown; slightly glittering.

A hard, compact, heavy, tough, fine-grained rock, which appears under the lens to consist of about 6 parts of blackish-green Amphibole, in minute glittering blades, and of 4 parts of brown Feldspar, with ill-defined form and cleavage, and feeble lustre. Many irregular fissures stained reddish-brown, and one also lined with tiny scales of brown Mica and perhaps a little Chlorite.

Fracture uneven. Streak greenish-white, dotted with light brownish-red.

Weathers rather evenly, to dull shades of reddish and yellowish-brown.

Another variety (1531) is a little coarser.

Specimen 1532 contains also a light green paste, filled with minute scales resembling Chlorite. A seam of yellowish- and reddish-white Quartz, $\frac{1}{8}$ inch thick, crosses the specimen. Effervesces slightly in acid.

Specimen 1533 is traversed by more reddish-brown films.

Specimen 1534 contains much more Mica, both disseminated throughout and in a thin seam. Another thin seam consists of grayish-white and reddish-brown Feldspar.

Effervesces slightly in acid.

Weathers evenly to a blackish-green, and to the depth of over $\frac{1}{8}$ inch, with a reddish-brown section.

Specimens 1535, 1536, and 1537, are like 1534, with much Mica disseminated in minute scales, and with the other minerals rather ill defined.

Weathers to reddish-brown.

Specimen 1538 rather resembles No. 322, but most of the scales appear to be a brown Mica. Films of Calcite traverse the rock, so that it effervesces strongly in acid.

Streak grayish-white and brownish-red.

Specimen 1539 is like 1538, but it is a little coarser, and seems to contain more Chlorite.

No. 325 (Sp. 1428).—*Chloritic Dioryte-Wacké*.

Laurentian.—W. line of Sect. 18—T. 47—R. 45.

Reddish-brown, almost dull.

A decomposed variety of No. 307, the Feldspar being reddish-

brown, the Amphibole blackish-green, and hardly distinguishable without a lens, and the interstices between them being occupied by brick-red particles. Many irregular fissures covered with films of brick-red and reddish-brown Ochre, a brownish-gray substance, and blackish-green Chlorite.

Streak brick-red.

Weathers unevenly to a yellowish-brown, mottled by reddish-brown.

No. 326 (Sp. 818).—*Chloritic Dioryte-Schist*.

Huronian.—N. of North-Western Hotel, Marquette.

Greenish-gray, minutely speckled with reddish-brown; minutely glittering.

A tough, hard, compact, fine-grained calcareous schist, which appears under the lens to consist of about 4 parts of a reddish-brown mineral in fibrous facets (altered Amphibole), of 3 parts of minute scales of grayish-white Mica and blackish-green Chlorite, and of 3 parts of a grayish-white crystalline Feldspar, in minute particles.

Fracture even. Streak reddish-white. Effervesces decidedly in acid. The fissures of lamination are stained chocolate-brown and often covered with films of grayish-white Calcite and olive-green Chlorite.

In another specimen, 823, a very little of the Feldspar is reddish-white.

No. 327 (Sp. 1099).—*Blackish-Green Dioryte-Schist*.

Huronian.—Edwards Mine.

Blackish-green and glittering.

A hard, compact, heavy, homogeneous rock, chiefly of rather fine texture, and with a slight tendency to a flaky structure. It appears to consist mostly of greenish-black Amphibole, sometimes in fibrous facets $\frac{1}{16}$ to $\frac{1}{8}$ inch across, often iridescent, and rather micaceous in cleavage, but chiefly in minute scales or flakes, probably associated with a large quantity of Chlorite. A very little

grayish- or greenish-white Feldspar, in minute particles, can also be distinguished by the lens.

Fracture uneven. Streak greenish-white. A few irregular fissures, with reddish-brown stains or covered with films of brownish-white Calcite.

Weathers rather unevenly, by the splitting off of the flakes, to a dirty brownish-gray, inclining to green.

No. 328 (Sp. 1384).—*Greenish Dioryte-Schist*.

Laurentian.—S. W. corner Sect. 12—T. 47—R. 47.

Greenish-black, speckled with grayish-white; glittering.

A very hard, tough, compact, homogeneous, calcareous, porphyritic rock, of medium grain, composed of about 7 parts of greenish-black Amphibole, in narrow fibrous facets, rarely distinct crystals, $\frac{1}{16}$ to $\frac{1}{4}$ inch long, and of 3 parts of brownish and grayish-white Feldspar, in massive particles just visible to the eye. A little Pyrite is disseminated in minute yellow particles. A few fissures and seams stained reddish-brown.

Fracture rather uneven. Streak greenish-white. Effervesces slightly in acid.

Weathers evenly and smoothly, to a brownish-black.

No. 329 (Sp. 1385).—*Greenish Dioryte-Schist*.

Laurentian.—S. W. corner Sect. 12—T. 47—R. 47.

Resembles No. 328, but lighter colored.

The proportion of the Amphibole to the Feldspar is about 5 to 3. The Amphibole is often of a blackish-green color. Minute scales of blackish-green Mica are disseminated in small quantity. There is a slightly schistose structure, and the weathered surface is greenish-gray and slightly ridged and minutely pitted by the removal of the Amphibole and Mica and projection of tiny laminae of Feldspar.

No. 330 (Sp. 1401).—*Greenish Dioryte-Schist*.Laurentian (?)—Near centre of N. W. $\frac{1}{4}$ of Sect. 29—T. 47—R. 42.

Greenish-black, speckled with greenish-gray; glittering.

A compact, hard, tough Dioryte, of medium texture and apparently of coarsely schistose structure. Its constituents, which are visible to the eye, are a greenish-black Amphibole, in tiny facets, and irregular grains of greenish-gray, sometimes reddish-white, altered Feldspar, generally massive, but often showing a cleavage or an imperfect crystalline shape. The facets of Amphibole are much broken up by the irregular insertion of particles of the Feldspar. Much bronze-yellow Pyrite is disseminated in tiny grains. Parallel seams occur, lined with a fibrous film of Chlorite, with greenish-gray streak, and produce the apparent schistose structure.

Fracture uneven. Streak greenish-white.

Weathers to the depth of $\frac{1}{8}$ inch, with an even surface of reddish-white color, roughened and speckled by projecting crystals of weathered greenish-gray Amphibole.

No. 331 (Sp. 821).—*Calcareous Dioryte-Greenstone*.

Huronian.—N. of North-Western Hotel, Marquette.

Olive-green, mottled with chocolate-brown.

A compact, hard, brittle, fine-grained, calcareous rock, which appears under the lens to be chiefly composed of minute scales of olive-green Chlorite, in many spots altered into chocolate-brown, with a few acicular blades (altered Amphibole?) of the same colors, and many minute silvery-gray glistening scales, disseminated throughout. A few grayish and greenish-white particles (Feldspar?) can also be distinguished. The alteration of the Chlorite is sometimes so produced as to mark the section with narrow chocolate-brown concentric bands.

Fracture uneven. Streak grayish-white, often more or less reddish. Effervesces decidedly in acid. Many irregular fissures in all directions, rendering it difficult to obtain a fresh fracture, and occupied by films of grayish-white and reddish-brown Calcite, and blackish-green Chlorite, partly altered into chocolate-brown.

Weathers unevenly to blackish-green, mottled with chocolate-brown.

No. 332 (Sp. 1527).—*Fine-grained Dioryte-Greenstone*.

Laurentian.—W. branch of Ontonagon River, Sect. 13—T. 46—R. 41.

Grayish-green, glittering.

A soft, compact, tough, homogeneous, fine-grained rock, made up of about 6 parts of minute scales of soft, light-green to blackish-green Chlorite, and 4 parts of plates of grayish-white, sometimes brown, Feldspar, with good cleavage—both minerals having a high lustre.

Fracture uneven. Streak greenish-white. Effervesces slightly in acid.

Weathers evenly to reddish-brown.

In another variety, Specimen 1528, a little Calcite occurs in tiny geodes, while, in 1529, a larger part of the Feldspar is colored brown.

No. 333 (Sp. 819).—*Epidotic Dioryte-Greenstone*.

Huronian.—Lower Bed, N. of North-Western Hotel, Marquette.

Chocolate-brown, streaked and mottled with yellowish-green; dull.

A compact, hard, tough, rather fine-grained calcareous rock, made up of about 6 parts of reddish-brown, grayish- and reddish-white Feldspar, in minute crystalline facets, of 1 part of reddish-brown scales or needles without lustre (altered Amphibole?) and uniformly disseminated, and of 3 parts of a yellowish-green translucent mineral, resembling Epidote, in tiny masses, and especially in many seams, mostly parallel, usually about $\frac{1}{16}$ inch thick. These seams possess a marked transverse cleavage, which produces a fibrous structure on their section. Many irregular seams also occur, from a film up to $\frac{1}{16}$ inch in thickness, of grayish-white Calcite, in crystalline plates $\frac{1}{4}$ inch across, of grayish-white glassy Quartz, associated with the latter, and of soft chocolate-brown fibrous films, with brownish-red streak, resembling altered Amphibole.

Fracture rather uneven. Streak reddish-white. Effervesces decidedly in acid.

Weathers rather evenly, but roughly, to a blackish-green, mottled with chocolate-brown and yellowish-brown stripes.

No. 334 (S).—*Dioryte-Greenstone*.

Huronian.—Lower Bed (West of Marquette Mine).

Grayish-green, faintly spotted by blackish-green; minutely glittering.

A tough, hard, compact, heavy and very fine-grained calcareous rock, which consists of about equal bulks of somewhat rounded blackish-green masses in a greenish-gray paste. The former often indicate traces of cleavage in feebly shining surfaces, and are apparently altered blades of Amphibole.

The light-colored paste appears, under the lens, to consist chiefly of greenish-gray Feldspar (greenish-white on thin edges), with many minute silvery-white scales or narrow blades, as of a Mica.

The surface of the fissures is covered with films of brownish-gray Calcite, and reddish-brown Ochre.

Fracture rather uneven. Streak greenish-white. Effervesces strongly in hydrochloric acid.

Weathered surface very rough and uneven, being pitted in a peculiar manner, by the erosion of the blackish-green masses, into irregular rounded cavities, $\frac{1}{8}$ to $\frac{1}{2}$ inch across and $\frac{1}{4}$ inch deep—the general color being greenish-gray, mottled by dirty reddish-brown spots at the bottom of the cavities.

No. 335 (Sp. 826).—*Micaceous Greenstone-Schist*.

Huronian.—Lower Bed—South of North-Western Hotel, Marquette.

Grayish-green, with minute dull chocolate-brown and glittering reddish-brown specks, mottled with chocolate-brown on cleavage surfaces.

A rather brittle, calcareous schist (almost a slate), chiefly made up of a greenish-gray feldspathic material of impalpable texture, resembling that of No. 339, but dotted with many tiny chocolate-

brown spots and streaks, usually $\frac{1}{32}$ inch across, and containing much Mica and Chlorite disseminated throughout in reddish-brown glistening irregular scales, rarely over $\frac{1}{32}$ inch across. The seams of lamination are covered with soft films of Chlorite, of a blackish-green, much mottled with bright chocolate-brown.

Fracture uneven. Streak greenish and reddish-white. Effervesces strongly in acid. Differs from No. 339 in the apparently increased proportion of Chlorite.

Weathers evenly, to shades of reddish-brown.

No. 336 (Sp. 827).—*Micaceous Greenstone-Schist*.

Huronian.—South of North-Western Hotel, Marquette.

Greenish-gray, sometimes with slight reddish tinge; glittering very slightly.

A rock of fine-grained texture which reveals its constituents under the lens. It resembles No. 335, but is coarser, and the schistose structure is more irregular and less distinctly marked. It appears to consist of about equal quantities of minute granules of reddish-white Feldspar, and minute scales of reddish-brown Mica, dispersed throughout. The seams of lamination are covered with a film of soft greenish-black Chlorite, made up of exceedingly minute scales, which produce a shining surface.

Fracture very uneven. Streak grayish-white, sometimes reddish or greenish-gray. Effervesces decidedly in acid. Fuses at 4.5 to a black and grayish-white enamel.

Weathered surface uneven, and in spots very rough and cellular, by the weathering out of the Mica; has a blackish-brown color, mottled in the rough spots by reddish-brown. This roughness is produced by the projection of the parallel scales of Feldspar and Mica, and reveals more clearly the schistose texture of the rock.

No. 337 (Sp. 1096).—*Micaceous Greenstone-Schist*.

Huronian.—Lower Bed—Edwards Mine.

Grayish-black and glittering.

A very fine-grained, homogeneous schist, which consists of about

6 parts of grayish-white Feldspar (and smoky Quartz?) and of 4 parts of black Mica, mostly in minute scales, but much of which is in blades, often fibrous and suggesting altered Amphibole. A little blackish-green Chlorite is also disseminated throughout.

Fracture uneven. Streak grayish-white, often inclining to greenish. Somewhat magnetic. Fissures stained to a dirty reddish-brown.

Weathers unevenly, to a brownish-gray, grayish-brown, and covered with minute black granules of Magnetite.

No. 338 (Sp. 1100).—*Schalstone*.

Huronian.—Lower Bed—Washington Mine.

Blackish-gray, slightly greenish, minutely streaked with grayish-white.

A hard, compact, very tough and fine-grained schist (almost a slate), which consists of about 4 parts of greenish-white, sometimes grayish-white, Feldspar, in minute granules—4 parts of a Mica, in minute brown or blackish-brown scales—and 2 parts of grayish-white crystalline Calcite. The latter is mostly gathered in many thin, lenticular, parallel flakes, $\frac{1}{16}$ to $\frac{1}{4}$ inch in length, whose grayish-white color contrasts with the prevailing dark color of a section. One feldspathic bunch occurs in the specimen, $\frac{1}{4}$ inch long.

Fracture uneven. Streak grayish-white.

Weathers very unevenly, to a dirty greenish-gray, the surface being covered with circular pits, $\frac{1}{8}$ to $\frac{3}{8}$ inch across, whose bottoms are usually colored reddish-brown.

No. 339 (Sp. 824).—*Green Aphanite-Schist*.

Huronian.—Lower Bed—S. of North-Western Hotel, Marquette.

Grayish-green; dull.

A compact, tough, homogeneous rock, of impalpable grain, and rather schistose structure, which appears under the lens to consist of a greenish-gray translucent Feldspar, sometimes slightly speckled by reddish-gray Mica and blackish-green Chlorite. Of the latter

many exceedingly minute glistening scales are disseminated throughout.

Fracture rather uneven. Streak greenish-white. A few tiny veins, sometimes swelling into lenticular masses $\frac{1}{4}$ inch across, of a material in which the glistening scales predominate. A few fissures lightly stained to a yellowish- and reddish-brown, slightly mottled with a light greenish-gray. Fuses at 4, to a black glass.

Weathers evenly and rather smoothly, to a greenish-gray, with yellowish-white specks, revealing a few scales of the Mica to the lens.

Specimen 825 resembles 824. Fuses at 4, to a greenish-black glass.

Weathers, with an even surface soft to the touch, to a dirty greenish-gray, tinged with reddish-brown; which glistens slightly and appears under the lens to be covered with minute projecting scales of Mica.

No. 340 (Sp. 817).—*Greenish-gray Chlorite-Potstone*.

Huronian.—Lower Bed—N. of North-Western Hotel, Marquette.

Light greenish-gray, mottled, by fissures, with light reddish-brown.

A soft, compact, finely granular, schistose rock, apparently made up of about 8 parts of grayish-white Feldspar, and 2 parts of minute scales of a grayish-white Mica (possibly Talc), and greenish-gray Chlorite. Contains much less Chlorite than No. 341. A few minute veins of white Quartz occur, and many fissures running irregularly, but so as to impart the schistose structure, and lined with a film of reddish-brown material with greasy feel (probably decomposed Chlorite). Effervesces slightly in acid. Streak greenish-white. Fuses at 5.5, to a greenish-brown glass.

Weathered surface uneven, and of a darker, dirty-green color.

No. 341 (Sp. 1494).—*Green Chlorite-Potstone*.

Huronian.—Lower Bed—Sunday Lake Outlet.

Grayish-green, mottled with grayish-brown.

A very soft, compact, friable, highly altered chloritic rock, of

impalpable texture, consisting of about 3 parts of brown, vaguely defined, irregular masses, about $\frac{1}{8}$ inch across, in a grayish-green paste. In one part of the latter a slight cleavage and lustre were observed, resembling those of a Feldspar. Many brownish films traverse the rock in all directions.

Fracture very uneven. Streak brownish-red and grayish-green. Effervesces slightly in acid. Yields a very large amount of water, on ignition in a matrass. This rock seems to show the last stage in the alteration of a Dioryte into a species of Chlorite-Potstone.

Another variety (Specimens 1495, 1496, and 1497) is traversed by a network of soft, fibrous, apple-green films of Chlorite.

No. 342 (Sp. 884).—*Black Trappean Dioryte.*

Huronian.—Lower Bed—L'Anse Iron Range.

Black, speckled with greenish-white and reddish-brown; glittering.

A hard, tough, compact, coarse, heavy rock, made up of about 5 parts of black Hornblende in irregular crystalline lamellar masses, usually $\frac{1}{16}$ inch long and often showing facets of high lustre—and of 5 parts of greenish-yellow and sometimes grayish-white Feldspar, in irregular tabular crystals, $\frac{1}{16}$ inch long. Many of the interstices of the Feldspar, and many irregular fissures, are stained reddish and yellowish-brown.

Fracture uneven. Streak grayish-white. The crystals both of Hornblende and Feldspar are sometimes $\frac{1}{8}$ inch long and the latter are sometimes covered with a minute striation. Feebly magnetic. Powder ash-gray, inclining to brownish. The magnet separates 5 per cent. by weight, in grayish-black particles.

Weathers rather unevenly to a dirty brownish-gray, and finally disintegrates into an angular sand.

In another specimen (885) the fissures are more minute and the cleavage surfaces are stained reddish-brown; so that it is difficult to obtain a fresh unaltered surface only an inch square. Effervesces but very feebly in acid.

Weathers evenly to a blackish-green, speckled with grayish- and reddish-white.

No. 343 (Sp. 886).—*Black Trappean Dioryte.*

Huronian.—Lower Bed—L'Anse Iron Range.

Resembles No. 342, but its texture varies in fineness down to a grain in which the crystals become glittering points which can hardly be distinguished by the eye. Few of the interstices have the yellowish-brown stain. The specimen does not perceptibly affect the compass, but the magnet separates about 4 per cent. from the pulverized rock.

The weathered surface of the coarse parts of the rock is roughened by the projection of the greenish-black crystals of Hornblende and a few black octahedra of Magnetite.

No. 344 (Sp. 888).—*Trappean Dioryte.*

Huronian.—Lower Bed.—L'Anse Iron Range.

Greenish-gray, speckled with black; glittering.

Resembles No. 342, but consists of about equal parts of imperfect crystals of Hornblende and Feldspar. The former occurs in short brownish-black, imperfect crystals, often showing a lamellar structure, and sometimes a slight iridescence on a cleavage surface. The Feldspar is greenish-white, very rarely grayish-white, glassy and translucent to semi-transparent; its fusibility is about 3.5, and it is almost insoluble in boiling hydrochloric acid. Very feebly magnetic. Powder yellowish-gray. The magnet separates 2 per cent. by weight of grayish-black particles. The interior portion of this specimen, 2 or 3 inches below the weathered surface, is converted into a very friable mass, in which the crystals cohere very loosely—those of Feldspar assuming a brownish-gray to greenish-gray tint.

No. 345 (Sp. 889).—*Altered Trappean Dioryte.*

Huronian.—Lower Bed.—L'Anse Iron Range.

Chocolate-brown, with glittering greenish-gray specks, banded with grayish-green.

A soft, compact, fine-grained, weathered rock, which appears under the lens to consist of about 7 parts of tiny dull plates or particles, sometimes laminated, of a brick-red and reddish-brown color, (altered Hornblende), with about 3 parts of tiny glittering facets of greenish-gray Feldspar, often grayish-green and soft. A few parallel bands and a short transverse seam occur, of a greenish-gray color, and about $\frac{1}{8}$ inch thick, in which the soft grayish-green material predominates, having a greasy feel and resembling Serpentine, with a few scattered brown masses of Hornblende. The seam is traversed by a thinner seam of fibrous structure and reddish-brown, brick-red, and blackish-green color—apparently altered Hornblende. A very few minute glittering black scales occur, apparently of Micaceous-Iron.

Weathered surface rather even and smooth, about $\frac{1}{32}$ inch deep, and of a brownish-yellow color, mottled with greenish-black—the section being grayish-green.

No. 346 (Sp. 905).—*Speckled Trappean Dioryte.*

Huronian.—Lower Bed.—L'Anse Iron Range near W. line Sect. 18—T. 49—R. 33.

Resembles No. 344, but is a little coarser, many of the crystals being $\frac{1}{8}$ inch long, and about half the Feldspar is of a grayish-white color.

Feebly magnetic. Powder ash-gray, inclining to greenish. The magnet separates 3 per cent. by weight, in grayish-black particles.

Weathered surface even, but roughened by projection of the crystals of Hornblende and harder plates of Feldspar, and of a dirty cream color, speckled with blackish-green.

No. 347 (Sp. 912).—*Black Trappean Dioryte.*

Huronian.—Lower Bed.—L'Anse Iron Range.

Iron-black, speckled with gray; glittering.

A hard, compact, tough, rather coarse, highly crystalline rock,

made up of about 7 parts of iron-black lamellar Hornblende, in irregular masses and plates, and 3 parts of a grayish and yellowish-white Feldspar, with decided cleavage, in crystals and plates which cover a section with facets and minute lines $\frac{1}{8}$ inch long. A minute seam crosses the specimen, filled with a reddish-brown Ochre, and a few minute irregular fissures, stained reddish-brown.

Fracture uneven. Streak grayish-white, sometimes dotted with reddish-brown.

Weathers to the depth of about $\frac{1}{32}$ inch, with a rather even surface of a brownish-gray color, roughened by projecting grains of the Hornblende.

No. 348 (Sp. 913).—*Brown Trappean Dioryte.*

Huronian.—Lower Bed.—L'Anse Iron Range.

Blackish-brown, speckled with gray; glittering.

Like No. 347, but of a little finer texture, and with a blackish-brown substituted for the iron-black Hornblende. Many fissures occur, mostly parallel, and generally occupied by a film of a yellowish-green color, apparently Epidote.

No. 349 (Sp. 915).—*Brown Trappean Dioryte.*

Huronian.—Lower Bed.—L'Anse Iron Range, S. of L'Anse, Sect. 9—T. 49—R. 33.

Like No. 348, but has the coarseness of No. 347, and is traversed in all directions by blackish-green films of Chlorite, giving greenish-gray streak.

No. 350 (Sp. 996).—*Fine-grained Green Trappean Dioryte.*

Huronian.—Lower Bed.—W. of Slate River, Sect. 28—T. 51—R. 31.

Dark grayish-green, speckled with brown and grayish-white; glittering.

A compact, tough, hard rock, which resembles Nos. 342, 343,

and 346, but is finer-grained and poorly crystallized. It appears to consist of about equal bulks of grayish-white Feldspar, in thin tabular flakes, and a brown Feldspar in tiny facets, both about $\frac{1}{16}$ inch across, and irregular grains of grayish-green crystalline Hornblende.

Fracture uneven. Streak greenish-white.

Weathers unevenly to a reddish-brown, mottled by gray, and the constituents appear to weather equally.

Another specimen (997), is a fine-grained and tougher variety. The surface of the joints is stained reddish-brown.

No. 351 (Sp. 911).—*Green Porphyry*.

Huronian.—Lower Bed.—L'Anse Iron Range, N. W. $\frac{1}{4}$ of Sect. 9—T. 49—R. 33.

Dark bluish-green; dull, with brown glittering specks.

A rather hard, brittle, compact, heavy, crystalline rock, made up of about 3 parts of a brown and orange-brown or copper-colored Feldspar, with good cleavage, in about 7 parts of a dark bluish-green, dull, aphanitic paste.

Fracture uneven. Streak greenish and reddish-white. Many minute fissures in all directions, stained with films of yellowish and reddish-brown.

Weathers unevenly to a reddish-brown.

On a polished section, under the lens, the paste is resolved into 3 minerals: well defined, dull, blackish-green, crystals of altered Hornblende, amounting to about 3 parts of the rock—a green homogeneous paste, probably chloritic, amounting to about 3 parts—and nearly 1 part of Pyrite, in yellowish-white, angular particles.

No. 352 (Sp. 887).—*Brown Wacké*.

Huronian.—Lower Bed.—L'Anse Iron Range.

Reddish-brown, mottled with light-yellow; mostly dull, but with a few glittering points.

A very soft and friable, fine-grained, decomposed rock, produced by the weathering of the preceding rock, in which the Feldspar pre-

dominates over the Hornblende, both occurring in tiny altered grains, distinguishable by the eye. In the yellow parts of the specimen, the Feldspar is light-yellow to yellowish-white, and the Hornblende blackish-green; and in the reddish-brown, the color is due to the reddish-brown altered crystals of the latter mineral. The cleavage and general characteristics of both minerals are indistinct.

No. 353 (Sp. 914).—*Speckled Wacké*.

Huronian.—L'Anse Iron Range, N. side of above Dioryte Dyke.

Yellowish-white, minutely speckled with reddish-brown.

A rather soft and brittle, compact, fine-grained rock, made up of about 6 parts of reddish-brown, soft, irregular grains, apparently of a reddish Ochre, derived from alteration of Hornblende, in a soft yellowish-white paste, which imparts a greasy feel to the rock and apparently consists of a Feldspar, altered to Kaolin. It is apparently a decomposed form of a finer grained variety of Nos. 347 and 348. A few minute glittering black scales, apparently of Micaceous-Iron.

Fracture uneven. Streak brownish-red, dotted with yellowish-white.

No. 354 (Sp. 1110).—*Black Dioryte-Aphanyte*.

Huronian.—Dyke.—Washington Mine.

Grayish-black; minutely glittering.

A compact, tough, hard, fine-grained rock, which appears to consist of about equal bulks of grayish-white Feldspar, in minute particles, and of a black mineral, with high lustre, (resembling the black mineral of No. 205,) in minute flakes, scales, or blades, sometimes $\frac{1}{16}$ inch long. Much bronze-yellow Pyrite is disseminated throughout, in particles and films, sometimes over $\frac{1}{4}$ inch across, especially in seams associated with films of grayish-white Calcite.

Fracture conchoidal. Streak gray. Fissures occur, stained greenish-black and greenish-gray.

No. 355 (Sp. 1382).—*Black Dioryte-Aphanyte*.

Laurentian.—Dyke.—N. W. $\frac{1}{4}$ of Sect. 29—T. 47—R. 42.

Grayish-black, slightly glittering.

An exceedingly hard, compact, heavy, tough, homogeneous, almost crypto-crystalline rock, which appears under the lens to consist of about 3 parts of minute facets of grayish-white Feldspar, with good cleavage and lustre, in 7 parts of a dull black paste, hardly touched by the file.

Fracture even. Streak gray.

Weathers evenly, to a dirty yellowish-brown, to the depth of $\frac{1}{32}$ inch, with a surface rendered harsh to the touch by minute projecting points.

No. 356 (S).—*Black Dioryte-Aphanyte*.

Dyke near Forestville.

Like No. 355. Facets of a black Feldspar, with high lustre, can also be distinguished, which are sometimes $\frac{1}{32}$ to $\frac{1}{16}$ inch long. Surface of fissures stained a light brownish-red, or brownish to yellowish-gray; possesses the strongly marked cross-cleavages (in 3 planes at right angles to each other) peculiar to a dyke.

No. 357 (S).—*Green Dioryte-Aphanyte*.

Dyke, half an inch wide, crossing obliquely a Huronian Dioryte-Schist.
Light-House Point, Marquette.

Grayish-green and dull.

A very hard, compact, heavy, crypto-crystalline rock, of the texture of porcelain or many Felsytes, resembling a green Jasper. Nothing can be distinguished in it, even by the lens, but a few tiny particles of Pyrite.

Fracture rendered exceedingly uneven, by the whole rock being traversed irregularly by small fissures, stained reddish-brown; and it is for the same reason difficult to obtain a fresh fracture half an inch square. The hardness is less than that of a Felsyte. No

trace visible in this specimen of the cross-cleavage of No. 356. Streak greenish-white.

Weathers rather unevenly, to a light brownish-gray, the vein sometimes sharply projecting above, and sometimes sharply sunken below, the surface of the schist.

No. 358 (Sp. 732).—*Arenaceous Sandstone-Schist*.

Huronian.—Bed XIII.—Spurr Range, Sect. 23—T. 48—R. 31.

Gray, mottled with grayish-white, with many tiny specks of dark greenish-gray.

An arenaceous schistose Sandstone, almost exactly like No. 359, without the bands, made up of minute granules of glassy Quartz, sometimes intermixed with a greenish-gray substance (probably Chlorite), and tiny particles and seams of a dirty yellowish and reddish-brown color. The surfaces of the layers are covered with films of a gray color, mottled with dirty shades of yellowish and reddish-brown, containing many minute scales of brownish-gray Mica.

Fracture rather even. Streak grayish-white. Slightly magnetic, and with polarity, from a thin adhering layer of Magnetite.

Weathers smoothly to dark brownish shades.

No. 359 (Sp. 739).—*Magnetic Arenaceous Sandstone-Schist*.

Huronian.—Bed XIII.—Spurr Range, Sect. 23—T. 48—R. 31.

Grayish-white, with bluish-gray, reddish-brown, and blackish-gray bands.

A rather brittle and friable, loosely aggregated, fine-grained, arenaceous, laminated Sandstone, almost of a slaty structure. This rock is made up of laminae, usually varying in thickness from $\frac{1}{32}$ to $\frac{1}{4}$ inch, most of which are gray, grayish-white, and bluish-gray, and consist of arenaceous Quartz; and some of which, at intervals of an inch or more, are light reddish-brown and black, glittering, rarely more than $\frac{1}{8}$ inch in thickness, and consist of mixtures of Magnetic Iron and ferruginous Quartz. On examination by a lens, the gray

and grayish-white laminæ are seen to consist of minute grains of milky Quartz; the bluish-gray laminæ, of grains of smoky Quartz; the reddish-brown, of ferruginous and milky Quartz; and the black, which are always associated with the last, of a mixture of octahedral crystals of Magnetite, with ferruginous Quartz, the former mineral amounting to about $\frac{3}{4}$ of the bulk of the layer, as separated by a magnet from the powder. There are also many minute seams, usually less than an inch long, filled with brown Ochre, sometimes parallel to the lamination and often crossing it obliquely and irregularly.

Fracture uneven. Streak grayish-white. Powder of the darker layers blackish-gray and glittering; the magnet separates about 60 per cent. of the bulk, in a grayish-black and glittering powder, with a remainder of a brownish-gray and dull.

On account of the presence of the Magnetite, this rock is decidedly magnetic. The material and structure are identical with those of the common pebbles in specimens of certain Quartzites, but they differ in the absence of Magnetite from the latter and in their more yellowish tints.

Weathered surface is darker than the fresh fracture, and the edges of the ferruginous layers generally assume a yellowish-brown color.

No. 360 (Sp. 923).—*Chloritic Sandstone-Schist*.

Silurian.—Presqu'isle.—West side, North of the Neck.

Light greenish-gray, inclining to apple-green, minutely speckled with white; dull.

A fine-grained rock, which is a variety of the Kaolinic Sandstone-Schists, belonging to the Silurian. The color is light, and is only very slightly variegated with thin brown lines in some places. It consists of about 7 parts of grayish-green Quartz, in angular granules distinguishable by the lens, and of 3 parts of grayish- to yellowish-white Kaolin, in scattered particles visible to the eye, with a few minute scales apparently of Chlorite and Mica. The structure is decidedly schistose—which is produced by the dissemination of many flat, thin flakes, sometimes $\frac{1}{2}$ inch across, of soft greenish-gray and blackish-green Chloritic Schist, with light greenish-gray

streak. A few minute scales of silvery-white Mica are dispersed over the cleavage surfaces and are distinguishable by the eye.

Streak of the rock, greenish-white. The surfaces of the cleavage-planes, and especially of the joints of the rock, are stained or mottled with reddish- and yellowish-brown.

Weathered surface uneven and rough, and of a light reddish-brown color.

MINERALOGICAL NOTES.

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THE small variety and imperfect crystallization of the minerals of this region were remarked by Foster and Whitney, in Part II. of their Report, published in the year 1851; and brief notes are given in that volume, on pages 95, 18, 82, etc., of the following eighteen minerals: Galena, Sulphuret of Zinc, Iron Pyrites, Sulphuret of Copper, Specular Oxide of Iron, Magnetic Oxide of Iron, Oxide of Manganese, Quartz, Pyroxene, Hornblende, Garnet, Mica, Orthoclase, Talc, Serpentine, Chlorite, Calc-Spar, and Dolomite.

During the period of twenty-one years which has since elapsed, and the extensive opening up of this region by mines and roads, the occurrence of perhaps fifteen more minerals has been discovered; but several of these are found only in traces or small quantities, and it is difficult to obtain well-crystallized specimens, worthy of the cabinet, of any but two or three. A few hasty notes will now be given of such facts as have come to my notice in the field or in collections, in regard to the following minerals:

Graphite.	Garnet.
Galenite.	Epidote.
Sphalerite.	Muscovite.
Pyrite.	Magnesian Mica.
Chalco-pyrite.	Orthoclase.
Hematite.	Triclinic Feldspars.
Martite.	Tourmaline (?).
Magnetite.	Andalusite.
Pyrolusite.	Staurolite.
Turgite.	Talc.
Göthite.	Serpentine.
Limonite.	Kaolin.
Quartz.	Chlorite.
Pyroxene (?).	Calcite.
Anthophyllite.	Dolomite.
Amphibole.	Siderite.

Graphite (popularly called "Plumbago") occurs in tiny scales and in films in the carbonaceous slates. (Nos. 246 to 251.)

Galenite ("Galena") was observed by Foster and Whitney in small quantity at Presqu'isle. An argentiferous variety has been since found, in the region north of the Carp River, in quantities sufficient to induce the opening of several mines. It is, at these localities, associated with Sphalerite, Pyrite, and Chalcopyrite, (and, it was reported at the Holyoke mine, Pyrotilpnite,) in milky Quartz. (Holyoke and Lake Superior Silver Lead Mines, etc.)

Sphalerite ("Zinc Blende," or "Black-Jack") has been observed at Presqu'isle, the Holyoke Mines, the Sedgwick Mines, etc., always in small quantity and with the association stated under Galenite.

Pyrite ("Iron Pyrites") is very commonly disseminated through all the rocks, but almost always in tiny irregular particles or in small cubes, rarely $\frac{1}{4}$ of an inch across. In some cases it has been suspected to be auriferous (Pyritiferous Conglomeritic Talcose Schist, north side of Lake Palmer, S. W. $\frac{1}{4}$ of N. E. $\frac{1}{4}$ of S. 25—T. 47—R. 27).

Chalcopyrite ("Copper Pyrites") is the only ore of copper (excepting a few traces of Green Carbonate at Presqu'isle, etc.) which has been noticed in this region, and always at a very few localities (Presqu'isle, Holyoke Mine, Sedgwick Mine, etc.), and in small quantity: usually in tiny particles and strings, associated with Galenite, as stated under that mineral.

Hematite ("Specular Ore"). I have neither the opportunity nor the necessary suite of specimens for a proper description of the characteristics of this mineral peculiar to this region. All its common earthy and amorphous forms are easily studied in the vast beds which have been opened; and I believe small veins have occurred, at the Jackson Mine, and the Iron Mountain Mine, containing small crystals of Specular Ore. The only specimens of interest to the collector are the following: Black Micaceous-Iron, in seams or sheets, sometimes a foot or more across (Lake Superior Mine, etc.); the so-called "Bird's Eye Ore," (No. 6); indurated red and

yellow Ochre, often in films of coppery color and lustre, lining geodes in Milky Quartz, which form fine specimens at several localities (Iron Mountain Mine, etc.); and Red Chalk, which may be procured in abundance from the decomposed Chloritic Schist at "Kimball's Cut," on the Peninsula Railroad, and in the E. part of S. 18—T. 47—R. 26. An unusual association is the occurrence of much Micaceous-Iron in small masses and seams, along with Quartz, Chlorite, and crystallized Feldspar, in a coarse Dioryte on the east side of lake *Angeline*.

Martite (part of the "Specular Ore"). A pseudomorphous form of Hematite after Magnetite (Dana's System of Mineralogy, page 142), is so commonly distributed in tiny octahedra or triangular scales, rarely $\frac{1}{8}$ - $\frac{1}{4}$ inch across, that I have applied the name to one schist (No. 2, Appendix B). It sometimes occurs in Chlorite-Schist, but is usually associated with brownish-red Jasper, and fine specimens consisting of alternations of blackish-blue Martite and bright-red Jasper, with the contrast heightened by the glacial polish, may be easily obtained at the Cleveland Knob, etc. Specimens also are common, containing tiny octahedra of Magnetite, of Martite, and of the one partially altered into the other.

Magnetite ("Magnetic Iron Ore") is very commonly disseminated through most of the rocks, generally associated with Pyrite in the crystalline rocks, in particles, or in octahedra which are rarely $\frac{1}{8}$ inch in diameter. In the beds of ore the grains are imperfectly crystalline and sometimes loosely adherent, like the "shot ores" of the Adirondack Iron-region of New York; the magnetic character is sometimes very decided, so that the powder clings to the fragments; the surface is often iridescent, and good specimens are easily obtainable at the Washington Mine, etc.

Pyrolusite ("Binoxide of Manganese") of an iron-black or brownish-black color, is abundantly disseminated through some Hematite ores in several deposits (as at N. E. cor. of Sect. 12—T. 47—R. 27), in pulverulent coatings, tiny scales and films, and mamillary masses made up of radiating needles, sometimes 2 or 3 inches in diameter; some of which form fair specimens for the cabinet (Sp. 893 and 894).

It also occurs on a rosy Quartzite, and is associated with Ochre and a little Mica (Sp. 897), with Magnetite and Anthophyllite (No. 178), or with Turgite (Sp. 895). Streak black and sometimes sub-metallic. Gives evidence of alteration, by affording water, when heated in a closed tube, and may be the mineral from this region reported as Manganite in Dana's localities (System of Mineralogy, page 784). Credner also mentions the occurrence of "streaks of a pure, compact, black Psilomelan, mixed with tiny particles of Hausmannite" (Article, loc. cit., page 543).

Turgite (part of the "Hematite"), of a reddish-black color, has been found to occur (Sp. 895, from N. W. $\frac{1}{4}$ Sect. 9—T. 49—R. 33), in botryoidal masses associated with reniform coatings of brownish Ochre and brownish-black Pyrolusite. Streak brick-red, sometimes brownish-yellow. When heated before the blowpipe in a closed tube, it decrepitates and yields water.

Göthite (the glittering crusts on the "Hematite") has been found in abundance (at the well-known locality at the Jackson Mine), in lamelliform crystals of a brownish-black color, usually less than $\frac{1}{2}$ inch in length, arranged in stellated or radiating groups, in drusy cavities of Limonite (or perhaps of Turgite?) and Hematite. The finest specimen I have seen was a stalactite of Limonite, about one foot long, completely covered with radiating blades of Göthite over one inch in length. It also occurs at the Lake Superior Mine (and probably elsewhere), in seams crossing a Feldspathic Argillyte, etc. (Sp. 1139). Streak brownish-yellow.

Limonite (popularly called "Hematite") has been found at the Jackson Mine, Lake Superior Mine, Foster Mine, and several others, in considerable quantity, and with all the variety of mamillary, botryoidal, and stalactitic forms which are common to this ore. It is associated with Hematite, Göthite, Turgite, Pyrolusite, and many varieties of Ochre, and good specimens may be easily obtained.

Quartz ("Flint," "Chert," etc.) is very commonly distributed, in the ordinary massive forms of milky Quartz, smoky Quartz, etc., in connection with the ores, but good crystals are very rare. Sev-

eral coarse varieties of Jasper, Chalcedony, and Semi-Opal are easily obtained.

Pyroxene (Augite) may possibly be an accessory constituent of certain rocks. Pyroxenic Diabase is reported to occur, but, so far as my observations have gone, I believe that rock and this mineral to be entirely absent from the Iron-Region.

Anthophyllite is the name first applied by Prof. G. J. Brush to the brownish-gray hydrous micaceous mineral, in tiny scales and blades, which enters largely into the constitution of the schists already described (Nos. 174 to 178). See also Wright's observations, in Appendix C.

Amphibole (popularly called "Hornblende"), although the universal constituent of the Diorytes, in its black and greenish-black variety—Hornblende—almost always occurs in small fibrous poorly crystallized blades. The most coarsely crystallized specimens may be procured from a ridge between Negaunee and Teal Lake, in the swamp near Barlie's Brook (N. E. qr. of S. W. qr. of Sect. 22—T. 47—R. 27), near a waterfall in a swamp (N. E. cor., S. W. qr. of S. W. qr., Sect. 7—T. 47—R. 27), and on "Raspberry Hill" (Sect. 7—T. 47—R. 26). Seams of *Actinolite*, however, occur in one schist (No. 17), and a quartzose vein occurs in Dioryte (on the crest of the hill, north of Lake Fairbanks), which contains an abundance of massive Actinolite, of a coarse columnar structure, in layers 2 or 3 inches thick, associated with a little Chlorite. *Tremolite* is distributed in small short blades through a dolomite (No. 103), and was also observed in that association, in the Menominee region, by Credner (Article, page 527); and this is, I suspect, the "Kyanite" said to occur in a marble at Sect. 36—T. 42—R. 29. *Asbestos* was found by Dr. Houghton at Presqu'isle, and is distributed in considerable quantity through a rock near Lake Gogebic, so as to form an Asbestos-rock, filled with small garnets.

Garnet sometimes occurs in coarse, partially decomposed dodecahedrons, generally less than $\frac{1}{2}$ inch in diameter, in Talcose and Chloritic Schists, at the Washington Mine, at Republic Mountain, Smith Mountain, etc., but good specimens are rare.

Epidote may be easily obtained, in small imperfect crystals, from the quartzose veins which traverse the Dioryte on the shore between Light-House Point and Granite Point, between Negaunee and Teal Lake, and elsewhere, and from similar veins in Chloritic and Amphibole-Gneiss.

Muscovite ("Mica") in tiny scales is disseminated through the Granite in small quantity.

Magnesian Mica, a brown, brownish-black, and black variety, is disseminated in tiny scales through the altered forms of Dioryte and Chloritic Gneiss, in association with similar scales of Chlorite. It is generally softened by decomposition, so as to cut like Chlorite. There may possibly be another Mica, represented by the black scales in the same rocks; and one variety (at the Washington Mine), distributed in isolated scales, has been denominated *Ottrelite* by Prof. G. J. Brush (Vol. I., page 105).

Orthoclase ("Feldspar") is the chief constituent of the Granite, occurring in coarse reddish masses in which the Quartz is sometimes so arranged as to produce a Graphic Granite.

Feldspar, of, I suspect, two triclinic varieties, probably Oligoclase and Albite, is an important constituent of the Diorytes and Gneisses, occurring generally in small irregular thin plates, but sometimes in well-crystallized but tiny prisms (No. 344).

The striation is not usually strongly marked or very common to the facets. The color of the Feldspar in the Diorytes is most commonly greenish-white, while in the Gneisses it generally inclines to grayish-white; though both colors occur in both these classes of rock. It has been generally subjected to a process of decomposition, by which it assumes a flesh-red, salmon-color, or deep-brownish-red (whose incipient stages, just staining the edges of or fissures in the grains, may be best studied in the coarser Gneisses, No. 258), and which ends in the production of Kaolin (Nos. 227 and 244).

In one Dioryte in which the Feldspar is greenish-white, where the texture is compact and fine-grained (No. 318), veins occur of almost pure Feldspar, which resemble Orthoclase in color and general appearance, but contain many drusy geodes in which char-

acteristic crystals of some triclinic variety may be distinguished. On the North shore of Lake Angeline, Sect. 10—T. 47—R. 27, small veins occur, in a coarse Dioryte, of an aggregate of milky Quartz, bunches of minute scales of Green Chlorite, Micaceous-Iron, and an imperfectly crystallized Feldspar, from which geodes may be obtained sometimes containing fair crystals of the latter. Mention has already been made of a purplish Feldspar, in radiating plates, which occurred, associated with green Quartz, in a seam through Amphibolyte (No. 319).

Between Forestville and Palmer's Saw-Mill is a ledge of Greenstone, by the roadside, traversed by many veins of a Feldspar, from which geodes, containing good crystals, were procured. Similar veins were noticed in the Talcose Schists near Palmer's Saw-Mill, and in those on the Lake Shore near the mouth of Chocolate River, being there associated with Epidote, Calcite, and Quartz.

Tourmaline is said, by Dr. Houghton (Appendix E), to occur at the mouth of Dead River in "beautiful specimens in small quantities."

Andalusite, of a pink color and coarsely-fibrous structure, is disseminated in some abundance through Mica-Schist, often in association with Staurolite. It occurs in imperfect crystals or crystalline masses, whose bright color contrasts well with the dark matrix. Fine specimens, an inch or more in length, are said to occur in the collection at the State University, Ann Arbor, Mich.

Staurolite ("Cross-stone") is abundantly disseminated through Mica-Schist (No. 301) in blackish-brown, perfect crystals, sometimes in twins, less than an inch in length, often associated with Andalusite.

Talc ("Soapstone") is disseminated through certain Schists of rather uncommon occurrence (Nos. 53, 54, 74, etc.), generally in association with Chlorite, but always in minute scales or films, of no particular interest as specimens. The only exception, to my knowledge, is on the North side of the West end of Moss Mountain (N. E. qr. of Sect. 11—T. 47—R. 27), where some seams of quite pure Talc occur in Talcose Schist, part of which is indurated into a

kind of greenstone. The *Steatite* which is also said to occur North of Teal Lake is probably a similar indurated Talcose Rock. Dr. Credner mentions a "Talcose rock, consisting only of fibrous Talc, which forms a kind of soapstone" at the Upper and the Little Bequensec Falls (T. 39—R. 30); also the occurrence of Laumontite and Quartz in a Talcose Slate at the latter Falls.

Serpentine occurs in tiny films and seams, through an altered Magnesian Dioryte (No. 322), especially at Presqu'isle; but no good specimens of the pure mineral have been found.

Certain bright green films in this rock were found by T. S. Hunt to contain Chromium, so that Chromite and other allied minerals may yet be found.

Kaolin is very generally distributed in small white masses, having a soapy feel, sometimes in lumps as large as a hen's egg. It is most abundant in certain Ochre-Schists (No. 244) at the Marquette Mine, etc., imparting to them shiny surfaces and greasy feel, and the association of these layers and seams of aggregated Ochre and Kaolin, with Chloritic Schists at the Lake Superior Mine, suggests that they are probably derived from the decomposition of the latter. It is very commonly distributed in small particles through certain schists (No. 227) and the Silurian Sandstones. In the latter instances the particles often retain a rectangular form, suggesting the fragments of Feldspar from which this mineral has always been derived.

Chlorite is one of the most common minerals, both in the altered Diorytes, and the Gneisses, Schists, etc., already described. There is no difficulty in obtaining specimens of the pure mineral in bunches made up of tiny scales, associated with Feldspar and Quartz (see Feldspar). A coarse seam, made up of large blackish-green plates, resembling Chloritoid, was also observed at one locality on the edge of the Granite region, but crystals are very rare and minute.

Calcite ("Calc-Spar") is mentioned by Foster and Whitney as having been found in good crystals at Presqu'isle and forms abundant seams through one rock there (No. 242).

Elsewhere it has been observed only as crusts on calcareous al-

tered Diorytes (near Marquette), on calcareous Chloritic Schist (North shore of Teal Lake), etc.

Dolomite is distributed in flesh-colored rhombs, $\frac{1}{4}$ to 1 inch in diameter, through some parts of the siliceous Dolomite-Marbles, sometimes contrasting finely with the lighter-colored rock (No. 109).

In other localities small geodes occur, lined with small rhombs of white Dolomite (No. 104).

Siderite ("Spathic Iron") is disseminated in concretionary films through a Limestone already described (No. 101), and also in small bunches in a boulder (No. 189) whose origin is unknown; but not in specimens worthy of notice.

A few specimens, of perhaps other minerals, as yet await identification—one of which bears a resemblance to Vesuvianite (No. 147), while another occurs, in some abundance, near Negaunce, in veins associated with Quartz, Epidote, and crystallized Feldspar.

APPENDIX B.

LITHOLOGY.

BY

T. B. BROOKS AND A. A. JULIEN.

APPENDIX B.

CATALOGUE of the Michigan State Collection of Huronian Rocks and associated ores of the Iron-Region of Lake Superior, numbered 1 to 100.

Duplicate suites have been forwarded to the following institutions and individuals without charge :

University of Michigan, Ann Arbor, Mich.
Michigan State Library, Lansing, Mich.
State Agricultural College, Lansing, Mich.
Hillsdale College, Hillsdale, Mich.
Kalamazoo College, Kalamazoo, Mich.
Adrian College, Adrian, Mich.
Albion College, Albion, Mich.
Olivet College, Olivet, Mich.
Boston Institute of Technology, Boston, Mass.
Harvard University, Cambridge, Mass.
School of Mines, University of Pennsylvania, Philadelphia, Pa.
School of Mines, Columbia College, New York.
Union College, Schenectady, N. Y.
Cornell University, Ithaca, N. Y.
Smithsonian Institute, Washington, D. C.
Sheffield Scientific School, Yale College, New Haven, Conn.
Stevens Institute, Hoboken, N. J.
Washington University, St. Louis, Mo.
The State Cabinet, Madison, Wis.
Royal School of Mines, Stockholm, Sweden.
Royal School of Mines, Freiberg, Saxony.
Museum of Practical Geology, London, England.
United States Military Academy, West Point, N. Y.
Prof. Raphael Pumpelly, Cambridge, Mass.
A. R. Marvin, Esq., Cambridge, Mass.
Alexis A. Julien, Esq., School of Mines, New York.
J. Blodget Britton, Esq., Philadelphia, Pa.
A few suites are still undistributed.

[The following descriptions (except the numbers in Roman numerals of the Huronian formation to which the specimen belongs, the locality, popular or provisional name in brackets, and the approximate specific gravities) are by Mr. Julien; and the references to specimens by numbers are all to his descriptions contained in Appendix A. Chap. X., Vol. I., contains analyses of all the ores. Specimens numbered 1, 4, 14, 60, 62, and 82 to 100, both inclusive, are wanting in the suites: these varieties of rock were of least importance for the purposes of this report, and in some instances would have been obtained with great difficulty. It is believed that Mr. Julien's very minute descriptions, in Appendix A, of specimens from my private collection, identical with those wanting here, will cause their omission not to be seriously felt.—T. B. BROOKS.]

No. 1.—Talcose Quartz-schist. See No. 150.

No. 2.—Below Formation V. Martite-Schist, from Clarksburgh. Specific gravity of 5 pieces varied from 4.12 to 4.39; average 4.21. Pseudomorphous after Magnetite. Rather fine-grained. Many octahedra, more or less sharply defined. Slightly magnetic. Many cavities containing more or less Kaolin. No distinct lamination. Resembles No. 239, but differs in its cellular structure and Kaolin.

No. 3.—Below Formation II. or III. Brownish Chloritic Gneiss, from S. W. $\frac{1}{4}$ Sect. 30—T. 48—R. 28. Specific gravity of 5 pieces varied from 2.65 to 2.76; average 2.70. Feldspar light-brown, and with good cleavage and lustre. Seams of Chlorite. Lamination not very distinct. Differs from No. 276 chiefly in the color of Feldspar.

No. 4.—Schalstone. See No. 338.

No. 5.—Below Formation V. Fine-grained Hematite-Schist (red specular ore), from West-end Mine, Cascade. Specific gravity of 8 specimens varied from 4.40 to 4.94; average 4.72. Mostly very fine-grained, with thin bands full of ill-defined octahedra. Slightly magnetic, but more than No. 2. Structure decidedly schistose, almost slaty. Little lustre. A variety of No. 240.

No. 6.—Below Formation V. Granuliferous Specular-Iron Schist (Bird's-eye ore), from Bagaley Mine, Cascade. Specific gravity of 6 pieces varied from 3.61 to 3.90; average 3.74. Chiefly

made up of exceedingly minute scales of Micaceous-Iron. Perhaps one-twentieth of its bulk consists of imperfectly crystallized and decomposed Garnets (?), $\frac{1}{32}$ inch in diameter. Allied to No. 237.

No. 7.—Formation IV. Red Feldspathic Gneiss, 100 yards north of West-end Mine, Cascade. Specific gravity of 5 pieces varied from 2.53 to 2.62; average 2.57. Chiefly red cleavable Orthoclase. A very little white Mica. Quartz in parallel flakes. No allies.

No. 8.—Formation V.—Brownish-gray Quartzite (Lower Quartzite), Republic Mine. Specific gravity of 5 pieces varied from 2.65 to 2.71; average 2.67. Fine-grained. Quartz, brownish-gray. Many specks of Ochre. Differs from No. 129 only in greater proportion of brownish Ochre.

No. 9.—Formation V.—Mottled Pink Dolomite-Marble (marble), from Chocolate Quarry, L. S. Specific gravity of 4 pieces varied from 2.80 to 3.06; average 2.88. Very fine-grained. Blackish-brown streaks and spots. A Quartz vein. Resembles No. 106, differing in grain.

No. 10.—Formation V.—Mottled Chloritic Schist (clay slate), from Chocolate Quarry, L. S. Specific gravity of 5 pieces varied from 2.73 to 2.81; average 2.77. Blackish-green and light chocolate. Almost slaty. Resembles Nos. 182 and 183 (829), and also No. 192 in its character as a transition from Chloritic Schist to Argillyte.

No. 11.—Formation V.—Salmon-colored Dolomite (marble), Morgan Furnace Quarry. Specific gravity of 8 pieces varied from 2.78 to 2.87; average 2.82. Chiefly made up of the mineral, Dolomite, in large masses, with fine cleavage and lustre. Many fine-grained gray veins. An unusual form of Nos. 108, 109, etc.

No. 12.—Formation V.—Mottled Feldspathic Argillyte (clay slate), from Morgan Furnace Quarry. Specific gravity of 9 pieces from 2.71 to 2.88; average 2.80. Blackish and reddish-brown. Weathers reddish-gray. Like No. 191.

No. 13.—Formation V.—Talcose Siliceous Schist (Novaculite), from Whetstone Quarry, Teal Lake. Specific gravity of 5 pieces varied from 2.71 to 2.78; average 2.73. Ash-gray to brownish-gray on fracture, greenish on cleavage-surface. Like No. 161, but less fissile.

No. 14.—Formation V.—Talco-Siliceous Dolomite, from Lake Fairbanks's Kilns. Like Nos. 110 and 111 (800).

No. 15.—Formation VI.—Magnetic Quartz-Schist, from Republic Mine. Specific gravity of 5 pieces varied from 3.13 to 3.42; average 3.29. Fine-grained. Grayish-black. Quartz, Magnetite, and a chloritic Mica. Resembles the dark layers of Nos. 151 and 153.

No. 16.—Formation VI.—Micaceous-Iron Quartz-Schist, from Cannon, Sect. 28—T. 47—R. 30. Specific gravity of 6 pieces varied from 2.92 to 3.42; average 3.16. Fine-grained. Reddish-gray. Quartz, Micaceous-Iron, and Magnetite. Structure inclining to slaty. Seams covered with Micaceous-Iron. Differs very slightly from Nos. 32 and 33.

No. 17.—Formation VI.—Actinolitic Magnetite-Schist (magnetic ore), from Magnetic Mine, Sect. 20—T. 47—R. 30. Specific gravity of 4 pieces varied from 4.15 to 4.51; average 4.36. Alternate fine-grained and crypto-crystalline laminae. Thin seams of altered Actinolite. Allied to No. 228, with Actinolite in place of Chlorite.

No. 18.—Formation VII.—Coarse Altered Dioryte, from Republic Mine. Specific gravity of 5 pieces varied from 2.94 to 3.08; average 3.03. Greenish-black, speckled with gray. Semi-porphyr-itic. Contains a little Chlorite and brown Mica; resembles No. 303.

No. 19.—Formation VIII.—Magnetic Quartz-Schist, from Republic Mine. Specific gravity of 5 pieces varied from 3.46 to 3.57; average 3.51. Fine-grained. Quartz, Magnetite, and perhaps Mica. Almost slaty. Resembles No. 233 in texture and general appearance.

No. 20.—Formation VIII.—Banded Argillyte-Slate (clay slate), from R. R. Cut, E. of Negaunee and Teal Lake. Specific gravity of 5 pieces varied from 2.67 to 2.71; average 2.69. Cleavage across stratification. Like No. 221 (983) in material and texture, and between Nos. 191 and 221 (983) in color.

No. 21.—Formation VIII.—Fine-Grained Greenish Quartzyte, from N. W. end of Lake Fairbanks. Specific gravity of 5 pieces varied from 2.64 to 2.69; average 2.66. Slightly mottled with reddish-brown. Like No. 126, but with grains less distinct.

No. 22.—Formation IX.—Micaceous Altered Dioryte, from Re-

public Mine. Specific gravity of 5 pieces varied from 2.96 to 3.05; average 2.99. Black, speckled with gray. Contains much brownish-gray Mica, especially conspicuous on the weathered surface. Resembles No. 303, but is much more micaceous; also like No. 18.

No. 23.—Formation X.—Magnetic Quartz-Slate (magnetic schist), from Republic Mine. Specific gravity of 4 pieces varied from 3.73 to 3.86; average 3.79. Resembles No. 19. One thin seam occurs, containing many minute Garnets.

No. 24.—Formation X.—Manganiferous Ochrey Hematite. Specific gravity of 5 pieces varied from 3.10 to 3.54; average 3.28. Thin seams and bunches of Pyrolusite and Quartz. Tiny bunches of Kaolin.

No. 25.—Formation X.—Disintegrated Ochrey Hematite (Hematite ore), from Rolling Mill Mine, Negaunee. A coarse angular gravel. Minute crystalline scales of Pyrolusite more abundant than in No. 24.

No. 26.—Formation X. Banded Limonitic Quartz-Schist (Foster Rock), from Foster Mine. Specific gravity of 5 pieces varied from 2.80 to 2.99; average 2.88. Grayish-brown Quartzyte with thinner layers of brownish-black Limonite; allied to No. 156.

No. 27.—Formation X. Brown Anthophyllite-Schist, from Washington Mine. Specific gravity of 5 pieces varied from 3.44 to 3.62; average 3.52. Many minute black scales of Magnetite. Banded. Like No. 174.

No. 28.—Formation X. Green Feldspathic Argillyte, from N. W. end of Lake Fairbanks. Specific gravity of 5 pieces varied from 2.93 to 3.17; average 3.08. A crypto-crystalline schist apparently made up of Feldspar, Chlorite, and a little Pyrite. Similar in texture to No. 209, but partly decomposed by weathering.

No. 29.—Formation XI. Black Dioryte-Schist, from Republic Mine. Specific gravity of 5 pieces varied from 2.98 to 3.05; average 3.02. No traces of alteration. Decidedly schistose. Allied to Nos. 328 and 329, but their structure is granular, while in this the generally parallel arrangement of the blades of Amphibole produces a fibrous structure.

No. 30.—Formation XI. Coarse Black Dioryte, from Republic Mine. Specific gravity of 4 pieces varied from 2.74 to 3.04; average 2.92. Like Nos. 18 and 22. Greenish-black. Few traces

of alteration; perhaps a little Chlorite. Resembles Nos. 303 and 306.

No. 31.—Formation IX. Black Micaceous Greenstone-Schist, from south of and under Grand Central ore deposit. Specific gravity of 5 pieces varied from 2.78 to 2.82; average 2.79. Almost aphanitic. Much Mica in minute scales, which have a coppery color on the cleavage planes. A little Chlorite. Allied to Nos. 335 and 336, but differing especially in finer grain and more irregular structure.

No. 32.—Formation XII. Micaceous-Iron Quartz-Schist (Jasper), from Republic Mine. Specific gravity of 4 pieces varied from 3.09 to 3.80; average 3.45. Very fine-grained. Grayish-white and smoky Quartz and scales of Micaceous-Iron. A few thin quartzose layers. Allied to No. 172, but with coarser and unbroken Quartz-layers.

No. 33.—Formation XII. Micaceous-Iron Quartz Schist [banded] (Jasper Schist), from Michigamme Mine. Specific gravity of 5 pieces varied from 3.09 to 3.50; average 3.23. Alternations of layers in which reddish-gray Quartz or Micaceous-Iron predominates. Exactly like No. 152 to the eye, but the black layers are pseudo-morphous after Magnetite.

No. 34.—Formation XII. Disintegrated Ochrey Hematite (Hematite), from Lake Superior Mine. A gravel made up of angular fragments of brownish-red Hematite, mostly of the size of peas; a disintegrated variety of a common earthy Hematite.

No. 35.—Formation XII. Ochrey Hematite-Schist (Hematite), from Winthrop Mine. Specific gravity of 4 pieces varied from 2.69 to 3.09; average 2.82. Fracture earthy, and adheres strongly to the tongue. Cleavage-surfaces shining. An ordinary variety of Hematite.

No. 36.—Formation XIII. Micaceous-Iron Quartz-Slate (mixed or 2d class ore), from Republic Mine. Specific gravity of 5 pieces varied from 3.41 to 3.88; average 3.66. Many scales are triangular. Like No. 32.

No. 37.—Formation XIII. Micaceous-Iron Quartz-Schist (2d. class ore), from Lake Superior Mine. Specific gravity of 5 pieces varied from 3.31 to 3.98; average 3.63. Quartzose layers broken up and irregular. Large folia of Micaceous-Iron. Allied to No. 172, but with coarser Quartz-layers.

No. 38.—Formation XIII. Specular-Iron Schist, from Lake Angelina Mine. Specific gravity of 4 pieces varied from 4.47 to 4.96; average 4.68. Many minute octahedra. Allied to No. 237.

No. 39.—Formation XIII. Granular Magnetite (magnetic ore), from Republic Mine. Specific gravity of 5 pieces varied from 4.98 to 5.01; average 4.99. Grayish-black. Grains nearly as large as mustard-seed. Slightly resembles No. 229, without its structure and fineness of grain.

No. 40.—Formation XIII. Soft Fine-Grained Magnetite (magnetic ore), from Spurr Mountain. Specific gravity of 5 pieces varied from 4.64 to 4.87; average 4.74. Brownish-black. Resembles No. 229, but differs in color and structure.

No. 41.—Formation XIII. Hard Fine-Grained Magnetite (magnetic ore), from Michigamme Mine. Specific gravity of 5 pieces varied from 4.72 to 4.97; average 4.84. Blackish-brown. Like No. 40.

No. 42.—Formation XIII. Compact Magnetite-Schist (Slate ore), from Edwards Mine. Specific gravity of 4 pieces varied from 4.86 to 4.95; average 4.91. Blackish-brown. Much of this ore is crypto-crystalline. A few thin greenish films of Chlorite. Allied to No. 228, but differs chiefly in color and a less slaty structure.

No. 43.—Formation XIII. Chloritic Magnetic Hematite-Schist (Granular green specular ore), from New York Mine. Specific gravity of 4 pieces varied from 4.01 to 4.40; average 4.18. Compact like No. 42, and containing more Chlorite. Many minute octahedra. Perhaps schistose. A transition variety between Nos. 228 and 239.

No. 44.—Formation XIII. Kaolinic Hematite-Schist (specular ore), from Cleveland Mine, School-house opening. Specific gravity of 5 pieces varied from 4.54 to 4.69; average 4.59. Very fine-grained. Brownish-black, speckled minutely with grayish-white. An ordinary variety, allied to No. 2.

No. 45.—Formation XIII. Specular-Iron Schist (steely specular ore), from Jackson Mine. Specific gravity of 5 pieces varied from 4.87 to 5.23; average 5.07. Blackish-brown. Allied to No. 237.

No. 46.—Formation XIII. Micaceous-Iron Schist (specular slate ore), from Republic Mine. Specific gravity of 4 pieces varied from 5.09 to 5.56; average 5.24. Structure inclining to slaty. Slightly magnetic. An ordinary variety.

No. 47.—Specular-Iron Schist (specular slate ore), from Jackson Mine. Specific gravity of 4 pieces varied from 5.11 to 5.14; average 5.12. Very fissile, this cleavage crossing the stratification at a high angle. Allied to No. 237.

No. 48.—Granular Specular-Iron Schist (specular slate ore), from Lake Superior Mine. Specific gravity of 5 pieces varied from 4.79 to 5.31; average 5.04. Thin folia approaching Micaceous-Iron. Many tiny granules of red Ochre disseminated throughout, perhaps derived from Martite. Allied to No. 237, but differs in the granules and higher lustre.

No. 49.—Micaceous-Iron Schist (slate ore), from Champion Mine, No. 4 shaft. Specific gravity of 8 pieces varied from 4.42 to 5.00; average 4.70. Tiny scales. Slightly magnetic. Like No. 46.

No. 50.—Formation XIV. Gray Ferruginous Quartzite (Upper Quartzite), from Republic Mine. Specific gravity of 5 pieces varied from 2.74 to 3.03; average 2.82. Many minute scales of Micaceous-Iron. Differs from No. 21, chiefly in the black scales.

No. 51.—Micaceous Conglomerate-Schist (conglomerate), from Washington Mine. Specific gravity of 5 pieces varied from 2.66 to 2.70; average 2.69. Many films of brownish-gray Mica enveloping nodules of Quartz. Resembles No. 122, but differs in the Mica and its less abundance.

No. 52.—Arenaceous Magnetic Quartz-Schist, from Michigamme Mine. Specific gravity of 4 pieces varied from 2.89 to 3.08; average 2.98. Minute granules of white Quartz and Magnetite. Loosely aggregated bunches of the former. The arenaceous Quartz is like that of No. 358.

No. 53.—Formation XIII. Grayish-green Talc-Schist, from Republic Mine. Specific gravity of 5 pieces varied from 3.00 to 3.30; average 3.09. Chiefly made up of Talc, in minute scales. Differs from No. 226, chiefly in deeper color and greater compactness.

No. 54.—Formation XIII. Brownish magnetic Talc-Schist, from Old Washington Mine. Specific gravity of 5 pieces varied from 2.75 to 2.84; average 2.78. Talc in corrugated folia. A few crystals of Magnetite, and slightly magnetic. Almost slaty. Resembles No. 81, but differs in color and greater coarseness.

No. 55.—Formation XIII. Gray Feldspathic Argillyte, from

Barnum Mine, Hanging Wall. Specific gravity of 5 pieces varied from 2.76 to 2.89; average 2.83. Chiefly Feldspar, less Mica, and a little Magnetite and Pyrite. Slightly magnetic. Somewhat resembles No. 196, but differs in its fibrous films and its Magnetite.

No. 56.—Formation XV. Micaceous Feldspathic Argillyte, from Champion branch R. R. Specific gravity of 4 pieces varied from 2.82 to 2.89; average 2.85. Grayish-black. Much black Mica, in minute scales; partly in brownish-gray films. Resembles Nos. 210 and 213, but without their slaty structure.

No. 57.—Formation XVI. Limonitic Quartz-Schist (Hematite), from South of Champion Kilns. Specific gravity of 5 pieces varied from 2.70 to 3.00; average 2.84. Smoky-gray and yellowish-brown ochrey bands. Compare No. 157.

No. 58.—Formation XVII. Grayish-green Anthophyllite-Schist, from R. R. Cut, Bi-ji-ki River. Specific gravity of 5 pieces varied from 3.04 to 3.34; average 3.15. Contains thin layers coarsely crystallized. Compare No. 178 (1116).

No. 59.—Formation XVII. Anthophyllitic Magnetite-Schist, from Bi-ji-ki River. Specific gravity of 9 pieces varied from 3.16 to 3.60; average 3.39. Black scales of Magnetite. A little Pyrite. Slightly magnetic, and the magnet separates about 40 per cent. from the powdered rock. Allied to No. 178 (1155), but with a much greater proportion of Magnetite.

No. 60.—Dioryte-Greenstone (concretionary), Ely's Point, Marquette.

No. 61.—Formation XIX. Staurolitiferous Mica-Schist (also containing Andalusite), from Island in Michigamme Lake. Like No. 301. Specific gravity of 5 pieces varied from 2.58 to 2.79; average 2.70.

No. 62.—Green Siliceous Schist, like No. 158.

No. 63.—Porphyritic Chlorite-Schist, like No. 186.

No. 64.—Quartzose Carbonaceous Slate (Plumbago), from L'Anse Range, Sect. 9—T. 49—R. 33. Specific gravity of 4 pieces varied from 2.10 to 2.17; average 2.12. Like No. 248.

No. 65.—Pyritiferous Talcose Gneiss, from Falls of Sturgeon River, Sect. 8—T. 39—R. 29. Specific gravity of 4 pieces varied from 2.67 to 2.76; average 2.71. Much grayish-green Talc, in thin seams. A few cubes of Pyrite. Resembles No. 298, but more bunched in structure.

No. 66.—Greenish-gray Fine-Grained Dolomite-Marble, from Sect. 11—T. 39—R. 29. Specific gravity of 5 pieces varied from 2.79 to 2.84; average 2.81. Almost crypto-crystalline in texture. Like No. 105, but a little finer.

No. 67.—Purple Ochrey Hematite (Hematite), Breen Mine Ore. Specific gravity of 5 pieces varied from 3.16 to 3.22; average 3.18. A few indistinct fucoidal impressions. Color reddish-brown, inclining to purple. A common variety, but of unusual color.

No. 68.—Hematite-Schist, from Sect. 11—T. 39—R. 29. Specific gravity of 7 pieces varied from 3.30 to 3.88; average 3.56. Blackish-blue, and almost without lustre. A dull, less fissile variety of No. 237.

No. 69.—Porphyritic Speckled Dioryte, from Sturgeon Falls, Menominee River. Specific gravity of 9 pieces varied from 2.92 to 3.03; average 2.98. Fibrous blades of brownish-green Amphibole, about $\frac{1}{8}$ inch long, and white compact Feldspar; making a fine contrast. Has no allies.

No. 70.—Chloritic Aphanyte-Schist, from M. and O. Road (Gorge). Specific gravity of 9 pieces varied from 2.94 to 3.07; average 2.98. Perhaps derived from the alteration of a Dioryte. Thin seams of brown Mica. Resembles No. 339, but is more decidedly chloritic.

No. 71.—Quartzose Chloritic Dioryte (Conglomeritic Diorite), from 20th mile-post, M. H. & O. Road. Specific gravity of 5 pieces varied from 2.90 to 2.93, average 2.91. Imperfect crystals of greenish-black Amphibole, with a high lustre. Much Chlorite in scales and films. Slightly resembles Nos. 305 and 308.

No. 72.—Speckled Dioryte, from Marquette Greenstone Quarry. Specific gravity of 5 pieces varied from 2.70 to 3.00; average 2.87. Finer-grained than No. 75, and with more alteration in its two constituents. Resembles No. 309.

No. 73.—Chlorite-Potstone Schist, from Marquette Greenstone Quarry. Specific gravity of 5 pieces varied from 2.53 to 2.68; average 2.60. Much Calcite disseminated, especially in seams and bunches. An intermediate variety between Nos. 340 and 341, consisting chiefly of the fine-grained material of the former, enveloped in broad films of Chlorite.

No. 74.—White Talcose Slate, from Grace Furnace, Marquette. Specific gravity of 5 pieces varied from 2.60 to 2.64; average 2.62.

Very fissile. Thin flakes of Quartz, separated by films of whitish Talc. No allies.

No. 75.—Blackish-green Dioryte, from Light-House Point Quarry, S. E. side. Specific gravity of 8 pieces varied from 2.96 to 3.08; average 3.03. A little Epidote in thin seams. Feldspar greenish-gray, partly altered to a reddish-orange. Somewhat resembles No. 303.

No. 76.—Quartzose Chlorite-Schist, from Light-House Point Quarry, N. W. side, Marquette. Specific gravity of 5 pieces varied from 2.92 to 3.03; average 2.96. Greenish-black Chlorite in continuous films. Almost a slaty structure. Seams of Quartz and of Calcite. Only slightly resembles No. 182.

No. 77.—Porphyritic Mottled Dioryte, from Pic-Nic Rocks, Marquette. Specific gravity of 10 specimens varied from 2.82 to 3.00; average 2.90. Constituent minerals unchanged on the weathered surface. Same as No. 317.

No. 78.—Magnesian Altered Dioryte (Serpentine), from Presqu'isle, Lake Superior, N. E. corner. Specific gravity of 8 pieces varied from 2.80 to 2.92; average 2.86. Many facets of altered Amphibole conspicuous. Resembles No. 321, but is a little less altered.

No. 79.—("Trap"), from Washington Mine. Specific gravity of 5 pieces varied from 2.85 to 3.01; average 2.93. Much Pyrite. May be a variety of the Aphanyte, Nos. 354 and 355, but much coarser.

No. 80.—Reddish Chloritic Gneiss. Weathers to yellowish-gray, slightly greenish and reddish. Resembles No. 276.

No. 81.—Bluish-black Argillyte-Slate (clay slate), from Huron Bay.

No. 82.—Trappean Dioryte. (Nos. 347, 348, and 349.)

No. 83.—Green Porphyry. (No. 351.)

No. 84.—Jasper-Schist. (Nos. 166 and 167.)

No. 85.—Jasper-Breccia. (Nos. 124 and 125.)

No. 86.—Talc Chloritic Gneiss. (Nos. 298 and 299.)

No. 87.—Hornblende-Gneiss. (Nos. 261 and 262.)

No. 88.—Hornblende-Schist. (No. 271.)

No. 89.—Pseudomorphous Chlorite-Schist. (Nos. 179, 180, and 181.)

No. 90.—Black Gneiss. (No. 257.)

No. 91.—Chloritic Argillyte. (No. 219.)

- No. 92.—Chloritic Dioryte. (No. 324.)
No. 93.—Epidotic Hornblende-Gneiss. (No. 268.)
No. 94.—Black Dioryte-Aphanyte ("Trap"). (Nos. 354, 355,
and 356.)
No. 95.—Coarse Red Granite. (No. 252.)
No. 96.—Ferruginous Granite. (No. 253.)
No. 97.—Ferruginous Crystalline Limestone. (No. 101.)
No. 98.—Chloritic Dioryte-Wacké. (No. 325.)
No. 99.—Brown Wacké. (No. 352.)
No. 100.—Coarse Green Amphibolyte. (No. 319.)

APPENDIX C.

LITHOLOGY.

BY

CHAS. E. WRIGHT.

APPENDIX C.

[NOTE.—The numbers given in the subjoined list of seventy-eight specimens are according to T. B. Brooks's private collection, and by these numbers the specimens are referred to in Report, Vol. I. Duplicate suites of the same rocks, numbered 1 to 78, have been furnished to the State Agricultural College, Lansing, Michigan, to the State Normal School, Ypsilanti, Mich., to Prof. Sill's Institute, Detroit, Mich., and to the School of Mines, Freiberg, Saxony. A duplicate suite, numbered 6001 to 6078, was also furnished to the University of Michigan at Ann Arbor.

The correct names (immediately succeeding the numbers) are the results of a microscopic examination of thin plates made at Freiberg, Saxony, by Chas. E. Wright, under the direction of Professors Von Cotta and Kreisler; but their valuable results were not received in time to be employed in my Report, where the provisional names (given at the close of each description) only are used.

The difficulty of procuring specimens that shall be exact duplicates may account for some of the differences in names.

The mounted plates employed by Mr. Wright in these investigations were prepared by him and are now in his possession.—T. B. BROOKS.]

Specimen No. 1001 (Freiberg determination).—Dark-green Diorite, compact and fine-grained, containing considerable chlorite or decomposed hornblende. The feldspar shows under the microscope the striation of the twin crystals. On a fresh fracture may be readily seen several small white spots, owing probably to the decomposition of a lime feldspar. It contains a very little magnetic ore and pyrites as accessory minerals. Hardness = 4. Streak powder very pale green. Spec. gr. = 2.78.—Formation XI.—Location, Pioneer Quarry, Jackson Mine.—Provisional name employed in body of Report, Chloritic Schist.

Sp. No. 1002 (Freiberg determination).—Grayish-green Diorite, fine-grained, and containing less chlorite than No. 1001, but has more cleavage, which is very distinct in two directions. The hornblende in a section of the rock under the microscope appears of a leek-green color, and possesses the dichromatic property only in a slight degree. The feldspar is partially decomposed. Some of the feldspar crystals are tinged with red. The specimen contains a little iron pyrites and magnetic ore. Hardness = 4.—Streak powder light-green or yellow.—Sp. gr. = 2.68.—Formation XI.—Location, Pioneer Quarry, Jackson Mine.—Provisional name in body of Report, Dioritic Schist.

Sp. No. 1003 (Freiberg determination).—Compact Diorite, very similar to No. 1002. Color grayish-green. The crystals are more distinct than in No. 1002. The hornblende is slightly dichromatic. The feldspar is somewhat decomposed. On a fresh fracture can be seen several yellow spots of ochreous iron ore. Magnetic iron ore and chlorite are contained as accessories. Hardness = 5. Streak powder very pale green. Spec. gr. = 2.82.—Formation XI.—Location, South of West part of Jackson Mine.—Provisional name in Report, Hornblendic Diorite.

Sp. No. 1004.—Dark-green Diorite. Very fine-grained and compact. In a section under the microscope can be seen crystals of feldspar and hornblende. Some of the feldspar crystals show the striation plainly and are probably labradorite. Chlorite and magnetic ore are contained as accessories. Hardness = 4.5. Streak powder pale green. Spec. gr. = 2.85.—Formation XI.—Location, South of West part of Jackson Mine.—Provisional name in Report, Hornblendic Diorite.

Sp. No. 1005.—Dark-green Chloritic Diorite Schist. The texture is so fine that the single ingredients cannot be seen even with a loupe. A section under the microscope shows an apparent semi-fluid structure, with a broken and deranged appearance. With a power of 100 diameters no crystals can be seen. Certain portions of the light-green amphibolitic mineral not only possess the property of polarizing the light, but are also dichromatic. It contains a little magnetic ore and pyrites. Hardness = 3.5. Streak powder

pale green. Spec. gr. = 2.68.—Formation XI.—Location, South-west part of Jackson Mine.—Provisional name used in Report, Chloritic Schist.

Sp. No. 1006.—Fine-grained Dioritic Schist. Partially decomposed and contains considerable chlorite and clay. Hardness = 3. Streak powder light-green. Spec. gr. = 2.82.—Formation XI.—Location, South-west part of Jackson Mine.—Provisional name in body of Report, Chloritic Schist.

Sp. No. 1007.—Grayish-green Diorite. On a fresh fracture the cleavage planes of the hornblende may be seen. The grains or crystals of the feldspar are too small to be recognized even with a good loupe. Examined under microscope striated feldspar can be seen. The hornblende possesses the dichromatic property very distinctly. The rock contains a few crystals of actinolite and grains of magnetic ore. Hardness = 5. Streak powder pale yellow. Spec. gr. = 3.—Formation XI.—Location, N. E. corner Sect. 1—T. 47—R. 27, or N. W. corner Sect. 6—T. 47—R. 26.—Provisional name used in Report, Diorite.

Sp. No. 1008.—Dark-green Diorite. The cleavage planes of the hornblende can be seen with the unaided eye. On a weathered surface the feldspar is very much decomposed and worn away, leaving the crystals of the hornblende very prominent. Under the microscope it may be readily seen that the percentage of the amphibole exceeds that of the feldspar. Needles of actinolite are disseminated through the rock. It contains a few crystals of magnetic ore and pyrites. Hardness = 4.5. Streak powder greenish-white. Spec. gr. = 2.91.—Formation XI.—Location, N. E. corner Sect. 1—T. 47—R. 27, or N. W. corner Sect. 6—T. 47—R. 26.—Provisional name used in Report, Diorite.

Sp. 1009.—Fine-Grained Diorite. Color grayish-green. This is a tough rock, in which the single minerals are not visible to the naked eye. A weathered surface shows but little decomposition of the feldspar. With the microscope the amphibole and feldspar appear to be about equally divided. The accessory minerals are pyrites and magnetic ore. Hardness = 5. Streak powder nearly

white. Spec. gr. = 2.90.—Formation XI.—Location, N. E. corner Sect. 1—T. 47—R. 27, or N. W. corner Sect. 6—T. 47—R. 26.—Provisional name used in Report, Diorite.

Sp. No. 1010.—Same as 1009, except specific gravity, which is 2.77.—Formation XI.—Location N. W. $\frac{1}{4}$ of N. W. $\frac{1}{4}$ Sect. 7—T. 47—R. 26.—Provisional name used in Report, Diorite.

Sp. No. 1011.—Aphanite or very fine-grained Diorite. The texture resembles a compact, dark-colored limestone. Under the microscope a power of 100 diameters is hardly sufficient to resolve the apparently homogeneous ground mass, but with a power of 400 diameters the amphibole is seen to consist of hornblende in broken crystals, and small needles of actinolite, that are closely interwoven through the entire rock, giving it a grayish-green color. Hardness = 5. Streak nearly white. Spec. gr. = 2.90.—Formation XI.—Location, N. W. $\frac{1}{4}$ of N. W. $\frac{1}{4}$ of Sect. 7—T. 47—R. 26.—Provisional name used in Report, Diorite (compact).

Sp. No. 1012.—Grayish Diorite. Having an open texture with dark-green spots, resembling very much a Diabase. Under the microscope can be seen crystals of a double striated feldspar, very similar to labradorite; also sections of crystals corresponding to augite. This would seem to confirm the supposition of its being a Diabase: the unmistakable dichroism of the hornblende determines it as a Diorite. It is possible that a Diabase may be found either above or below this. As accessories may be considered (augite, labradorite) magnetic ore and pyrites. Hardness = 5. Streak nearly white. Spec. gr. = 3.00.—Formation XI.—Location, N. W. $\frac{1}{4}$ of N. W. $\frac{1}{4}$ Sect. 7—T. 47—R. 26.—Provisional name used in Report, Diorite.

Sp. No. 1013.—Dark-green Diorite. The cleavage planes of the hornblende are quite distinct. Under the microscope the hornblende and feldspar appear to be about equally divided. The crystals of hornblende are checked or striated parallel to the principal axis. Dr. Zirkel, in his work on Basaltic Rock, 1870, considers this one of the best characteristics for hornblende in distinguishing it from augite. Striated crystals of hornblende appear to possess a

stronger dichromatic power than plain ones. The feldspar shows no striation. It contains a very little pyrites. Hardness = 5.5. Streak powder pale green. Spec. gr. = 2.91.—Formation XI.—Location, N. W. $\frac{1}{4}$ of N. W. $\frac{1}{4}$ Sect. 7—T. 47—R. 26.—Provisional name used in Report, Diorite.

Sp. No. 1014.—Light-green Diorite. Under the microscope the crystals of hornblende and feldspar are very indistinct. The hornblende is very light-colored and is but slightly dichromatic. It contains as accessories chlorite and magnetic ore. Hardness = 5.5. Streak powder nearly white. Spec. gr. = 2.81.—Formation IX.—Location, N. W. $\frac{1}{4}$ of N. W. $\frac{1}{4}$ of Sect. 7—T. 47—R. 26.—Provisional name used in Report, Diorite.

Sp. No. 1015.—Chloritic Schist. This is a very dark-green colored specimen, composed principally of chlorite, feldspar and hornblende. With the microscope can be detected a few grains of quartz, and leaves of mica. Hardness = 4. Streak pale-green. Spec. gr. = 2.68.—Formation XI.—Location, Pioneer Quarry, E. of Negaunee, Sect. 6—T. 47—R. 26.—Provisional name used in Report, Chloritic Schist.

Sp. No. 1016.—Grayish-green Diorite or Dioritic Schist. Under the microscope it appears very similar to No. 1004. Hardness = 4.5. Streak powder pale-green. Spec. gr. = 2.82.—Formation XI.—Location, Pioneer Quarry, E. of Negaunee, Sect. 6—T. 47—R. 26.—Provisional name used in Report, Diorite.

Sp. No. 1017.—Aphanite. Color dark-green. Somewhat decomposed. Under the microscope the amphibole is seen to consist of actinolite. It contains considerable magnetic ore and a small percentage of mica. There are several narrow seams in the section filled with actinolite and feldspar. Hardness = 5. Streak powder yellow to brown. Spec. gr. = 3.15.—Formation XI.—Location from South of New England Mine, N. E. $\frac{1}{4}$ Sect. 20—T. 47—R. 27.—Provisional name used in Report, Compact Diorite.

Sp. No. 1018.—Diorite with Mica. Very dark-green specimen. The rock shows but little signs of decomposition. The cleavage

planes of the hornblende are very distinct. Under the microscope it can be seen that the percentage of the hornblende exceeds that of the feldspar. The hornblende is strongly dichromatic. The mica is of a brownish-yellow color and is dichromatic. As accessories may be counted magnetic ore and pyrites. Hardness = 5.5. Streak powder light-green. Spec. gr. = 3.09.—Location, S. E. $\frac{1}{4}$ Sect. 15—T. 47—R. 28.—Provisional name used in Report, Hornblendic Diorite.

Sp. No. 1019.—Gneiss with Micaceous Diorite. Color dark gray. Contains orthoclase and a white feldspar resembling albite. The amphibole under the microscope has a deep-green color and the mica a yellowish-brown; both are dichromatic. There is a very little quartz and decomposed iron ore in the section. Hardness = 5. Streak gray. Spec. gr. = 2.74.—Location, N. W. $\frac{1}{4}$ of Sect. 15—T. 47—R. 28.—Provisional name used in Report, Dioritic Schist.

Sp. No. 1020.—Gneiss and Amphibole Rock. Color a dark green. It shows no signs of decomposition. Under the microscope it can be seen that the percentage of the amphibole (hornblende and actinolite) exceeds that of all the other minerals. The feldspar shows no striation. The amphibole is strongly dichromatic. The mica is very distinct. It contains magnetic ore and pyrites. Hardness = 5.5. Streak powder pale green. Spec. gr. = 3.00.—Location, N. E. of Old Michigan Mine, near N. W. corner Sect. 18—T. 47—R. 28.—Provisional name used in Report, Hornblendic Diorite.

Sp. No. 1021.—Gneiss with Hornblende Rock. Resembles No. 1020. Under the microscope the mica appears to be finely divided and evenly distributed. The hornblende possesses the dichromatic property in a remarkable degree, changing from a deep green to pale yellow. The hornblende, quartz and mica are contained nearly in the same proportion. It contains, as an accessory, magnetic ore. Hardness = 6. Streak powder pale green. Spec. gr. = 3.03.—Formation IX.—Location, Washington Mine.—Provisional name used in Report, Diorite (dark green).

Sp. No. 1022.—Hornblendic Gneiss with Mica, very similar to 1021, only the mica is more grouped together and in large leaves. It contains small crystals of magnetic ore, that are clustered together. Hardness = 5.5. Streak nearly colorless. Spec. gr. = 3.04.—Formation XI.—Location, Southward of Old Washington Mine.—Provisional name used in Report, Chloritic Schist.

Sp. No. 1023.—Changed Gneiss. A gray rock, containing a little chlorite. The actinolite has changed to a pale yellow color, but is still dichromatic. The magnetic ore does not appear to have decomposed, as the white ground mass surrounding the grains of ore is not stained or tinted. Hardness = 4. Streak powder gray. Spec. gr. = 2.83.—Location, near N. and S. Centre line Sect. 1—T. 47—R. 29.—Provisional name used in Report, Dioritic Schist (spotted).

Sp. No. 1024.—Diorite. Compact and fine-grained. Somewhat decomposed. The two varieties of amphibole (hornblende and actinolite) are very evenly distributed through the section. The needles or spikes of the actinolite are very small. There are several crystals of calcite which in the polarized light appear very similar to a triclinic feldspar. Hardness = 4. Streak powder white. Spec. gr. = 2.63.—Location, E. side of Sect. 13—T. 47—R. 28.—Provisional name used in Report, Diorite (conglomeritic).

Sp. No. 1025.—Calcareous Diabase or Diorite. The crystals of calcite are quite large and easily distinguished. On a fresh fracture can be seen a black mineral, which is about the hardness of calcite (3) and resembles hornblende or augite. It possesses no visible cleavage and is probably a decomposition. Under the microscope the calcite, as in 1024, resembles labradorite. The black mineral in the section has a pale green color. With the prisms turned at right angles, the black mineral gives a dark field. What is interesting is, that the mineral is slightly dichromatic. On a weathered surface the calcite is decomposed and washed out, leaving the rock very porous. Hardness = 5.5. Streak powder gray. Spec. gr. = 2.70.—Location, N. E. $\frac{1}{4}$ of N. E. $\frac{1}{4}$ of Sect. 14—T. 47—R. 28.—Provisional name used in Report, Dioritic Rock (amygdaloidal).

Sp. No. 1026.—Fine-grained Chloritic Schist. Contains considerable mica. On a fresh fracture the glistening specks of mica can be readily distinguished from the dark green chlorite. Under the microscope the small grains of quartz are rendered very distinct. It contains a few crystals of magnetic ore, also needles of actinolite. Hardness = 3. Streak powder light green. Spec. gr. = 2.93.—Formation XI.—Location, Lot 4—Sect. 20—T. 28—R. 30.—Provisional name used in Report, Chloritic Schist.

Sp. No. 1027.—Dark-gray Anthophyllite Rock, or Quartzite containing anthophyllite. It has a distinct parallel cleavage. The anthophyllite is unevenly distributed through the section in seams, and is nondichromatic, which distinguishes it from actinolite. The quartz consists of small grains ($\frac{1}{20}$ millm.). It contains minute crystals of magnetic ore (less than $\frac{1}{100}$ millm. in diameter). Hardness = 4-7. Streak powder white. Spec. gr. = 3.21.—Formation XII.—Location, Lot 5—Sect. 20—T. 48—R. 30.—Provisional name used in Report, Anthophyllitic Schist.

Sp. No. 1028.—Fine-grained Chloritic Schist. Color dark-green, similar in appearance to 1026. In a section can be seen considerable Amphibole. It contains less Mica than 1026. Hardness = 4. Streak light-green. Spec. gr. = 2.84.—Location, Lot 5—Sect. 21—T. 48—R. 30.—Provisional name in Report, Chloritic Schist.

Sp. No. 1029.—Light-gray Quartzite or Granulite-like rock. The grains of quartz are small. The gray color is caused by hornblende, which, in a section under the microscope, resembles fine moss. This is probably a metamorphic rock. Hardness = 7. Spec. gr. = 2.67.—Formation L.—Location between Sects. 20 and 21—T. 48—R. 30.—Provisional name used in Report, Quartzose Gneiss.

Sp. No. 1030.—Fine-grained Gray Chloritic Schist. The grains of quartz are small. The chlorite is very evenly distributed through the section. It contains a few broken crystals of hornblende. Hardness = 6. Streak gray. Spec. gr. = 2.64.—Formation XIX.—Location, Lot 7—Sect. 30—T. 48—R. 30.—Provisional name used in the Report, Quartzose Mica Schist.

Sp. No. 1031.—Coarse-grained Hornblende Gangue Rock. The cleavage planes of the hornblende can be easily recognized with the naked eye. By using only the upper prism and revolving it, some of the hornblende crystals change from white to yellow. It contains considerable chlorite, also a few leaves of mica and several minute crystals of magnetic ore, that average less than $\frac{1}{100}$ of a millm. in diameter. Hardness = 4. Streak powder greenish-black. Spec. gr. = 3.10.—Formation XIX.—Location, Lot 7—Sect. 30—T. 48—R. 30.—Provisional name used in Report, Mica Schist (with seams of black hornblende).

Sp. No. 1032.—Anthophyllitic Schist and Magnetic Ore. The rock on a fresh fracture has a dark-gray color, with several yellow spots. The acicular crystals of anthophyllite are woven together, forming a reticulated mass. Some of the grains or crystals of the magnetic ore are nearly a millimeter in diameter, while others in the section can scarcely be seen with a power of 100 diameters. Hardness = 6. Streak brown. Spec. gr. = 3.27.—Formation XVII.—Location, Lot 3—Sect. 30—T. 48—R. 30.—Provisional name used in Report, Anthophyllitic Schist.

Sp. No. 1033.—Anthophyllitic Schist and Magnetic Iron Ore. Very similar to 1032. The anthophyllite is more or less colored yellow. Hardness = 6. Streak powder brown. Spec. gr. = 3.33.—Formation XI.—Location, Lot 3—Sect. 30—T. 48—R. 30.—Provisional name used in Report, Quartzose Anthophyllitic Schist.

Sp. No. 1034.—Magnetic Ore, with Quartz, Actinolite and Chlorite. The specimen is very friable. Some portions of it consist nearly of pure silica that resemble a freestone, and is cut in different directions by thin seams filled with magnetic ore. The actinolite has a brown color and the chlorite in the section a deep green. The magnetic ore constitutes nearly one-half the entire rock. Hardness = 5-7. Streak black. Spec. gr. = 3.34.—Formation XIII.—Location, Lot 4—Sect. 20—T. 48—R. 30.—Provisional name used in Report, Quartzose Magnetic Schist (banded).

Sp. No. 1035.—Specular Iron Ore and Quartz.—Formation XII.—Lot 4—Sect. 20—T. 48—R. 30.—Provisional name in Report, Specular Quartz Schist.