

Jaspilyte. Sericite schist. Porphyrel.]

with *hematite* or *limonite* scales and by darker concentric layers of the same, presenting pisolitic structure. The concentric structure pertains, however, only to the borders of these grains, their interior portions being amorphous, and supposed to have been originally of *glauconite*. One section.

*Age.* Animikie, lying below the limestone No. 1289—at least further north.

N. H. W.

## No. 1295. JASPILYTE.

Same place as the last; portion of the same mass.

*Ref.* Annual Report, xvi, pages 69, 120; Bulletin vi, pages 115, 422.

*Meg.* Red and gray, flinty.

*Mic.* There are no round masses of the changed glauconite in this portion of the rock, but while the mass in general consists of the same interlocking, secondary quartz grains, the iron films, instead of being concretionary, are in parallel fine films nearly straight, lying in the body of the quartzitic mass. These give color to the rock. As these are wanting, and as the quartz becomes finer, so the rock approaches flint. Compare No. 1277. Two sections.

*Age.* Animikie.

N. H. W.

## No. 1296. SERICITE SCHIST.

On a traverse made north from Gunflint lake, about half a mile west of the east end of the lake.

*Ref.* Annual Report, xvi, pages 69, 120.

*Meg.* A fine-grained, hard, siliceous, gray, roughly schistose rock, with minute scales of a mineral like sericite. No section.

*Age.* Archean (Keewatin).

U. S. G.

No. 1297. PORPHYREL. (*Schistose.*)

On the same line, north from Gunflint lake, in Canada, as Nos. 1294 and 1295.

*Ref.* Annual Report, xvi, pages 69, 120.

*Meg.* Porphyritic with feldspars. Compare Nos. 1279, 1283 and 311. A fine-grained, siliceous rock, gray or greenish gray, with some pyrite.

*Mic.* Large patches of *actinolite* are perhaps the most conspicuous element in this rock. They are light green in natural light, but show a slightly darker green when the polarizer only is used, and the fibres are brought into parallelism with its principal section. Smaller particles and single fibres are scattered through the slide.

*Quartz* is the next in importance. It is distributed everywhere in fine sub-angular, glassy, clear grains, forming the general matrix. These grains are generally not in contact, but are separated by another finer matrix which becomes visible on lowering the condenser in natural light, but which is translucent in general, and polarizes aggregately between crossed nicols, apparently a kind of *kaolin*. But these quartzes are sometimes larger and in contact. They then have more irregular shapes

and more tortuous boundaries with respect to each other, and enclose partially some of the areas of kaolin. These larger areas in part break up into grains having separate orientation.

There are many roundish areas, occupied chiefly by the fine kaolinic substance, which extinguish as individuals, but which are filled with secondary substances, amongst which can be distinguished *calcite*, *quartz* of secondary origin, *muscovite* and *zoisite*.

*Zoisite* is also scattered throughout the slide. It is distinguished by its clear transparency and its high refraction, the latter property being brought out on lowering the condenser. Between crossed nicols also it is often blue (or gray). It is in the midst of the actinolite and sometimes occupies the central portion of the actinolite groups, but in general it is in fine isolated grains scattered through the kaolin, as well as in large cleaved but loosely aggregated masses.

*Apatite* is found in a few quite sizeable grains.

*Biotite* is rare, in very fine brown leaves, but more frequent in certain areas than in others.

*Sphene* is seen in a few isolated grains, some of them being quite large. Two sections examined.

*Age.* Archean (Keewatin).

*Remark.* This rock is one of those regenerated, sub-porphyrific clastics which, while revealing its originally fragmental condition, is yet a perfectly crystalline rock. It has the outward megascopic aspect of a fine-grained granite, and is light colored. The old feldspars are the most decayed portion of the rock, but they are now firm with the formation of innumerable grains of other feldspar, of quartz, of muscovite and of zoisite. The smaller clastic feldspars are micro-granulated and lost, but the largest are evident by the four extinctions that occur on rotation. Their borders are interhooked with the matrix by new feldspathic growths. The quartz is wholly secondary.

N. H. W.

#### NO. 1300. HORNBLLENDE SCHIST.

About three-fourths of a mile north of Gunflint lake; from the "black belt" in the Keewatin schists.

*Ref.* Annual Report, xvi, pages 69, 120.

*Meg.* Coarse hornblendic rock, associated with micaceous schist, lying in a rudely stratified belt in the green schists and other rocks that constitute the Keewatin north of Gunflint lake.

*Mic.* *Green hornblende* abundant. Two forms of *feldspar*, one in large grains, much altered, and the other fresh and glassy, evidently of later date. *Quartz* not abundant. *Diopside* common, but generally not in large masses. *Sphene*, *epidote*, *calcite*, *apatite*. One section.

*Age.* Archean (Keewatin).

(Granite. Feldspar schist.)

*Remark.* If this were originally a basic intrusive rock, and were then sheared and altered by such action, it would perhaps have produced a rock like this. If it had been a coarse debris from basic rocks, produced by erosion, such as some parts of the Ogishke conglomerate, and had been sheared in the same way, it would probably also have produced such a rock. The diopside shows distinct cleavages parallel and perpendicular to the optic plain in a section perpendicular to an optic axis, being therefore the pinacoidal cleavages rather than the prismatic.

N. H. W.

## NO. 1301. GRANITE.

At a point about a mile north of Gunflint lake, on the same town line.

*Meg.* An imperfect granite or gneiss.

*Mic.* The foregoing description of No. 1300 would also apply to this rock, only requiring less hornblende and more quartz. One section.

*Age.* Archean.

N. H. W.

NO. 1304. FELDSPAR SCHIST. (*Micaceous.*)

North from Gunflint lake, at the "black belt."

*Ref.* Annual Report, xvi, pages 70, 120.

*Meg.* Shows a blending of the characters of the mica schist and those of the regenerated porphyritic schist (porphyrel).

Making a closer inspection of the rocks of the Vermilion group (*i. e.*, the Couthiching of Lawson) at this point, they are found to extend north and south about fifteen rods. There is certainly a conformable transition from the Keewatin to this, which is chiefly mica schist, at least superficially. At some depth within the rock perhaps there would be found a greater proportion of hornblende, since it seems that the mica results from the natural decay of the hornblende. The interbedded, light-colored rock is the gray "porphyritic" rock of the lake shore, but has some mica scales. It acts here much like the so called "dikes" of gneiss that are interstratified with the Vermilion group or mica schists north of Vermilion lake. It fades out by very slow transitions into the mica schist, and it also is replaced abruptly by it. It runs to needle-shaped points and vanishes conformably in the darker rock. If it is, hence, eruptive, then this porphyritic rock everywhere is eruptive, and also the schist into which it graduates at the lake shore. Rock No. 1304 shows a blending of the characters of the mica schist with those of the rock that shows the porphyritic characters. The belt from which this came is about ten inches wide, and such are numerous in the schists. Indeed, there can be seen almost every kind of transition and every direction of gradation between the schist, the hornblende rock and the porphyritic and gneissic rock. They all occur as strings and as isolated portions in each of the others. There are belts of coarsely hornblende rock that alternate several times in the mica schist, conformably with the strike, but the former are confused, lumpy and uncertain. They may have been basic eruptives in the sediments of the Keewatin at the time of their accumulation, and so spread out as sheets approximately conformable to the sediments.

The section foregoing was made on the town line extended north from the south side of the lake between T. 65-1 and T. 65-2 W.

*Mic.* Green hornblende and a little biotite give color to the rock. There is much secondary quartz and glassy feldspar and some larger feldspars that appear to be *orthoclase*. There are also much decayed feldspars, on one of which a determination by extinction on  $n_p$  in the acute angle of the optic plane indicates *andesine-oligoclase*. The glassy feldspars generally show no cleavage nor twinning, and therefore it is difficult to determine them specifically. It appears in some cases that an old feldspar furnished the nucleus on which the fresh feldspar grew. One section.

*Age.* Archean (Keewatin).

N. H. W.

NO. 1305. DIABASE. (*Dense.*)

Gunflint lake, north shore.  
*Ref.* Annual Report, xvi, pages 72, 120.

*Meg.* Associated with the rock which bears the rusty film seen on some of the rocks of the Animikie. Dark, fine, apparently embracing lumps of gray flinty taconyte, like No. 1307.

*Mic.* Microliths of *feldspar*, *augite* and of *magnetite*, very much as in the rock No. 1280, lie in a dim, slightly polarizing brown matrix which may have been at first of glass, but is now composed wholly of the above minerals. The little feldspars are frequently in couples, as if albite twins, but their extremities are not uniformly placed, one or the other projecting too far at one or at both ends. They are also sometimes separated by a portion of the surrounding semi-opaque matter, which is in general heavily charged with the magnetite rods. One section.

*Age.* Animikie.

*Remark.* This was apparently a surface extension of a basic igneous rock, involving the bottom beds of the Animikie. Its petrographic alliance with No. 1280, which is in the midst of the Keewatin schists, indicates that No. 1280 is really of the date of the sills of the Animikie. The banded structure presented by this slide is due to the concentration of the magnetite in some belts, compared with its scarcity in others.

N. H. W.

NO. 1306. DIABASE. (*Dense and magnetited.*)

Same place and same rock mass, but from a specimen numbered 1305 and 1306, showing a gray film.  
*Ref.* Annual Report, xvi, pages 72, 120; Bulletin vi, pages 121, 129, 422.

*Meg.* Heavy with magnetite.

*Mic.* In the midst of the opaque part of this slide are scattered minute light spicules, which can be nothing but *feldspars*, the same as those seen in No. 1305. The rest of the slide is gray and sub-transparent—apparently a glassy part, less ferruginous, and in this also can be seen the same feldspar microliths. One section.

*Age.* Animikie.

N. H. W.

NO. 1307. TACONYTE. (*Sideritic.*)

Same place.  
*Ref.* Annual Report, xvi, pages 72, 120; Bulletin vi, pages 121, 129, 422.

*Meg.* So-called limestone, of Gunflint lake.

*Mic.* The most of this slide is made up of *siderite* and *quartz*, the latter being of secondary origin, as shown by its interlocking borders. These are mingled throughout the slide rather uniformly, the siderite grains making roundish patches such as to suggest that it is the result of replacement of some earlier mineral which was granular.

Magnetite. Quartzite and muscovadyte.]

In the siderite patches are other substances, and particularly *pyroxene*(?) which in occasional elongated grains has a transverse cleavage and parallel extinction, as if it were orthorhombic, while its high polarization is like *epidote*. Other grains show conclusively that this mineral is not orthorhombic. Its optic plane is perpendicular to the scant cleavage. It is scattered in finer particles throughout most of the siderite patches. At the same time there is much *magnetite* in form of a fine powder. These give the siderite patches, in common light, the form and manner of distribution of the glauconite (so called) of the rock taconyte, and the rock might be called taconyte, were it not that the patches are largely of siderite and epidote. One portion of the slide is free from epidote and iron oxide, and is then simply a sideritic taconyte, or "cherty carbonate." One section.

*Age.* Animikie (probably iron-bearing member).

*Remark.* This close association of basic igneous rock with the sideritic taconyte, well known about Gunflint lake, seems to link them in some measure in a common history or in a succession of chemical transformations having a common cause, and is quite significant.

N. H. W.

## NO. 1308. MAGNETITE.

Near the north shore of Gunflint lake, about on sec. 13, T. 65-3 W., if the United States system of survey were extended to the Canadian shore.

*Ref.* Annual Report, xvi, pages 72, 73, 120; Bulletin vi, pages 117, 131, 422.

*Meg.* Fine-grained, compact, nearly pure magnetite. No section.

*Age.* Animikie (iron-bearing member).

U. S. G.

## NO. 1309. QUARTZYTE AND MUSCOVADYTE.

East end of Gunflint lake.

*Ref.* Annual Report, xvi, pages 72, 73, 120; Bulletin vi, pages 117, 131, 422.

*Meg.* A condition of "muscovadyte," near contact with the gabbro.

*Mic.* Essentially quartzite at the present time. The grains are of uniform size, wholly reformed, but without interlocking. They fit closely to each other, filling all the interstices, but do not interlock. They contain numerous globular inclusions which extinguish independently and which are always at or near the centre. They are separated from each other by a yellowish film which is chloritic or serpentinous, but occasionally this is replaced by iron ore, which spreads irregularly about the grains of quartz. When the iron increases thus the greenish-yellow substance also increases, and it then occasionally shows the polychroism of *actinolite*, into which secondary quartz sometimes has insinuated itself in the manner of a micropegmatyte. This change goes further, for in connection with the increased occurrence of magnetite and of actinolite is also considerable of the *epidote* mentioned in No. 1307 and of *augite*, the latter even forming large but much altered crystals, while a yellowish substance resembling *bowlingite* may be the residuum from olivine.

The foregoing describes one of the slides. Another slide, having the same number, has much less of quartz, or none, but granular *augite* and *feldspar*, with a liberal sprinkling of *magnetite*, compose the rock. Here frequently the finer magnetite grains are clustered near the centres of the feldspars. This is a typical muscovadyte. Two sections.

*Age.* The quartzite is supposed to be of the age of the Animikie, and the other seems to be a part of the gabbro. The first section described shows a transition from the muscovadyte to quartzite, in a manner represented by Bayley (Nineteenth Annual Report), which requires that both slides be referred to the gabbro.

[NOTE. In the light of the latest conclusions as to the nature and relations of the muscovadyte to the gabbro, such curious combinations as this are explained by referring both the quartzite, the muscovadyte and the magnetite, with all their associations, primarily to the Keewatin, the quartzite and magnetite appearing abundant when the Keewatin happened to contain a jaspilyte lode which suffered the metamorphosing action of the gabbro revolution, the normal gabbro itself being the last term in the series of rock genesis, formed by complete refusion where the original Keewatin contained no jaspilyte.]

N. H. W.

NO. 1310. LIMESTONE (*with tuff?*)

North shore of Gunflint lake.

*Ref.* Annual Report, xvi, pages 72, 73, 121; Bulletin vi, pages 115, 121, 129, 130, 422.

*Meg.* Breccia of flint, etc., in limestone.

*Mic.* The sections consist of the well-known granular limestone, in the main, but contain chloritic and finely siliceous portions, evidently of foreign nature, which remain mainly dark between crossed nicols, and which, in one case, show a rhyolitic structure, with quartz and magnetite. It appears, therefore, possible, if not probable, that it is of the nature of a lapillus from an adjoining volcanic source. The rock also contains more *siderite* than *calcite*. Two sections.

*Age.* Animikie (probably the iron-bearing member).

*Remark.* In several instances it has been stated that there were evidences of local volcanic action in the rocks of the bottom of the Animikie in the vicinity of Gunflint lake and North lake, but in nothing has this been indicated more strongly than in this slide. From this it is reasonable to infer that the flinty, angular fragments which characterize this limestone in the vicinity of Gunflint lake are generally of the nature of devitrified volcanic glass.

Two additional sections were made of this breccia, cutting some of the siliceous masses, and the black strings, but showing nothing decisive as to the nature and origin of these inclusions. The siliceous masses are apparently not of clastic structure. Special conditions are responsible, apparently, for the carbonate of iron here, in the iron-bearing member, instead of the usual oxide.

N. H. W.

Siderite. Diabase. Quartzite.]

NO. 1311. SIDERITE (*with tuff*).

North shore of Gunflint lake.

*Ref.* Annual Report, xvi, pages 73, 121.*Meg.* Another stage of this rusting rock. (Compare No. 1289).

*Mic.* Mainly carbonate of iron, with some scattered dark patches, but not showing any new or even characteristic features, except the prevalence of granular crystals of siderite. The dark patches are presumed to be of rhyolitic origin, one being apparently of glass hardly devitrified. One section.

*Age.* Animikie.

N. H. W.

## NO. 1312. DIABASE.

At the narrows at the outlet of Gunflint lake.

*Ref.* Annual Report, xvi, page 121; Annual Report, xvii, pages 199, 204.*Meg.* Black, heavy and close-jointed.

*Mic.* The diabasic structure is distinct, notwithstanding the fineness of grain, yet the shapes and the occasional breaking of the *feldspar* borders by *augite* show that the two minerals were nearly cotemporary in origin. Many conspicuous *magnetite* spicules pierce the other minerals, but less frequently the feldspars. The substance lying in the interstices of the feldspars and augites is greenish, sub-crystalline or micro-crystalline, and indistinct, and represents doubtless a devitrified portion of the glassy magma. One section.

*Age.* Sill in the Animikie.

N. H. W.

NO. 1313. QUARTZYTE. (*Ferriferous.*)

Near the narrows at the outlet of Gunflint lake, on the west side.

*Ref.* Annual Report, xvi, pages 73, 121.*Meg.* Gray, siliceous and magnetited.

*Mic.* Mostly interlocking, secondary *quartz*, but with considerable *iron ore*, and a little of rusty fibrous *actinolite*(?) Another section having this number is quite different, consisting of very fine or flinty texture, and uniform grain; it is like the supposed nodule of glass in No. 1311, and probably was not correctly numbered. Two sections.

*Age.* Animikie.

*Remark.* The iron ore in this slide consists of both magnetite and siderite, and they present a structure that appears to be a remnant of an earlier taconitic origin. These ores are independent of each other. There is no sign that one was derived from the other, but they appear to have been about cotemporary in origin. The siderite is somewhat limonated, but that is due to recent exposure.

N. H. W.

NO. 1314. DIABASE. (*Porphyritic.*)

Animikie bay, west end of Gunflint lake; also cut by the new railroad.

*Ref.* Annual Report, xvi, pages 78, 85, 121.

*Meg.* Diabase, having conspicuous feldspar crystals of porphyritic habit.

*Mic.* The section shows none of the large feldspars. It is in all respects similar to No. 1312, except that the elements are all coarser, and that through alteration much *actinolite* has been developed. One section.

*Age.* Sill in the Animikie.

N. H. W.

NO. 1316. GRANITE.

North side of Black Fly bay, at the outlet of Gunflint lake.

*Ref.* Annual Report, xvi, pages 73, 121; Annual Report, xvii, pages 199, 203.

*Meg.* Gneissic.

*Mic.* Much decayed, the feldspars being rendered almost non-transparent. Contains *quartz*, some *pennine*, *sphene* and probably *orthoclase* and *oligoclase*. One (thick) section.

*Age.* Archean.

N. H. W.

NO. 1317. HORNBLLENDE SCHIST.

Enclosed in No. 1316.

*Ref.* Annual Report, xvi, page 121.

*Meg.* A rather fine-grained rock, composed of hornblende and feldspar with a few large grains of quartz. No section.

*Age.* Archean.

U. S. G.

NO. 1318. DIORYTE. (*Camptonite?*)

At the first falls going north from the outlet of Gunflint lake.

*Ref.* Annual Report, xvi, page 121; Annual Report, xvii, page 199.

*Meg.* Darker portion of the gneiss, spreading irregularly, but in manner of a dike.

*Mic.* The rock is colored by *hornblende*, which is in distinct, well-cleaved crystals, as well as in form of an alteration product which is less doubly refractive, almost non-pleochroic and has an imperfect short fracture-cleavage parallel or nearly parallel with which extinction takes place, and is in general a fibro-scaly, dull-green substance which seems to agree physically with the descriptions of *uralite*. Fresh *actinolite* (or *grünerite?*) fibres pass through this substance, showing a fine twinning. This uralitic substance has  $n_p$  for acute bisectrix.

*Epidote* in considerable quantity is also present. The original feldspars are much altered and are indeterminable. They are rejuvenated by secondary growths which are fresh, and which are distributed irregularly through the old grains, and about their borders. With *pennine* in small amount, and some *calcite* and *quartz*. One section.

*Age.* Archean.

*Remark.* This rock is the same as No. 61G, described on pages 160, 161, Seventeenth Annual Report. It is in form of a dike, and cuts both granite and schist.

N. H. W.



Taconyte. Quartzite.]

## NO. 1319. TACONYTE.

North side of the point that lies north of Animikie bay, Gunflint lake.  
*Ref.* Annual Report, xvi, pages 77, 121. (Compare No. 437.)

*Meg.* Fine, siliceous.

*Mic.* Taconyte. The rock is mostly *quartz*, but it is stained with iron and other substances so as to show the peculiar globular structure of taconyte. These globules are not heavily charged with iron, but in the main are translucent, though sometimes entirely opaque. Some of the finest-grained ones, which suggest a possible derivation from devitrification of volcanic glass, are crowded with feathery tufts of fibres (or trichites?), which are exceedingly fine. It is evident, however, that these fibres are of later date than the deposition of these grains in this rock, since they extend beyond the borders of the grains into the surrounding interlocking matrix of quartz. If these grains are of original volcanic glass, their devitrification was probably effected about the time of the deposition of the interlocking quartz. One section.

*Age.* Animikie.

N. H. W.

NO. 1320. TACONYTE. (*Banded.*)

A condition of No. 1319. (Compare No. 1277.)  
*Ref.* Annual Report, xvi, pages 77, 121.

*Meg.* The rock appears "streamed." In the field said to be a condition of rock No. 1319.

*Mic.* The whole rock consists of quartz and *magnetite*, in a rhyolitic(?) structure, the magnetite being in cubes and the quartz in interlocked, very fine grains. The structure is the same as that of the rhyolitic fragment mentioned in No. 1310, but much coarser. One section.

*Age.* Animikie.

*Remark.* It is in keeping with the intimations that precede, that a rhyolitic rock should be found in place, and this may be that rock. It is at or near the bottom of the Animikie. This seems to be the rock that supplied the supposed grains of volcanic glass seen in No. 1319.

N. H. W.

## NO. 1322. QUARTZYTE.

North side of the same point. In fallen, at least transported, masses; the original beds not seen.  
*Ref.* Annual Report, xvi, pages 78, 85, 88, 121; Annual Report, xviii, page 62; Bulletin vi, pages 117, 422.

*Meg.* Granular, firm, gray quartzite.

*Mic.* The forms of the original rounded grains are distinctly outlined by the curving bands of colored impurities, outside and inside of which extinction is simultaneous for the same grain. The secondary growths have formed an interlocking granular quartzite. Besides the quartz grains there are a few of feldspar and one

of flint, or devitrified rhyolite (No. 1277). There are also several that are perfectly isotropic, greenish gray in common light, but in convergent light on lowering the lower nicol there appears a mesh or maze of very fine spicules and crystalliths, which are also probably a result of devitrification. One section.

*Age.* Animikie.

*Remark.* This rock, although not seen *in situ*, is distinctly allied to the rock No. 1319, in containing, amongst a prevalent sand of round quartz grains, a few grains of devitrified glass, or aporhyolyte. There is here a strong suggestion that the pre-Animikie surface was covered, to a greater or less extent, by volcanic rocks which furnished this debris. These rounded pebbles of devitrified glass, although consisting now largely of fine secondary quartz, and in that respect resembling some parts of the taconyte of the Animikie, are free from iron. This slide is illustrated by figure 9, plate II.

N. H. W.

NO. 1323. DIABASE.

Top of the hill (or ridge running east and west) north of Animikie bay, Gunflint lake.  
*Ref.* Annual Report, xvi, pages 78, 121.

*Meg.* Gabbro like, sometimes porphyritic like No. 1314.

*Mic.* The *magnetite*, which is in crystals and skeleton crystals, cuts the *augite*, and slightly the *feldspar*. The rock is weathered. Decay in patches in the feldspars has produced apparently a mica which is near *muscovite*. One section.

*Age.* Sill in the Animikie.

N. H. W.

NO. 1324. ZIRKELYTE.

Near the diabase contact, near the top of the ridge north of Animikie bay, Gunflint lake; same place as the last. This underlies the diabase sill. Compare No. 1327.  
*Ref.* Annual Report, xvi, pages 78, 121.

*Meg.* Flinty lower part of a diabase sill.

*Mic.* The slide consists entirely of the same fine-grained, flinty substance already mentioned, more or less clouded by magnetite and by belts of radiating trichites, the latter being in the main arranged along fissures, but sometimes disposed in radiating clusters in the mass of the rock. There is also another coarser crystallization, consisting of a highly doubly refracting mineral, apparently *pyroxene* or *actinolite*, which along a certain boundary is abruptly separated from the finer rock, but which in another part of the slide graduates into the finer, showing that they have a similar origin. These coarser crystalliths graduate into finer and finer needles, sometimes forming four-armed black crosses which polarize near the point of crossing, but which, where separated, can be seen to blend into the finer trichites and are lost in the finer mesh. This fine crystallization, whether polarizing or not, is embraced in a fine siliceous(?) granular background—the body of the so-called flint

Quartzite. Granite.]

or zirkelyte. The most of the magnetite is found in borders along the belts of the coarser crystalliths above. One section.

*Age.* Animikie.

*Remark.* The slide does not fairly represent the rock having this number, but is evidently made from one of the thin, flinty lenticular parts embraced in No. 1324. The rock itself is coarser.

N. H. W.

NO. 1327. QUARTZYTE. (*Actinolitic?*)

Northwest corner of sec. 23, T. 65-4, west from Gunflint lake. (Compare No. 1324.)

*Ref.* Annual Report, xvi, pages 80, 121; Annual Report, xix, pages 194, 201.

*Meg.* Gray, quartzose, underlying a cherty magnetite.

*Mic.* The quartz is wholly secondary, so far as seen in the slide, with interlocking borders, the grains being sub-rounded. If ever this quartz was of clastic structure, it has lost it now, not even the boundaries of any original grains (except rarely and doubtfully) being preserved. It is permeated in a loose manner by conspicuous radiating rosettes of *actinolite*(?) fibres, each of the rosettes having about the size of the individual quartz grains, making a handsome and unusual appearance between the nicols. These fibres pierce the surrounding quartz in all directions. The rosettes are not promiscuously placed in the quartz, but are at the boundaries of the quartz. They have the appearance, as mentioned below, of having grown up from some other original substance which was a constituent of the rock before the metamorphism to which it has been subjected had acted upon it. The rock, indeed, was probably a taconyte. The quartz, as well as the original glauconite, if such were ever present, have been recrystallized simultaneously.

Mingled with the quartz, which shows no trace of rounded clastic boundaries, is a liberal ingredient of volcanic glass, largely devitrified. In this substance the actinolitic(?) rosettes take their source, radiating not only through the glass, but also into the quartz adjacent. Some portions of this volcanic glass do not contain these rosettes, but are charged with indefinite ultra-microscopic forms, which cannot be determined. This rock is a phase of the taconyte of the Animikie. It is illustrated by figure 10, plate II. One section.

*Age.* Animikie (iron-bearing member).

*Remark.* The appearance of this rock in thin section is similar to that of uxulianyte, which has tourmaline arranged in a stellate grouping, in quartz, but the fibres in this are finer.

N. H. W.

## NO. 1328. GRANITE.

Bottom of the test pit in N. W.  $\frac{1}{4}$  sec. 23, T. 65-4 W.

*Ref.* Annual Report, xvi, pages 80, 121.

*Meg.* There are three specimens of this rock. One is a pinkish granite with little hornblende (and biotite), and the others are much darker colored and much

richer in hornblende. The excavation passed through the iron-bearing member of the Animikie and struck granite.

*Age.* Archean.

U. S. G.

NO. 1329. DIABASE (*with olivine*).

About one-eighth of a mile west of the northeast corner of sec. 22, T. 65-4 W.  
*Ref.* Annual Report, xvi, pages 81, 121; Annual Report, xix, pages 195, 201.

*Meg.* An ordinary diabase, looking like the diabase of the Logan sills in the adjoining Animikie strata. No section.

*Mic.* W. S. Bayley's description of this rock is as follows:\*

"This specimen is a sample of a great dyke that cuts the gneiss underlying the rocks above mentioned. No. 1329 does not correctly represent the dyke, but it is the only sample that has been furnished. It is a very coarse-grained olivine-diabase, with long, lath-shaped crystals of a plagioclase near andesine, large grains of light-colored olivine, and interstitial, allotriomorphic, dark pink, slightly pleochroic augite, with much irregular magnetite in and around the augite. This last named mineral is quite fresh, except in small areas immediately next to feldspars, where it is slightly chloritized. The rock resembles very strongly the substance of the great dykes everywhere cutting the Animikie in the lake Superior region."

*Age.* Probably Cabotian dike cutting Nos. 1330 and 1331.

U. S. G.

NO. 1330. AMPHIBOLYTE.

Near the quarter post between secs. 20 and 21, T. 65-4, west of Gunfint lake.  
*Ref.* Annual Report, xvi, pages 82, 83, 121.

*Meg.* Greenstone, harsh, firm, hornblendic.

*Mic.* The rock consists almost exclusively of well crystallized hornblende, with the angle  $c \wedge c$  (maximum) measured on 010 at  $20^\circ$ . It has  $n_p$  as the acute bisectrix. There is, however, a sprinkling of magnetite throughout some of the larger grains. One section.

*Age.* Archean (Keewatin).

N. H. W.

NO. 1331. AMPHIBOLYTE.

From the same place as No. 1330.  
*Ref.* Annual Report, xvi, pages 82, 121.

*Meg.* Green schist, schisted condition of No. 1330.

*Mic.* Like the last, but finer and containing a considerable feldspar. There are also isotropic, brown areas (*biotite*) elongated with the structure, in which appear small biotite scales. One section.

*Age.* Archean (Keewatin).

N. H. W.

\*Nineteenth Annual Report, p. 195.

Greenstone. Peridotyte.]

NO. 1334. GREENSTONE. (*Muscovadyte*.)

Most southerly exposed part of the same greenstone as No. 1333. In a ridge thirty rods south of Nos. 1330-1332, but from its most southerly exposed portion.

*Ref.* Annual Report, xvi, pages 83, 84, 121; Annual Report, xix, pages 195-197, 199-203.

*Meg.* Greenstone.

*Mic.* Pyroxene (*augite*) in globular and angular grains, and in ragged masses, with *plagioclase* and a little *magnetite*. The feldspars are crowded with inclusions. *Leucoxene* is common in rather dark grains. One section.

*Age.* Archean (Keewatin metamorphosed).

*Remark.* This rock in its internal structure illustrates the familiar fact that minerals in incipiency under metamorphism assume globular forms at first. These augitic grains are identical with those seen in the pyroxenic gneisses in the long point (Muscovado point) at the northeastern side of Gabemichigama lake, and at other places mentioned, and they are in all cases to be attributed to the general metamorphosing effect of the gabbro revolution on the clastic greenstones of the Archean. Mr. Bayley argued that this rock is degenerated or crushed gabbro (Nineteenth Annual Report, pages 196, 197). He apprehended its petrographic alliance with the normal gabbro, but put it at the wrong end of the series of change. It is at the incipiency of gabbro rather than at its degeneracy. It is at its cradle rather than at its grave. It was a clastic greenstone originally. It is now a metamorphic rock. The normal gabbro occurs but few rods south of this rock.

N. H. W.

NO. 1335. GREENSTONE. (*Muscovadyte*.)

Rock of the hill north of Chub (Akeley) lake.

*Ref.* Annual Report, xvi, pages 83-85, 87, 95, 98, 121; Annual Report, xix, pages 195-197, 199-201, 203.

*Meg.* A rather indefinite, greenish rock.

*Mic.* *Hornblende* and *plagioclase* feldspar, in imperfect, fine, granular association, compose this rock. It has also a globular pyroxene (probably *diopside* or incipient *augite*) rather thickly scattered throughout the slide. This is in globular grains and in groupings of grains and frequently small globular pyroxenes are enclosed in the larger. With a little biotite that composes the rock. One section.

*Age.* Archean (Keewatin).

*Remark.* It is reasonable to assume that this rock was also originally a basic clastic of the greenstone kind. It approaches muscovadyte in its present condition, and as Bayley states might be styled a granulitic gabbro.

N. H. W.

NO. 1336. PERIDOTYTE (*with fayalite*.)

From an excavation at Chub (Akeley) lake, for ore. This lies on the greenstone No. 1335, dipping southward under Chub lake. It is closely associated with the iron ore, and is, indeed, a part of the ore of the locality, varying to quartzite.

*Ref.* Annual Report, xvi, pages 83, 84; Annual Report, xix, pages 195, 197, 198, 201, 203, 204.

*Meg.* Heavy with magnetite, but fresh.

*Mic.* The rock consists essentially of olivine and augite, with a few scattered grains of plagioclase and a notable amount of *magnetite*.

The *augite* embraces the other minerals poikilitically, but it is not a common mineral although it exists in some large grains.\*

The appearance of the olivine suggests at once the occurrence of hypersthene, because it is conspicuously cleaved and frequently presents parallel extinction. But a closer examination shows that the grains cleaved and not cleaved have the same index of refraction, and a very high double refraction, even higher than ordinary olivine. Sections that show the highest colors are the most distinctly cleaved, and those that show no regular cleavage exhibit a bisectrix  $n_p$ , the axial angle being rather small. This form of olivine has the special name *fayalite*.

One or two small grains of *labradorite*(?) serve to show the thinness of the slide, and hence to furnish an estimate of the double refraction of the fayalite.

Some reddish yellow portions are apparently *bowlingite*. They are nearly dark between the nicols.

*Age.* Cabotian (modified jaspilitic Keewatin).

*Remark.* This form of peridotyte might take the name of *picryte* or *cumberlandyte*. This rock is illustrated by figure 11, plate II. N. H. W.

No. 1338. QUARTZYTE. (*Gray.*)

Associated with the ore No. 1336.

*Ref.* Annual Report, xvi, pages 85, 121; Bulletin vi, pages 118, 127, 422.

*Meg.* Compact, vitreous, with magnetite.

*Mic.* Quartz, with some *augite* and *magnetite*. One (thick) section.

*Age.* Pewabic (modified jaspilyte of the Keewatin). N. H. W.

No. 1339. QUARTZYTE. (*Pyroxenic.*)

Chub lake. Pyroxenic portions of the strata associated with the ore.

*Ref.* Annual Report, xvi, pages 85, 121; Bulletin vi, pages 118, 127, 422.

*Meg.* Dark with pyroxene.

*Mic.* The rock is about equally divided between quartz and diallagic *augite*. From the latter many minute fibres of *actinolite*(?) radiate into the quartz, along the margins where the quartz and augite unite. In another section some distinct form of *amphibole* is developed, twinned like *grünerite*. So far as can be seen the quartz with its numerous inclusions is latest in origin. Magnetite grains are in both quartz and augite. Four sections.

*Age.* Pewabic quartzyte (modified jaspilyte of the Keewatin). N. H. W.

\*This mineral has a higher refractive index than the olivine, which it surrounds, and hence cannot be hornblende, as identified by Bayley (Nineteenth Annual Report, p. 197, fig. 3), and it cannot be hypersthene, since it is not perceptibly pleochroic, and has not parallel extinction in sections cut in the zone 001:100. Bayley's figure, however, does not agree with his descriptive text, where this mineral is described as augite.

Quartzite. Gabbro.]

NO. 1340. QUARTZYTE (*with diallage*).

One-eighth of a mile west of the ore pits (No. 1336) at Chub lake.

*Ref.* Annual Report, xvi, pages 85, 122; Annual Report, xvii, pages 199, 203; Annual Report, xviii, page 62; Annual Report, xix, pages 198, 199, 201, 203.

*Meg.* Purplish-gray, vitreous, with magnetite.

*Mic.* The *magnetite* is in the main at the borders of the *quartz* grains, which are rounded, closely compacted and adjusted at their margins, but not interlocked, yet embraces frequently small, round magnetites. A few grains of *diallage*, with *enstatite* in the parting planes parallel to 100, are in like manner crowded amongst the quartzes, generally giving place to the forms of the quartz, but sometimes independent of the quartz. In the former are small globular inclusions of pyroxene and of magnetite. It is only the generally rounded shapes of the quartz grains and their uniformity of size that can be considered perhaps an indication of their earlier clastic origin, for at present the original outlines are lost, if they ever had any others. The three principal minerals—quartz, magnetite and diallage—mutually enclose small globular individuals of the others. One section.

*Age.* Pewabic (modified jaspilyte of the Keewatin).

N. H. W.

NO. 1341. GABBRO. (*Muscovadyte*.)

Near the top of the quartzite ridge visible on the north side, a sill, one-fourth of a mile west of the ore pits (No. 1336), Chub lake.

*Ref.* Annual Report, xvi, pages 85, 122; Annual Report, xix, pages 198, 201, 203.

*Meg.* Granular, gray, magnetited.

*Mic.* Prof. W. S. Bayley's description of this rock is as follows:

"The gabbro interbedded with the crystallized quartzite is in an intermediate phase between the coarse grained normal olivine gabbros and the granulitic varieties, in which the pyroxene occurs in small rounded grains. The olivine is in the ordinary form. The plagioclase is in irregular grains, with a tendency to the lath-shaped forms of diabasic feldspar. Its gabbroitic character is evinced in the abundance of dust-like particles scattered through it, and especially by their thick accumulation toward the centres of all grains. The pyroxene is a light colored augite, thickly crowded with magnetite grains, small masses of limonite and tiny plates of brown biotite. Some of the augite is in ophitic plates between the feldspars, but most of it is in little rounded grains. The magnetite, nearly all of which is secondary, is thickly strewn through the section in long irregular grains in and between the other constituents, especially the augite and olivine, and in tiny rounded grains in the augite and the plagioclase."

In the light of previous descriptions and interpretations, this rock is a secondary one. The above description would apply to many muscovadytes or regenerated greenstones. The bed from which the rock came is hence to be regarded as originally

a layer of basic sediments interstratified in the jaspilyte, and not as an intrusive of the nature of the Logan sills of the Animikie. The general globular forms of the minerals show the incompleteness of the fusion, and the occasional ophitic growths of the augite show what would have been the rock had the recrystallization been unimpeded. This interstratification of basic and acid sediments in the iron lodes of the Keewatin is illustrated by figures 1 and 2, page 48, of Bulletin vi. One section examined.

*Age.* Cabotian muscovadyte (modified Keewatin).

N. H. W.

NO. 1343. QUARTZYTE (*with fayalite, etc.; peridotite*).

Sec. 25, T. 65-5, north of Flying Cloud lake.

*Ref.* Annual Report, xvi, pages 87, 88, 122; Annual Report, xix, pages 199, 201, 204.

*Meg.* Quartz, with ferro-magnesian minerals.

*Mic.* This is somewhat like No. 1340, but is in general coarser grained. It has *augite* (diallagic), *grünerite*, *fayalite*. The *quartz* holds many globular inclusions of the other minerals. Such small globules are also disseminated in the olivine and in the hypersthene. The minerals are all fresh and perfectly intact as to chemical perfection, with abrupt boundaries but rounded outlines. There is a little also of the orange-yellow mineral resembling what has been mentioned as *bowlingite*. One section.

*Age.* Pewabic (modified jaspilyte of the Keewatin).

*Remark.* This is a remarkable rock, and is worthy of a special name, but the horizon containing it does not always show all these minerals. It is stratigraphically in the place of some jaspilyte rocks. The question that arises as to its origin can be stated thus: Is it the result of silicification of the gabbro, or is it the result of the metamorphism of the jaspilyte? (See Part III.) If there be no irregularities in the structure, the horizontal distance north and south over which it is exposed, would give it a thickness of 300 to 500 feet, including interbedding gabbro. N. H. W.

NO. 1344. GABBRO (*with biotite*).

Sec. 25, T. 65-5. Interbedded in No. 1343.

*Ref.* Annual Report, xvi, pages 87, 88, 122.

*Meg.* Granular, like muscovadyte. Interbedded in No. 1343; eight feet thick.

*Mic.* *Plagioclase*, *olivine*, *augite*, *biotite*, *magnetite*. In the *augite* and in the *olivine* are numerous globular inclusions, and these are occasionally seen in the *plagioclase*. See the description of Nos. 1341 and 1365. One (thick) section.

*Age.* Cabotian (regenerated Keewatin).

N. H. W.

NO. 1345. MUSCOVADYTE. (*Dioritic.*)

From a hill south of Bingoschick lake, north from the last.

*Ref.* Annual Report, xvi, pages 87-89, 94, 98, 122; Annual Report, xix, pages 199-201.



Muscovadyte. Labradorite.]  
Biotite gneiss. Slate.

*Meg.* The same indefinite greenstone as No. 1335, forming a continuous prominent east and west range, underlying the ferruginous quartzite above.

*Mic.* *Plagioclase*, *hornblende*, a little *biotite* and a little globular *augite* make up this rock. These all (except the hornblende) are in roundish or globular form and are frequently included in the large hornblendes. The plagioclase is *labradorite*. One section.

*Age.* Keewatin (regenerated basic clastic).

N. H. W.

NO. 1347. MUSCOVADYTE.

North shore of Muscovado lake, sec. 36, T. 65-5.

*Ref.* Annual Report, xvi, pages 88, 89, 122; Annual Report, xix, pages 199-201. (Compare No. 2197.)

*Meg.* Granular gabbro.

*Mic.* The rock is characterized by a uniformly granular and globular condition of all the minerals, which are those characteristic of granulitic gabbro. The *feldspars* sometimes contain small rounded *augites* and *magnetites* poikilitically, and the *augites* hold the *magnetites* in the same way. One (thick) section.

*Age.* Cabotian (regenerated fragmental Keewatin).

N. H. W.

NO. 1348. LABRADORYTE. (*Anorthosyte.*)

North part of sec. 11, T. 64-5, south side of Bashitanequeb lake. Forms an elevated bluff.

*Ref.* Annual Report, xvi, pages 89, 122.

*Meg.* Like the well-known "feldspar rock."

*Mic.* The rock consists almost entirely of *labradorite*, whose extinction angle on 010 is 22°; but there is a little *magnetite*, about which, on its borders, is a little brown *biotite*. There are also a few small, straggling shreds of *augite*. Several larger grains of *augite* are alternately twinned with *bronzite*(?) in narrow bands. One section.

*Age.* Cabotian.

N. H. W.

NO. 1350. BIOTITE GNEISS.

North side of the point, sec. 32, T. 65-5, Gabemichigama lake.

*Ref.* Annual Report, xvi, pages 89, 122; Annual Report, xxi, page 148.

*Meg.* Apparently finely fragmental, a condition of the rock which lies below the gabbro. (See Nos. 1089-1092 and 1777.)

*Mic.* Granular, consisting of *plagioclase*, *diopside*, *biotite*, *quartz*, *magnetite*. One (thick) section.

*Age.* Keewatin (changed).

N. H. W.

NO. 1351. SLATE.

S. W. ¼ sec. 29, T. 65-5. North of Gabemichigama lake.

*Ref.* Annual Report, xvi, pages 89, 122.

*Meg.* Fine, fragmental, sedimentary, highly tilted (45°) toward the northeast.

*Mic.* This slate is made up of a fine clastic dust of *hornblende*, *biotite*, *feldspar* and *quartz*, colored, also, in part, apparently, by *leucoxene*, the quartz being rather rare. One section.

*Age.* Probably Upper Keewatin.

N. H. W.

NO. 1352. SLATE.

Same place as the last; same rock.  
*Ref.* Annual Report, xvi, pages 90, 122.

*Meg.* Coarser slate.

*Mic.* It is apparent that the *quartzes* and the *feldspars* have been enlarged by later growth, as they extend in small hooked projections into the surrounding matrix with the same orientation, embracing the *biotite* leaves and the *actinolite* spicules. It is noticeable that numerous microgranulitic inclusions have a tendency to a globular outline, some of which are also of devitrified glass. Some glassy feldspars are entirely developed new and some old ones are clouded. Sometimes the *biotite* is clustered about a *magnetite* grain. The *biotite* is frequently pierced by spicules of *actinolite*. One section.

*Age.* Probably Upper Keewatin.

N. H. W.

NO. 1353. GRIT. (*Gray.*)

Same place as the last; same rock mass.  
*Ref.* Annual Report, xvi, pages 90, 122.

*Meg.* Coarser slate, a gray grit, with quartz grains.

*Mic.* This is a more freshly and coarsely fragmental rock than the last. There were sizable grains of *feldspar*, *quartz* and of *hornblende*, with a great amount of finer debris concerned in the original composition. There is no apparent recombination, but a degradation visible in the present condition of these grains. There was also apparently a porphyritic or trachitic zirkelyte which furnished pebbles as a debris for the constitution of this rock. Such fine pieces are now nearly isotropic, but sometimes embrace the forms of small crystals which are shown by the predominance of doubly polarizing fine minerals over spaces having geometric forms. These supposed zirkelyte pebbles have prevalingly rounded outlines and are sprinkled with fine dust which appears to be of the same nature as the coloring matter of the rock in general. One section.

*Age.* Probably Upper Keewatin.

N. H. W.

NO. 1354. SLATE.

A little south of the centre of sec. 29, T. 65-5.  
*Ref.* Annual Report, xvi, pages 90, 122.

*Meg.* Samples of the same rock, one coarser than the other.

Conglomerate. Actinolite schist.]  
Graywacke. Quartzite.

*Mic.* The coarser-grained rock is identical with the last. The original *feldspars* were coarsely twinned and the *quartzes* appear to have been derived from an eruptive rock.

The finer rock (which is very fine) is dark with all the colored minerals, particularly with *biotite*. There are spots in the slide where these biotite scales are prevailingly set edgewise across the section. Then by their greater polarization colors they give the whole slide a spotted aspect, which is increased by the occurrence of actinolite in the same areas. Two sections.

*Age.* Probably Upper Keewatin.

N. H. W.

NO. 1356. CONGLOMERATE.

At about the centre of the N. E.  $\frac{1}{4}$  sec. 31, T. 65-5.

*Ref.* Annual Report, xvi, pages 91, 122.

*Meg.* Supposed to be a portion of the Ogishke conglomerate when collected.

*Mic.* The rock is undoubtedly a part of the Ogishke conglomerate, having the peculiar twinned feldspars and parts of their matrix, like the Kekequabic porphyry. Compare Nos. 1062-1066, 1080, 1095. One section.

*Age.* Keewatin (Ogishke).

N. H. W.

NO. 1357. ACTINOLITE SCHIST.

A little northeast from the last.

*Ref.* Annual Report, xvi, pages 91, 122.

*Meg.* Fine grained, grayish green.

*Mic.* The rock consists very largely of fine spicules of *actinolite*, which are rarely in union, but lie criss-cross in a mesh, with minute *feldspar* and *quartz* grains between. One section.

*Age.* Keewatin (Ogishke).

N. H. W.

NO. 1358. GRAYWACKE.

South shore of Gabemichigama lake, near the southeast corner of sec. 31, T. 65-5 W.

*Ref.* Annual Report, xvi, pages 91, 122.

*Meg.* A fine-grained, compact, siliceous graywacke or quartzite. No section.

*Age.* Archean (Keewatin).

U. S. G.

NO. 1359. QUARTZYTE (?)

Near the same place; probably a little southwest.

*Ref.* Annual Report, xvi, pages 91, 122.

*Meg.* A rather fine-grained, granular, yellowish rock. The hand sample shows large reflecting cleavage faces of some mineral, perhaps biotite, which includes poikilitically the smaller grains of the rock.

*Age.* Archean (Keewatin).

U. S. G.

## NO. 1360. GABBRO.

South side of Gabemichigama lake; probably in N. E.  $\frac{1}{4}$  sec. 6, T. 64-5 W.  
*Ref.* Annual Report, xvi, pages 92, 122.

*Meg.* The ordinary gabbro, somewhat decayed and coated with a green mineral, probably *malachite*. No section.

*Age.* Cabotian.

U. S. G.

## NO. 1361. DIABASE.

About on the town line between T. 64-5 and T. 64-6 W., south side of Gabemichigama lake. A basaltic dike at the shore.

*Ref.* Annual Report, xvi, pages 92, 122.

*Meg.* Heavy and firm, dark, medium grained.

*Mic.* Although the ophitic structure is evident, still there were many of the *augites* which were as early in origin as the *feldspars*. These are small and roundish. The later ones are frequently interlaminated with the feldspars, which, in a few cases, have taken fantastic shapes, with spreading, recurving branches like a rigid wand. The *augites* also embrace much of the glassy magma, now charged with magnetite particles. One section.

*Age.* Dike in the Keewatin.

N. H. W.

NO. 1362. MUSCOVADYTE (*with quartz, etc.*)

From near the top of the irony bluff south side of Gabemichigama lake.  
*Ref.* Annual Report, xvi, pages 92, 122.

*Meg.* Dark, heavy with iron ore, crumbling.

*Mic.* *Hypersthene*, *magnetite*, *quartz* make up this slide in the order named, quartz being about one-fifth of the whole, the *hypersthene* embracing the other minerals poikilitically, and being sometimes stained with hematite. One (thick) section.

*Age.* Cabotian (changed Keewatin).

N. H. W.

NO. 1364. QUARTZYTE (*with hypersthene, etc.*)

Near the bottom of the quartzyte bluff, south side of Gabemichigama lake.  
*Ref.* Annual Report, xvi, pages 92, 122. Compare No. 118E.

*Mic.* *Quartz*, *hypersthene*, *magnetite*, *diallage* compose this rock, about four-fifths being quartz. In the quartz are numerous small inclusions, generally grouped near the centres of the grains. Finer inclusions run in lines across the quartzes. The *hypersthene* sometimes embraces all the other minerals poikilitically, forming plates of considerable size, in the manner of *augite* in a *diabase*, and also encloses globular grains of *diallage* and apparently of *olivine*. Two sections.

*Age.* Pewabic (changed jaspilyte of the Keewatin).

*Remark.* Considering only the evidence of the slides Nos. 1362 and 1364, it appears that the bottom of the quartzyte bluff is less pyroxenic than the top. That signifies that at this place there is a gradation increasing toward the gabbro, and

Peridotyte. Gabbro. Greenwacke.]

warrants the hypothesis that the pyroxenic element depends on the proximity of the gabbro. It would then be left to inquire, on the hypothesis that the Pewabic was a pure quartzite originally, whether that difference is due to infiltration of hypersthene, etc., into the quartzite, or the infiltration of quartz into the base of the gabbro, accompanied by an alteration of its ferromagnesian minerals, and especially of augite, into hypersthene, and the entire loss of the feldspars. But as the Pewabic quartzite is only a changed jaspilyte varying to muscovadyte, it must have contained originally more or less greenstone debris capable of giving origin to all these ferromagnesian minerals *in situ*.

N. H. W.

## NO. 1365. PERIDOTYTE.

A little northeast from the "narrows" of Gabemichigama lake, on the south shore.  
*Ref.* Annual Report, xvi, pages 93, 123.

*Meg.* Heavy, banded, a part of the "olivinitic iron ore."

*Mic.* This rock consists almost wholly of olivine (*fayalite*), with a little *hypersthene* and *magnetite*. There is also a little *grünerite*, distinguished by its multiple twinning, its higher refraction (tested by the Becke method) and its higher double refraction. The surface roughness of the *grünerite* is visibly less than that of the olivine, which it pierces, and than the *hypersthene*, yet the fine Becke line always moves toward the *grünerite* on raising the objective.

Examining another slide, it appears that there is a little *quartz* in this rock. It is in round grains in the *hypersthene*, or indents its borders. Two sections.

*Age.* Cabotian (changed Keewatin).

N. H. W.

NO. 1366. GABBRO. (*Muscovadyte*.)

At the narrows of Gabemichigama lake. Embraced in the Pewabic quartzite No. 1364. Compare Nos. 1341 and 1344.

*Ref.* Annual Report, xvi, pages 93, 123.

*Meg.* Fine-grained gabbro.

*Mic.* *Plagioclase*, *augite*, olivine, *magnetite* are the essentials in this slide, without an ophitic structure in the main; some of the augites are small, rounded, and apparently as early as the feldspar. The *magnetite* is in rounded masses, and in larger branching parts, frequently embracing parts of the *augite*. The feldspar is generally clouded with a dust of minute crystallites which it is impossible to determine, but which is in part apparently pyroxene and *biotite*. The latter also appears in larger masses independent of the feldspar. One section.

*Age.* Originally a layer in the jaspilyte of the Keewatin (now granular gabbro in the Pewabic quartzite, dating from the gabbro revolution).

N. H. W.

## NO. 1367. GREENWACKE.

Various samples (10) obtained in the ascent of the hill (or mountain) from the southwest shore of Gabemichigama lake, near the narrows, intended to show the features that might be considered of sedimentary origin.

*Ref.* Annual Report, xvi, pages 93-95, 97-99, 123.

*Meg.* Of the lot thin sections have been made of only four. They are separately distinguishable for purposes of description as (a), (b), (c) and (d), though these distinctions were not recorded in the field-book.

(a) *Macroscopically*, the sample has a variable character, a fine-grained, dark rock, being associated with a coarser one, both being dark gray or greenish.

*Mic.* The section was evidently made from the coarser sort. The section consists essentially of long, spindling *feldspars*, somewhat radiating in arrangement and of *amphibole*, with some small, scattering grains of *pyrite* and of *magnetite*. In polarized light some quartz grains are brought to light. The materials of the rock are probably all, except the quartz, of eruptive, basic origin, and the structure of the slide indicates a fragment of an altered diabase. The intimate relations of the feldspar lamellæ with the amphibole, give the impression that they are both of secondary origin. Sometimes a rod of amphibole separates two otherwise contiguous lamellæ of the feldspar, and on emerging from the feldspar the rod of amphibole spreads out into a fan-shaped or palmate series of fibres. In most cases, however, such rods terminate near the termination of the feldspar lamellæ. The amphibole does not show any characteristic cleavages, but rather a fibrous and fragmental structure. (Compare the *cornes vertes* of Michel Lévy. *Comptes Rendus, Société Géologique de France*; Sess Extrord. 1890, page 916.) One section.

(b) *Meg.* Is a light-gray, fine-grained, apparently siliceous or feldspathic rock, having a somewhat elongated or schistose structure.

*Mic.* In high powers the section shows principally a greenish yellow (pyroxenic or amphibolic) element constituting at least one-half of the rock. It polarizes like pyroxene, probably *diopside*. Mingled with these is what appears to be granular *leucoxene* or *sphene*, but as it is in groups and isolated it is more like the former. According to Prof. Lacroix, the piece is almost certainly an altered limestone, what the French petrographers call *corne verte*.

In the midst of the green element is a granular transparent mineral which has the aspect of a feldspar and which on making the following tests proves to be *anorthite*.

I made a powder of the rock, and boiled the powder in hydrochloric acid for fifteen or twenty minutes. After washing and coloring it with malachite green, and again washing, the powder remained permanently colored, *i. e.*, a large portion of it did, showing an attack by the acid and the formation of a gelatinous or skeleton silica, like that formed by *anorthite* under such treatment. Yet in this colored powder are still numerous, clear, nearly colorless grains, which have high refraction and high double refraction. While clear and glassy they still have a little tinting of a yellow or a greenish yellow. They constitute in some cases apparently one-third

Greenwacke.]

of the powder, and show the proportion of pyroxene in the rock. They give the faintly green tint to the rock *en ensemble*. The sphene is not so much as to make any impression on the powder nor on the rock as a whole. One section.

*Remark.* This is a remarkable result. No such a rock could have been expected in this greenstone. It is, of course, so far as it goes, testimony to the fragmental character of the whole rock, for this is but a fragment like many fragments included in it, though most of the foreign pieces are not of this character. The entirely altered character of this rock leads one to expect that all the other fragmental parts have suffered a similar profound alteration, or at least have suffered the same metamorphosing force.

I found a fragment of the anorthite which gave an oblique bisectrix  $n_p$ . Extinction on it with a cleavage, was  $29^\circ$ . While this is not determinative for anorthite, it is not discordant with that mineral if the obliquity of the section be considered.

I made an assay Boricky, and it gave chiefly lime, but also considerable soda, indicating not a pure anorthite.

(c) *Meg.* Is quite a different rock. It contains a large amount of quartz, so much as to make this the most evident and abundant ingredient, and the rock can be described best from that point of view.

*Mic.* The quartz surrounds and encloses all the other substances except the dark sub-opaque element, whose nature is problematical. The most frequent of these enclosures is a triclinic feldspar whose extinction on  $n_p$  in one of the larger grains is  $65^\circ$ , indicating *andesine* according to the late tables of M. Fouqué (Bulletin de la Société de Minéralogie de France, 1894). This feldspar is sometimes in grains of sizes sufficient for the determination of the orientation of the lamellæ by the microscope, when they are also well preserved, and such grains appear to have preceded by but a very short interval, if at all, the small grains, which are completely surrounded frequently by the quartz plages poikilitically, and which are much changed to a mica, probably *damourite* according to Lacroix. These little changed feldspars are frequently rounded, but were probably originally simple, stout crystals, whose corners have been destroyed. Their habit and greater decomposition indicate that they were originally of some other species, but it is impossible now to identify it. It was probably more alkaline than the other larger crystals.

The dark substance mentioned has the wandering outlines of a magma residue, and its opacity agrees with that supposition. But it is not of uniform character. Sometimes it surrounds the quartz and the undecayed feldspars. But throughout it are shapes which indicate the former existence also of some of the changed feldspar grains. They are now nearly opaque, but they pass by an insensible gradation into the grains which are certainly of the more changeable feldspar. There is a grada-

tion from the grains of feldspar which now consist essentially of damourite into the nearly opaque substance. It seems as if the change to which the whole rock has been subjected was concentrated here, and that the damourite has lost by it its crystalline structure. There are also, in these semi-opaque spots, signs of the former existence of large mica plates which have now become opaque, except that they show yet a kind of striation of dark and light in the presumed direction of the original cleavage. These mica plates, if they were such, were of the original rock, are much larger than the microscopic damourite scales in the changed feldspars, and were evidently more changeable than they, since they are only found in this altered state, while the damourite, itself a result of a transformation of the same kind, is usually well preserved.

In short, according to the suggestion of Prof. Lacroix, this sample, No. 1367 (c), is a metamorphosed granite, the original mica having been fused by the heat of the surrounding molten rock, and the molten result having then enclosed some of the smaller and more decomposable feldspars. These feldspars themselves, previously changed to damourite by the same cause, suffered further change, even becoming like the original mica. The only parts of the original rock fragment which were not sufficiently heated for fusion are the quartz, the andesine(?) feldspars and the most of the damouritic feldspars. One section.

*Remark.* This being apparently a fragment in the midst of a tuffaceous rock, it must have been thrown out as a granitic mass from the deeper-seated portion of the crust, and the changes above described took place while it was floating loosely in the molten matter within the volcano from which it was finally ejected. It is thus in harmony with the change evinced by specimen (b). What later metamorphism, if any, this mass has suffered, is not shown here.

(d) *Mic.* Is similar to No. 1367 (a), with the addition of pyroxene, but the feldspars are not radiated and spindle-shaped. They occur more scantily as in a clastic rock. Much amphibole pervades the slide, usually in fine, granular form, but sometimes spreading and fan-shaped or curved and one-sided. The pyroxene is in large crystals, much shattered and separated along the cleavages. The grain and texture vary from place to place in the slide, with micro-granulitic areas. One section.

*Age.* These are all from the Archean (Keewatin).

N. H. W.

NO. 1368. DIORYTE. (*Greenstone.*)

Same place as No. 1367, but intended to show the most evident eruptive characters. From near the summit of the hill.

*Ref.* Annual Report, xvi, pages 94, 99, 123.

*Mac.* A hard, green or gray, compact rock, fine grained.



Marble. Conglomerate.]

*Mic.* This rock does not differ from No. 1367(a) essentially. The feldspar is in form of spindle-shaped, often radiating microliths, whose lamellæ are frequently separated by a narrow, rod-like amphibole. Yet in the main the feldspars run rigidly amongst the fibres of the amphibole, the latter frequently having the palmated form mentioned under No. 1367. The spindle-shaped microliths of feldspar look quite fresh compared to a few larger albite-twinned feldspars which are scattered throughout the slide. One section.

*Age.* Archean (Keewatin).

N. H. W.

NO. 1369. MARBLE.

Just east of Ogishke Muncie lake, near the centre of N.  $\frac{1}{2}$  sec. 24, T. 65-6 W.  
*Ref.* Annual Report, xvi, pages 95, 123.

*Meg.* A fine-grained, siliceous, pinkish and greenish marble, similar to No. 1371. No section.

*Age.* Archean (Keewatin).

U. S. G.

NO. 1371. MARBLE.

Northeast end of Ogishke Muncie lake, sec. 24, T. 65-6. From the hill of greenstone where the marble becomes involved in the greenstone conglomerate. Compare Nos. 746, 760, 1378 and 1681.  
*Ref.* Annual Report, xvi, pages 96, 123; Annual Report, xvii, pages 199, 205.

*Meg.* Light colored, dense, irregularly faintly striped with impurities, and considerably separated by short joint-planes and seams.

*Mic.* While the rock is composed of *calcite*, there are small spaces which are nearly isotropic, and in these there are also small isolated and attached crystals of calcite that are idiomorphic. In this isotropic substance are also a few needle-like, bright blades, which, having parallel extinction, appear to be *muscovite* or microliths of some feldspar, as well as a few other transparent crystalline grains which cannot be distinguished from feldspar, but whose nature cannot be determined. One section.

*Age.* Archean (Keewatin).

*Remark.* This marble is supposed to be a product of segregation from the alteration of the feldspars in the adjoining greenstone.

N. H. W.

NO. 1372. CONGLOMERATE. (*Greenstone.*)

Sec. 24, T. 65-6, shore of Ogishke Muncie lake.  
*Ref.* Annual Report, xvi, pages 96, 98, 123.

*Meg.* Greenstone, appearing conglomeratic.

*Mic.* The rock is plainly a fragmental one, but *calcite* is the most conspicuous and most abundant single mineral. It is disseminated widely, and almost everywhere, even in the pebbles, in minute particles. With the calcite is a considerable amount of fresh *feldspar* in form of microlitic crystals. These lie in the calcite in an ophitic manner. These seem to be simple crystals. Although two or three are sometimes

adjacent and parallel, they do not extinguish as if twinned. There are more numerous isotropic areas similar to those mentioned in the marble (No. 1371), and these are sometimes specked with fine grains of calcite and with feldspar microliths. There is a considerable amount of dust of a dark *leucoxene* or of *magnetite* and red *hematite* scattered through the slide, and the differences in the manner of distribution of these materials have much to do with the pebbly aspect of the slide, for they are wanting in places and abundant in others, or very fine in some and coarse in others. The isotropic areas are occupied mainly by a faintly-green substance, apparently chloritic, and this extends also through the body of the rock as a bond of coloration. This substance is also unevenly disseminated, adding to the pebbly aspect of the section. These differences of aspect accompany other slight differences of composition, viz.: in some of the pebble-like spots the calcite is in fine round pellicles, and having high colors, appears like globular pyroxene. Such areas are markedly contrasted with the surrounding rock in which the calcite is in distinctly crystalline forms. Again, the feldspar spicules are more abundant or are nearly absent in some angular or sub-rounded areas. One section.

*Age.* Archean (probably Upper Keewatin).

*Remark.* The differences mentioned can be explained apparently only by assuming original differences in the composition of the rock, however uniform and simple the mineralogical composition at present. The isotropic areas, which in bright light also show very fine, globular, indistinct spots, which faintly transmit light, are therefore to be considered as bits of glassy volcanic debris now devitrified. This rock illustrates well the effusive or agglomeratic composition of the great bulk of the greenstones of the Keewatin in the region south and east from Ogishke Muncie lake.

N. H. W.

No. 1373. CHERT(?)

Fragment in No. 1372, near the marble.  
*Ref.* Annual Report, xvi, pages 96, 123.

*Meg.* Chert of a light greenish-gray color, connected with rock No. 1372.

*Mic.* The most of the slide is exceedingly fine grained and its individual components cannot be made out, presenting an overlapping interference and an aggregate gray color in common light. Between crossed nicols the field is nearly dark, but sprinkled with small angular spots in which some colored light gets through. It is probable that the rock consists largely of chloritized *hornblende* and *calcite*, for there are quite a number of idiomorphic crystals of calcite, porphyritically scattered throughout the slide. One section.

*Age.* Keewatin.

*Remark.* Owing to its composition this rock is perhaps not properly called chert.

N. H. W.

Greenwacke. Marble.]

NO. 1374. GREENWACKE. (*Conglomerate.*)

Same place as the last.

*Ref.* Annual Report, xvi, pages 97, 123.

*Meg.* Rounded, concretionary, or pebble-like masses, from a quarter to a third of an inch in diameter, seen on the weathered surfaces of the same conglomerate.

*Mic.* The section is made parallel to the weathered surface. The slide appears, in general, much like that of No. 1372, but is nearly free from calcite. There are variations in the fineness of the grain, and some dark areas of hematite, but the differences are not worthy of special description. The slide seems not to cut any of the round masses that are visible on the weathered surface. It contains, however, several large feldspar fragments. The weathered surface of this rock is shown by figure 12, plate II. One slide.

*Age.* Archean (Keewatin).

N. H. W.

## NO. 1375. GREENWACKE.

In section 13, adjacent to the above; in the narrow place between Ogishke Muncie lake and the lake south of Townline lake.

*Ref.* Annual Report, xvi, pages 97, 123.

*Meg.* Schistosely disintegrating, light green and siliceous condition of the same conglomerate.

*Mic.* The slide shows much *calcite* and coarser grains of *feldspar*, as well as areas nearly isotropic which were probably of volcanic glass originally. They are now devitrified as in No. 1372. The rock, indeed, must be very near No. 1372 in all respects. One section.

*Age.* Archean (Keewatin).

N. H. W.

## NO. 1378. MARBLE.

Same place as No. 1375.

*Ref.* Annual Report, xvi, pages 97, 123.

*Meg.* Rusty and calciferous; appears in patches.

*Mic.* The slide shows a rock made up like the marble at Ogishke Muncie lake (No. 1371), and like it, and like the siderite of the Animikie near the west end of Gunflint lake, it contains patches, now coarsely devitrified, which were probably of the nature of volcanic glass when they were deposited in this rock. These indicate some close connection, geographic if not genetic, between the origin of these rocks and the action of volcanic forces. One section.

*Age.* Archean (Keewatin).

N. H. W.

## NO. 1379. GREENWACKE.

South end of the east bay of Saddle Bags lake on the town line between T. 65-5 and T. 65-6.

*Ref.* Annual Report, xvi, pages 98, 123.

*Meg.* Gritty greenstone.

*Mic.* In the slide are the outlines of numerous large pieces of feldspar crystals, now wholly filled with the usual elements of this rock, viz.: *chlorite*, *calcite*, etc., only differing from the rest of the rock in being more brightly transparent in common light, and more dark between crossed nicols. The rock is well charged with *calcite*. One section.

*Age.* Archean (Keewatin).

N. H. W.

NO. 1380. GREENWACKE.

The same from the east side of the east bay of Saddle Bags lake.

*Ref.* Annual Report, xvi, pages 98, 123.

*Meg.* Greenstone.

*Mic.* This rock varies, not so much for having had original fragments of feldspars, as from being more abundantly supplied with the substance that has given it isotropic areas. Some of these appear like old vesicular scoria. Otherwise it is like the last. One section.

*Age.* Archean (Keewatin).

N. H. W.

NO. 1381. DIORYTE (?) (*Greenstone.*)

West side of Frog Rock lake.

*Ref.* Annual Report, xvi, pages 98, 123.

*Meg.* Green and rather massive.

*Mic.* Conspicuous forms of *uralite* and of *feldspar* are the first noticeable feature. This *uralite* came from a twinned pyroxene, which is still preserved in the twinning and in the idiomorphic outlines of some of the sections. These lie in a matrix which appears fragmental, made up of similar materials in finer grains with considerable *chlorite*. The rock is less altered than most of the foregoing greenwackes, but more altered than the similar tuffaceous rocks (as No. 1049, etc.) seen about Kekequabic lake and about the lakes westward from there. The rock shows much *leucoxene* and *chloritic* isotropic material, some *calcite* and apparently a little *epidote*. One section.

*Age.* Archean (Keewatin).

*Remark.* It remains uncertain whether this rock is an altered diabase, or a debris of basic rock.

N. H. W.

NO. 1382. DIORYTE (?) (*Greenstone.*)

Near the centre of sec. 19, T. 65-5, south of Frog Rock lake.

*Ref.* Annual Report, xvi, pages 98, 123.

*Meg.* Same kind of rock as the last.

*Mic.* Much of the rock is isotropic, occupied by the well-known chloritic substance, but there are outlines of crystals and parts of crystals of *feldspar*, all much decayed. Of *calcite* and of *uralite* there is less than in No. 1381. One section.

*Age.* Archean (Keewatin).

N. H. W.

Greenwacke. Argillyte. Dioryte.]

NO. 1383. GREENWACKE.

From the centre of the same section, south of Frog Rock lake.

Ref. Annual Report, xvi, pages 98, 123.

*Meg.* Greenstone.

*Mic.* With the elements mentioned in Nos. 1381 and 1382, in this rock are also angular grains of *quartz*, and a large increase of *calcite*. One section.

*Age.* Archean (Keewatin).

N. H. W.

NO. 1384. GREENWACKE.

Associated with the last, interbanded with it, and finer grained.

Ref. Annual Report, xvi, pages 98, 123.

*Meg.* Finer grained than the last.

*Mic.* Similar to the last. Here, however, the areas of the larger crystals are occupied sometimes entirely by *calcite* in a finely granular state. One section.

*Age.* Archean (Keewatin).

N. H. W.

NO. 1385. ARGILLYTE.

West end of Ogishke Muncie lake at the southern portage to Dike lake. Near the centre of the west side of the S. W.  $\frac{1}{4}$  sec. 27, T. 65-6 W.

Ref. Annual Report, xvi, pages 78, 99, 124.

*Meg.* Almost black, fissile argillyte, showing markings on the surface like minute ripple marks, but which may be due to movements since the solidification of the rock. No section.

*Age.* Archean (Keewatin).

U. S. G.

NO. 1386. DIORYTE. (*Greenstone.*)

Summit of East Twin mountain.

Ref. Annual Report, xvi, pages 99, 124.

*Meg.* A coarse greenstone.

*Mic.* The original ophitic structure is very evident, although the pyroxene is now wholly altered to *uralite*. The *feldspar* is well preserved, considering the age of the rock and the position of great exposure, showing its twinning lamellæ distinctly, both albite and pericline. There is one large crystal which shows a pegmatitic intergrowth of quartz and feldspar, and isolated angular areas of quartz appear elsewhere. The uralitic product takes the form, also, of numerous needles, which, by reason of their higher double refraction and their form, appear to be of *actinolite*. A little *calcite* is sheltered in some of the interstices of the larger crystals. One section.

*Age.* Archean (Keewatin).

*Remark.* This was plainly an original basic igneous rock of the diabase order, and owing to its known age it illustrates the preservation of the mineral composition in the oldest known rocks having a known igneous origin, and, by comparison, it

indicates that most of the others, foregoing, in which the origin is doubtful, and the rock is much more changed, were probably not originally massive, but are rather of the nature of rock No. 1395, *i. e.*, clastic.

N. H. W.

NO. 1387. DIORYTE. (*Greenstone.*)

From the north slope of the same hill as No. 1386.

*Ref.* Annual Report, xvi, pages 99, 124.

*Meg.* Finer grained.

*Mic.* The ophitic structure is less evident, but in all other respects this rock does not essentially differ from No. 1386. Between the twin lamellæ of the *feldspars* is frequently a thin layer of the *hornblendic* material. One section.

*Age.* Archean (Keewatin).

N. H. W.

NO. 1391. FLINT. (*Gritty.*)

From one of the more northerly subordinate hills north of East Twin mountain.

*Ref.* Annual Report, xvi, pages 100, 124.

*Meg.* Appearing quartzose, the weathered surface showing whitened pebbly forms of old feldspars.

*Mic.* The most conspicuous feature is the angular *quartzes* and micro-granulitized old feldspars, which lie in a fine matrix made up of greenstone debris, *feldspathic*, *chloritic* and *leucoxenitic*. In high power this darker debris can be resolved sufficiently to disclose also the characters of *actinobite*. The old feldspars are so completely lost that the mass appears flinty. They appear distinct on removing the upper nicol. One section.

*Age.* Evidently a part of the Ogishke conglomerate.

N. H. W.

NO. 1392. CONGLOMERATE. (*Greenstone.*)

From the same subordinate hill range, between Ogishke Muncie lake and East Twin mountain.

*Ref.* Annual Report, xvi, pages 100, 124.

*Meg.* Imperfectly porphyritic, fine grained, siliceous.

*Mic.* Of the two sections with this number, one is similar to, but more apparently fragmental than, some of the Kekequabic porphyry, except that the ferromagnesian element is wholly altered to irregularly spreading and often branching masses of hornblendic material, and is also scattered as a chloritic powder throughout the slide. There is some *calcite* and much *quartz* in the fine groundmass, which otherwise, along with some *feldspar*, has a granulitic structure, causing the rock to resemble the porphyry referred to. The greater decay of the augitic element, and the rather scant or wholly absent secondary growths about the large feldspar crystals, ally it, however, to the conglomerates about the west end of Ogishke Muncie lake, which also contain debris from some porphyry.

Flint. Conglomerate.]

The other section having the same number is a dark flint, composed of debris from the basic rocks, similar to No. 1391, but less acid. Two sections.

*Age.* Archean (Keewatin).

N. H. W.

## NO. 1394. FLINT.

In the same subordinate series of low hills as No. 1392.

*Ref.* Annual Report, xvi, pages 100, 124.

*Meg.* Flinty, often greenish or grayish, several samples, closely related and banded together in a gritty greenstone (No. 1393).

*Mic.* Two sections have this number. They both show a thinly banded rock. In one the bands consist of coarser and finer granulitic quartz, accompanied by belts of *actinolite* needles. In the other the banding is caused by greater and less amounts of *calcite* accompanied by fine *actinolite* needles. In this also the interlocking of the quartzes is less evident. Indeed, some of the quartz is angular and coarser and sharp like fragmental non-detrital debris. Two sections.

*Age.* Archean (Keewatin).

N. H. W.

NO. 1395. CONGLOMERATE. (*Greenstone.*)

In the same series of subordinate hills as No. 1392.

*Ref.* Annual Report, xvi, pages 100, 124.

*Meg.* Conglomeratic, green, showing some sedimentary structure; a widely disseminated rock.

*Mic.* The rock contains some large *feldspars*, but more ragged than in No. 1392, and somewhat more permeated by products of alteration, still perfectly evident as feldspars with twinned lamellæ. A large part of the rock is of hornblende, which exists as patches and as scattered fibres and cleavage-plates. The differences in the appearance of the rock, whether in hand specimen or under the objective, are due in part to the differences in the manner of distribution of the larger elements, feldspar and hornblende. There are pebble-like areas in which these crystals are not present, but which consist of granulitic quartz and feldspar, and there are others of pure *quartz* with a single orientation. There are others still in which there is much fine hornblende in spicules, with fine feldspars and *magnetite*. In most cases these parts are distinctly separable from the general rock mass, but it is evident that in the rock mass all these parts are more finely commingled to make the general matrix. One section.

*Age.* Archean (Keewatin).

*Remark.* These differences of grain are explicable on the assumption that the rock is a conglomerate, a part of the Ogishke conglomerate, but were the differences somewhat less marked, the rock would be similar to several that have been called amphibolyte and dioryte, and others whose origin has been uncertain and which

have been named greenstone. This seems to be the prevalent character of the greenstone area about Ogishke Muncie lake. These rocks have not been sheared; indeed, shearing is almost unknown in this district, and is rare in the state, and all original structures as well as original composition are well preserved, as shown by the characters of the rock forming the summit of East Twin mountain (No. 1386). Nos. 1391-1395 represent the broken and sedimentary beds intervening between the Twin peaks and Ogishke Muncie lake, sometimes running in lower ranges and also forming isolated small hills.

N. H. W.

NO. 1396. GREENWACKE. (*Regenerated.*)

From the hill directly east of Alpha lake, sec. 29, T. 65-6 W.

*Ref.* Annual Report, xvi, pages 100, 124.

*Meg.* Uniform, green, rather fine-grained, appearing like a massive rock.

*Mic.* This rock does not show the differences of granular structure seen in No. 1395, but the grains are of uniform size. They are all small. The most abundant are of *hornblende*, and invariably show two periods of growth, but there are a few of epidote(?) indicated by a faintly yellow color and higher double refraction. These are yellowish and short, while the hornblendes are greenish and mostly elongated in section. The *feldspar* grains are smaller, and indistinct, hiding themselves in the obscurity of the fine groundmass, which last is largely isotropic between the nicols, though plainly containing numerous imperfectly polarizing crystalline elements.

Several of the hornblendes appear between crossed nicols like enlarged feldspars, but on making tests in convergent light these give the figure of an optic axis in the field, which fully accounts for their low illumination, and hence for their resemblance to feldspars. One section.

*Age.* Archean (Keewatin).

*Remark.* This rock, which is allied to the green schist of Kekequabic lake, is a difficult one to name. In the field it was taken for a part of the fragmental rocks of the region. Its secondary hornblendic growths are perhaps due to the action of later metamorphic force, intensified by the dike(?) (No. 1397) which cuts it near the lake shore.

N. H. W.

## NO. 1397. DIABASE.

Cutting No. 1396.

*Ref.* Annual Report, xvi, pages 100, 124.

*Meg.* A medium-grained diabase, with its augite evidently largely changed to hornblende. Also contains pyrite. No section.

*Age.* Archean, probably.

U. S. G.

## NO. 1398. ESTERELLYTE.

North side of Kekequabic lake on the point on which is the southwest corner of sec. 29, T. 65-6 W. Same as No. 1399.

*Ref.* Annual Report, xvi, pages 100, 124.



Esterellyte.]

*Meg.* The hand sample consists of some of the esterellyte and some fine-grained, hard, greenish graywacke. The latter is probably a fragment included in the former, although from the hand specimen and the field description this point is not clear. No section.

*Age.* Archean (Keewatin).

U. S. G.

NO. 1399. ESTERELLYTE.

From the knob, southwest corner sec. 29, T. 65-6, Kekequabic lake. Taken from the weathered surface. Compare Nos. 1061, 1062, 1094, etc.

*Ref.* Annual Report, xvi, pages 100, 124.

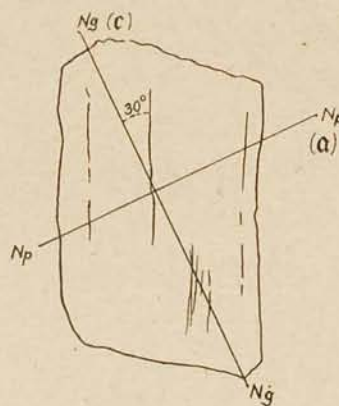
*Meg.* Coarsely porphyritic with feldspar and more finely porphyritic with pyroxene. Shows pebbly forms.

The gray porphyry (No. 1094) at the southwest corner of sec. 29, T. 65-6, rises about 100 feet above the lake, and composes the whole peninsula, making a knob by itself. It is very siliceous (No. 1398). It is massive, or coarsely jointed. The feldspar crystals are not always perfect in form, but approximate a true crystalline shape. They seem to be of orthoclase. They weather red. The long exposed (or at least the burnt) surface of the whole rock becomes reddish, but the surface scales off by fire and keeps a fresh gray color exposed. There is in some places a prevailing direction—that of the general strike—seen in the longer axes of the crystals. They are also apt to stand vertical, edgewise, in the same direction. In the rock are boulder forms. These are most frequently of greenstone, and then they are not porphyritic, but sometimes they are of some rock which weathers a pinkish-red color. They are also of a siliceous gray rock, resembling the matrix of the porphyry, but finer grained, and also of other light-weathering kinds. But in the main this is a homogeneous rock. These boulder-forms are by no means a common occurrence, at least at this place. Yet, in other places, there is a various distribution apparent in the crystals. They are either more conspicuous and more numerous, or else less frequent, in rounded spots; or they stand out at different angles, as if they had been dependent on the varying nature, position, structure or grain of the enclosing rock. This distribution and confused arrangement are so combined as to bring out to view indistinct outlines of former included boulders. From this I conclude that the whole rock is a modified condition of the sedimentaries here prevalent, and that it indicates what would become of the whole formation (conglomerate, graywacke, slate, chert, etc.), if under similar conditions the rearrangement and recrystallization had been carried to completion—a syenite or a granite, at least an acidic rock. Here there is no basic surplus to give the rock a doleritic aspect. Where this has been the case the singular "ambiguous greenstone" has apparently been the product, a kind of fragmental basalt.

*Mic.* The much-twinned *feldspars* are conspicuous and remarkable. In one instance one of these crystals embraces completely one of the *pyroxenes*. This is, however, a rare structure. Usually the crystals of the porphyritic elements are wholly independent. Sometimes *quartz* figures amongst the large elements in a granophyric manner, but in general it is confined to the finer groundmass in which it is granulitic with feldspar.

It is very difficult to decide from optic properties what is the species of the feldspar. Several observations make it certain that  $n_g$  is in the acute bisectrix, and hence the mineral is optically positive. The optic angle is also small, comparatively, being nearer to that of anorthoclase ( $45^\circ$ ) than of any of the feldspars.

On such an index of elasticity, extinction (on indistinct cleavage) is  $4^\circ$  to  $5^\circ$ . The



Section oblique to 010, showing the positions of  $N_g$  and  $N_p$  in the principal part of the crystal.

FIG. 44. AEGYRINE-AUGITE IN NO. 1399.

section shows, at the same time, no albite or other twinning. It is hence about parallel to 010. A section showing  $n_p$  nearly perpendicular has both albite and pericline(?) bands. The extinction angle here, between the optic plane and the albite bands, is  $72^\circ$  to  $74^\circ$ . The angle of the axes round  $n_p$  is evidently larger than round  $n_g$ . The angle between the albite and pericline(?) macles on a section cut perpendicular to  $n_p$  is  $87^\circ 30'$ . It is noticeable that the pericline(?) bands extinguish simultaneously with the albite bands, set by set, as in microcline twinning, although the albite lines are long and frequent, and the periclinal(?) are short, far apart and infrequent. The twinning of all the crystals is coarse, very abundant and distinct. There are also twinings on the Carlsbad and Bovenno plans. Some of these characters indicate labradorite or *andesine*, and some indicate *anorthoclase*.

The pyroxene is also interesting. It is, in general, green, but frequently the color fades out in patches, or at the centre, which extinguishes at a different angle. Indeed, there is an irregular zonal structure in some of the crystals, this being made evident by the successive extinctions, there being four, and indistinctly sometimes six different extinctions in a crystal favorably cut. These are distributed in zones which are generally better developed at one end of the crystal than at the other.

As shown by the diagram above, the axis  $n_g$  is in the acute angle of the crystal, making a large angle with the vertical axis, which is an anomaly for augite, indicating the soda-bearing ægyrine. There seems to be no exception to this in the numerous sections (010) of the slide.

There is a little *biotite* and some scattered grains of *sphene* in the rock. One section.

*Age.* Archean (intrusive in the Upper Keewatin).

*Remark.* See under No. 1094.

N. H. W.

#### NO. 1400. ESTERELLYTE.

From the south side of Kekequabic lake, near the great diabase dike which crosses the lake, making a couple of islands.

*Ref.* Annual Report, xvi, pages 101, 102, 124.

*Meg.* Similar in aspect to Nos. 1398 and 1399. Compare No. 1061.

*Mic.* It is unlike the last in having lost its augites, which have become altered to *actinolite*, some of which is blue in common light. The rock has also taken in a notable amount of *calcite*. *Sphene* is quite common. One section.

*Age.* Archean (Keewatin).

*Remark.* It is noteworthy that the effect of the dike with its hot water and gases has been to destroy the augites in the porphyry.

N. H. W.

Diabase. Granite. Greenwacke.]

## NO. 1401. DIABASE.

Small island in Kekequabic lake; E.  $\frac{1}{2}$  N. E.  $\frac{1}{4}$  sec. 31, T. 65-6 W.

Ref. Annual Report, xvi, pages 101, 124; see, also, Annual Report, xv, pages 153, 368.

*Meg.* A rather fine-grained, fresh, dark-gray diabase. No section.*Age.* Perhaps Keweenawan.

U. S. G.

## NO. 1402. GRANITE.

On the west side of the dike in the southerly of the islands.

Ref. Annual Report, xvi, pages 101, 124; Bulletin ii, pages 41, 422.

*Meg.* Fine, gray, red-weathering.

*Mic.* The section appears like the granite seen on the south side of the lake further west, in larger amount, but rather finer. There is no augite, but in its place is a congeries of *biotite* scales mingled with some *actinolite*. The old feldspars are present, but smaller and apparently in fragmentary condition, and crowded with minute crystallites resulting from alteration; while, with the appearance of considerable *calcite*, the micro-granulitic groundmass of quartz and feldspar has risen to the aspect and proportions of a granitic structure. One section.

*Age.* Archean (intrusive in Upper Keewatin).

N. H. W.

## NO. 1403. GRANITE.

A little further west.

Ref. Annual Report, xvi, pages 102, 124.

*Meg.* Somewhat porphyritic. Compare Nos. 1044-1046.

*Mic.* The rock shows the old zoned feldspars, but in the sparse matrix which embraces them the grains are coarse, and, with their own fragments, constitute a granitic rock. There is no augite, but in its place is *actinolite*, or at least some amphibole, *epidote* and *biotite*. In this rock, in fine grains, are also *magnetite*, *hematite* and *sphene*, and apparently a little *garnet*. One section.

*Age.* Archean (intrusive in Upper Keewatin).

N. H. W.

NO. 1404. GREENWACKE. (*Conglomeratic.*)

From a ridge near the centre of the south side of sec. 31, T. 65-6, south shore of Kekequabic lake.

Ref. Annual Report, xvi, pages 102, 124.

*Meg.* Hardened, graywacke-like greenstone. Compare Nos. 1051 and 1059.

*Mic.* The green element in the rock is *hornblende*, which appears in the form of ragged crystals and crystal fragments which sometimes appear to have slight secondary enlargements and as fine debris throughout the slide. The next most abundant ingredient is a micro-granulitic rock which is in rounded pebbles. Sometimes the micro-granulitic structure is sub-microscopic, and sometimes it is quite coarse. Debris of the same kind is evidently dispersed widely and generally throughout the rock, constituting the most of the finer matrix. Then comes *quartz*,

clear and glassy, in isolated grains of considerable size, generally angular, and quartz in a granitic grouping of several grains interlocking. Then are to be noted ragged, much twinned, old *feldspars*, evidently of the same kind as seen in the granite and in the porphyry a little further south. One section.

*Age.* Archean (Upper Keewatin).

N. H. W.

NO. 1405. GRANITE.

Point on the south side of Kekequabic lake, N. W.  $\frac{1}{4}$  S. W.  $\frac{1}{4}$  sec. 31, T. 65-6 W.  
*Ref.* Annual Report, xvi, pages 102, 124.

*Meg.* A very fine-grained, light pinkish-gray rock which seems to be a phase of the granite of Kekequabic lake. Much like the light-colored dike near Ely. No section.

*Age.* Archean (Keewatin).

U. S. G.

NO. 1406. GREENWACKE.

From the point, N. W.  $\frac{1}{4}$  S. W.  $\frac{1}{4}$  sec. 31, T. 65-6, south shore of Kekequabic lake.  
*Ref.* Annual Report, xvi, pages 192, 124.

*Meg.* Greenish schist-conglomerate. Compare No. 1060.

*Mic.* This rock is almost identical with No. 1404, but with a less number of large quartz grains and many more of old feldspars, and of larger hornblendes. The margins of the large hornblendes are converted into a fringe of dirty yellow fibres, largely of hornblende still, but apparently also in part of *biotite*. These marginal parts have their fibres confused and bent, and appear to have been formed by friction against the hornblendes. This yellowish disintegration product sometimes enters along the fissures of the hornblende and appears sometimes in isolated areas in the hornblendes. It is also rather widely disseminated in the rock in general, becoming stained by *hematite*(?) so as to have an orange yellow color. The rock is plainly pebbly, but at the same time amongst the old feldspars, which are so much decayed as to be hardly discernible in some parts of the slide, there has been developed a fresh growth of secondary interlocking *quartz* of granitic structure. This is sometimes in isolated areas and is sometimes within the areas of the old feldspars. In the former case it might be interpreted as constituting pebbles or other debris of the clastic rock, but in the latter position it must have been developed within the rock. The pebbles in this rock are, so far as observed, of a fine micro-granulitic association of quartz or of quartz and feldspar. One section.

*Age.* Archean (Upper Keewatin).

N. H. W.

NO. 1409. GREENWACKE. (*Pebbly.*)

From the little island just west of the narrows near the north shore of Kekequabic lake.  
*Ref.* Annual Report, xvi, pages 102, 105, 125; Annual Report, xvii, pages 200, 206. See, also, Annual Report, xxi, pages 23-26.

Greenwacke. Dioryte.]

*Meg.* Hornblendic schist.

*Mic.* The rock consists of *hornblende* in crystals and in fragments, lying in a fine matrix of granular interlocking quartz and *feldspar*, through which sometimes the slenderest needles of hornblende run without deviation, and the larger hornblendes have been slightly enlarged by borders and by spicules from the extremities of the sections. They have been originally twinned. There are no large feldspars visible in the section. One section.

*Age.* Archean (Keewatin).

*Remark.* The hornblendes in this rock frequently show contrasting colors, *i. e.*, the central portions, with outlines of former augite crystals, are darker colored. This character, seen in many instances, is shown in another place to have been due to the manner of origin of the hornblendes, and indicates that this hornblendic element was derived wholly from alteration of augite. The original rock was probably a volcanic tuff. Compare No. 1060.

N. H. W.

NO. 1410. DIORYTE. (*Schist with quartz.*)

From the top of the same island.

*Ref.* Annual Report, xvi, pages 102, 105, 125.

*Meg.* The same rock mass.

*Mic.* This rock has a surprisingly different aspect. It is much coarser grained. The *hornblendes*, though ragged and fragmentary, are large and are accompanied by *biotite* and *epidote*, the former encasing the latter poikilitically (compare No. 1106). In addition, there are conspicuous triclinic *feldspars* twinned on the Carlsbad and albite types, as well as on the pericline. They appear to be the same "old" feldspars as characterize the granite and the porphyry of the region. They are sometimes interfered with by the hornblendes and enclose small hornblendes as if the hornblendes, or that from which the hornblendes are derived, were of earlier date. Along with this are areas which appear to be of pebbly shapes and sizes, consisting of micro-granulitic quartz and feldspar, and lastly there are coarsely granitic interlocking quartzes, which appear to be the most recent element of the rock. Add to this a very little *calcite* and *magnetite* and *hematite* and the description is complete.

*Age.* Archean (Upper Keewatin).

*Remark.* This rock does not differ essentially from the "granite" of the south side of Kekequabic lake (compare No. 1414). The hornblende has a distinct tendency toward a green-blue color when cut perpendicular to one of the horizontal axes. It has  $n_x$  nearly parallel with the elongation, and hence is not riebeckite. The height of the island is about twenty feet. See the field description, Sixteenth Annual Report, page 103.

This rock again connects the granite petrographically with the rock No. 1409, the peculiar pebbly green schist of the region. Another section from No. 1410 shows characters of the hornblendic schist of the region without feldspars.

*Remark 2.* Owing to the important bearing of this rock section on the hypothesis of the generation of the granite of Kekequabic lake from metamorphism of the schist of the region, still another section was made of the rock No. 1410; and as this section is entirely of the character of the second slide above mentioned, being a hornblendic schist similar to rocks Nos. 1409 and 1411, from the same island, it is to be inferred that the rock above described as No. 1410 did not come from the top of this island, but from some part of the granitic rock of the region, an error being made in giving it this number; and hence that it does not prove such selective distribution of metamorphism on this island as above presumed.

It is deemed best to allow the foregoing description to stand with this correction, inasmuch as this idea of selective metamorphism along certain strata rather than others has since been published (*American Geologist* xxii, November, 1898, page 308), based on this thin section, and since, although here there is no warrant for the inference, it is a feature that is likely to be produced in the clastic rocks under the process of metamorphism which here is supposed to have taken place. Three sections.

N. H. W.

NO. 1411. GREENWACKE. (*Pebbly.*)

From the middle of the south cliff of the same island.

*Ref.* Annual Report, xvi, pages 103, 105, 125.

*Meg.* More siliceous, showing sedimentary banding.

*Mic.* This rock is like No. 1409. Besides the pebbly spaces occupied by microgranulitic structure, there are others which were once apparently feldspars which have lost their integrity and are now charged with the same kind of secondary grains, being revealed only by a faint extinction that supervenes four times over the grain in one revolution. One section.

*Age.* Archean (Upper Keewatin).

N. H. W.

NO. 1412. GREENWACKE.

The same as No. 1411, near the water, having boulders of rock like itself; Kekequabic lake.

*Ref.* Annual Report, xvi, pages 103, 105, 125.

*Meg.* Green, but having lumps of harder rock.

*Mic.* This rock is like No. 1409 in nearly all respects. The hornblendes show the forms of the original augite grains in the existence of the darker central areas. The surrounding fine interlocking matrix shows variations of size of grain, indicating transformations from a more coarse feldspathic (though clastic) condition. One section.

*Age.* Archean (Upper Keewatin).

N. H. W.

Greenwacke. Esterellyte. Dioryte.]

## No. 1413. GREENWACKE.

The same, near the water.

Ref. Annual Report, xvi, pages 103, 105, 125.

*Meg.* With hard, lenticular sheets.

*Mic.* The section is cut perpendicular to the structure. The rock consists of the same elements as the above, but is banded by variations in fineness and by the occurrence of some fragments of feldspar in the coarser bands, which are not visible in the finer. One section.

*Age.* Archean (Upper Keewatin).

N. H. W.

## No. 1414. ESTERELLYTE.

Near the south side of sec. 35, T. 65-7. In a low bluff at the shore of Kekequabic lake.

Ref. Annual Report, xvi, pages 103, 125.

*Meg.* Different forms of porphyry.

*Mic.* Only one section has been made. The slide shows a rock identical with the porphyry at the narrows of the lake (No. 1094, etc.). The old *feldspars* are encroached on at their corners, and all about their margins, by the micro-granulitic quartz and feldspar, and in some cases the same substance appears within the feldspars. Some grains, indeed, are almost destroyed by such encroachment. These feldspars are not zoned, but much twinned. One part of the slide shows a rock not porphyritic, but largely hornblendic (with some globular *pyroxene?*) with *biotite* and remnants of the old feldspars, being rather a quartz dioryte, but finer grained than that at the summit of the small island (No. 1410). One section.

*Age.* Archean (Keewatin).

N. H. W.

## No. 1415. DIORYTE (or amphibolyte).

Same place as No. 1414.

Ref. Annual Report, xvi, pages 103, 125.

*Meg.* Underlying No. 1414; greenish, massive.

*Mic.* With much *hornblende*, some *ægyrine-augite* and a little *actinolite* is much feldspar, these together making up the rock, so that there is very little of the fine, granular, interlocking matrix seen in the greenwackes in general. The *ægyrine* is included in the feldspars and appears to have maintained its composition more easily in such position, since generally only *hornblende* is seen in the rock. One section.

*Age.* Archean (Keewatin).

*Remark.* If a granular disintegration should permeate the feldspars of this rock it would be like some of the green schists of the region, and especially if at the same time the *ægyrine* were all converted to *hornblende*.

N. H. W.

## NO. 1416. GNEISS.

Same locality as No. 1414.

Ref. Annual Report, xvi, pages 103, 104, 125.

*Meg.* Reddish, porphyritic; intended to show the intergrading of the gneissic, the porphyritic and the conglomeritic characters of this rock.

*Mic.* The rock is mostly composed of ragged *feldspars* which are zoned, twinned, replaced by micro-granular new growths and reconstructed by secondary feldspathic material. The rock, therefore, is quite compact and firm. *Hornblende*, more or less changed to chlorite, comes next in amount. This runs in irregular, spreading streaks and strings, somewhat as in a schist, but not in a schistose uniformity of direction. It is accompanied by *magnetite* and by *actinolite*. *Epidote* is in scattered fine particles and *calcite* is quite common. Throughout the whole, and generally between and around the feldspars is more or less of the common micro-granulitic mosaic of *quartz* and *feldspar*. This varies in fineness. In some areas this structure alone fills the slide, and spreads in a band which runs with more or less distinctness from one side of the slide nearly to the other. This fine mesh is evidently due to a secondary development of later date than the deposit of the feldspars in the places they occupy, and indicates that a fine debris, largely feldspathic, has been entirely worked over and given this new crystalline condition, a structure, however, which did not much change the forms of the larger old feldspars. One section.

*Age.* Archean (modified Upper Keewatin).

N. H. W.

## NO. 1417. GNEISS.

Shingwak island, north of Animikie island, Kekequabic lake.

Ref. Annual Report, xvi, pages 105, 125.

*Meg.* Rock appearing like No. 1416.

*Mic.* The description No. 1416 will apply to this rock. One section.

*Age.* Archean.

N. H. W.

## NO. 1418. GNEISS.

Same island.

Ref. Annual Report, xvi, pages 105, 125.

*Meg.* The red crystals are in bands that alternate with others of a greenish biotitic rock.

*Mic.* Similar to No. 1417, except that the larger feldspars are more obscured and replaced by secondary, often micro-granulitic structure. One section.

*Age.* Archean.

N. H. W.

NO. 1419. GREENWACKE. (*Pebbly tuft.*)

From a very small island directly south of Shingwak island.

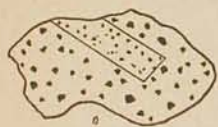
Ref. Annual Report, xvi, pages 105, 125.

*Meg.* Fine grained, greenish.



Greenwacke.]

*Mic.* The most of the rock is constituted of a varying granulitic association, supposed to be in part of *quartz* and *feldspar*, but so fine that it is difficult in some cases to prove it. This variation consists in the coarseness and the fineness of this substance, and in the consequent degree of translucency which it presents. Sometimes this variation is caused principally by the presence in varying amount of a greenish coloring matter. This matter is composed of globular *epidote*, of *actinolite* fibres and of *chlorite*, and it is evenly distributed throughout any individual space, differing from space to space, but it is always accumulated about the borders of the spaces in distinctly greater amount, so as to outline the spaces and separate them one from the other. These spaces are evidently those formerly occupied by volcanic glass or by fragments of minerals such as feldspar and perhaps by some ferro-magnesian mineral. Their shapes can be seen best by using converging light and by lowering the condenser. Sometimes there is a remnant of the old feldspar still visible in the central part of a space, which indicates the nature of the original grain. If this be the nature of these variations, they may have been (in some cases foregoing) mistaken for pebbles of devitrified glass, but in general they do not appear to be derived from feldspars. Again, if this be their nature, or whatever their nature, it is to be explained how it happened that, scattered through the slide, there are still preserved crystal fragments both of hornblende and of feldspar that



1418.  
FIG. 45.

show no such change, some of the former of which have slight increments of later date. These are accompanied by quartz in rounded and angular form, evidently fragmental in its present place. Such an association as shown by figure 45 rather indicates that this was a pebbly rock. Here, in a roundish space, is an

altered angular area, the two having different coarseness and different transparency. The crystal was optically embraced in the matter surrounding it, and both have suffered a micro-granulation or alteration of the same kind. Whether this took place in the present rock or in some rock from which both were derived is an important question. The existence of unchanged crystals in this rock points to some earlier state in which such change as the above was effected, and that by some agency the two were brought in a pebbly state, along with fresh crystal fragments, and were contributed to the formation of the present rock. This rock is illustrated by plate III, figure 1. One section.

*Age.* Archean (Upper Keewatin).

*Remark.* Material like the pebbly forms seen in this rock, but usually more broken and lost by friction and decay, is apparently quite commonly distributed amongst the clastic greenstones.

N. H. W.

## No. 1420. GNEISS.

West end of Animikie island, Kekequabic lake.

*Ref.* Annual Report, xvi, pages 105, 125.

*Meg.* Similar to Nos. 1417, 1418, 1419.

*Mic.* The largest feldspars are reconstructed by a microperthitic intergrowth of a fresh feldspar, which sometimes composes more than a half of the whole. The rock also contains more *calcite* and coarser *quartz* than the others. One section.

*Age.* Archean (modified Upper Keewatin).

N. H. W.

No. 1421. AMPHIBOLYTE. (*Greenwacke.*)

Southwest end of Kekequabic lake; sec. 4, T. 64-7.

*Ref.* Annual Report, xvi, pages 105, 125.

*Meg.* Somewhat conglomeritic.

*Mic.* The most conspicuous feature is the abundance of *hornblende*, which is not only in distinct crystals, often showing its prismatic cleavages in basal sections, but in minute fibres scattered everywhere. The old feldspars are in remnants, in the main, from their original sizes, being eaten up by the prevalent alteration of the micro-granulitic substance mentioned in the description of No. 1419. In some cases a considerable portion of the feldspar substance remains and extinguishes uniformly. In other cases parts of it remain, contiguous, but extinguishing at slightly different angles, those parts being permeated at their borders by the same granulitic alteration, and in still other feldspars the entire crystal is sufficiently intact to show its form and its size, with complete and simultaneous extinction (though still varying in a shadowy manner). These most intact feldspars are still sprinkled throughout with *calcite*, *pyroxene* and *zoisite*, so that their albite twinning is scarcely visible.

The hornblendes are supplied with slight secondary growths. In some places they are bent, and certain branching ramifications, which enclose the large hornblendes, are composed of a yellowish and dirty granulated substance, which is apparently hornblendic and has resulted from a crushing of the hornblende crystals along their mutual contacts. These all lie, as in numerous other instances, in a very fine plexus of *feldspar*, *actinolite* and *quartz*, with a little *leucocene* and *magnetite*, the amount of quartz being small and uncertain. One section.

*Age.* Archean (modified Upper Keewatin).

N. H. W.

## No. 1422. GNEISS.

From a small island south of the point, west part of sec. 3, T. 64-7, Kekequabic lake.

*Ref.* Annual Report, xvi, pages 105, 125.

*Meg.* Greenish, with sparsely disseminated red crystals.

*Mic.* There is much *calcite* in this rock. The old feldspars are very much permeated and replaced and zoned by secondary feldspars, and very much of the rest

Greenwacke. Diabase.]

of the rock (aside from *calcite* and *actinolite*) is composed of a coarse reticulated mosaic of new feldspar (with little or no quartz). One section.

*Age.* Archean (modified Upper Keewatin).

N. H. W.

NO. 1423. GREENWACKE. (*Knotty.*)

At the head of the bay, on the town line, west end of Kekequabic lake.  
*Ref.* Annual Report, xvi, pages 106, 125.

*Meg.* Greenish, schistose conglomerate, apparently decayed.

*Mic.* This rock is similar to No. 1419, with the exception that all original parts are finer, and the distinctions all fade out to a more uniform rock, into which also is introduced much *calcite*. There is also a larger proportion of crystals, as compared with pebbles of glass. There appears to be also some *epidote*, and there is one remarkable group of crystals of iron ore which are black and apparently rhombohedral, like *ilmenite*, in accord with the presence of some *leucoxene*. One section.

*Age.* Archean (Upper Keewatin).

N. H. W.

## NO. 1424. GREENWACKE.

Same place as the last.  
*Ref.* Annual Report, xvi, pages 106, 125.

*Meg.* Knotty projections in No. 1423.

*Mic.* In this section the structure and nearly the composition of No. 1423 are presented, but the old crystals are still larger and more abundant; the augite is converted to a *uralite*, preserving, however, the angular form of the augite. At the same time the feldspars are dim by the introduction of chlorite and *calcite* and by a general breaking down of the grains so that they do not show any enlargements nor any clear and unique extinction. Notwithstanding these deformities they are perfectly evident as feldspars. The surrounding fine matrix is almost entirely feldspathic; whether of fragmental debris or of secondary growth is not apparent. But amongst the coarser elements is occasionally an angular quartz. One section.

*Age.* Archean (Keewatin).

N. H. W.

## NO. 1425. DIABASE.

Dike on the north shore of the bay at the west end of Kekequabic lake; E.  $\frac{1}{2}$  S. W.  $\frac{1}{4}$  sec. 34, T. 65-7 W.  
*Ref.* Annual Report, xvi, pages 106, 125.

*Meg.* A rather fine-grained, fresh, black diabase. No section.

*Age.* Perhaps Cabotian.

U. S. G.

## NO. 1426. GREENWACKE.

S. E.  $\frac{1}{4}$  sec. 34, T. 64-7, near the head of the broad, shallow bay, Kekequabic lake.  
*Ref.* Annual Report, xvi, pages 107, 125.

*Meg.* Greenish and fine grained, with evident hornblendes.

*Mic.* In the usual fine groundmass, largely of actinolitic and feldspathic materials, are *hornblendes* which, having the form of the augite in the porphyry, are evidently derived from that mineral by uralization. The rock contains no evident old feldspars. The hornblendes have secondary growths. One section.

*Age.* Archean (Keewatin).

N. H. W.

NO. 1427. GRANITE.

On the portage from Spoon lake northward.

*Ref.* Annual Report, xvi, page 125.

*Meg.* A drift piece showing the red rock cutting a biotitic gneiss. Must have come from some place further north or northeast.

*Mic.* The nature of the rock shows that it belongs with the Kekequabic lake series of granites. The supposed "vein" consists of a belt across the slide in which biotite is wanting, making it appear lighter colored and perhaps causing a redness on weathering. The whole rock is coarsely crystalline. Indeed the old feldspars are regenerated by new growths, and in many instances the clear new growths make up their principal portion. They embrace optically new *hornblendes*, *pyroxenes* and *biotite*, while the old ones are free (or almost free) from them, are much twinned, clouded and eaten into by the fresh quartz-feldspar granitic (and granitic) groundmass. The old feldspars are abundant in the so-called vein, and the fresh growths are in the rock on either side. One section.

*Age.* Archean (Keewatin).

*Remark.* This is a rock, whatever its source, which must, however, be near its present place, which shows how the old feldspars and hornblendes, and the old micro-granulitic matrix are converted into a coarser, fresh, firm granite. What could have caused this but igneous contact? It indicates that further toward the northeast is probably an outcrop of such granite in the midst of the green schists, and if it has been correctly explained, there should be evidence of some sort of gabbro activity in the vicinity.

N. H. W.

NO. 1428. GRAYWACKE. (*Slaty.*)

Southeast shore of Knife lake; the point which is near the centre of the east side of N. E.  $\frac{1}{4}$  sec. 28, T. 65-7 W.

*Ref.* Annual Report, xvi, pages 109, 125; Annual Report, xvii, pages 200, 206.

*Meg.* Siliceous slate.

*Mic.* A fragmental rock, of *quartz* and old *feldspars* (the coarsest elements), *calcite* and a fine matrix of quartz, feldspar and *leucoxene*. One section.

*Age.* Archean (Keewatin).

N. H. W.

NO. 1436. GRANITE.

Sec. 10, T. 64-10, Bassimanan (Basswood) lake.

*Ref.* Annual Report, xvi, pages 110, 126; Annual Report, xvii, pages 200, 206.

Granite. Amphibolyte.]

*Meg.* Medium grained, granitic or gneissic.

*Mic.* This rock, in the same manner as No. 1427, is made up of old *feldspars* and new generations, with *biotite* and *hornblende*, all embraced in a coarse, granitic, interlocking, new generation of quartz and feldspar. The old feldspars are completely permeated by quartzes and by new-grown feldspar and are sometimes almost lost by the new invasion, but very frequently they remain as cloudy nuclei surrounded by fresh borders. There is also in the section a light-yellow *pyroxene* resembling epidote, but differs from epidote in not having the axial plane perpendicular to the main cleavage, but forming an angle of  $30^{\circ} \pm$  in the section exposed. This is probably *diopside*. This diopside is developed in a spreading, straggling manner, often in scattered small granules, in the midst of one of the old feldspars. One section.

*Age.* Archean granite.

*Remark.* Coming upon this rock after the details of the examination of the Kekequabic lake granite, the comparison is vivid and complete. It suggests the question whether all the Bassimenan lake granite is not of the same sort, a regeneration of clastics. As to the cause of that regeneration, it is not possible here to enquire. But that the process seen commenced in some of the graywackes or green schists and carried out to an imperfect degree in the granitic rocks about Kekequabic lake, is completed here in the Bassimenan lake granite (or gneiss), is as palpable as any petrogenetic process can be made.

N. H. W.

## NO. 1437. AMPHIBOLYTE.

S. W.  $\frac{1}{4}$  sec. 5, T. 64-10. Long peninsula in Bassimenan lake.

*Ref.* Annual Report, xvi, page 126.

*Meg.* Dark, micaceous and hornblendic.

*Mic.* *Hornblende*, much of it zoned by second growths is the chief coloring matter, but *biotite* is common, also *sphene*, which indeed is unusually common. The hornblendes are earlier than the *quartz* and than most of the *feldspar*, being idiomorphic toward all the rest and unbroken except by their own interference and by an occasional *biotite*. There are a few nuclei of the old feldspars still visible, but most of the feldspar and all of the quartz is of secondary granitic origin and structure. One section.

*Age.* Archean (Keewatin).

N. H. W.

NO. 1439. AMPHIBOLYTE. (*Greenstone.*)

Bluff on the right bank, just below the Pipestone rapids, southwest extremity of Bassimenan lake.

*Ref.* Annual Report, xvi, pages 111, 126.

*Meg.* Even-grained, schistose greenstone.

*Mic.* The *hornblendes* are rather small and prevailingly elongated in the same direction. It is green or bluish-green with variation to yellowish on rotation.

*Sphene* is rather common mainly in the form of irregular groups of small globules or grains, but occasionally in isolated crystals. These groups have an elongation parallel with the hornblendes. With an occasional large *quartz* the foregoing constitute the colored elements. These elements lie in an interlocking fine network which is in the main feldspathic, but somewhat quartzose, wholly of fresh and secondary date, the *quartz* sometimes becoming coarser and forming nests of interlocking grains from which feldspar is wholly excluded. There is occasionally a trace of an older feldspar, shown by its decayed state. This network of quartz and feldspar is also interlocked in the margins of the hornblendes and encloses innumerable small hornblende shreds. The hornblende fragments here differ noticeably from those at Kekequabic lake. They are not sharp nor idiomorphically crystalline, but rounded at their extremities. They do not show crystal boundaries, but appear to be shreds or remnants (though fresh still) of hornblendes left after some destroying action had passed over them, without any secondary growths. They surround the sphenes and they sometimes embrace feldspar grains. They probably originated about cotemporary with the surrounding network. One section.

*Age.* Archean (Keewatin).

N. H. W.

NO. 1440. CHLORITE SCHIST. (*Greenstone.*)

From the same bluff as No. 1439.

*Ref.* Annual Report, xvi, pages 111, 126.

*Meg.* Very fine grained.

*Mic.* The rock embraces the same elements in about the same structure as No. 1439, but all much finer, and in place of sphene is a dark colored *leucoxene*. There is also a much greater proportionate amount of decayed *feldspar*, which is accompanied by the generation of considerable *calcite* and by needles and scales of *muscovite*(?). Throughout the slide there is also much isotropic chloritic(?) substance. Indeed the green element which takes the place of hornblende is in the main in this condition. One section.

*Age.* Archean (Keewatin).

N. H. W.

NO. 1441. GRANITE.

Cuts Nos. 1439 and 1440.

*Ref.* Annual Report, xvi, pages 111, 126.

*Meg.* Chloritic granite.

*Mic.* The structure is granitic, with *quartz*, *orthoclase* and *microcline*. The small amount of *chlorite* and of *hornblende* is hardly worthy of notice in giving name to the rock. The feldspars (except the microcline) are not much altered, though interspersed with fine *calcite* and *muscovite*. In the rock is a large percentage of quartz. One section.

*Age.* Archean.

N. H. W.

Greenwacke. Quartz schist.]

## NO. 1444. GREENWACKE.

Head of the portage from Fall lake to Garden lake. Replaces abruptly the jaspilyte at the head of the portage.

Ref. Annual Report, xvi, pages 111, 126.

Meg. Greenstone.

Mic. *Hornblende* in sharp, angular shreds and spicules, with secondary enlargements, and decayed *feldspars*. These seem to make up this rock, which has not a distinct schistose structure. The appearance of the hornblende is in contrast with that of No. 1439. Its spicules are sharp and fine, and twinning is not uncommon. At the same time the crystals are ragged and defective, even the zonal enlargements, and the sharp spicules. *Chlorite* and some of the old feldspathic element are within them in irregular spaces. The feldspar grains are all small, roundish and much decayed, having *chlorite* and apparently minute scales of *muscovite* and of *actinolite*, generated as secondary products. Still they are bound together in an interlocking plexus of secondary fresh feldspar. That the hornblende was a product of alteration from *pyroxene* is indicated by the remnants of that mineral still visible within the larger hornblendes. A little *leucoxene* is disseminated in rather dark coarse groups. One section.

Age. Archean (Keewatin).

N. H. W.

NO. 1446. QUARTZ SCHIST. (*Magnetic.*)

At the rapids between Garden and White Iron lakes (once known as Silver City).

Ref. Annual Report, xvi, pages 112, 126; Bulletin vi, pages 8, 10, and plate V, figure 3. (Compare Nos. 950 and 951.)

Meg. Thin-bedded magnetic quartz schist.

Mic. Two sections have been made, and the description of Hensoldt was made from them. They were very thick. On reducing one of them to the standard thickness the parts all become more distinct. *Magnetite* is seen to be distributed not only in somewhat regular bands, intermixed with quartz, but in finer particles is everywhere throughout the slide. The *quartz* is wholly of the secondary, interlocking kind, and its grains are somewhat elongated prevailingly in the direction of the structure. These two, with *actinolite*, constitute the rock. If there be any glassy, fresh feldspar it is masked by its resemblance to the quartz, and none has been detected. The *actinolite* is in fine detached needles or fibres parallel with the structure. Two sections.

Age. Keewatin (recrystallized).

N. H. W.

## NO. 1448. GREENWACKE.

N. W.  $\frac{1}{4}$  sec. 4, T. 62-14. At a fresh drilling for iron, north of Mud lake.

Ref. Annual Report, xvi, pages 112, 126.

Meg. Fine-grained, characterless greenstone.

*Mic.* The rock consists plainly of a fine debris of basic eruptive materials, in which, with much decay, has been a generation of much *calcite* and some fresh *feldspar*. It is much dimmed by *chlorite* and *leucoxene*. One section.

*Age.* Archean (Keewatin).

N. H. W.

NO. 1449. KAOLIN (?)

Stone mine at Soudan.

*Ref.* Annual Report, xvi, page 126; Annual Report, xix, pages 125, 127; Bulletin vi, pages 37, 422.

*Meg.* A soft, greasy-feeling substance, white or greenish and pinkish white in color. It is a much disintegrated schist.

An analysis of this material is as follows:

SiO <sub>2</sub>	60.05
Al <sub>2</sub> O <sub>3</sub>	27.55
Fe <sub>2</sub> O <sub>3</sub>	1.30
CaO	.38
MgO	.77
Na <sub>2</sub> O	.31
K <sub>2</sub> O	4.26
P <sub>2</sub> O <sub>5</sub>	.11
H <sub>2</sub> O	5.30
Total,	100.03

This would perhaps indicate kaolin mixed with some undecomposed orthoclase. No section.

*Age.* Archean (Keewatin).

U. S. G.

NO. 1450. GREENWACKE. (*Graywacke.*)

Cut by the Tower spur track from the mines.

*Ref.* Annual Report, xvi, pages 113, 126.

*Meg.* Light colored, greenish, siliceous, mainly massive.

*Mic.* The rock has, microscopically, a decidedly schistose structure. It consists of the usual ingredients of graywacke, but finer than is usual in graywackes. It has a few spicules of *actinolite*, a little *calcite* and apparently a considerable *zoisite*, the last generally in fine grains, giving its characteristic very low polarization colors, but serving to give a light color to the rock, and by its high refractive index obscurity to the slide between the nicols. One section.

*Age.* Archean (Keewatin).

N. H. W.

NO. 1451. JASPILYTE.

Sec. 2, T. 61-15 W. Southeast from Tower, five miles.

*Ref.* Annual Report, xvi, pages 113, 126.

*Meg.* White and black-banded jaspilyte, the black bands being only in part of magnetite. A little pyrite is present. No section.

*Age.* Archean (Keewatin).

U. S. G.



Graphite and pyrite. Magnetite-tremolite schist.]  
Hornblende. Pyroxenyte.

## NO. 1452. GRAPHITE AND PYRITE.

Same locality as No. 1451.

Ref. Annual Report, xvi, pages 113, 126.

*Meg.* A rough, apparently brecciated, rock composed largely of pyrite and a black substance which is in part graphite. No section.

*Age.* Archean (Keewatin).

U. S. G.

## NO. 1453. MAGNETITE-TREMOLITE SCHIST.

Black River Falls, Wisconsin. Associated with magnetic ore of the York opening in the Tilden mound.

Ref. Annual Report, xvi, page 126.

*Meg.* Magnetite mingled with short, gray fibres.

*Mic.* The amphibole is colorless, has positive elongation and  $n_p$  in the acute angle of the axial plane. Its colorlessness and high double refraction with maximum extinction at  $16^\circ$  are the only known characters which necessitate the name tremolite instead of actinolite. With a little *calcite* and much magnetite the rock is rendered nearly black in hand sample. Three sections.

*Age.* Taconic(?)

N. H. W.

NO. 1454. HORNBLENDE. (*Fibrous.*)

Same place as the last.

Ref. Annual Report, xvi, page 127.

*Meg.* The strongly, long-fibrous mass is faintly green, and presents a fold across the fibres.

*Mic.* The maximum extinction angle is  $22^\circ$ . The bisectrix ( $n_p$ ) is in the acute angle of the axial plane, and lies oblique to the fibration, the optic plane being parallel with the fibration. These characters, with the faint pleochroism, make this to be common hornblende. One section.

*Age.* Taconic(?)

N. H. W.

## NO. 1456(?) PYROXENYTE.

Black River Falls, Wisconsin. Near the river, and near the granite. Just southwest from the so-called Tilden mound.

Ref. Annual Report, xvi, page 127.

*Meg.* The "bedding" is about vertical, and curiously twisted and curled.

*Mic.* The rock consists almost solely of *pyroxene*, having a few crystals of *sphene* and a few accessory small grains of *quartz*. One section.

*Age.* Archean (Keewatin?).

*Remark.* This rock differs so widely from the field description and from the preserved hand sample (Sixteenth Annual Report, page 127), that it appears there is some error in the notation. The preserved hand sample is a fine, siliceous, jaspilitic rock.

N. H. W.

[NOTE. Nos. 1457 to 1500, inclusive, were collected north of Gunflint lake, outside of Minnesota territory, and there are no sections of them. They are not here described, but brief field notes concerning them can be found in the Sixteenth Annual Report, pages 75, 76, 127-129.]

NO. 1501. QUARTZ, PYRITE, ETC. (*Vein material.*)

West side of East Eagle Nest lake; N. E.  $\frac{1}{4}$  N. E.  $\frac{1}{4}$  sec. 34, T. 62-14 W.

*Ref.* Annual Report, xviii, pages 13, 21, 59; Annual Report, xix, pages 125, 127; see, also, Annual Report, xv, pages 32-33.

*Meg.* Vein material composed largely of quartz, with considerable pyrite, some calcite and also apparently chalcopyrite. An assay was made of this specimen for gold and silver. A trace of gold was found, but no silver. No section.

*Age.* Archean (Keewatin).

U. S. G.

NO. 1502. QUARTZ.

At the mines at Tower. Embraced in considerable masses in immediate proximity to the so-called chalcidonic silica in the green schist.

*Ref.* Annual Report, xviii, page 59.

*Meg.* Vitreous quartz.

*Mic.* The individual orientations extend parallel (roughly) with each other, showing a coarse fibrous structure. Each individual is united to its neighbors by a granular border, each extending into the other, as evinced by the orientations; at the same time a shadowy extinction goes over each grain. One section.

*Age.* Archean (Keewatin).

N. H. W.

NO. 1503. QUARTZ.

Vein one-half inch wide, running transverse to the green schist at Tower.

*Meg.* Granular.

*Mic.* This has not the fineness of the jaspilitic silica, although it interlocks in the same way. The size, however, of the grains varies, some being not more than a hundredth part the size of others. One section.

*Age.* Archean (Keewatin).

N. H. W.

NO. 1508. BLACK SCHIST (*with pyrite nodules*).

From pits north of Chester peak, near Soudan.

*Ref.* Annual Report, xviii, pages 11, 59.

*Meg.* Dark, heavy schist, which is apparently carbonaceous. In the schist is scattered some pyrite and there are also pyrite nodules, elongated and spherical. The largest spherical nodule of pyrite in the specimens collected is two and a quarter inches in diameter. It has a central mass half an inch in diameter, of granular

Quartz. Agglomerate.]

pyrite, and the rest of the nodule is made of pyrite radiating out from this mass. In another nodule the centre is about an inch in diameter, and the radiating border only a quarter of an inch in thickness. No section.

*Age.* Archean (Keewatin).

U. S. G.

No. 1509. QUARTZ. (*Chalcedonic veins.*)

In the jaspilyte on the top of Chester peak, near Soudan.

*Ref.* Annual Report, xviii, pages 11, 59.

*Meg.* Small, white veins, apparently of the same constitution as white jaspilyte, cross red jaspilyte. No section.

*Age.* Archean (Keewatin).

U. S. G.

No. 1510. AGGLOMERATE. (*Basic.*)

*Ely.* From the agglomerate at the railroad cut.

*Ref.* Annual Report, xviii, pages 13, 59; American Geologist, vol. ix, pages 359-368. Compare Nos. 1624 and 1625.

*Meg.* Collected so as to show the forms of two boulders and the darker green rock separating them.

*Mic.* One section is from the interior of one of the boulder forms, and the other from the edge of the rounded mass. That from the interior shows a fine diabasic structure in the arrangement of the minute chloritic *feldspars*, which are radially arranged, for the most part, but are in other places grouped in a somewhat parallel arrangement. They are much altered, but reveal a fine albite twinning without distinct terminations. The surrounding material is dimmed by much alteration, but occasionally a grain of *pyroxene* is seen in the mass. It also contains *calcite*, *leucoxene*, and apparently a few *hornblendes* and some traces of a secondary feldspar.

The other section is completely altered. It shows no diabasic structure. The distribution of *leucoxene* is the most marked regular feature. At one side of the slide it is in annular groups and roundish nests of about uniform size. By degrees, departing from this part of the slide, these become larger, but thinner, and so dispersed at last that on breaking up they spread more and more diffusely, coalesce and cause a general dissemination of leucoxene throughout the slide. The most concentrated portion of this leucoxene is associated with a micro-granulitic generation of secondary(?) *feldspars*. These little grains do not interlock; indeed, they are entirely isolated and free from each other and may represent a feldspathic sand. In the midst of them are also a few *pyroxene*(?) grains. Suddenly appears, in the midst of this structure, a rectangular network of bright spicules whose individual cross-sections with the highest power have about the thickness (apparent) of the spider lines, and also have parallel extinction. They are too fine to be determined, but appear to be of *actinolite*. The rest of the slide appears to consist of a uniform granular mixture of all

these parts with a preponderance of the feldspathic elements—all in a state of fine comminution, resolvable only in bright light by the high-power objective. Two sections.

*Age.* Archean (Keewatin).

*Remark.* This agglomerate extends widely southwestwardly from this locality. It has been discussed in the American Geologist (volume ix, pages 359–368), where it was supposed to be of early volcanic origin, the rounded masses having the nature of bombs, buried in the cotemporary pulpy product of trituration of basic ash and debris. This view as to the nature of the fine material separating the bombs is sustained by the general composition of the second slide above described. Examined with a low-power objective its aspect is that of a devitrified basic glass, which originally existed in the form of a sand, much resembling the rock No. 1419 (plate III, figure 1), and is illustrated by the photograph reproduced in plate III, figure 2. N. H. W.

NO. 1511. AGGLOMERATE. (*Basic.*)

From the greenstone agglomerate at the railroad cut, Ely. Taken from the "amygdaloidal" portions of some of the bombs.

*Ref.* Annual Report, xviii, pages 13, 59.

*Meg.* The tubes are filled with *calcite* and are at the circumferences of the bombs, penetrating from one-fourth of an inch to two inches from the interior surface radially toward the centre. Their diameter is about one-fourth of an inch and less.

*Mic.* The section does not show any of the tubes, but some large areas of *calcite*. The rock in general, seen in common light, is sprinkled rather uniformly with fine nests of *leucoxene*, but this element also appears in minute veinlets. In the groundmass, which is chloritic and rather dark, are minute microliths of *feldspar*(?) twinned on the albite plan, which, with a considerable decay, have apparently been extended right and left by secondary feldspathic growths so as to govern extinction on either side, and such microliths, as well as their enlargements, are frequently seen to present a stellar and radiated structure, extinguishing with an imperfect, constant black cross as they are rotated. It might perhaps be more reasonable to assume that this feldspathic element is altogether original, and that the crystals were concentrated from a magma, but have since decayed. This would be in keeping with their general appearance of alteration, and with the indefiniteness which characterizes the limits of their extension into the surrounding mass. Some *pyroxene* is seen, and in a single instance it is distinctly ophitic toward the feldspars. One section.

*Age.* Archean (Keewatin).

N. H. W.

NO. 1514. GRANITE.

Hinsdale stone quarry, *i. e.*, in the Giant's range at the crossing of the Duluth and Iron Range railway.

*Ref.* Annual Report, xviii, page 59.

Granite. Gneiss.]

*Meg.* The hand samples show two kinds of granite welded together in a distinct contact. One is quite coarse grained and the other is very much finer grained. The section was made from the coarser granite.

*Mic.* The rock is characterized by much *quartz* in large grains interlocking in the manner of the granitic and granulitic quartzes of Kekequabic lake. The feldspars are *orthoclase*, *oligoclase* and *microcline*. The former two are partly fresh and partly much altered, the altered portions being as a rule at the centres of the crystals. The interlocking border is nearly always composed of fresh feldspar. The *microcline* is wholly fresh and interlocking. *Sphene* and *apatite* are in distinct characteristic crystals. *Hornblende* and *biotite* compose an inferior portion of the rock. One section.

*Age.* Archean granite.

*Remark.* In the foregoing slide can be seen several instances of hornblende entirely included within the old feldspars, having the short, stout habit of the augites seen in the feldspars of the Kekequabic lake esterellyte, but in general the hornblende is elongated, and is distinctly associated with the later growths. N. H. W.

## NO. 1515. GRANITE.

North Redwood P. O., near Redwood Falls; Minnesota river.

*Ref.* Annual Report, xviii, page 59.

*Meg.* Massive, gray, uniform, without bands of color, but having a gneissic elongation of the crystals.

*Mic.* There is much of the old feldspathic element in this rock, and though filled with impurities it shows in some instances its albite twinning. The most of the rock still consists of fresh *quartz*, *microcline*, *micropegmatyte* and of *sphene*, with some *biotite* and *brown hornblende*. One section.

*Age.* Archean.

N. H. W.

## NO. 1516. GNEISS.

Same place as No. 1515.

*Ref.* Annual Report, xviii, page 60.

*Meg.* Gray, with alternating and intershading of micaceous and feldspathic belts.

*Mic.* The section is made transverse to the banding, but the structure is not apparent in the slide. The rock is similar to the last, except that the contrast between decayed and undecayed feldspar is not so marked. There is a small amount of what may be considered an old feldspar, but the whole rock appears to have suffered a second incipient alteration. Even the fresh *microclines* are dimmed by it. *Biotite* and *sphene* as in the last, with a grain of *garnet*. One section.

*Age.* Archean.

N. H. W.

## NO. 1518. GNEISS.

Morton quarries, Morton, Minnesota valley.

Ref. Annual Report, xviii, page 60.

*Meg.* Gneissic, with much red orthoclase.

*Mic.* Orthoclase, oligoclase, microcline, quartz, essentially compose this rock. The feldspar grains are all affected uniformly by a later process of decay which has given rise within them to scattered scales of calcite and muscovite. There are areas and grains included within the larger feldspars which show much more decay than the rest, but there is no marked general separation either in position or in stage of alteration between the fresh feldspar and the old. One section.

*Age.* Archean.

N. H. W.

## NO. 1519. HORNBLENDE BIOTITE GNEISS.

Morton quarries. From a dark, nearly black, inclusion in the body of the rock.

Ref. Annual Report, xviii, pages 24, 60.

*Meg.* Medium grained, micaceous.

*Mic.* Hornblende and biotite give the dark color to the rock. The rock is very fresh and clean. The feldspars are conspicuously twinned on the albite and pericline plans and occasionally zoned, but they contain frequently central cores so much altered that the twinning bands are destroyed. The twinning striations do not continue through the new zonal growths. In such cases it is possible that the fresh portion is a secondary growth about an old decayed crystal. But very little quartz is seen. One section.

*Age.* Archean.

N. H. W.

## NO. 1521. QUARTZYTE.

Pokegama falls, Mississippi river, Itasca county.

Ref. Annual Report, xviii, page 60.

*Meg.* Gray, granular. (Compare Nos. 1525A, 1526 and 257H-259H.)

*Mic.* The grains have been enlarged by interstitial growths, forming a solid quartzyte. The grains almost without exception are loosely charged with minute acicular trichiths which are only visible when the quartz is extinct and in high power; they also extinguish parallel with the threads. If these be not due to an accidental impurity in the balsam, they are a feature of quartz not before noticed in the state. One section.

*Age.* Pokegama (bottom of the Animikie).

N. H. W.

## NO. 1525(a). QUARTZYTE.

Pokegama falls.

Ref. Annual Report, xviii, page 60.

*Meg.* Spottedness shown in the quartzyte. One of the spots was in the centre of the chip from which the section was made.

*Mic.* There is nothing in the appearance of the slide which will explain the spottedness unless it be a greater amount of dirty impurities which seems to prevail

Quartzite. Hematite.]

irregularly in the *quartz* in certain places. This slide shows a small amount of *microcline*(?) and apparently a small amount of another feldspar, and also a grain of colorless *tourmaline*, which seems to be of secondary origin, since it surrounds several small quartz grains. This *tourmaline* has a yellow or orange color of double refraction, and a strong polychroism, darker when it agrees with the horizontal thread. It has  $n_p$  in agreement with its elongation, and an imperfect cleavage parallel with the cross section. One section.

*Age.* Pokegama (bottom of the Animikie.)

N. H. W.

## NO. 1526. QUARTZYTE.

Pokegama falls; same place as the last.

*Ref.* Annual Report, xviii, pages 15, 60.

*Meg.* Shows another spottedness. Here the rusty spots weather out and produce a pitted surface on the quartzite in which the round surfaces of the grains are exhibited.

*Mic.* Between the rounded *quartz* grains is much of a substance which is isotropic, but transparent, clear and colorless, having some hematitic staining in the form of dirty particles, as well as some indefinite microliths. Occasionally some of this inter-granular, isotropic substance is replaced by, or at least charged with, coarser crystallites which appear to be actinolite, or both actinolite and mica. Still more rarely a cleaved grain resembling feldspar is seen in the midst of the same substance. Sometimes a dim translucency between crossed nicols appears in small spots, denoting imperfect crystallization. This substance is so abundant sometimes that the rounded quartzes that lie in it do not come into contact. It everywhere acts as a filling which surrounds them. While in general the rock consists of coarse clastic quartz, there are roundish spots or areas where this substance prevails, and this is no doubt the cause of the megascopic spottedness mentioned. The microscopic aspect is seen in figure 3, plate III. There seems to be no way to interpret this structure other than to refer it to fine volcanic ash accumulated cotemporary with the formation of the rock.

If this be volcanic ash it is comparable with the similar phenomena seen at the eastern end of the Mesabi range in the vicinity of Gunflint lake, and with the volcanic phenomena reported on the Penokee range by Van Hise.\* The trichiths mentioned in No. 1521 do not appear in this rock nor in No. 1525A. One section.

*Age.* Pokegama (bottom of the Animikie.)

N. H. W.

## NO. 1527. HEMATITE.

Prairie River falls, S. E.  $\frac{1}{4}$  sec. 34, T. 56-25 W.

*Ref.* Annual Report, xviii, pages 15, 60; Bulletin vi, pages 120, 422.

\* *Bulletin of the Geological Society of America*, vol. iv, p. 435, 1893.

*Meg.* Compact hematite in polygonal forms, like small basaltic columns an inch and a half in diameter. In places the hematite has the granular texture so common in taconyte. No section. See plate IV. This basaltic structure is transverse to the bedded structure of the rock.

*Age.* Animikie (iron-bearing member).

U. S. G.

No. 1528. TACONYTE.

Prairie River falls; at the horizon of the iron ore.  
*Ref.* Annual Report, xviii, pages 15, 60.

*Meg.* Siliceous, somewhat granular and iron bearing.

*Mic.* The different individual round grains are in different degrees of internal fineness and have different amounts of hematite. In some the ore is magnetite, and in others hematite, and in others partly limonite. In some grains is no iron ore. The rock is completely silicified at the present time, making a very hard, compact mass. The ultimate granular structure varies from coarse jaspilitic quartz to "flint," and apparently to glass and devitrified glass. The constituent large grains of which the rock is composed do not differ from the usual rounded taconitic grains, but exhibit a remarkable difference of internal structure. One section.

*Age.* Pokegama (at the top of the quartzyte).

N. H. W.

No. 1529. JASPILYTE.

Same place as Nos. 1527 and 1528, but somewhat above No. 1528.  
*Ref.* Annual Report, xviii, pages 15, 60; Bulletin vi, pages 115, 422.

*Meg.* Peculiar "streamed" or interleaved and brecciated, white, red and black jaspilyte. In some places coarsely crystallized quartz is present. No section.

*Age.* Animikie (iron-bearing member).

U. S. G.

No. 1530. TACONYTE.

Prairie River falls; at the horizon of the iron ore. (Compare No. 1294.)  
*Ref.* Annual Report, xviii, pages 15, 60; Bulletin vi, pages 115, 120, 422.

*Meg.* Jaspilyte and hematite, closely intermixed, but not interlaminated, presenting an oolitic aspect.

*Mic.* There is a concentric fine layering that forms the periphery of most of the compound or taconitic grains, same as seen in No. 1294, but in some cases this layering is wanting on one side of a certain grain, and in others it appears to cross the central part and again to be enclosed in a later layering unconformable with that of the central part. From this it can be inferred that these pebbles had this structure prior to their being incorporated in this rock. They are made up of finer grains of interlocking or jaspilitic quartz than that which lies between them. The iron is not abundant, only serving to give a ferriferous tone to the rock. One section.



Taconyte.]

*Age.* Pokegama (top of the quartzyte).

*Remark.* Nos. 1530 and 1294, from opposite ends of the known Mesabi Iron range, are remarkable phases of the taconyte, and are alike in their remarkable characters. Several photographs are shown on plate III, viz.: figure 4 from No. 1294, shows the general oolitic structure in its best condition; figure 5, from the same rock, shows the same when permeated and almost lost by the accumulation of iron ore; figure 6, from No. 1294, shows the amorphous nucleus which, having been once surrounded by the oolitic concentric bands, was broken and again surrounded by similar concentric bands non-conformable with the former. Such irregularities are common and show that this structure did not grow up within this rock since consolidation, but pertained to these grains prior to their lodgment in this mass. Figure 7, from No. 1294, shows the non-conformity of the nuclei with the encircling bands, proving the earlier existence of the nuclei. This figure shows, also, an irregular streamed structure in the nuclei and a passage of this into the conspicuous peripheral banding. This, with other similar gradations from one to the other, indicates that the internal structure of the nuclei, although usually amorphous, might sometimes assume an imperfect banding, having perhaps the same origin. Figure 8, from No. 1530, shows the general aspect. At the centre of the photograph is a grain which is shown magnified in figure 9. In this grain the nucleus is different from any other seen in either No. 1294 or No. 1530. It is distinctly a fragmental compound nucleus. It embraces eleven main parts, and three of them are of angular apparently earlier quartz, the others being of flint (or devitrified glass) and of coarser interlocking taconitic quartz of varying size of grain. This shows that the "taconitic" structure of the rock taconyte, so far as it involves the fine interlocking quartz, sometimes was formed before the rock taconyte, as now ordinarily known, was deposited; and therefore, that within the individual, rounded, pebbly grains of the taconyte, the interlocking quartz may have developed earlier than in the mass of the taconyte, and may have been in each pebbly grain dependent on a primordial condition of the pebble itself. This different development of the interlocking quartzes, in the different rounded pebbles, even in the pebbles of the nucleus shown in figure 9, may not, however, have been due to difference of time, but the general silicification may have been all simultaneous throughout the rock, and the varying grain of the interlocking quartz may then have been due to this primordial difference of the original pebbly masses. Figure 10, from No. 1530, shows the encircling bands about an amorphous but ferruginated nucleus, broken and displaced. This also shows that these encircling bands were formed before the pebbles acquired their present positions. Some of the pebbles cracked irregularly, apparently by shrinkage, after the formation of the encircling bands, and in some cases they seem to have

separated permanently into angular pieces which again were encircled by the same kind of bands. This shrinkage is also shown in figure 10. Some of the pebbles are but scantily furnished with the encircling bands. In those cases the nuclei are not distinctly amorphous, but are finely granular and ultra-microscopically crystalline like "flint" or devitrified glass. Yet some of these also appear to have had, and to have lost, such encircling bands. In such flinty pebbles the hematite of the rock is distributed as a crystalline powder, greatly in contrast with the hematitic blotches and opaque nuclei of the other pebbles. In some cases, however, these contrasts appear in the same pebble, showing that whatever was the nature and origin of one was also the nature and origin of the other.

It is impossible to say that there are any other minerals than quartz and hematite in these slides. The former, in an interlocking mosaic, fills all the spaces between these oölitic pebbles, penetrates within the bands, and into the nuclei. In the bands it embraces the hematitic powder and extinguishes in the "patchy" manner of apobsidian. In the nuclei it variously mingles with the hematite, but sometimes it forms microscopic spheruliths whose rays, having a mass of hematite at the centre, are of negative elongation, and hence appear to be of chalcedony. This negative character cannot be affirmed of the interlocking quartz in general, although it has frequently been designated chalcedonic quartz; with one nicol it shows a faint absorption or pleochroism.

It seems impossible to explain these taconitic pebbles except by assuming that they were originally volcanic ash or sand. Compare Part III for further considerations. Compare No. 1630A. N. H. W.

#### NO. 1532. CONGLOMERATE.

Same locality as No. 1527. Underlies the ore.  
*Ref.* Annual Report, xviii, pages 15, 60.

*Meg.* The matrix of the conglomerate is a coarse, gray, granular quartzite. The pebbles are small, rarely over half an inch in diameter. They are of quartz (largely), dark, fine-grained schist or argillyte, greenstone and red hematitic rock. No section.

*Age.* Animikie (Pokegama quartzite member). U. S. G.

#### NO. 1537. HEMATITE.

N. W.  $\frac{1}{4}$  N. W.  $\frac{1}{4}$  sec. 21, T. 56-24 W.  
*Ref.* Annual Report, xviii, pages 18, 60.\*

*Meg.* A red, slaty, impure hematite, more or less granular like taconyte. Gives forty-seven per cent of metallic iron. No section.

*Age.* Animikie (iron-bearing member). U. S. G.

\*On page 60 the locality is, by a typographical mistake, given as T. 56-14 instead of T. 56-24.

Granite and diabase. Calcite, laumontite.]  
Serpentine.

NO. 1541. GRANITE AND DIABASE. (*Contact specimen.*)

Duluth. On the Weller road, so-called, one and one-half miles from lake Superior, but about two miles from the business part of Duluth.

*Ref.* Annual Report, xviii, pages 26, 61.

*Meg.* A specimen showing the contact of Nos. 1540 and 1542. The two rocks are closely welded together; the contact plane is sharp and distinct and there is practically no blending of the two rocks, but the dark rock (No. 1540) has some reddish feldspar in it. Neither of the rocks is particularly finer grained at the contact. No section.

*Age.* Cabotian.

U. S. G.

NO. 1542. GRANITE. (*Red.*)

Duluth. On the Weller road (formerly so-called), now Piedmont avenue, at about two miles from the business part of the city.

*Ref.* Annual Report, xviii, pages 26, 61.

*Meg.* Crystalline, red, with some light-green spots.

*Mic.* The red, striated *feldspars* are surrounded by *quartz* which has also in some cases insinuated itself into the feldspars in a micropegmatitic manner. The latter are zoned by differing shades of hematitic redness. There is (or was) a little green *hornblende*, but it is largely chloritized. About these hornblendic spots can be seen remnants of *pyroxene* in isolated areas and grains. One section.

*Age.* Cabotian.

*Remark.* The rock appears to have been at first a part of the gabbro, but is now much altered by its contact on the clastics.

N. H. W.

NO. 1544. CALCITE, LAUMONTITE. (*Vein material.*)

From a vein in the gabbro at Rice's point, Duluth.

*Ref.* Annual Report, xviii, page 61.

*Meg.* A roughly banded vein, an inch to an inch and a half in thickness, composed of calcite and laumontite, with some serpentine-like material on the surfaces. No section.

*Age.* Vein in Cabotian rocks.

U. S. G.

NO. 1545. SERPENTINE.

In a vein in the gabbro at Rice's point, Duluth.

*Ref.* Annual Report, xviii, page 61.

*Meg.* Fine, yellowish.

*Mic.* The nearly isotropic substance shows a cloudiness distributed characteristically of serpentine, in which are the remnants of some highly polarizing ferromagnesian minerals (*pyroxene?*), and occasionally of a twinned *feldspar*, with disseminated *calcite*. One section.

*Age.* Cabotian.

N. H. W.

## NO. 1547. JASPILYTE.

Lee mine, Tower.

Ref. Annual Report, xviii, pages 28, 30, 39, 61; Bulletin vi, pages 59, 422.

*Meg.* Reddish, earthy-looking, with pyrite.

*Mic.* There is some variation in the fineness of grain, there being some roundish and irregular areas much finer than the rest, suggesting a confused mechanical manner of accumulation. The "earthy" appearance is due apparently to the presence of a considerable *chlorite*. This completely fills some small areas, and is finely disseminated generally. Iron is in the form of *hematite*, *magnetite* and *pyrite*.  
One section.

*Age.* Archean (Keewatin).

N. H. W.

## NO. 1549. BRECCIA.

Lee mine, Tower.

Ref. Annual Report, xviii, pages 29, 61.

*Meg.* A brecciated mass, cemented by quartz. Composed of quartz and hematite, with some copper sulphide, probably both bornite and chalcopyrite; also a little azurite. No section.

*Age.* Archean (Keewatin).

U. S. G.

## NO. 1550. JASPILYTE.

Lee mine, Tower.

Ref. Annual Report, xviii, pages 29, 61.

*Meg.* Pinkish, finely-banded jaspilyte, with some magnetite and red jaspilyte.  
No section.

*Age.* Archean (Keewatin).

U. S. G.

## NO. 1557. GRAYWACKE.

Tower; at the railroad, just south of the Tower mine (Nos. 8 and 9).

Ref. Annual Report, xviii, pages 42, 61; Bulletin vi, pages 37, 44, 46, 422.

*Meg.* Light-colored graywacke, greenish white, with distinct grains of quartz; dips N. 75° to 80°.

*Mic.* The large *quartzes* are in a matrix of finer quartz, *calcite*, *sericite* and interlocking micro-granulitic quartz, the last evidently occupying places once filled by fragments of some feldspar crystal. The quartzes show slight shadowy extinction.  
One section.

*Age.* Archean (Keewatin).

*Remark.* This rock was originally a coarsely-fragmental accumulation of quartz and feldspars, like some of the green schists about Kekequabic lake, but by the exigencies of geological time the feldspars have been lost.

N. H. W.

Jaspilyte. Breccia.]

## No. 1559. JASPILYTE.

Stone mine, Tower, at the railroad cut.

*Ref.* Annual Report, xviii, page 61.*Meg.* Interbedded in No. 1558, *i. e.*, in the green schist of the region.

*Mic* Insinuated amongst the quartzes and the grains of ore, and sometimes extending sparsely throughout the rock, as seen in the slide, are shreds of green *hornblende*, the element of the green schists, having a uniform elongation, and plainly being a portion of the schists cotemporary with the jaspilyte. The *quartz* is finely granular and interlocking, varying in fineness from band to band.

The most interesting portion of the slide is the *siderite*, which not only is in fine grains, but in two instances is in crystals of considerable size in which are included both quartz and iron ore grains. One section.

*Age.* Archean (Keewatin).

*Remark.* The fact that the *siderite*, which has been taken to be the source of the iron ore of the Vermilion range, surrounds both the ore and the quartz, shows that it is the latest of the elements to take its place, instead of being the first, and the source of the ore. It is related to the oxides of iron and of silicium as *augite* is related to *labradorite* in the well-known ophitic structure of *diabase*.

N. H. W.

No. 1560. JASPILYTE. (*Disintegrated.*)

Dump of the Stone mine.

*Ref.* Annual Report, xviii, page 61.*Meg.* Loose white quartz, a naturally disintegrated jaspilyte.*Mic.* The fineness varies; the grains are all angular. One preparation.*Age.* Archean (Keewatin).

N. H. W.

## No. 1561. BRECCIA.

Dump of the Stone mine, Soudan.

*Ref.* Annual Report, xviii, page 61.

*Meg.* A beautiful breccia of jaspilyte and hematite cemented by quartz. The quartz is commonly coarse grained like ordinary vein quartz, but in places approaches the fineness of the jaspilyte quartz. In spots the quartz has not entirely filled the spaces between the rock fragments, thus leaving cavities into which quartz crystals project. No section.

*Age.* Archean (Keewatin).

U. S. G.

## No. 1563. BRECCIA.

Dump at the scam southwest of the Breitung mine, Soudan.

*Ref.* Annual Report, xviii, page 61; Bulletin vi, pages 51, 422.

*Meg.* Rough green schist, apparently brecciated, and more or less iron stained. There is considerable of a mineral with a mica-like cleavage, quite soft, but the cleavage lamellæ are not elastic. No section.

*Age.* Archean (Keewatin).

U. S. G.

NO. 1564. HEMATITE AND LIMONITE.

Same place as No. 1563.

*Ref.* Annual Report, xviii, pages 34, 36.

*Meg.* "There is in this ore belt, besides, a considerable amount of limonite, some of it in botryoidal surfaces on quartz crystals, and on hematite (No. 1564). The limonite sometimes is further covered with a thin blue coat, and in some cases, especially in the vicinity of pyrite, there is a surface of coxcomb crystals, like hematite, covered with black, which last possibly is manganese." No section.

*Age.* Archean (Keewatin).

U. S. G.

NO. 1565. JASPILYTE. (*Gray.*)

Dump of the scam, southwest of the Breitung mine.

*Ref.* Annual Report, xviii, pages 34, 62; Bulletin vi, pages 77, 78, 422, plate VIII, figure 2.

*Meg.* Flinty, gray to dark-gray jaspilyte.

*Mic.* This is a "cherty iron carbonate," so called, supposed by some to be the primal nature and source of the iron ore of the district. It consists essentially of interlocking secondary quartz, but irregular multiple grains of *siderite*, sometimes of rhomboidal shape, are mingled with it. There is also a finer dust of hematite, but this plays a very unimportant part. This dust is embraced in the quartz and in the siderite, and occasionally a quartz is surrounded by the siderite. One section.

*Age.* Archean (Keewatin).

N. H. W.

NO. 1567. JASPILYTE (*with coarse quartz*).

Breitung mine, Tower, in a ridge separating this mine from the old Tower mine.

*Ref.* Annual Report, xviii, pages 35, 62.

*Meg.* Pebbly, with vitreous but angular quartz, appearing detrital.

*Mic.* The quartz is quite different from that which forms the jaspilyte at large, being in large grains of single orientation, though having a shadowy extinction, and evidently enlarged by new quartz. It all seems to be crowded by lines of inclusions, whether old or new, and also is penetrated about the margins by minute crystals of hematite, making it appear to be of later date than the hematite. These quartzes lie in hematite. One section.

*Age.* Archean.

N. H. W.

Jaspilyte.]

## NO. 1568. JASPILYTE.

From the cut made for the high tunnel running south from the Tower mine where it crosses the light "ore streak."

*Ref.* Annual Report, xviii, pages 40, 62; Bulletin vi, pages 59, 60, 76, 422.

*Meg.* The egg-shaped mass was entirely enclosed and isolated in the schists. It showed somewhat peripherally concentric color bands, rather indistinct and broad, hardly comparable with the banding of the jaspilyte and iron.

*Mic.* There is nothing noteworthy different from the normal jaspilyte of the region. It is a uniform mass of fine, interlocking *quartz* grains, with scattering grains of *hematite*. One section.

*Age.* Archean (Keewatin).

N. H. W.

NO. 1571. JASPILYTE. (*Greenish.*)

Banded in the jaspilyte north of the Tower mine.

*Ref.* Annual Report, xviii, page 62; Bulletin vi, pages 54, 78, 80, 422, plates II, IX.

*Meg.* The rock appears in the main green, but has a large percentage of silica and of iron.

*Mic.* There is a banded variation in the relative amounts of the three elements, *iron*, *quartz* and *hornblende* (or *chlorite*), producing the same structure as seen in the ordinary jaspilyte. Indeed, this varies from the ordinary jaspilyte only in having present a varying amount of the green element, which is identical with that of the adjoining schists. It is sometimes distinctly green hornblende and sometimes largely of chlorite. Two sections.

*Age.* Archean (Keewatin).

*Remark.* This specimen shows the alliance of the jaspilyte in its manner of origin, with the enclosing green schists.

N. H. W.

NO. 1572. JASPILYTE (*with siderite*).

East end of the Stuntz mine; east end of the North ridge, Tower.

*Ref.* Annual Report, xviii, page 62.

*Meg.* Siliceous, white and red jaspilyte, with white granular veinings, one vein being a quarter of an inch wide, effervescing feebly in cold HCl.

*Mic.* The veinings are of *siderite* and cross the rock in all directions. The same substance also permeates the red jaspilyte and is seen to surround the hematite grains. One section.

*Age.* Archean (Keewatin).

*Remark.* There could be no better demonstration of the later date of the siderite.

N. H. W.

[NOTE.—Nos. 1573 to 1606, inclusive, were collected in Ontario, outside of Minnesota territory, and only those are here described of which we have sections. Brief field notes concerning the others can be found in the Eighteenth Annual Report, pages 50-59, 62, 63.]

## No. 1573. GNEISS.

North bay, on lake Nipissing, Ontario.

Ref. Annual Report, xviii, pages 50, 51, 62.

*Meg.* Gray gneiss, fresh, quite siliceous, banded.

*Mic.* The section shows *quartz* and glassy *feldspars* much resembling quartz, with a little *biotite*, *apatite* and *sphene*. The centres of the feldspars are sometimes, but not usually, occupied by a mass of alteration products in a manner precisely like those noted in the "old feldspars" of the region of Kekequabic lake. One section.

*Age.* "Laurentian."

*Remark.* This rock is a recrystallized sedimentary one, shown by its universal coarsely banded structure, and the constant and parallel direction and width of the bands. The existence of the central decayed cores in the feldspars can be referred to the survival of remnants of older feldspars existing in the original clastics.

N. H. W.

## No. 1579. AMPHIBOLYTE.

Stobie mine, Ontario. From the dump of the deep shaft which was abandoned.

Ref. Annual Report, xviii, pages 52, 62.

*Meg.* Coarsely crystalline with hornblende.

*Mic.* Two-thirds of the slide is composed of a large *hornblende* crystal. In the rest of the slide is a mingling of small hornblendes, *feldspar*, *sphene*, *magnetite*, *biotite*. *Sphene* frequently surrounds the magnetite grains. One section.

*Age.* (?)

N. H. W.

## No. 1590. GRAYWACKE.

Railroad crossing of Vermilion river, Ontario.

Ref. Annual Report, xviii, pages 54, 63.

*Meg.* There are four specimens of this number. Three of them show a dark, laminated, little slaty, fine-grained, graywacke-like rock. The other is much coarser grained, non-laminated and rough weathering; it has distinct grains of quartz.

*Mic.* The section was made from the last mentioned specimen. *Quartz* and *feldspar* grains make up the mass of the rock. These are sub-angular, angular and sub-rounded. The quartz is more abundant than the feldspar, which appears to be sometimes *orthoclase*, sometimes *plagioclase*, and rarely *microcline*. The feldspar is frequently considerably altered and filled with dust-like black inclusions. This black material, which is perhaps carbonaceous, is common throughout the slide, especially between the grains of quartz and feldspar. There are some small flakes of *chlorite* and also of a colorless to yellowish, brightly polarizing, micaceous mineral, though not certainly muscovite. One section.

*Age.* "Huronian," probably Lower Cambrian.

U. S. G.



Tuff. Conglomerate. Quartzite.]

NO. 1592. TUFF. (*Volcanic.*)

Northwest from the railroad crossing of Vermilion river, Ontario. From a ridge that rises from seventy-five to a hundred feet above the railroad.

*Ref.* Annual Report, xviii, pages 54, 63.

*Meg.* Appears like a "curious conglomerate."

*Mic.* In general the slide is nearly dark between crossed nicols, but angular areas, more light than the rest, are more or less sprinkled with small polarizing crystals of various kinds. These angular areas are mainly filled with chloritic substance, which frequently is arranged perpendicularly to the peripheries in fibres, and is also sometimes actinolitic, with high polarization colors. It is also variously irregular, streamed, and in rosettes. Some of the finer angular areas are of quartz, and some are striated feldspar crystals. The matrix which contains these angular areas is at present nearly dark, even in common light, apparently because of spicules and grains of magnetite. One section.

*Age.* "Huronian," probably Lower Cambrian.

*Remark.* Volcanic products from this region have already been signalized by G. H. Williams (Bulletin of the Geological Society of America, vol. II, pages 138-140). This locality is easily accessible, and the deposit forms a conspicuous hill, or ridge, at the railroad. On the authority of Dr. Robert Bell, who stated that the black slates graduate conformably into this rock, the slates at the Vermilion river (No. 1590) are here made the same age as this volcanic tuff.

N. H. W.

## NO. 1595. CONGLOMERATE.

At one and a half miles east of Algoma, Ontario. In the typical Huronian region, by the railroad. Logan's "third slate conglomerate," underlying a gray to black roofing slate.

*Ref.* Annual Report, xviii, pages 55, 63.

*Meg.* Conspicuously conglomeratic, but not distinctly bedded.

*Mic.* The fine gray matrix consists of clastic materials in which are some fine quartz and some *pyroxene*, but which is mostly composed of indeterminable and inseparable debris of basic elements (chloritic, leucoxenic and basaltic). In this matrix are angular grains of quartz, of triclinic *feldspar*, of *microcline*, *sphene* and apparently of a devitrified *glass* or *aporhyolyte*. These elements were evidently not long exposed to friction of oceanic agitation, if at all, and indeed the whole rock may be of the nature of volcanic tuff, having an origin very similar to that of many pebbly greenstones of the Archean. One section.

*Age.* "Huronian."

N. H. W.

NO. 1598. QUARTZYTE. (*Feldspathic.*)

Four miles east of Algoma, Ontario, by the railroad.

*Ref.* Annual Report, xviii, pages 55, 63.

*Meg.* Fine, reddish.

*Mic.* Amongst the fine compacted and feebly-interlocking *quartz* is also interlocking striated *feldspar*, the latter being perhaps one-tenth of the whole. There are also a few grains of *siderite*(?) with rusty surroundings. Shreds of *hornblende* are scattered throughout the slide, also some *sphene* and *leucoxene*. One section.

*Age.* "Huronian."

N. H. W.

NO. 1605. DIABASE. (*Coarsely porphyritic.*)

As boulders at Algoma. (Compare No. 601.)  
*Ref.* Annual Report, xviii, pages 58, 63.

*Meg.* Diabasic, with coarse feldspars.

*Mic.* The large feldspars are permeated by bands and isolated scales of *sericite* and by clusters of *zoisite* grains. In a section somewhat oblique on  $n_z$  extinction on a cleavage is  $46^\circ$ , indicating *bytownite*. The *pyroxene* is frequently twinned on 100, and has a strong cleavage parallel to 100, showing the species to be *diallage*, and less conspicuous cleavages, seen in basal sections parallel to 110 and  $\bar{1}\bar{1}0$ . The section also has conspicuous large angular masses of dark *leucoxene*. With a little *biotite* and also a little *hornblende*, the rock is quite a complex and interesting one. One section.

*Age.* (?)

*Remark.* This is apparently the rock which exists in form of dike near Silver Islet (No. 601), the coarse feldspar of which has been named *huronite*. N. H. W.

NO. 1607. CALCITE. (*Spherulitic.*)

Dietz and Dugan's slate quarries, three miles north of Carlton. (Compare No. 1616.)  
*Ref.* Annual Report, xx, pages 27, 33.

*Meg.* Soft, rusty calcareous masses in the slates. These are sometimes a foot or two in longer dimension.

*Mic.* The *calcite* is arranged spherulitically, and in spreading, radial fans, the central part being more highly doubly refracting than the fans. The coarse characteristic cleavages form approximate concentric rings round the central part, crossing the fans in curving lines. In some of the interstitial angular areas is a very fine, dusty substance, composed apparently of debris of the same kind as in the slates. One section.

*Age.* Animikie.

N. H. W.

NO. 1609. CALCITE. (*Massive.*)

A mile and a half south of Cloquet, at the old trial quarry in the slates opened by the St. Paul and Duluth railroad.  
*Ref.* Annual Report, xx, page 33.

*Meg.* An unweathered portion of the calcareous concretions abounding in the slates.

Calcite and graywacke.\* [Iron ore.]  
Greenstone.

*Mic.* The *calcite* here is more granular, massive, and mingled evenly with a certain amount of fine debris, apparently of *feldspar* and *quartz*. One section.

*Age.* Animikie.

N. H. W.

NO. 1611. CALCITE. (*Gritty.*)

Calcareous nodule from the slates at Carlton, east of the depot, north of the railroad, ten to twenty feet above the railroad grade.

*Ref.* Annual Report, xx, page 33.

*Meg.* Even grained, dark, apparently gritty.

*Mic.* The slide shows large interlocking *calcites*, in which are scattered angular *quartz* grains and *feldspar* fragments. Two sections.

*Age.* Animikie.

*Remark.* The presence of this rock debris in these nodules rather precludes the assignment of them to any organic agency.

N. H. W.

NO. 1616. CALCITE AND GRAYWACKE.

Two miles north of Thomson, near the St. Louis river.

*Ref.* Annual Report, xx, pages 29, 32.

*Meg.* One of the calcareous, rusty-weathering nodules, from the slate formation at this place. Compare Nos. 1607, 1609 and 1611. This specimen seems to be composed of graywacke cemented by calcite. No section.

*Age.* Animikie.

U. S. G.

NO. 1618. IRON ORE. (*Magnetic.*)

"Ore from the narrow magnetic belt on Camp's land, S. W.  $\frac{1}{4}$  sec. 33 [T. 63-12 W.], about a mile southwest of Ely."

*Ref.* Annual Report, xx, page 34; Bulletin vi, page 202.\*

*Meg.* Soft, black, slaty, magnetic and graphitic iron ore with lenses of jaspilyte. No section.

*Age.* Archean (Keewatin).

U. S. G.

NO. 1619. IRON ORE.

Same place as No. 1618.

*Ref.* Annual Report, xx, page 34; Bulletin vi, page 202.

*Meg.* Rather pure, but somewhat porous, iron ore consisting largely of hematite. The mass is magnetic, but when powdered only a few grains are attracted by a hand magnet. No section.

*Age.* Archean (Keewatin).

U. S. G.

NO. 1621. GREENSTONE.

S. W.  $\frac{1}{4}$  sec. 33, about a mile southwest from Ely. In the midst of an indefinite greenstone is a harder and apparently a more siliceous area which still is visibly a portion of the same rock; from this harder mass this sample is taken.

*Ref.* Annual Report, xx, page 34.

\*By a typographical error this rock is referred to in Bulletin vi as No. 1613 instead of No. 1618.

*Meg.* Fine grained, light green.

*Mic.* There is a very fine, almost structureless mingling of all the products of change of basic rock materials, viz., *calcite*, *leucoxene*, *chlorite*, glassy *feldspar*, *sericite*. There are, besides, areas over which the general extinction is simultaneous, though enclosing numerous of the above minerals, due apparently to the remnant of old feldspar crystals whose characters are otherwise undiscoverable.

There is a general elongation of all the substances in one direction, making a close schistosity. One section.

*Age.* Archean (Keewatin).

N. H. W.

NO. 1624. AGGLOMERATE. (*Basic.*)

From the greenstone agglomerate cut by the railroad at Ely. Same rock as No. 1511.

*Ref.* Annual Report, xx, page 34; American Geologist, vol. ix, page 359.

*Meg.* Fine grained, with amygdaloidal tubes of calcite. Part of the scale that surrounds the bombs.

*Mic.* The section shows only the rock, which is in all respects the same as No. 1511, and especially in showing in part a somewhat radiated or sheaf-like arrangement of the little feldspars. One section.

*Age.* Archean (Keewatin).

N. H. W.

NO. 1625. AGGLOMERATE. (*Basic.*)

Same place as No. 1624.

*Ref.* Annual Report, xx, page 34.

*Meg.* Some of the dark green schistose rock that fills the interspaces between the bombs.

*Mic.* *Chlorite*, *calcite*, *leucoxene*, and scattered small grains of a highly polarizing mineral which is certainly secondary, resembling *epidote*; these compose the rock, but the latter two are in the form of isolated small grains in the large masses of the former two. There is also a little *pyrite*. One section.

*Age.* Archean (Keewatin).

*Remark.* The internal structure of No. 1624 is plainly igneous; that of No. 1625 has no suggestion of igneous origin.

N. H. W.

NO. 1626. AGGLOMERATE. (*Basic.*)

Same place as No. 1624.

*Ref.* Annual Report, xx, page 34; Annual Report, xxiii, pages 204, 213.

*Meg.* A part of the bomb from toward the centre. Compare No. 1511.

*Mic.* The feldspars are fine, and are arranged in radiated or sheaf-like clusters. They are long and slender. Much leucoxene clouds the rock. There are a few isotropic areas of *chlorite* and many scattered grains of *calcite*. One section.

*Age.* Archean (Keewatin).

Actinolite, magnetite schist.]  
Slate. Quartzyte.

*Remark.* It appears from all the microscopic examinations made on these bombs that their interiors and the surrounding amygdaloidal scales are of igneous structure, the feldspars being arranged as if consolidated at the second stage of cooling, while the rock filling interstices between the bombs is destitute of igneous structure, but similar to some of the greenstone itself where no agglomeratic structure is seen, and may have been originally a volcanic ash or a basic detrital debris. N. H. W.

NO. 1628. ACTINOLITE, MAGNETITE SCHIST.

No. 2 of the drill at Wicks', sec. 27, T. 60-13, one mile south of the granite.

*Ref.* Annual Report, xxi, pages 82, 153; Annual Report, xxii, page 161; vol. iv, page 391.

*Meg.* Black and gray, fine, banded rock, with magnetite.

*Mic.* There is much *actinolite* in fine needles which pierce the section in all directions. Besides *magnetite* there is apparently only a feldspar which proves to be *oligoclase-albite*, by extinction of  $84^\circ$  on  $n_p$ , taken on a twinning line, the acute optic angle being apparently that which contains  $n_g$ . The actinolite fibres are frequently placed at an angle of about  $90^\circ$  with each other over considerable areas, suggesting that they are arranged in an obliterated feldspar crystal in the directions of the principal cleavages, since in all cases the actinolite penetrates the feldspars with great freedom. Two sections.

*Age.* Animikie.

N. H. W.

NO. 1629. SLATE. (*Ferruginous.*)

No. 3 of the drill at Wicks', sec. 27, T. 60-13.

*Ref.* Annual Report, xxi, pages 82, 153; Annual Report, xxii, page 161; vol. iv, page 391.

*Meg.* Collected under the name "black slate."

*Mic.* The rock consists chiefly of *magnetite*, but this is evidently mingled with *feldspar* and *actinolite* as in No. 1628. The section is too thick to separate them optically. One section.

*Age.* Animikie.

N. H. W.

NO. 1630. QUARTZYTE. (*Gray, jaspilitic, magnetic.*)

No. 4 of the drill at Wicks'.

*Ref.* Annual Report, xxi, pages 82, 153; Annual Report, xxii, page 161; vol. iv, page 391.

*Meg.* Gray quartzyte, sometimes porous, sometimes non-homogeneous, with angular and rounded masses.

*Mic.* The *quartz* is all secondary and interlocking, varying much in coarseness. It is very fine within the rounded pebbles. It is clouded by gray and dirty powder which in high power seems to be resolvable into fine *magnetite*. One section has strictly the taconyte structure and is illustrated by figure 11, plate III. Two sections.

*Age.* Animikie.

N. H. W.

## NO. 1630A. TACONYTE.

*Ref.* Annual Report, xxi, pages 82, 84, 153; vol. iv, page 391.

*Meg.* Balls about one-third of an inch in diameter from No. 4, siliceous, and lighter colored than No. 4.

*Mic.* The rock is the same as that section of No. 1630, which shows the taconitic structure, except that it is less ferruginous. The taconitic globules are surrounded by a rim of iron ore. Compare No. 1530. One section.

*Age.* Animikie.

N. H. W.

## NO. 1631. IRON ORE.

No. 5 of the drill core at Wicks'.

*Ref.* Annual Report, xxi, pages 82, 84, 153; Annual Report, xxii, page 161.

*Meg.* Magnetite.

*Mic.* Reflected light shows that the ore embraces both *hematite* and *magnetite*. One (thick) section.

*Age.* Animikie.

N. H. W.

NO. 1632. QUARTZYTE. (*Pinkish.*)

No. 6 of the drill at Wicks'.

*Ref.* Annual Report, xxi, pages 82, 153; Annual Report, xxii, page 161; vol. iv, page 391.

*Meg.* Pinkish quartzite, fine grained.

*Mic.* The rock is a little stained by *hematite*. Mingled with the interlocking *quartzes* are a few grains of some triclinic *feldspar*, very fine needles of *actinolite* lying scattered in the quartzite mass, and occasionally a green hornblende shred of larger dimensions and rarely a small epidote. One section.

*Age.* Animikie (Pokegama).

*Remark.* This rock was originally essentially a clean quartz sand, and it has been changed by interstitial quartz, which has rendered the grains angular. At the same time there is no evidence of any of the "taconitic" quartz in the slide, although there are some grains that are nearly isotropic and contain hematite dust, which may have been originally of the same nature as the globular masses that characterize the taconyte.

N. H. W.

NO. 1633. QUARTZYTE. (*Clastic.*)

No. 7 of the drill at Wicks'.

*Ref.* Annual Report, xxi, pages 82, 153; Annual Report, xxii, page 161; vol. iv, page 392.

*Meg.* Quartzite, partly fragmental.

*Mic.* The three sections illustrate different conditions of this rock: 1. Fragmental grains of *quartz*, perfectly rounded and mostly of uniform size, but with secondary borders interlocked in a surrounding matrix of secondary fine, taconitic quartz. Within one of these larger rounded grains of quartz is a small *zircon*(?) crystal, its length about four times its width. 2. The rock consists wholly of

Quartzite. Conglomerate.]

secondary interlocking quartz, of varying fineness, but which, in common light, reveals a taconitic structure with *magnetite*, some *limonite*, the latter being yellowish red, often staining *actinolite*(?) so that it is opaque. 3. With a more or less broken taconitic structure and fine interlocking quartz, is a considerable amount of glauconite, so-called, and of rusty and green pleochroic *chlorite* as well as (apparently) *actinolite*, some powder of magnetite, and numerous rhombs and irregular grains of *siderite*, the last being stained sometimes to a light yellow by oxidation. The *siderite* lies in the glauconite, and also within the rusty chlorite. The glauconite is mingled intimately with the iron-stained elements, but usually maintains its distinctness and its color. The chlorite is apt to be stained by iron. When it appears in slender spicules it can be seen to be partly green and partly rusty, the green color being apparent when, on rotation over the polarizer, it is brought into coincidence with the principal section of the polarizer. When perpendicular to it the rusty color only is visible. The glauconite itself appears to be a mass of finer scales of chlorite. Three sections.

Age. Animikie.

N. H. W.

## NO. 1634. CONGLOMERATE.

No. 8 of the drill at Wicks'.

Ref. Annual Report, xxi, pages 83-85, 153; Annual Report, xxii, page 160.

Meg. "Greenstone" materials, embracing many pebbles and grains of quartz.

Mic. The quartz grains are the most conspicuous and important element. They are not altogether rounded, and are sometimes occupied by several interlocking orientations, with also many minute inclusions. They are embraced primarily in a fine groundmass of interlocking quartz. This groundmass of interlocking quartz varies in fineness and appears pebbly, *i. e.*, it is in pebble-like areas, as if it depended on old feldspars which it had permeated and replaced. Mixed irregularly throughout the whole is much green dichroic chlorite in fine grains and shreds. This is frequently compact, scaly, and then resembles the *glauconite*, which has been noted at this stratigraphic horizon many times. It is disposed in somewhat angular and sub-rounded areas, but not so as to show the taconitic structure. Its arrangement seems to be dependent on that of the coarser grains of quartz, etc., occupying the spaces between them. In one of the slides the pebbly appearance of the areas of interlocking quartz is quite marked, and resembles that seen in the Ogishke conglomerate, and in some of the fragmental rocks about Kekequabic lake, where the pebbly aspect was found to be due to replacement of old feldspars which formed constituent parts of the original conglomerate. Three sections.

Age. Animikie (Pokegama).

*Remark.* The green element in this rock is evidently derived from a debris from the Archean greenstones. It never shows the taconitic globular structure. That appears at a higher horizon and at this place contains only quartz and iron ore.

N. H. W.

## NO. 1635. CONGLOMERATE.

The lower portion of No. 8 of the drill at Wicks'.

*Ref.* Annual Report, xxi, pages 83, 153; Annual Report, xxii, page 160.

*Meg.* No. 8 consists of "greenstone" materials embracing many pebbles and grains of quartz.

*Mic.* The slide is made from the lower portion of No. 8 and consists of a granitic debris with considerable infiltration and alteration. This debris is old *feldspars* now containing much *muscovite*, some being apparently *oligoclase* and some *orthoclase*, *quartz*, *hornblende* (largely chloritized), *leucoxene* (alteration from *sphene*) and *chlorite*. One section.

*Age.* Animikie (Pokegama).

N. H. W.

## NO. 1636. GRANITE.

No. 10 of the drill at Wicks'.

*Ref.* Annual Report, xxi, pages 83, 153; Annual Report, xxii, page 160.

*Meg.* Granite.

*Mic.* The rock is not fresh, but consists of coarse *oligoclase*, *microcline*, *orthoclase* and *quartz*, of which quartz is the latest, with small amounts of *pennine*, *apatite*, *calcite* and *sphene*, and with much kaolinic alteration throughout the feldspars. One section.

*Age.* Archean (granite).

N. H. W.

NO. 1637. GRIT. (*Green.*)

N. E.  $\frac{1}{4}$  S. W.  $\frac{1}{4}$  sec. 22, T. 60-13, near Wicks', on the Mesabi range.

*Ref.* Annual Report, xxi, pages 83, 84, 153.

*Meg.* Like No. 1634, mainly fragmental material (green), in which are conspicuous grains of lavender quartz.

*Mic.* The green color of the rock is due to debris of green *hornblende* largely chloritized, but in which are distributed coarse *quartzes*, with irregular borders and large irregular crystals of *microcline*. One section.

*Age.* Animikie (Pokegama).

N. H. W.

## NO. 1638. QUARTZYTE.

S. E.  $\frac{1}{4}$  N. W.  $\frac{1}{4}$  sec. 28, T. 60-13, near Wicks', on the Mesabi range.

*Ref.* Annual Report, xxi, pages 84, 153.

*Meg.* Nearly all quartz, in form of clastic grains.



Sandstone. Quartzite.]  
Magnetite. Gneiss.

*Mic.* This rock consists of grains of quartz, rounded, somewhat increased in size by secondary growth, its margins interlocking in a fine groundmass of interlocking quartz. It is like one of the sections described of No. 1633. One section.

*Age.* Animikie (Pokegama).

N. H. W.

No. 1639. SANDSTONE. (*Green.*)

Same locality as No. 1638.

*Ref.* Annual Report, xxi, page 153.

*Meg.* Green, with included sand grains.

*Mic.* Angular and sub-rounded grains of quartz are thickly set in a matrix of amorphous green debris similar to much of that already noted at Wicks', but which in this section is chloritic, rarely revealing any hornblende remnants. One section.

*Age.* Animikie (Pokegama).

N. H. W.

No. 1640. QUARTZYTE. (*Pinkish.*)

N. W.  $\frac{1}{4}$  N. E.  $\frac{1}{4}$  sec. 32, T. 60-13, near Wicks'.

*Ref.* Annual Report, xxi, pages 85, 153.

*Meg.* Similar in aspect to No. 1632.

*Mic.* This rock is coarser than No. 1632. It appears like a fragmental quartzite with borders (narrow) of secondary growth. Cotemporary, probably, with the secondary quartz has been an occasional development of a small grain of triclinic feldspar, in all respects like that in the quartzite of Pokegama falls (No. 1525A), and of microcline. These feldspars, however, may have been original clastic grains in the rock. One section.

*Age.* Animikie (Pokegama).

N. H. W.

No. 1641. MAGNETITE.

"Magnetite from N. W.  $\frac{1}{4}$  N. E.  $\frac{1}{4}$  sec. 32, T. 60-13; natural loadstone, only found in small quantity; blends off into the rock of the iron belt (No. 1631 of the drill record)."

*Ref.* Annual Report, xxi, page 153.

*Meg.* Rather coarsely crystalline magnetite. No section.

*Age.* Animikie.

U. S. G.

No. 1642. GNEISS. (*Very fine grained.*)

At the so-called "silver pit," opened by Chester (compare No. 442), sec. 11, T. 59-14.

*Ref.* Annual Report, xxi, page 153; Bulletin vi, page 203, and foot-note.

*Meg.* Average character of the rock of the dump at the old "Silver pit." Finely siliceous.

*Mic.* The rock consists largely of quartz, but also contains some feldspar. These are very fine grained and interlocking, and hence wholly of secondary origin, the original rock having been a jaspilite. There are also clusters of fine globular grains of pyroxene, probably diopside, and some hornblende, muscovite, sphene, and apatite. One section.

*Age.* Archean (Keewatin).

*Remark.* The name gneiss is applicable only in the sense that it is a recrystallized fragmental, and contains all the elements usual in that rock, but it would be correctly denominated a feldspathic quartzite, the darker elements being merely accessory. The rock is on the south side of the Giant's range of granite, and is not far distant from a deposit of jaspilitic hematite. It was no doubt once covered by the Animikie, as well as by the gabbro, and it may owe its recrystallization either to the gabbro or to granite.

N. H. W.

[NOTE. Nos. 1643 to 1669, inclusive, were collected outside of Minnesota. We have sections of only two (Nos. 1644 and 1649) of these specimens described below. Notes concerning Nos. 1643 to 1669 can be found in the Twenty-first Annual Report, pages 153 and 154; also, on pages 86 to 112.]

NO. 1644. GREENSTONE.

From the north side of the Republic hill, Republic, Michigan.

*Ref.* Annual Report, xxi, page 153.

*Meg.* Approaching hornblende schist.

*Mic.* Feldspar, hornblende, quartz, leucoxene, evidently sheared basic eruptive, originally of coarse grain. One (thick) section.

*Age.* (?)

N. H. W.

NO. 1649. GNEISS.

At the dam in the Racket river, at Potsdam, New York.

*Ref.* Annual Report, xxi, page 154.

*Meg.* Very quartzose, medium grained, sometimes reddish and sometimes gray.

*Mic.* Fresh, glassy microcline, quartz—these are plainly of the latest generation. There are older (at least centrally altered) grains of a triclinic feldspar, having extinctions near oligoclase, a little hornblende, magnetite, sphene, biotite, leucoxene. Calcite appears as a product of decomposition, lodged in the cores of the altered feldspars. The small, isolated sphenes are in the fresh quartz and microcline. Two sections.

*Age.* (?)

N. H. W.

• NO. 1670. DIORYTE(?) (with quartz).

Segregation from the slates at Little Falls, Morrison county.

*Ref.* Annual Report, xxi, page 154; Streng and Kloos, Annual Report, xi, pages 74-76.

*Meg.* One of the smaller segregations.

*Mic.* Hornblende and garnet, both presenting idiomorphic contours, thus appearing to be of earlier date, lie in a groundmass of fine interlocking quartz, the grains of which they enclose poikilitically, and hence are of later date than the quartz. The groundmass also embraces a few grains of sphene and irregular dust-like spangles of dark leucoxene(?) approaching magnetite in opacity. One section.

*Age.* Archean (Keewatin).

N. H. W.

Dioryte. Slate. Greenstone. Gabbro.]

NO. 1671. DIORYTE (?) (*with quartz*).

Same place as No. 1670.

*Ref.* Annual Report, xxi, page 154. Compare Annual Report, xxiv, pages 3-10.*Meg.* Fragment of the hornblendic layer which encloses the segregation shown in No. 1670.*Mic.* Like No. 1670 except that the *garnets* are nearly absent, being very small and scarce. One section.*Age.* Archean (Keewatin).*Remark.* Rocks Nos. 1670 and 1671, having been called "quartz dioryte" by Streng and Kloos, we prefer not to change from their designation, although there are some peculiarities of structure which might warrant another name. This rock is not an eruptive, but forms isolated knots in the garnetiferous schists of the place, these knots varying in size from a few inches to a foot or two. They are indigenous in the slates in the same manner as granitic knots are sometimes seen in schists. N. H. W.NO. 1672. DIORYTE (*with quartz*).

Same place as No. 1670.

*Ref.* Annual Report, xxi, page 154.*Meg.* Similar to No. 1670. A dense, fine-grained black rock with porphyritic hornblendes and garnets. No section.*Age.* Archean (Keewatin).

U. S. G.

NO. 1673. SLATE. (*Garnetiferous.*)

Little Falls, on the Mississippi river, in Morrison county.

*Ref.* Annual Report, xxi, page 154.*Meg.* A rather fine-grained, black, slaty rock, containing porphyritic garnets and also apparently some hornblendes. No section.*Age.* Archean (Keewatin).

U. S. G.

## NO. 1677. "GREENSTONE."

Randall, Morrison county.

*Ref.* Annual Report, xxi, page 154.*Meg.* A roughly schistose, siliceous and also calcareous, rusty-weathering, indefinite greenstone. No section.*Age.* Archean (Keewatin).

U. S. G.

NO. 1678. GABBRO (*with biotite*).

Quarried at Little Falls, Morrison county, on the west side of the river.

*Ref.* Annual Report, xxi, page 154.*Meg.* Having much the aspect of the gabbro at Duluth.*Mic.* The rock is slightly ophitic, but some of the augite was earlier than the feldspar, and takes the form of *diallage*. It encloses the *olivines*, which are wholly

altered and have given place to *magnetite* and to *bowlingite*, the latter of a yellowish green color, and entirely separated from the irony ingredient, which seems to have been concentrated almost entirely into the fine crystals of magnetite which lie alongside. The diallage has sometimes a faint pink or rose tint, and shows the twinning 100. *Biotite* encloses all the other minerals, and is strongly dichroic. The feldspar, having an extinction on  $n_x$  of  $23^\circ$ , is *labradorite*. One section.

*Age.* Cabotian (?)

*Remark.* This rock is petrographically, in all essentials, like the Duluth gabbro, and it may be reasonably inferred that it is of the same age. It is also in the general line of extension of the strike of the mass of that rock.

N. H. W.

NO. 1681. MARBLE.

West bank of the Mississippi, just below the mouth of Swan river, Morrison county.

*Ref.* Annual Report, xxi, page 154.

*Meg.* Fine grained, slightly pinkish. Compare Nos. 746, 760, 1371.

*Mic.* The rock shows a fine, even grain, without impurities, and without cavities. One section.

*Age.* Archean (Keewatin).

N. H. W.

NO. 1682. GNEISS. (*Biotite quartz schist.*)

Near the centre of the S. E.  $\frac{1}{4}$  N. W.  $\frac{1}{4}$  sec. 30, T. 128-19, Morrison county.

*Ref.* Annual Report, xxi, page 154.

*Meg.* Fine grained, hardly gneissic, not banded.

*Mic.* The most of the rock is *quartz*, interlocked, but *biotite* is conspicuous in small scales. *Garnet* and a little *sphene* are scattered sparsely in the quartz ground-mass. Mixed with the interlocking quartz are numerous glassy feldspars. One section.

*Age.* Archean.

*Remark.* In its garnetiferous character this rock is allied to the schists at Swan river and at Little Falls. It also contains similar segregations of "quartz dioryte."

N. H. W.

NO. 1683. QUARTZ DIORYTE (?)

"Hardened segregations from No. 1682, similar to those seen at Little Falls." See Nos. 1670 and 1672.

*Ref.* Annual Report, xxi, page 154.

*Meg.* Fine-grained, nearly white, siliceous rock, holding crystals of hornblende. No section.

*Age.* Archean.

U. S. G.

NO. 1684. GABBRO. (*Hornblendic.*)

Philbrook, near the mouth of Fish Trap creek, northwestern corner of Morrison county.

*Ref.* Annual Report, xxi, page 155.

Gabbro.]

*Meg.* Rather coarse grained, gray.

*Mic.* Except that the augite has been converted to *hornblende*, this is like the Duluth gabbro, the large crystals of *labradorite* also being somewhat altered by the introduction of *zoisite* and *sericite*. There seems never to have been any olivine in the rock, but there are several crystals of *apatite* of the first consolidation. The hornblende lies about the feldspars in an ophitic manner. One section.

*Age.* Probably Archean.

*Remark.* This rock has the characters of the Cabotian gabbro when affected by contact with clastic acid rock.

N. H. W.

NO. 1685. GABBRO. (*Hornblendic.*)

"A darker, more magnetited condition of No. 1684."

*Ref.* Annual Report, xxi, page 155.

*Meg.* A very dark, greenish-gray, almost black, coarse-grained rock, composed of feldspar, much hornblende, and perhaps some augite. Apparently a uralitized gabbro. No section.

*Age.* Probably Archean.

U. S. G.

## NO. 1685A. GABBRO.

The same place as No. 1684.

*Ref.* Annual Report, xxi, page 155.

*Meg.* Similar to No. 1684.

*Mic.* The *augite* is not entirely changed to *hornblende* in this slide, and there is a remarkably frequent supply of idiomorphic *apatites*. These lie in the hornblende, in the *magnetite* and in the unchanged augite. One section.

*Age.* Probably Archean.

*Remark.* This rock is allied petrographically to No. 1678, the gabbro quarried at Little Falls.

N. H. W.

NO. 1686. GABBRO. (*Saussuritized.*)

Same place as No. 1684. Somewhat quarried.

*Ref.* Annual Report, xxi, page 155.

*Meg.* Nearly white.

*Mic.* The rock consists, in places, entirely of *zoisite*, but in general the *feldspars* also contain numerous scales of *sericite*. Through the whole sometimes the remnants of feldspar crystals can be seen to be present by the continuance of the interrupted straight belts of albite twinning. This indicates that this alteration is not due to shearing, since if sheared the twinning lines would be likely to be distorted. One section.

*Age.* Probably Archean.

N. H. W.

NO. 1687. GABBRO. (*Sheared.*)

Same place as No. 1684, Philbrook, Morrison county.

*Ref.* Annual Report, xxi, page 155.

*Meg.* Schistose.

*Mic.* The original crystalline structure is entirely broken up and fragmentary. The augite has given place to *hornblende*, polychroic (blue, green, yellow) and fibrous; olivine is wanting, and *magnetite* is abundant. The feldspars, while broken and dislodged, are not saussuritized markedly, although some small grains of *zoisite* and of *sericite* are developed. The most frequent element which permeates the broken feldspars is hornblende in form of more minute fibres. *Calcite* is generally distributed. One section.

*Age.* Probably Archean.

*Remark.* The marked contrast between this rock, which is known to have been sheared, and No. 1686, which consists largely of zoisite, without other signs of shearing, taken from the same rock mass, rather indicates that the shearing process is not that which first tends to the destruction of the feldspathic element in this gabbro. The areas occupied by these variations from the normal condition of this gabbro are quite small.

N. H. W.

## NO. 1688. TACONYTE.

"Three samples of taconyte showing various conditions of change toward hematite, Hale mine, near Merritt, on the Mesabi range."

*Ref.* Annual Report, xxi, page 155.

*Meg.* One of the samples shows a very hard, fine-grained, grayish taconyte, iron-stained and altered to limonite and hematite along fissures. Another sample is a yellowish chert with considerable limonite, and another is a similar cherty rock with crystallized limonite. No section.

*Age.* Animikie (iron-bearing member).

U. S. G.

## NO. 1689. BRECCIA (?)

From the Cincinnati property (sec. 2, T. 58-16 W.), Mesabi Iron range.

*Ref.* Annual Report, xxi, pages 118, 155.

*Meg.* A heavy, iron-bearing, black taconitic rock, containing fragments of dark chert and magnetite. The fragments are in part rounded and in part angular and often not sharply separated from the matrix. The rock may be a conglomerate or a breccia, but from its position, apparently near the base of the black slate member of the Animikie, it seems more likely to be a breccia. No section.

*Age.* Animikie (near the base of the black slate member).

U. S. G.

*Remark.* This remarkable rock has not as yet been examined microscopically. It may be of the nature, in part, of a volcanic tuff.

N. H. W.

Sandstone. Taconyte. Wad. Iron ore.]

NO. 1690. SANDSTONE.

Bottom of shaft No. 2, at the Cincinnati mine, sec. 2, T. 58-16 W.  
*Ref.* Annual Report, xxi, pages 119, 155.

*Meg.* A disintegrated sandstone, composed of rounded, iron-stained quartz grains. No section.

*Age.* Animikie (Pokegama quartzyte). U. S. G.

NO. 1691. SANDSTONE. (*Ferruginous.*)

"Form showing the penetration of iron into this quartzite, hardened and reddened, Cincinnati mine."  
 Sec. 2, T. 58-16 W.  
*Ref.* Annual Report, xxi, page 155.

*Meg.* Same as No. 1690, but cemented by iron ore, both limonite and hematite. No section.

*Age.* Animikie (Pokegama quartzite). U. S. G.

NO. 1692. TACONYTE.

"Taconyte from a shaft on the Cincinnati mine." Sec. 2, T. 58-16 W.  
*Ref.* Annual Report, xxi, page 155.

*Meg.* Yellowish, grayish and brownish, fine-grained, cherty taconyte, with some limonite. No section.

*Age.* Animikie (iron-bearing member). U. S. G.

NO. 1693. TACONYTE.

"Ditto, from the Duluth Ore company (Berringer)."  
*Ref.* Annual Report, xxi, page 155.

*Meg.* Rather soft, gray, granular taconyte cemented in bands by silica and iron ore, much of which is magnetite. No section.

*Age.* Animikie (iron-bearing member). U. S. G.

NO. 1694. WAD.

Shaft No. 23, Biwabik mine, ninety-four feet down.  
*Ref.* Annual Report, xxi, page 155.

*Meg.* Soft, black, crumbling bog manganese. Gives off water in closed tube. No section.

*Age.* Animikie (iron-bearing member). U. S. G.

NO. 1695. IRON ORE.

Shaft No. 25, Biwabik mine.  
*Ref.* Annual Report, xxi, page 155.

*Meg.* Hard, massive hematite, also softer hematite, somewhat brecciated, and limonite. No section.

*Age.* Animikie (iron-bearing member). U. S. G.

## NO. 1696. QUARTZYTE.

Pit in S. E.  $\frac{1}{4}$  N. E.  $\frac{1}{4}$  sec. 4, T. 58-16 W., Chicago property.

Ref. Annual Report, xxi, pages 124, 155.

*Meg.* A very fine-grained, compact, pinkish quartzite. Similar to No. 1632.  
No section.

*Age.* Animikie (Pokegama quartzite).

U. S. G.

NO. 1697. QUARTZYTE. (*Ferruginous.*)

McKinley, Mesabi range. From the well sunk for water at the mining camp.

Ref. Annual Report, xxi, page 155.

*Meg.* Collected as "black slate."

*Mic.* The rock is essentially composed of fine interlocking quartz, but with so much iron that it has a dark color. The iron is in at least three forms: (1) *Magnetite*, which is black, and in very fine grains, grouped loosely in certain areas; (2) *Goethite*, which is rusty yellow and arranged frequently in radiating spangles; and (3) a reddish-brown, feebly translucent form which is in coarser isolated grains coated with a thin opaque crust of what appears to be magnetite. This reddish-brown ore is like chromite. On uncovering the slide and after washing off the Canada balsam in benzine, this dark-brown portion was dissolved in boiling hydrochloric acid, and is therefore *hematite*. One section.

*Age.* Animikie.

N. H. W.

## NO. 1698. HEMATITE.

"A clayey ball changed to hematitic rock, from the southern pits at McKinley's; probably from the black slate horizon."

Ref. Annual Report, xxi, page 155.

*Meg.* A mass, somewhat slaty, of soft red hematite. No section.

*Age.* Animikie.

U. S. G.

## NO. 1699. HEMATITE.

Lone Jack mine, Virginia.

Ref. Annual Report, xxi, page 155; vol. iv, pages 371, 372.

*Meg.* Iron gravel, reddish, angular and sub-rounded.

*Mic.* The sections consist of slices of two of the balls composing the gravel. They are chiefly opaque, but slightly translucent with dark brownish red color in a few scattered small areas. Two sections.

*Age.* Cretaceous (?)

N. H. W.

## NO. 1700. SILICA-KAOLIN.

"Mixed kaolin and spongy ochre and hematite, Mesabi Mountain mine, near Virginia."

Ref. Annual Report, xxi, page 155.

*Meg.* Soft, greasy, white, reddish and brownish material, the result of alteration of the taconyte. See under No. 1701. No section.

*Age.* Animikie (iron-bearing member).

U. S. G.



Silica-kaolin.]

NO. 1701. SILICA-KAOLIN.

Same place as No. 1700.

Ref. Annual Report, xxi, page 155.

*Meg.* Similar to No. 1700, but harder and finely banded, white and brownish. This specimen is closely similar to No. 70(S), the description of which is as follows:\*

“Specimen No. 70 is a consolidated fine white powder, with a greasy feel. It can be easily cut with a knife into any desired shape. It is mainly white, with frequent bands of brown or light red. That these bands are later in origin than the reduction of the rock to its present condition, and result from the precipitation of iron oxide from infiltrating waters, along the weakest zones, is quite certainly shown by a study of this and other specimens from the same place. For while the bands are in general beautifully distinct and parallel, yet they take advantage of any weaker line which offers, whatever the direction, and offshoots from the main band may be found, striking off at an angle, and generally terminating blindly. This material was at first supposed to be a kaolin, and later, from its evident origin and by analogy with other powders of like nature, but developed on a smaller scale, it was suspected to be a silica powder. An analysis was made of the white portion of the rock with the following result:

*Analysis of No. 70 (Chemical Series No. 238) by C. F. Sidener.*

Silica	SiO <sub>2</sub>	77.89 per cent
Alumina	Al <sub>2</sub> O <sub>3</sub>	13.55 “
Sesquioxide of iron	Fe <sub>2</sub> O <sub>3</sub>	1.83 “
Lime	CaO	trace
Magnesia	MgO	.36 per cent
Potash	K <sub>2</sub> O	.84 “
Soda	Na <sub>2</sub> O	.58 “
Water	H <sub>2</sub> O	4.45 “
Total		99.50

“This analysis shows the rock to be mainly a pure silica powder, with a large amount of the hydrous silicate of alumina, or kaolin; a very small residual portion of the decomposed and leached iron oxides, here evidently in the form of the hydrous sesquioxide; and small amounts of the calcium, magnesium, potassium, and sodium which entered into the composition of the rock from which this was derived.” No section.

*Age.* Animikie (iron-bearing member) or Cretaceous kaolin. U. S. G.

NO. 1702. SILICA-KAOLIN.

Same place as No. 1700.

Ref. Annual Report, xxi, page 155.

*Meg.* A banded rock similar to Nos. 1700 and 1701, except that it is hard and flinty. No section.

*Age.* Animikie (iron-bearing member), or Cretaceous kaolin. U. S. G.

\*J. E. SPURR. *Bulletin* x, pp. 81, 82.

## NO. 1703. TACONYTE.

Security mine, near Virginia.  
*Ref.* Annual Report, xxi, page 155.

*Meg.* Gray, granular taconyte containing blotches of limonite, which is in part weathered out, leaving roughly-rounded cavities. No section.

*Age.* Animikie (iron-bearing member). U. S. G.

## NO. 1704. SILICA-KAOLIN.

Mesabi mountain.  
*Ref.* Annual Report, xxi, page 155.

*Meg.* Soft, white, greasy rock, similar to Nos. 1700, 1701 and 1702, but not banded. See under No. 1701. No section.

*Age.* Animikie (iron-bearing member), or Cretaceous kaolin.

## NO. 1704A. FLINT.

From No. 1704.  
*Ref.* Annual Report, xxi, page 155.

*Meg.* Rounded flint pieces from No. 1704, apparently jaspilitic quartz. No section.

*Age.* Animikie (iron-bearing member), or Cretaceous kaolin. U. S. G.

## NO. 1705. TACONYTE.

Virginia mine.  
*Ref.* Annual Report, xxi, page 155.

*Meg.* Hard, gray, granular taconyte with streaks and blotches of limonite and red taconyte. The specimen is porous, due to the weathering out of part of the limonite. No section.

*Age.* Animikie (iron-bearing member). U. S. G.

## NO. 1706. HEMATITE.

Probably from the Virginia mine.  
*Ref.* Annual Report, xxi, page 155. (Compare No. 1939.)

*Meg.* Soft, granular hematite. Scattered through the specimen are minute specks of white, kaolin-like material. One side of the specimen shows a conglomeratic or brecciated structure. No section.

*Age.* Animikie (iron-bearing member). U. S. G.

*Remark.* This rock has some resemblance to the volcanic ash No. 1939, from the Gogebic iron range, but is much more highly charged with iron ore. N. H. W.

## NO. 1707. HEMATITE.

Virginia, Mesabi range.  
*Ref.* Annual Report, xxi, pages 132, 155.

*Meg.* A crucial specimen from the Virginia, taken so as to show the transition between the ore and the rock, there being a gradual change from the rock to the hematite of the range.

Mica schist. Magnetite.]

*Mic.* The fine *hematite* particles are formlessly grouped, with intervening spaces which were probably occupied by some other substance, but which in the slide are entirely empty except for a dust which is doubtless derived from the process of grinding followed by careless washing. It is hence impossible to detect from this slide the steps of last transition. One section.

*Age.* Animikie.

N. H. W.

NO. 1708. MICA SCHIST. (*Hornfels with cordierite.*)

Near Partridge river, a little west of Allen junction.

*Ref.* Annual Report, xxi, page 155. (Compare Nos. 370H, 387H.)

*Meg.* Black or gray, collected as a part of the "black slate" of the Animikie. Fine grained and dense.

*Mic.* The slide is thickly sprinkled with small isolated scales of *biotite* and a little *magnetite*. Mingled with the *biotite* scales are a few of *tourmaline*, which resemble the *biotite*, but are distinguished readily by noting the direction of greatest absorption, which is parallel with the horizontal spider line, that in *biotite* being parallel with the vertical line. The vertical axis of *tourmaline* is  $n_p$ , while with *biotite* the elongated sections have  $n_p$  perpendicular to their greater dimension. These little crystals of *tourmaline* also show the characteristic basal cleavage. The section in general is noteworthy for containing much *cordierite* in good preservation. This mineral forms the largest crystalline element. It encloses poikilitically all the other grains. Its pleochroism is very low (indeed, it is imperceptible), as in *cordierite* from the schists of contacts. Small interlocking grains of a feldspar whose index of refraction is lower than that of the *cordierite*, are probably of *albite*. Quartz shares in the fine interlocking matrix. There are also many small globular grains of high refractive index, which are probably *diopside*, their small size preventing the usual high colors of double refraction. Three sections.

*Age.* Animikie.

*Remark.* By the kindness of Prof. A. Lacroix it has been possible to compare this rock with the almost identical metamorphic Devonian schists of Canterets of the upper Pyrenees, and with numerous other *cordierite* schists. The metamorphism produced on the Devonian schists is due to granite contact, but in Minnesota this metamorphism is to be attributed to the gabbro which lies near adjacent to the outcrop.

N. H. W.

NO. 1709. MAGNETITE. (*Ore.*)

S. W.  $\frac{1}{4}$  N. W.  $\frac{1}{4}$  sec. 4, T. 62-11, near the north end of White Iron lake.

*Ref.* Annual Report, xxi, page 155.

*Meg.* Associated with vitreous quartz and with hornblende.

*Mic.* The associated minerals constitute the most of the slide. Besides *quartz* and green *hornblende* there is much *microcline* and rusty chlorite(?) or fibrous *actinolite*. One section.

*Age.* Archean.

N. H. W.

NO. 1710. GABBRO (*with hypersthene and bastite*).

Sec. 23, T. 61-12, Spellman's, north side of Birch lake. Associated with the iron ore about 200 feet from the granite.

*Ref.* Annual Report, xxi, page 156.

*Meg.* Rather coarse grained, pyroxenic.

*Mic.* The slide is principally occupied by *bastite*, an alteration product probably of bronzite or enstatite. It has parallel extinction, but its axial plane is perpendicular to the evident cleavage. It might easily be mistaken for an orthorhombic pyroxene. It has low refraction and low double refraction. Mingled with bastite is a pyroxene having higher refractive index, and two systems of rectangular cleavage, with one of which its extinction is parallel, which is apparently *hypersthene*. The slide also contains *biotite*, *labradorite*, *magnetite*, and a multiple-twinned colorless amphibole having high double refraction and  $n_e$  nearer parallel with its elongation, apparently grünerite. The magnetite is in small grains distributed through the pyroxenes.

*Age.* Cabotian.

*Remark.* In another section this rock appears largely hornblendic, twinned on the face 100, apparently grünerite.

N. H. W.

NO. 1711. MAGNETITE. (*Ore.*)

From the same place as No. 1710.

*Ref.* Annual Report, xxi, page 156.

*Meg.* Black ore, but with impurities.

*Mic.* The appearance is that of a gabbro gradually eaten into and replaced by *magnetite* in all directions, leaving only remnants of the original minerals, which remnants are bounded by curvilinear sides, with sharply angular corners. The minerals are *labradorite*, *diallage*(?) *brown hornblende*. One section.

*Age.* Probably Keewatin jaspilyte modified by the gabbro.

*Remark.* The ore encountered at this pit shows another phase of the ore known about a mile further east forming a ridge a short distance inland from the shore (Nos. 960 and 1138). This rock is illustrated by figure 12 of plate III.

N. H. W.

NO. 1712. HYPERSTHENE.

Same place as the last.

*Ref.* Annual Report, xxi, page 156. (Compare No. 960.)

*Meg.* Appearing hornblendic.

Gabbro. Slate. Greenstone.]

*Mic.* The slide consists entirely of *hypersthene*, but with numerous globular inclusions of *quartz* and apparently of *labradorite*. One section.

*Age.* Cabotian. An accident of the gabbro.

N. H. W.

NO. 1713. GABBRO (*with olivine*).

Same place as No. 1710.

*Ref.* Annual Report, xxi, page 156.

*Meg.* A medium-grained gabbro, composed of feldspar, augite, hornblende and apparently olivine. Biotite and pyrite are also present. No section.

*Age.* Cabotian.

U. S. G.

## NO. 1714. SLATE.

Same place as No. 1710.

*Ref.* Annual Report, xxi, page 156.

*Meg.* Hard, fine-grained, black, minutely banded, siliceous and magnetic slate, crossed by many quartz veinings. No section.

*Age.* Probably a dark jaspilyte of the Keewatin.

U. S. G.

NO. 1717. GABBRO. (*Muscovadyte*.)N. W.  $\frac{1}{4}$  S. E.  $\frac{1}{4}$  sec. 19, T. 63-9, Kawishiwi river, south side.*Ref.* Annual Report, xxi, page 156.

*Meg.* Fine grained. The structure stands vertical.

*Mic.* The slide consists apparently wholly of olivine and plagioclase. One (thick) section.

*Age.* Cabotian.

N. H. W.

NO. 1721. GREENSTONE. (*Granular and gritty*.)

Sec. 34, T. 64-9 W., Snowbank lake. From near the granite.

*Ref.* Annual Report, xxi, pages 97, 156.

*Meg.* Greenstone, appearing coarse and feldspathic.

*Mic.* The large *feldspars* are striated, but also considerably altered. They have ragged edges, due to decay, that interlock in a ragged, dentate manner with the surrounding matrix, but they do not interfere nor interlock with one another. They are not perceptibly zoned. They contain numerous minute inclusions uniformly distributed, resulting from alteration, chiefly *sericite*, but occasionally fresh glassy grains, evidently of some feldspar, which extinguish differently. Similar fresh feldspars are scattered generally throughout the fine matrix. *Quartz* appears as rather large grains in a manner similar to that of the feldspars, but has evident secondary enlargements, while *green hornblende* is so abundant as to have given name to the rock. It is in fine shreds and ragged masses, and shows no common structure or direction. Hexagonal *apatite* crystals rarely appear. One section.

*Age.* Keewatin.

*Remark.* There is but little sign of metamorphism in this rock. It appears in the main to be a debris of basic rock produced by erosion. Although it shows this coarser grain in a direction toward the granite, that change is not attributable to the advent of the granite, for the feldspars are all "old" feldspars. The hornblendes show no secondary growths. This rock suggests some of the coarse green schists of Kekequabic lake.

N. H. W.

## NO. 1722. GRANITE.

Boot island, in the central part of Snowbank lake.

*Ref.* Annual Report, xxi, page 156; Annual Report, xxii, page 157.

*Meg.* Rather fine grained, but with large crystals of a feldspar.

*Mic.* The coarse feldspar crystals seem to be largely of *microcline*. They enclose numerous smaller feldspars. One section.

*Age.* Archean (granite).

N. H. W.

NO. 1723. DIORYTE. (*Camptonite?*)

Near the same place as No. 1721.

*Ref.* Annual Report, xxi, page 156.

*Meg.* A dike, from six inches to thirty-six inches wide, cutting through the eastern continuation of No. 1721, which here becomes a coarse conglomerate, somewhat metamorphosed.

*Mic.* In a fine groundmass consisting solely of *feldspar* and *hornblende* micro-liths, the former tending indistinctly to a streamed structure (*i. e.*, a diabasic structure), are idiomorphic crystals of feldspar and hornblende. These later crystallizations are slightly zoned. One section.

*Age.* Archean (dyke).

*Remark.* The structure of this rock is much like that of esterellyte, with the exception that the flowage structure has not been noted in esterellyte in Minnesota. In like manner it cuts a rock (No. 1721), which resembles the green schists of Kekequabic lake, which are cut by the esterellyte of that locality. These coincidences are so striking that it is a reasonable inference to assume their equivalence of age, and an alliance in origin.

N. H. W.

NO. 1724. QUARTZYTE. (*Gray grit.*)

Shore of Snowbank lake, N. W.  $\frac{1}{4}$  sec. 35, T. 64-9.

*Ref.* Annual Report, xxi, page 156.

*Meg.* Gray, fine-grained crystalline rock. It appears some like the Ogishke conglomerate, and at the same time it is granitic, or granitized. There are areas which show a true granitic structure with abundant orthoclase(?) crystals. This rock and Nos. 1721 and 1723 are a part of the greenstone of this area. They some-