

The strong belt of Negaunee iron formation lies entirely north of this section, its closest approach being to within about 100 paces north of the northeast corner.

Only two dip needle traverses were run across the other iron belts in this section. The east line is crossed by a strong magnetic belt 110 paces south of the northeast corner, a weak belt about 350 paces south and another strong belt 550 paces south of the northeast corner. On the latter belt there was found outcrops of crumpled graphitic slate and Bijiki iron formation.

A strong belt was crossed at a point 500 paces east and 260 south of the northwest corner where nearly vertical graphitic slate was found in contact with grüneritic iron formation to the south. The dips were apparently  $85^{\circ}$  to the north but the dip needle readings indicate that the formations were overturned here. This belt strikes about east and west but does not line up with either of the strong magnetic belts that cross the east line of the section. No mapping was done in the area between so the relationship of these belts is not known.

The only recommendation for exploration that can be made for this section at present is that the dip needle survey should be completed and the magnetic belts and outcrops should be located and accurately mapped.

A wooded island, several hundred paces long, in the  $SE\frac{1}{4}$  of this section was not mapped, but is probably underlain by the Michigamme formation.

## Section 28. (T. 48 N., R. 30 W.)



This section was not mapped in detail, but the three quarter mile long peninsula, running westward into Lake Michigamme, near the northwest corner is probably an anticline of Bijiki.

The half mile long peninsula, running eastward, in the south half of this section, and the islands in the  $SE\frac{1}{4}$  of the  $SE\frac{1}{4}$ , are mostly Michigamme formation cut by east and west Superior pegmatites. The Michigamme formation consists here of mica schist, staurolitic schist and concretionary graywacke. The pegmatites are mostly feldspar-poor and some of them have a considerable amount of andalusite.

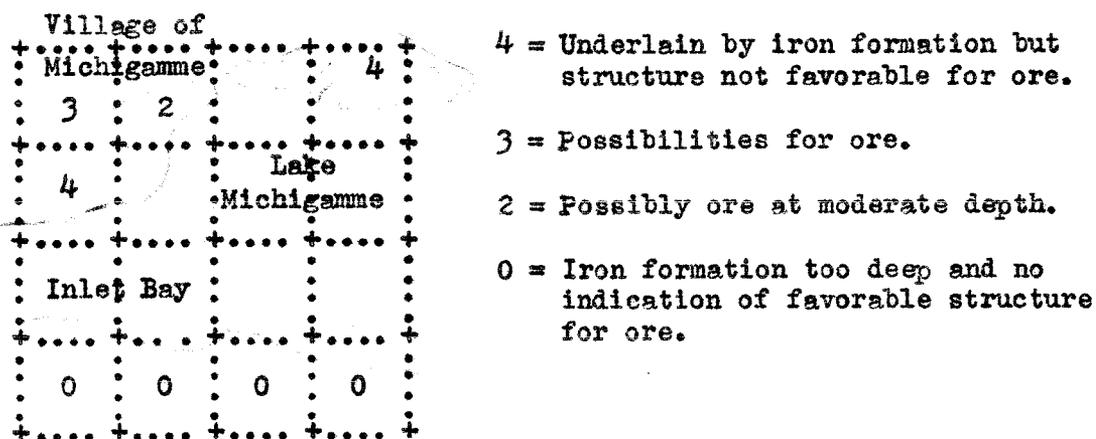
## Section 29. (T. 48 N., R. 30 W.)



This section was not mapped but several outcrops were visited and examined near the south line, where Michigamme schist and concretionary graywacke were found in the south tier of forties on the south side of the lake. It is suspected that either an anticline or upthrust of Bijiki occurs near the south line.

The peninsula, jutting eastward into Lake Michigamme, in the NW $\frac{1}{4}$  of the NW $\frac{1}{4}$  is apparently an anticline of Bijiki, but no mapping was done there.

Section 30. (T. 48 N., R. 30 W.)



In the NW $\frac{1}{4}$  of the NW $\frac{1}{4}$  there may be a chance for ore in the Goodrich and Negaunee horizons if they are folded in the same manner as the overlying Bijiki which forms a crumpled syncline, pitching eastward into Lake Michigamme, in the NE $\frac{1}{4}$  of the NW $\frac{1}{4}$ . There may be some low grade ore in the Bijiki horizon at moderate depth in this forty.

In the NE $\frac{1}{4}$  of the NE $\frac{1}{4}$  an anticline of Bijiki strikes eastward near the north line of the section. An east and west syncline of Bijiki probably underlies Lake Michigamme about the center of the

NE $\frac{1}{4}$  of this section.

The NW $\frac{1}{4}$  of the NE $\frac{1}{4}$  is mostly in a bay of the lake.

In the SW $\frac{1}{4}$  of the NW $\frac{1}{4}$  the gr<sup>n</sup>uneritic Bijiki outcrops in a badly crumpled and faulted anticline that pitches eastward and disappears into the lake near the center of the SE $\frac{1}{4}$  of the NW $\frac{1}{4}$ .

The N $\frac{1}{2}$  of the SW $\frac{1}{4}$  and the N $\frac{1}{2}$  of the SE $\frac{1}{4}$  are probably underlain by iron formations deep under the lake.

The south tier of forties, on the south side of the Inlet Bay are almost entirely underlain by Michigamme schist and graywacke.

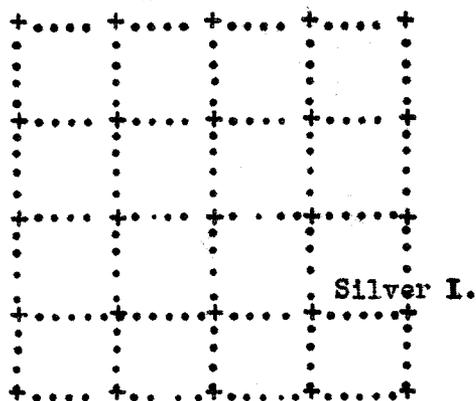
Section 31. (T. 48 N., R. 30 W.)

No mapping was done in this section and the only outcrops examined were Michigamme schist and graywacke near the north line. Most of the section is probably similar, with the iron formations so deeply buried that they have little effect upon a dip needle. The Michigamme strikes east and west in a series of folds with the cleavage nearly vertical. This section is south of the west arm of Lake Michigamme.

Section 32. (T. 48 N., R. 30 W.)

The above description of Section 31 also applies to this section.

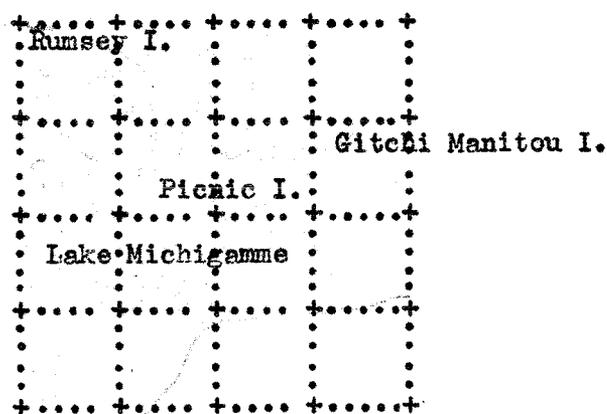
Section 33. (T. 48 N., R. 30 W.)



The mapping in this section was confined to that part of the west shore of Lake Michigamme that showed outcrops, and to all of the islands in the lake on this section.

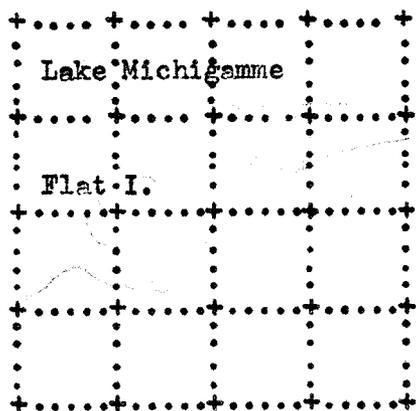
All of the outcrops are of the Michigamme and Clarksburg formations with east and west quartz veins and pegmatites. The Michigamme consists of east and west striking folds of concretionary and mica graywacke, mica and staurolitic mica schist. The Clarksburg appeared to be confined to a few beds of rather coarse tuff, none of them over a few feet in thickness. Several of the feldspar-poor pegmatites have an abundance of quite fresh appearing andalusite in crystals from one or two millimeters to several centimeters in diameter.

Section 34. (T. 48 N., R. 30 W.)



The only mapping done in this section was of the islands in the lake as shown in the accompanying small section map. The same formations were found as in Section 33 and with the same general strike and dip.

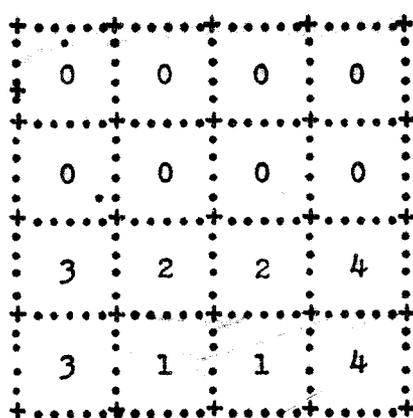
Section 35. (T. 48 N., R. 30 W.)



The only mapping done in this section was in the SE $\frac{1}{4}$  of the SE $\frac{1}{4}$  close to the south line. The outcrops were granitized Ajibik with numercus Superior pegmatites, all striking in general about S 60° W and dipping steeply northwestward. The shore of Lake Michigamme and Flat Island were examined but not mapped as the only outcrops found were of Michigamme or Clarksburg. No outcrops were found on Flat Island.

Magnetic work should be done in this section as the iron formations were mapped into the SW $\frac{1}{4}$  of the SW $\frac{1}{4}$  of Section 36 immediately to the east.

Section 36. (T. 48 N., R. 30 W.)



- 4 = Underlain by iron formations but structure not favorable for ore.
- 3 = Underlain by iron formations but not mapped and structure unknown but not likely to be favorable.
- 2 = Underlain by iron formations but ore either low grade or at great depth.
- 1 = Underlain by iron formations and structure favorable for ore.

c = # 7 Shaft, Champion Mine

From the Champion Mine workings, in the SW $\frac{1}{4}$  of the SW $\frac{1}{4}$  of Section 31 (T. 48 N., R. 29 W.), a wide magnetic belt continues about S 60° W to near the township corner. It then turns (probably both folded and faulted) to the northeastward, then bends back westward and enters this section, with a strike of about S 70° W, about 500 paces north of the southeast (township) corner. The belt then runs along the south tier of forties in this section, gradually curving more westerly, and near the south 1/4 post is striking east and west with the base of the belt very close to the 1/4 post. Just west of the north and south center line the belt appears to jog to the northward and then continues to the westward across the SE $\frac{1}{4}$  of the SW $\frac{1}{4}$  with a strike a little north of west.

The magnetic crest of this belt is about 200 paces north of its base and at the Champion Mine is about 100 feet in the hanging of the Goodrich contact. This leaves a width of from 400 to 450 feet for the Negaunee iron formation and as the dip is generally quite steep to the north, the probable width of the Negaunee is between 350 and 400 feet which seems to be about normal.

Clarksburg tuff and graywacke outcrop 300 paces north of the south 1/4 post or about 100 paces north of the crest of the magnetic belt. The Clarksburg strikes S 70° W and dips 75° northward. There are indications of a fault striking about S 65° W, and probably dipping northward, along the south edge of the ridge of Clarksburg. Whether such a fault is present or not, there would appear to be a possibility for ore, probably pitching northeasterly, in the Negaunee iron formation about 200 paces north of the south line in the SE $\frac{1}{4}$  of the SW $\frac{1}{4}$  and in the SW $\frac{1}{4}$  of the SE $\frac{1}{4}$ . There may also be ore in the base of the Goodrich.

A grünerite-magnetite phase of the Bijiki iron formation outcrops at frequent intervals for several hundred paces along another strong magnetic belt that is 200 paces north of and about parallel to the broad foot belt. This belt is widest and strongest near the north and south center line of the section but fades out a few hundred paces on either side of it. It is probably due to an upthrust or anticline of the Bijiki. The Clarksburg graywacke and tuff outcrop again, dipping northward, in the proper position parallel to and just north of this belt.

Time did not permit the completion of the dip needle survey in this section and the only work done in the SW $\frac{1}{4}$  of the SW $\frac{1}{2}$  was the running of the east and south boundaries. The dip needle readings along the south line of this forty continued low with a slight rise near the southwest corner indicating that, although the iron formation had not crossed the south line, it might be swinging a little closer to it. Numerous outcrops of granitized Ajibik, cut by pegmatites, all striking in general somewhat south of west and dipping northward, also indicated that the iron formation was still north of the line.

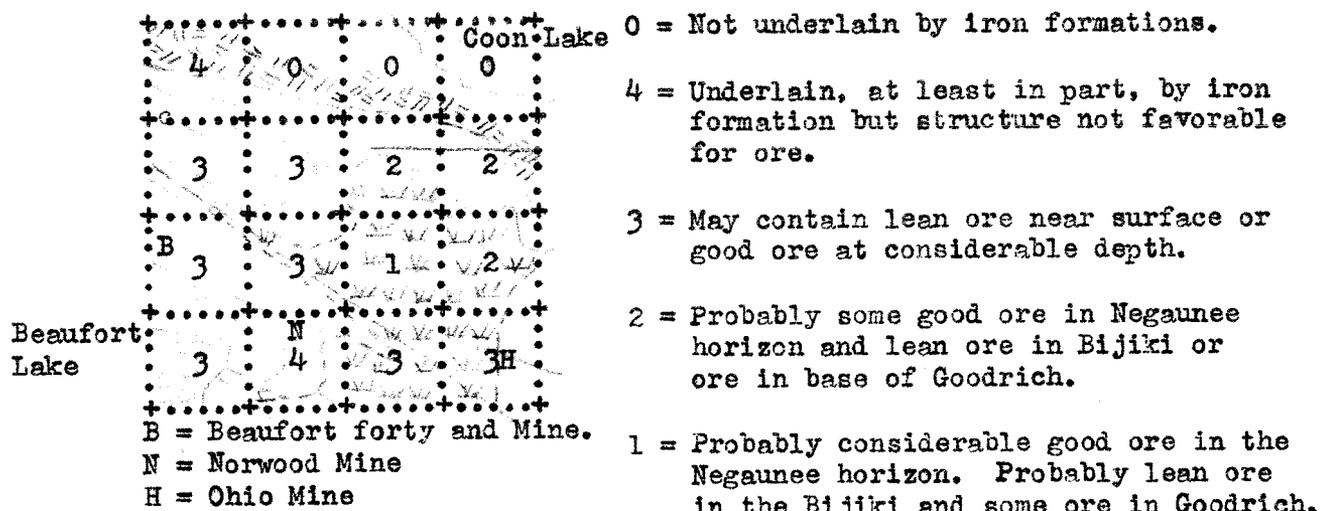
There is a row of old test pits, across the lower part of the Negaunee iron formation, near the north and south center line and a few pits along other north and south forty lines but no conclusive evidence was found that many of them reached ledge. Numerous pits, many of which reached ledge but got no ore, were also found across and along the belt of Bijiki that lies from 400 to 500 paces north of the south line. Any ore in this Bijiki horizon would more likely be found by drilling north of the Bijiki belt with the holes slanted to the south. The ore would

probably be lean and the tonnage small.

In the north half of Section 36 no magnetic belts were found and the iron formations, if present, are presumably very deeply buried. The only outcrops found were of Michigamme and Clarksburg formations.

The  $W\frac{1}{2}$  of the  $SW\frac{1}{4}$  of this section and the  $S\frac{1}{2}$  of Section 35 to the west should be thoroughly mapped. It seems likely that the iron formations may cross the south line of Section 35 near, or beyond, the south  $1/4$  post and either continue southwesterly across the  $NE\frac{1}{4}$  of Section 2 (T. 47 N., R. 30 W.) or recross the township line forming still another trough before swinging southward to connect with the iron formation on the northeast side of the Republic trough.

Section 22. (T. 48 N., R. 31 W.)



In the  $NE\frac{1}{4}$  of the  $NE\frac{1}{4}$  there is no iron formation, Ajibik slate and graywacke outcropping along the south shore of Coon Lake which covers most of this forty.

There is no iron formation in the  $NW\frac{1}{4}$  of the  $NE\frac{1}{4}$  which is underlain by Ajibik and by Clarksburg intrusives.

The  $N\frac{1}{2}$  of the  $NW\frac{1}{4}$  is mostly occupied by part of a large Clarksburg intrusion that extends across much of the northern part of this section. There is some buried iron formation, indicated by an outcrop of taconitic material and by two or three discontinuous magnetic belts, south of the river, in the  $NW\frac{1}{4}$  of the  $NW\frac{1}{4}$ .

The  $SE\frac{1}{4}$  of the  $NE\frac{1}{4}$  has southwest dipping Negaunee iron formation striking diagonally across its southwestern part and a coarse Clarksburg intrusion, cut by an east and west Sibley dike, in the northeastern half. Only a little concentration was seen in the outcrop where the iron formation is cut by the vertical Sibley dike, forming a westward pitching trough on the north side of the dike, but there may be ore deeper down in this trough, especially to the westward.

South of this Sibley dike the iron formation dips toward the river, presumably flattening out in depth from the surface dips of from  $45^\circ$  to  $60^\circ$ . Another magnetic belt, probably due to the Bijiki formation, strikes southeasterly across near the southwest corner of this forty and lies about 300 paces above and parallel to the base of the Negaunee. This would indicate a width of about 800 feet for the combined Negaunee and Goodrich or a thickness, from the observed dip of the Negaunee, of about 600 feet without any allowance for folds, faults or hidden intrusives. The Negaunee probably accounts for between 300 to 500 feet of this thickness.

The outcrops of the Negaunee show a progressive change in strike from  $N 70^\circ W$  near the west line to about  $N 45^\circ W$  near the center of the forty. This curving of the formation indicates

a trough, pitching southwestward under the river. Such a trough, probably cut by other dikes not seen in the outcrops, may contain ore in the Negaunee horizon as well as some additional ore in the base of the Goodrich.

In the SW $\frac{1}{4}$  of the NE $\frac{1}{4}$ , the conditions are similar to those in the forty just discussed except that the entire forty is underlain by the Negaunee iron formation, the large Clarksburg dike passing almost entirely north of this forty.

The S $\frac{1}{2}$  of the NW $\frac{1}{4}$  is underlain by iron formations as evidenced by several strong but somewhat discontinuous magnetic belts that appear to represent two narrow synclines of Bijiki that are separated by a broader anticline. There may be a moderate amount of low grade ore in the synclines. The Negaunee is less likely to be as closely folded and there may be ore in the Negaunee horizon but it is apt to lie at such a depth that exploratory work for it in these forties might better await developments on the adjacent forties to the east and southeast.

The NW $\frac{1}{4}$  of the SW $\frac{1}{4}$  includes the Beaufort Mine, in the Bijiki horizon, which is probably pretty well worked out except perhaps at greater depth. There is a fairly strong magnetic belt, somewhat interrupted, along the north side of the Beaufort pits. The formation is dipping steeply southward. There is another interrupted belt just south of the pits. This belt may be due to northward dipping Bijiki on the south limb of the trough but the dip needle readings suggest that this belt is also dipping southward and may be a repetition or upthrust of the northern belt, in which case there may be more Bijiki ore to the south of it and also under the east end of Lake Beaufort on the forty immediately to the south.

The SW $\frac{1}{4}$  of the SW $\frac{1}{4}$  is mostly under the east end of Lake Beaufort and may be underlain by ore in the Bijiki horizon. The underlying Negaunee may also carry ore but is probably at a considerable depth.

The NE $\frac{1}{4}$  of the SW $\frac{1}{4}$  is presumably largely anticlinal and unfavorable for ore except perhaps for a small, narrow trough of Bijiki near the center.

The SE $\frac{1}{4}$  of the SW $\frac{1}{4}$  carries an extension, worked by the Norwood Mine, of the ore body at the Beaufort. Only one small open pit, less than 500 feet long, and a few shallow test pits or shafts were found on this forty, and the ore appears to have been low grade.

The SE $\frac{1}{4}$  of this section is mostly under part of the large swamp that extends southward from the river, and very little of this area could be run because of the high water.

The NW $\frac{1}{4}$  of the SE $\frac{1}{4}$  is underlain by the iron formations and may contain ore in the Negaunee horizon at moderate depth in addition to possibilities of a little high grade ore at the base of the Goodrich and some lean ore in the Bijiki horizon.

The NE $\frac{1}{4}$  of the SE $\frac{1}{4}$  is underlain by both iron formations and seems to have possibilities for ore in its western part but the magnetic belts swing more to the eastward near the east line of the forty which suggests the beginning of an anticlinal structure although it is likely that crumpling and probable dikes may result in structural conditions favorable to the formation of some smaller ore bodies.

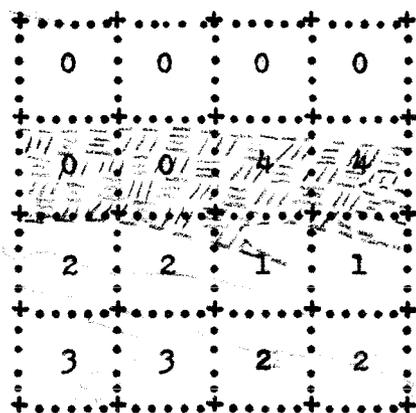
The SE $\frac{1}{4}$  of the SE $\frac{1}{4}$  includes the workings of the Ohio Mine in the Bijiki horizon. The magnetic belt passing near some of the old shafts and just north of the cave-in does not line up

with the belt extending east-southeast from the Norwood. Due to the high water level in the intervening swamp this magnetic belt could not be followed between the Norwood and the Ohio but it appears that the north side of the trough is displaced by a sharp fold or northwesterly striking fault. If so, it would seem that the best place to look for additional ore would be about the middle of the west line of this forty or in the southwest part of it.

The SW $\frac{1}{4}$  of the SE $\frac{1}{4}$  carries an extension of the magnetic belt that is just north of and in the foot of the Norwood pit. This belt, which could not be followed east of the center of this forty because of high water in the big swamp, strikes about 150 paces south of what is presumably the same belt that lies just north of the Ohio Mine cave-in. The topography suggests a fault striking about S 55° east passing through near the northwest corner of this forty. The ridge extending for several hundred feet eastward into the big swamp from a point just south of the northwest corner of the forty may be due to an upthrust on the south side of this probable fault and had probably best be avoided in drilling.

Ore might be found in steeply northward slanted drill holes located about 400 paces north and from 700 to 800 paces west of the southeast corner, or on the south side of the ridge, in similar holes located about 300 paces north and between 900 and 1,000 paces west. The Bijiki horizon may carry lean ore and the underlying Negaunee, which is likely to be encountered in 2,000 feet or less, may carry ore.

## Section 23. (T. 48 N., R. 31 W.)



0 = Not underlain by iron formation.

4 = Only a little of the lower part of the Negaunee iron formation in narrow belts.

3 = Underlain by iron formations but ore bodies small and lean, or else good ore at considerable depth.

2 = Probable ore at less than 3,000 feet. Some lean ore at less depth.

1 = Probable ore at less than 1,000 feet. Some lean ore at less depth.

The  $N\frac{1}{2}$  of this section contains no iron formation except for a few narrow belt of the lower part of the Negaunee caught up between forks of the large east and west Clarksburg intrusion. In the  $SE\frac{1}{4}$  of the  $NE\frac{1}{4}$  there are two or more such narrow troughs that may be large enough to contain a workable ore body, but this forty is not promising.

The  $N\frac{1}{2}$  of the  $SW\frac{1}{4}$  is underlain by Negaunee iron formation with the southern part of these forties also underlain by the Goodrich and the Bijiki. The dip is steep southward at surface but anticlines of Bijiki in the forties to the south of here indicate that the Negaunee may also reverse its dip near the south line of these forties thus forming a trough in which ore might occur. Even if the Negaunee does not come up again as the Bijiki does, it is likely that it will flatten out considerably and, as there is a strong probability that it will be cut by stringers of the large east and west Clarksburg dike just to the north, there is seemingly a fair chance for ore at workable depths.

The  $N\frac{1}{2}$  of the  $SE\frac{1}{4}$  appears to have a chance for ore as the conditions are similar to those in the forties to the west, and in

addition there seems to be an appreciable curvature to the strike of the Negaunee suggesting a trough or troughs pitching southward under the river. The Goodrich quartzite close above the Negaunee iron formation outcrops about 400 paces west and 200 south of the center of the section and dips less than  $30^{\circ}$  to the southward which is about the lowest dip seen along the north limb anywhere in the Lake Michigan area. This relatively low dip, coupled with the comparatively slow drop in the dip needle readings in going southward from outcrops of the Negaunee may indicate that ore bodies in this iron formation may be found closer to surface in these forties over a greater acreage than is usual for this area.

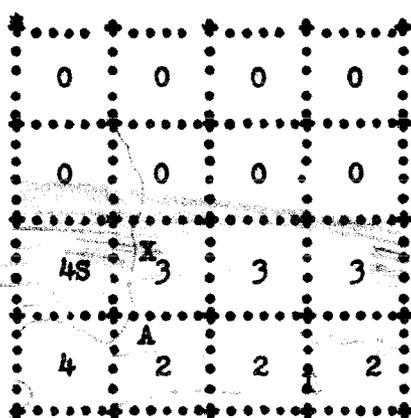
The SW $\frac{1}{4}$  of the SW $\frac{1}{4}$  is underlain by crumpled Bijiki iron formation quite close to surface. Except near the southwest corner of this forty, the Bijiki appears to be folded into a series of small, narrow synclines with wider anticlines between and the best chance for ore in this horizon is probably just south of the magnetic belt in the southwest corner. This belt is due to south dipping Bijiki and lies close in the footwall of the Ohio Mine workings to the west and the Portland pit to the south. This forty is also probably underlain by the Negaunee iron formation but its structure is not yet known though it may not be as closely folded as the overlying Bijiki. It is probably not too deep to be mined if ore bodies are located in it though search for ore in the Negaunee horizon on this forty had perhaps best be deferred until the forties to the north are tested.

The SE $\frac{1}{4}$  of the SW $\frac{1}{4}$  is probably mostly anticlinal with only small narrow troughs of Bijiki. This forty may also contain ore in the underlying Goodrich and Negaunee horizons but exploration

for it might await developments on the forties to the north.

The  $S\frac{1}{2}$  of the  $SE\frac{1}{4}$  is underlain at no great depth by the Bijiki, a great deal of which is probably anticlinal in structure and not very promising. Deeper down there may be ore in the Negaunee horizon but tests should await the exploration of the forties to the north or to the east in Section 24.

Section 24. (T. 48 N., R. 31 W.)



- 0 = Little or no iron formation and no ore.  
 4 = A little ore near surface and a moderate amount at depth.  
 3 = A little ore near surface with a chance for considerable ore at depth.  
 2 = Probably good ore at depth.  
 S = Spurr Mine. A = Anderson Saw Mill  
 x = Small open pits.

A large Clarksburg intrusion strikes about east and west through the middle of this section. North of this intrusion there appears to be only a little of the lower part of the Negaunee iron formation, with some narrow belts also caught up or included in, or between forks of, the Clarksburg. It does not seem likely that any profitable ore body will be found in the north half of this section.

In the next tier of forties to the south, branch dikes or sills of Clarksburg alternate with belts of the upper part of the Negaunee, with the Goodrich and Bijiki lying mostly to the south of the Clarksburg. There are probabilities of small ore bodies lying against or between some of the Clarksburg dikes and along the Goodrich contact.

In the NW $\frac{1}{4}$  of the SW $\frac{1}{4}$  a narrow ore body, in a magnetite-granular quartz phase of the Negaunee, was mined at the Spurr. The workings were along the south edge of a Clarksburg dike or sill and do not appear to have gone very deep. As there are dip needle indications of an anticline or upthrust to the south of this forty, it is probable that the iron formation forms a trough or at least flattens considerably at moderate depth and that more ore might be found by carrying the Spurr Mine workings deeper.

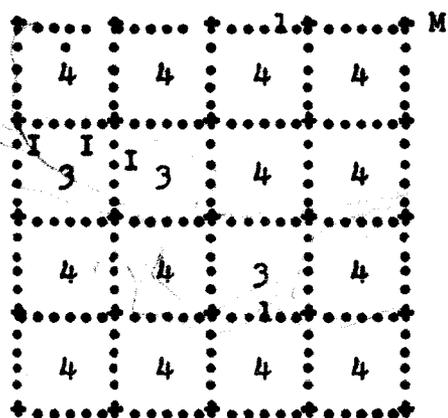
In the NE $\frac{1}{4}$  of the SW $\frac{1}{4}$  the iron formation strikes nearly east and west and the Clarksburg intrusive seems somewhat thinner. A small open pit near the center of this forty was apparently in ore though quite thin. The conditions for encountering more ore at depth seem better in this forty than in the forty to the west.

In the N $\frac{1}{2}$  of the SE $\frac{1}{4}$  the conditions also seem favorable for ore, especially at depth and at or near the Goodrich contact.

The SW $\frac{1}{4}$  of the SW $\frac{1}{4}$  has some apparent possibilities for a little ore in its northeastern part under the swamp south of the railroad. The northwest part of this forty is probably partly over an anticline.

The SE $\frac{1}{4}$  of the SW $\frac{1}{4}$  and the S $\frac{1}{2}$  of the SE $\frac{1}{4}$  seem to offer good possibilities of ore in a moderately deep trough near the north line of these forties, for what is probably an anticline or upthrust of iron formation seems to cross the southern part. The dip needle readings suggest that both limbs of this anticline, if such it is, will probably be found dipping south.

## Section 25. (T. 48 N., R. 31 W.)



4 = Underlain by iron formations but structure not favorable for ore in large amount except at considerable depth.

3 - Some ore near surface with fair chance for considerable ore at greater depth.

1 - Imperial Mine workings.

M - Michigamme Village.

The NE. In this quarter section on definite magnetic belts were found north of an anticline of grüneritic Bijiki that outcrops at intervals, near the north shore of an arm of Lake Michigamme, from 400 paces west to about 100 paces north of the east  $1/4$  post. The dip needle readings from the north line gradually decrease until near this anticline. While it is probable that there are folds and perhaps ore bearing troughs in these forties, the dip needle indications are that they are so deeply buried that the structure was not revealed by the magnetics.

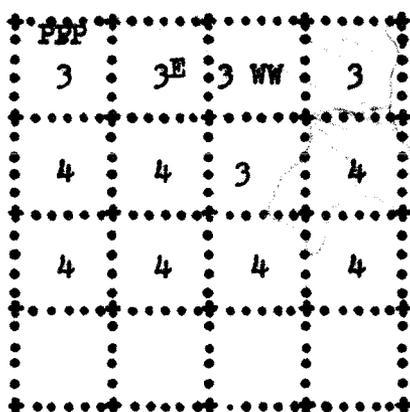
In the  $N\frac{1}{2}$  of the  $NW\frac{1}{4}$  the dip needle readings varied but little except for local rises of two or three degrees. No definite pattern to the slightly higher readings was noted and they may have been due to small, deeply buried folds or even boulders.

The  $S\frac{1}{2}$  of the  $NW\frac{1}{4}$ . The strong magnetic belt of grüneritic Bijiki that was followed and mapped along the northern edge of Lake Michigamme toward the center of this section, was lost at the edge of the swamp along the river. A strong belt, considered likely to be the same one, either faulted or folded sharply back, was picked up just north of the center and followed northeasterly a short distance where it curved through north to the west and was followed

to a point about 500 paces north of the west 1/4 post where it was lost. This belt skirted the north side of the workings of the Imperial Mine, which are confined to a half mile long fold in the formation. It is probable that a south dipping thrust fault, striking about N 60° W and about parallel to the river, may form the southern limit of the Imperial ore body. There may be more ore in this Bijiki horizon under the river south of this probable fault. There may also be ore in the Negaunee horizon deep below the Bijiki in this part of the area.

The south half of this section is mostly a valley occupied by swamp, river and bayous, and may be underlain by ore although the only favorable indications are topographic as, going southward, the dip needle readings steadily diminish.

Section 26. (T. 48 N., R. 31 W.)



4 - Underlain by iron formations but structure not very favorable for ore except perhaps at considerable depth.

3 - Probable ore in Bijiki horizon near surface and possibility of ore in Bijiki and Negaunee horizons at depth.

E - East Portland Mine.

P - Portland Mine.

W - Webster Mine.

The NE $\frac{1}{4}$  of the NE $\frac{1}{4}$  is underlain by both iron formations and probably contains some narrow troughs of Bijiki ore as it is traversed by several magnetic belts, most of them rather short. The magnetic belt, from the Imperial Mine to the east, passes through near the southeast corner of this forty and the break in this belt near the east line together with the arrangement of short and apparently broken belts on this fort suggest a thrust fault

striking about N 70° W through the southeast corner. There might be ore in both the Bijiki and the Negaunee iron formations on the north side of such a fault.

The NW $\frac{1}{4}$  of the NE $\frac{1}{4}$  contains the pits of the Webster Mine and more ore in the Bijiki formation might be found at greater depth as the dip needle mapping indicates the probability of an anticline or upthrust close south of the Webster. Such an anticline might have both limbs dipping southward and ore might be found on the north side under such an overturned fold. Such a fold or fault might also be the start of another trough a short distance south of the Webster ore body.

The NE $\frac{1}{4}$  of the NW $\frac{1}{4}$  contains the pit of the East Portland Mine, and the east end of the large pit at the Portland, on the continuation of the Bijiki ore body from the Webster, and at the latter mine, there might be another ore body encountered to the south of the old workings as the dip needle mapping indicated the probability of an anticline or upthrust about 100 to 200 paces south of the East Portland pit.

The NW $\frac{1}{4}$  of the NW $\frac{1}{4}$  contains the Portland pit in which might be found additional ore at depth as well as in what may prove to be another trough to the south. The ore body at the Portland is a continuation of that at the East Portland and Webster, only minor faulting and undulations in the iron formation narrowing the ore body between.

The S $\frac{1}{2}$  of the NW $\frac{1}{4}$  showed steadily decreasing dip needle readings to the southward, but all readings were sufficiently high to indicate that these forties are underlain by iron formation. Although the magnetic work gave no indication of structure favorable

for ore, except that the dip had probably become much flatter, a swamp across these forties might be taken as a favorable topographic indication.

The SW $\frac{1}{4}$  of the NE $\frac{1}{4}$  showed dip needle readings diminishing very gradually to the southward but high enough to indicate that there is iron formation at no very great depth. No favorable structure for ore was indicated by the magnetic work but most of this forty is occupied by a swamp and as the magnetic readings decreases so gradually it would indicate that the dip may have flattened a great deal and the possibility of ore beneath this swamp should be considered.

The SE $\frac{1}{4}$  of the NE $\frac{1}{4}$  is partly occupied by the main part of Bass Lake, to the east of which a few short indefinite magnetic belts were found. The land on the east side of Bass Lake is about 50 feet higher than the lake and swamp level and may be due to glacial till but this greater elevation may also be at least partly caused by this area being on the upthrow side of the thrust fault suggested in the discussion of the forty to the north. The chances for ore in this forty are not considered promising.

The entire south half of this section shows steadily decreasing dip needle readings and the iron formations probably lie at too great a depth for effective exploration at present, although there is probably a broad, somewhat crumpled, deeply buried syncline from here southward in which there may be ore at a depth perhaps not too great for mining.

Section 27. (T. 48 N., R. 31 W.)

This section is underlain by the iron formations but except for the north tier of forties the dip needle readings indicate that it may lie at considerable, although not necessarily prohibitive

depth. Exploration in this section should perhaps best start in the NE $\frac{1}{4}$  of the NE $\frac{1}{4}$  (south of the Ohio Mine) where there is a reasonable chance of locating ore at moderate depth, especially on one side or the other of a probable thrust fault that may be striking about N 60° W near the northeast corner of the section. This probable fault is shown on the small section map that accompanies the description of section 22 to the north. Another probable parallel fault, also indicated on the same map, probably enters this section east of the magnetic belt near the north quarter post, and ore bodies might be found near it in the NW $\frac{1}{4}$  of the NE $\frac{1}{4}$  and perhaps in the forty to the west of there.

In the rest of the section the dip needle readings generally decrease steadily to the south and it is likely that the iron formations are quite deep. A small elliptical area of fairly high dip needle readings was found about 450 paces south and less than 100 paces west of the east quarter post and while they may have been due to a belt of iron formation coming near the surface, it is considered more likely that these high readings may be caused by a buried boulder of iron formation, several of which only partly buried and up to 1,000 tons weight, were observed in the sections to the east of there. No outcrops were found in this section.

Section 34. (T. 48 N., R. 31 W.), is apparently devoid of outcrops and the magnetic readings decreased steadily to the southward and in no part of the area gave any indication that the underlying iron formations were near enough to surface to warrant exploration at present.

## Section 35. (T. 48 N., R. 31 W.)

The dip needle readings on this section become progressively lower to the south and southwest and no magnetic belts were found. The only readings that might have indicated proximity to an iron formation were found near the east quarter-post, about 500 paces west and 100 south of the northeast corner and near the center. In the first two instances a partially buried boulder, of grüneritic iron formation, and about 1,000 tons weight accounted for the anomaly. Near the center of the section the readings in a small oval were slightly higher than the surrounding readings and were probably due to a completely buried boulder. Many other similar areas would have undoubtedly been encountered had the magnetic surveying not avoided boulder strewn areas devoid of outcrops.

There are outcrops of east and west striking Michigamme schist in the  $SE\frac{1}{4}$  of the  $SE\frac{1}{4}$ .

It is assumed that any productive iron bearing horizons are probably from several hundred to more than 2,000 feet deep over most of this section, and that drilling on this section is probably not warranted until section 26 to the north has been tested.

## Section 36. (T. 48 N., R. 31 W.)

No magnetic belts were found on this section though irregularly scattered high dip needle readings near abnormally low (negative) ones were found in a boulder strewn area, of two or three acres extent, near the south quarter post. Considerable test pitting and trenching had been done there but the only pit that appeared to have reached ledge was sunk in the edge of what seemed to be a large angular boulder of magnetite interbedded with granular

quartz. This appeared to be a fragment of the Negaunee iron formation and showed, both in the hand specimens and the outcrop, well developed polarity--a condition that has frequently been observed in loose boulders of this material elsewhere in the district. This locality was described in Progress Report #11, "Geology of the Spruce River Area", 1944, Michigan Geological Survey.

Outcrops of east and west striking Michigamme formations were mapped near the northeast and the southwest corners of this section.

This section is probably largely underlain by the Bijiki and the Negaunee iron formations but at depths probably ranging from 1,000 to more than 2,000 feet and exploration is not considered advisable until work has been done in the south part of section 25 immediately to the north.



STRATIGRAPHIC INDEX of HAND SPECIMENS

Township and Range in parentheses,- as (48-30)  
 Section underlined,- as 24  
 Number of Specimen in section given last, as #1, 2

Glacial and post-Glacial,- (48-30) 19 #6.

Keweenawan,- (48-29) 6 #4. (49-30) 28 #10.

Superior  
 Pegmatites,- (47-29) 6 #4,35. (48-29) 31 #25. (48-30) 33 #1  
 (48-31) 22 #13. 23 #4.

" Feldspar-poor (48-30) 28 #2,3,10. 30 #6.

" " + Molybdenite (48-29) 28 #12,13. 31 #15.

Quartz Veins,- (48-29) 32 #1a. (48-30) 29 #1. 30 #4.  
33 #2. 34 #1f.  
 (48-31) 23 #3.

Sibley,- (47-29) 6 #44. (48-30) 20 #5,6,7,8,16.  
 (48-31) 22 #3,4.

Michigamme Slate,- (48-30) 34 #3b.

" Staurolite Schist (47-31) 1 #4. (48-30) 33 #2.

" Mica Schist (47-31) 1 #1. (48-30) 30 #1. (48-31) 25 #1a.

" Graywacke (47-31) 1 #1. (48-30) 28 #10,11. 30 #2,3.  
34 #1d,3a.

" " (Concretions) (48-30) 28 #4. (48-31) 25 #1b,1c.

Clarksburg Tuff (47-29) 5 #22,23. (48-29) 33 #2,3,4. (48-30)  
34 #1b,2.

" Tuff on Bijiki (47-29) 4 #6. 5 #9. (48-29) 32 #27

" Ash (fine tuff) (47-29) 4 #2. 5 #12,22,23,30. (48-29) 29 #14,15,16.  
 (48-29) 32 #17,19,20,32. 33 #1  
 (48-30) 19 #1,2,3,4,5.

" Ash on Bijiki (47-29) 4 #1. 5 #25. (48-29) 30 #3,4. 32 #21,22.  
 (48-31) 23 #5.

" Coarse dike (48-29) 31 #26. (48-30) 22 #5. (48-31) 22 #8,10.  
23 #8,9. (49-30) 10 #1.

" " " + Garnet, etc. (48-29) 32 #11.

" Fine grained (47-29) 5 #6,14. 6 #3,19. (48-29) 28 #5,6. 31 #6,7.  
 (48-30) 12 #5. 13 #11,24,26. 20 #1. 22 #5.  
 (48-30) 23 #15a. 24 #8. (48-31) 22 #5,7,9,11,14.  
 (48-31) 23 #6,7. 24 #3,4,5,11.

Basic dikes, Clarksburg or older,- (48-30) 1 #8. 13 #6. 24 #2,4,13.  
(48-30) 20 #10. 24 #1,2. (49-30) 28 #1,2,5.  
36 #4. (49-30) 26 #1.

Bijiki Slate,- (48-29) 29 #12. 30 #20,22. 32 #31.

Bijiki Iron formation,-  
Ore (48-29) 29 #1,2,3,4,11. 30 #5,6,7,19,21.  
(48-30) 25 #12.

Oxidized (47-31) 12 #1e. (48-29) 30 #17,18. 31 #29.

Iron carbonate (47-31) 12 #1h. (47-29) 5 #10,11,13,15,18,24,26,29.

Magnetite & quartz (48-30) 25 #1,2.

Grüneritic (47-29) 4 #3,5. (47-31) 12 #2a,3  
(48-29) 30 #23,24. 31 #27,28. 32 #4,23,24,25,28,30.  
(48-30) 25 #3,3a,4,4a,4b,5,6,7,8,9,10,11,13,14.  
(48-30) 26 #1,3. 30 #5. (48-31) 25 #2. 26 #1.

"Limonite" from (47-31) 12 #1a,1b,1c,1d,2b,4a,4b. (48-31) 26 #1.  
"grünerite"

from Greenalite (48-29) 30 #10,14. 32 #12. (48-30) 30 #6.  
(48-31) 22 #16.

Graphitic Slate (48-29) 29 #10,13. 30 #11,12,13,15,16.  
(48-30) 26 #2,3. (48-31) 26 #2,3,4.

Goodrich Graywacke,- (48-29) 30 #2. 32 #15,16. (48-31) 23 #2.

Quartzite (48-29) 30 #1,8,9. 32 #29.

Conglomerate (48-29) 31 #13. (48-31) 23 #1.

Negaunee Grüneritic (47-29) 5 #7,8.  
(48-31) 22 #1. 24 #6,7,8. 36 #1

Magnetite,qtz. (48-29) 31 #11. (48-31) 22 #2,6. 24 #9,10. 36 #2.

Slate & graywacke (48-29) 31 #18,23a,23b. (48-30) 20 #2.  
Hemlock (48-31) 22 #15.

Iron formation (47-29) 4 #4.

Ajibik Slate, gray- (48-29) 20 #3. 31 #3,9. (48-30) 20 #4.  
wacke quartzite (48-30) 22 #6,7. 23 #14a. (48-31) 23 #10.

Ditto (granitized) (47-29) 5 #5,27,28. 6 #2,5,6,20,21,25,26,42,43.  
(48-29) 31 #4,9a. (48-30) 22 #3.

Conglomerate (48-29) 21 #8,9. 32 #18.

Champion Pegmatites,- (47-29) 6 #38,39,40 (48-29) 6 #2

Pegmatites, probably  
mostly of Champion Age

(48-29) 20 #1. 21 #1 (48-30) 1 #7,13,15,16.  
(48-30) 2 #7. 12 #3,8. 13 #4,7,9,15,19,20.  
(48-30) 13 #21,25,27,28,29. 20 #12. 21 #4,8.  
(48-30) 23 #1,6,10,12. 24 #11,12. (49-30) 27 #5.  
(49-30) 28 #3,6,9. 35 #1,3. 36 #3.

Quartz veins, probably  
mostly Champion age.

(48-30) 12 #8. 20 #14. 23 #9.

Mesnard,-

(48-29) 28 #8.  
(48-30) 1 #11. 13 #3,5. 23 #11.

Mesnard or Kitchi

(48-30) 1 #2,3,4. 2 #1,6,8,10. 13 #23. 20 #9.  
granitized quartzite (48-30) 22 #2. 24 #5.

Kitchi graywacke

(48-29) 21 #2,3,4. (49-30) 35 #2.

Quartz monzonitic

gneiss (granitized graywacke) to graywacke & slate

(47-29) 6 #28, 36. (48-29) 6 #1,5,6. 20 #2.  
(48-29) 21 #5,10. 28 #1,2. (48-30) 1 #1,9,10,18,19.  
(48-30) 2 #2,3,9. 12 #1,2,4,6,6a,7,9.  
(48-30) 13 #8,10,12,13,14,16,17,18,22,30. 20 #19.  
(48-30) 21 #5. 22 #1. 24 #1,3,6,7,9,10,12,16,17,18,19.  
(49-30) 26 #6. 27 #1,2,3,4,6. 28 #4,8,9. 35 #4.

Conglomerate

(48-29) 21 #7. (48-30) 1 #17. 20 #11,18.

Laurentian? Granite

(48-30) 1 #12. 20 #15.

Keewatin?

(48-29) 21 #6. (48-30) 1 #5,6,14. (48-30) 28 #7.  
(49-30) 35 #1,2..

DESCRIPTIONS OF TRIMMED SPECIMENS:

LAKE MICHIGAN AREA:

W. A. Seaman

1946.

	R 30 W.	Range 29 W		
Twp		20	21	
48 N	25	30	29	28
		31	32	33
Twp				
47 N		5	4	

## 47-29 Section 4

#1. 130 paces N, 60 E of West 1/4 post. July 22, 1946

Amphibole (Cummingtonite?) partly radiated or in rosettes.	30%	0.1 x 2 <sup>mm</sup>
Amphibole (Dark blackish green) parallel fibers.	5%	2 x 2 <sup>mm</sup>
Biotite	10-20%	to 1/2 <sup>mm</sup>
Biotite ± Chlorite	20%	to 0.1 <sup>mm</sup>
Quartz ± other light colored granular material	20%	to 0.1 <sup>mm</sup>
Pyrite	Trace	0.2 <sup>mm</sup>
Unrecognized	10%±	mostly under 0.1 <sup>mm</sup>

Strike about N 60° E, dip steep NW. Has finer grained, lighter colored beds, one about 10<sup>mm</sup> thick showing in specimen.

Probably base, or near base of Clarksburg or top of Bijiki Iron formation plus fine basic ash. Within a few paces of high magnetics seemingly in the foot. Graywacke or perhaps a cherty iron carbonate plus Clarksburg ash.

#2. 470 paces south, 10 E of NW corner but about 40 paces south July 25, 1946  
of the "forty" line as this section is apparently short north and south.

Dark beds.

Amphibole fibrous, dark greenish black (Actinolite?), in pseudo-hexagonal thin aggregates about 2 to 3 <sup>mm</sup> in diameter and resembling chloritoid. Edges (or rims) of flat aggregates not quite parallel to centers.	over?	50%
Biotite	10%	0.1-0.2 <sup>mm</sup>
Pyrite	Trace	
Dark material, including edges of amphibole aggregates, biotite, ± chlorite	20-30%	

Light colored bands.

Dark amphibole (like in dark beds)	10%	1 <sup>mm</sup>
Biotite	10-20%	to 0.2 <sup>mm</sup>
Quartz ± other light colored granular material white, grayish, etc.	50%	under 0.1 <sup>mm</sup>
Unrecognized	25%±	

Strike, - East and west to N 70 E. Dip steep northward (overtured?). Close (above?) magnetic belt. Graywacke plus basic volcanic ash (Clarksburg)

#3. 870 paces South, 260 east of West 1/4 post. September 18, 1946.

- Grünerite, colorless to yellow, rather inter-laced. 50% to 0.1 x 1<sup>mm</sup>  
 Magnetite Trace  
 Quartz 5% 0.1<sup>mm</sup>  
 Unrecognized (Grünerite, quartz?) 45% to 0.1<sup>mm</sup>  
 Strike N 60 W, etc. (crumpled), Dip SW (crumpled)  
 Grünerite phase of Bijiki iron formation
- #4. 1720 paces South, 200 East of NW corner. September 18, 1946
- Amphibole, colorless to yellow, (Grünerite?) 60% to 1 x 3<sup>mm</sup>  
 Some flat aggregates to 10<sup>mm</sup> diameter.  
 Quartz (perhaps vein quartz, parallel to beds) 5% " 2<sup>mm</sup>  
 Quartz (granular) in beds and disseminated, perhaps recrystallized chert 5% " 1<sup>mm</sup>  
 Magnetite 5%+(?) 0.1<sup>mm</sup>  
 Carbonate veins, 0.2<sup>mm</sup> thick across bedding.  
 Fine, mostly dark, unrecognized 10% to 0.1<sup>mm</sup>  
 Light, unrecognized (perhaps grünerite) 15%
- Perhaps grüneritic phase of pre-Negaunee (pre-Hemlock) Iron formation. About 5 feet thick, lying between coarse biotite schist beds (that may be "Siamo" slate ± Ash (Hemlock?). All cut by narrow, irregular pegmatite and quartz veins. Strike, - N. 80° E. Dip, - 75° S SE (overturned?)
- #5. 120 paces N, 330 East of West 1/4 post. September 19, 1946
- Grünerite 20% to 0.05 x 0.5<sup>mm</sup>  
 Magnetite to 10% under 0.1<sup>mm</sup>  
 Quartz, much of it in flattened aggregates to 2<sup>mm</sup> diameter. Over 5% 0.1<sup>mm</sup>  
 Grünerite, quartz, etc. 50% under 0.05 x 0.5<sup>mm</sup>
- Strike East and west to north and south. (Crumpled). Generally curving to northward to the east. Dip north (to west), 40° to 70°.
- Grüneritic phase of Bijiki iron formation.
- #6. 120 paces North, 20 East of West 1/4 post. September 20, 1946
- Irregular fragments of rhomb carbonate (Ankerite?) some partly dissolved out 5-10% to 12<sup>mm</sup>  
 Irregular fragments of gray, fine grained somewhat porous, soft material 10% " "  
 Irregular fragments of brown to black basaltic appearing material, quite porous 5% " 5<sup>mm</sup>  
 Irregular cavities by volume 20% " 8<sup>mm</sup>  
 Quartz grains or fragments 2% " 2<sup>mm</sup>  
 Amphibole (dark, fibrous, greenish-black) 40-50% to 1 x 3<sup>mm</sup>  
 Pyrite and chalcopyrite Traces  
 Biotite 5% to 0.5<sup>mm</sup>  
 Unrecognized, mostly dark 10% to 0.5<sup>mm</sup>
- Strike about East & West (?), Dip northward(?).  
 Clarksburg Tuff.

#5. 360 paces south, 5 East of North 1/4 post. August 9, 1946

Feldspar, calcic or Albite	30-40%	to 5 x 8 <sup>mm</sup>
Feldspar (probably including end views & sections parallel to b), undetermined	10%	" " "
Quartz, disseminated & in small aggregates	30%	to 1 <sup>mm</sup>
Biotite ± other dark minerals	5-10%	under 1/2 <sup>mm</sup>
Sericite (much of it yellowish)	5-10%	" 2 <sup>mm</sup>
Feldspar, sericite, quartz	10-20%	under 1 <sup>mm</sup>

Strike,-a little west of north. Dip,-80°± eastward(?).

Granitized sediment--probably Ajibik quartzite. Exposed in an interrupted north and south striking ridge. Exposed width is a little over 20 paces.

#6. 540 paces South, 5 East of North 1/4 post. July 9, 1946

Chlorite ± Biotite	25%	mostly under 1/2 <sup>mm</sup>
Amphibole (dark greenish black)	10%	to 1/2 x 1 <sup>mm</sup>
Feldspar, quartz, etc.	20%	under 0.1 <sup>mm</sup>
Unrecognized, dark grayish to greenish black, and probably including ends of amphiboles and edges of chlorite and biotite plates.	50%+	under 0.1 <sup>mm</sup>

Strike,- N. 75° E. Dip 80° eastward. Probably a sheared basic dike, about 3 feet wide, in granitized Ajibik.

#7. 110 paces South, 100 East of North 1/4 post. July 16, 1946

Grünerite, interlaced (not radiated)	60-70%	0.1 x 1 <sup>mm</sup>
Magnetite, in 1-2 <sup>mm</sup> beds	5-10%	under 0.1 <sup>mm</sup>
Magnetite, disseminated	25%	to 1/2 or 1 <sup>mm</sup>
Pink garnets (mostly confined to a few narrow beds)	2- 5%	1/2 <sup>mm</sup>

Strike,-North 80° west, dip, -70° northward. Sheared, with an appreciable amount of the Grünerite orientated parallel to the shearing, (or about vertical) at 20° to the bedding. (Bedding dips 85° north in places)

Grünerite phase of the Negaunee iron formation, a few paces in the foot (south) of a very strong magnetic belt.

#8. 325 paces south, 475 east of north 1/4 post. July 9, 1946

Grünerite	70-60%	to 0.2 x 1 <sup>mm</sup>
Magnetite	20% or more?	to 1/2 <sup>mm</sup>
Reddish pink garnets	5-10%	1/2 <sup>mm</sup>

Strike,-about NW (folded and somewhat crumpled). Dip,-75° NE. Much of the Grünerite about evenly divided in orientation from parallel to the bedding to parallel to the cleavage, which is about 15° steeper.

Grünerite phase of the Negaunee iron formation, a few paces below (SW of) a very strong magnetic belt.

- #9. 410 paces south, 715 east of north 1/4 post July 16, 1946  
 Fragments of recrystallized iron carbonate ? % 1<sup>mm</sup> (across individual  
 (Ankerite?), to more than 30<sup>mm</sup>. Partly Cl)  
 dissolved out.  
 Areas or fragments of fine grained grayish 20%  
 material in which are many  $\frac{1}{2}$ <sup>mm</sup> plates of  
 chlorite or biotite.  
 Calcic Feldspar, a few fragments to 2x6<sup>mm</sup>  
 Clinocllore (?), a few plates to 3<sup>mm</sup>.  
 Rhombohedral carbonate matrix (?) 5-10% to 1<sup>mm</sup>  
 Grayish, soft, perf+ Cl (probably more  
 rhombohedral carbonate) 40+% under 0.5<sup>mm</sup>  
 Quartz, or other hard material ?% under 0.1<sup>mm</sup>  
 Irregular cavities, by volume 5% to 5<sup>mm</sup>  
 Chalcopyrite and pyrite Traces  
 Strike NW. dip steep NE.

Clarksburg tuff in top of Bijiki iron formation. (Or Bijiki plus  
 ash and fragments of Clarksburg). Near weak magnetic belt.

- #10. 7 or 8 paces east and 3 or 4 south of the #9 specimen, but  
 apparently about 5 paces stratigraphically NE of #9 and probably  
 below #9 as the formations here seem to be overturned. July 16, 1946

Rhombohedral carbonate (Ankerite?) 50-70% mostly under 1<sup>mm</sup>  
 Clinocllore or biotite 10% to  $\frac{1}{2}$  or 1<sup>mm</sup>  
 Quartz 5% to 1<sup>mm</sup>  
 Fine grained gray material, unrecognized 20% under  $\frac{1}{2}$ <sup>mm</sup>  
 Fine grained dark material 5% "  $\frac{1}{2}$ <sup>mm</sup>

A layer of iron rust in which small scales  
 of chlorite(?) are visible, coats the weathered surface to a  
 depth of several millimeters. The iron carbonated seems to  
 compose the bulk of the specimen as a fine groundmass or matrix  
 and also occurs in irregular spots and streaks (fragments or  
 broken beds?)

Strike, -about NW. Dip steep NE (overturned?). On, or very close  
 to a weak magnetic belt trending northwestward.

Cherty iron carbonate (recrystallized) phase of the Bijiki iron  
 formation, with probably a little fine Clarksburg ash mingled  
 with the top of the iron formation.

- #11. 370 paces South, 710 east of North 1/4 post. July 16, 1946

Ankerite (or other ferruginous rhomb carbonate) 50-85% to  $\frac{1}{2}$ <sup>mm</sup>  
 Chlorite or biotite, a few small areas  
 a few millimeters across 1-2% 0.1<sup>mm</sup>  
 Amphibole (actinolite?) one or more areas  
 3<sup>mm</sup> across.  $\frac{1}{2}$  x 1<sup>mm</sup>  
 Chlorite or biotite (or both), disseminated 5-10% 0.1<sup>mm</sup>  
 Iron rust coating several mm thick in which are  
 many 0.1<sup>mm</sup> scales of chlorite(?).

Strike,-NW. Dip,-Steep NE (Overturned?). On or near a weak magnetic belt trending about NW. Area between #10 and #11 is probably a syncline with both limbs about parallel and dipping NE. A finer grained iron carbonate phase of the Bijiki iron formation.

- #12. 100 paces North, 130 West of East 1/4 post. July 8, 1946  
(This 1/4 post is too far north).

Amphibole, greenish black, to (more abundant in some layers)	10-20%	to 1 x 2 <sup>mm</sup>
Biotite	5%	to 1/2 <sup>mm</sup>
Unrecognized dark minerals	10-20%	under 1/2 <sup>mm</sup>
Rhombohedral carbonate, disseminated (exclusive of 1-2 <sup>mm</sup> veins)	10%	under 1/2 <sup>mm</sup>
Unrecognized light colored minerals including some (perhaps considerable) quartz	25%	to 0.1 <sup>mm</sup>
Grayish to dark greenish, unrecognized	20-49%	under 0.1 <sup>mm</sup>

Prominently bedded in field, faintly in specimen. This is the matrix or country rock of the veins like specimen #1.

Strike, E NE, steep northward dip. Crumpled some in places.

Strike is northwesterly about 40 paces to the west and north. Graywacke plus Clarksburg ash overlying Bijiki iron formation. 50 paces or so above (north of) magnetic belt of medium intensity.

- #13. 435 paces south, 285 west of NE corner. September 3, 1946

Chlorite or biotite	10%	0.1 <sup>mm</sup>
Chlorite	1%	1/2 to 1 <sup>mm</sup>
Rhombohedral iron bearing carbonate	60-70%	0.1 <sup>mm</sup>
Quartz	10%(?)	0.1 <sup>mm</sup>
Unrecognized fine grayish to greenish black	10-20%	to 0.1 <sup>mm</sup>

Exposed surface has a crust, several mm thick, of iron rust with chlorite.

Strike,-NW. Dip varies from 80° SW to 70° NE. Crumpled in places.

From an area of moderately high readings between two northwest trending magnetic belts of which the northern one is weak but the southern one quite strong. Probably an anticline.

Cherty iron carbonate (plus a little fine Clarksburg ash?) phase of the Bijiki iron formation. Probably quite close to the top.

- #14. 440 paces South, 290 West of NE corner. September 3, 1946

Amphibole, greenish black and somewhat fibrous	60%	1x2 <sup>mm</sup> (a few larger).
Feldspar (altered partly to sericite (?) and quartz	20%	under 1 <sup>mm</sup>
Biotite (& chlorite?)	5%	to 1 <sup>mm</sup>
Unrecognized	15%	0.1 <sup>mm</sup> ±

Strike,-NW ? Dip NE? (Steep?)

Uralitic Diabase? Probably a Clarksburg dike.

#15. 450 paces South, 710 east of N 1/4 post (290 W of NE cor). Sept. 3, 1946

Rhombohedral iron carbonate (ankerite?)	50-80%	0.1 <sup>mm</sup>
Chlorite or biotite (or both)	25-15%	0.1 <sup>mm</sup>
Quartz	over 5%	0.1 <sup>mm</sup>

Coating of iron rust, with abundant chlorite scales, forms a crust several <sup>mm</sup> thick on the weathered surfaces.

Cherty iron carbonate (finely recrystallized) phase of Bijiki.  
(Near top?)

#16. 300 paces south, 480 east of North 1/4 post. September 3, 1946

Irregular fragments of fine grained dark rock  
 " " " " soft, light colored rock  
 " of rock made of granular quartz (Recrystallized chert or quartzite?)  
 Irregular carbonate (Ankerite?) rock  
 Irregular fragments of dark rock that is mostly dark amphibole.  
 Matrix that is mostly dark greenish black amphibole (1 x 2<sup>mm</sup>) with considerable biotite and chlorite in scales to  $\frac{1}{2}$ <sup>mm</sup>.

Clarksburg Tuff.

Strike,-??, Dip,-???. From what is probably a boulder of more than 50 tons. About 20 paces north of Gruneritic phase of the Negaunee iron formation--that by ledge, magnetics and character is almost undoubtedly near the base of the iron formation.

#17. 490 paces south, 260 West of NE corner. September 4, 1946

Fragments (?) of feldspar (sericitized?)-quartz	1% to 3 <sup>mm</sup>
Fragments of Rhomb carbonate (Ankerite?)	2% to 3 <sup>mm</sup>
Matrix (?) of greenish black (almost black) amphibole	50% to 1x4 <sup>mm</sup>
Biotite	5% to $\frac{1}{2}$ <sup>mm</sup>
Unidentified dark material (probably mostly ends of amphiboles and edges of biotite $\pm$ chlorite	20%
Feldspar, quartz and other (?) light colored minerals	20% to 1 <sup>mm</sup>

Strike North 45° W. Dip nearly vertical, varying from steep SW to 70° NE.

A 10 to 20<sup>mm</sup> bed or band runs through the specimen. This band is reddish brown and shows an abundance of biotite scales to  $\frac{1}{2}$ <sup>mm</sup> with no general parallelism of orientation. A few small amphibole crystals and a considerable amount of very fine grayish material much of which shows minute cleavage flashes.

Adjacent country rock is carbonate phase of Bijiki iron formation striking about parallel. Clarksburg (?) graywacke or ash at, or near the top of the Bijiki iron formation. Structure --may be crest of an anticline.

#18. 715 paces South, 275 West of NE. corner September 13, 1946

Light colored beds (to 10<sup>mm</sup>)  
 Granular quartz (Recrystallized chert?) to 50% 0.1<sup>mm</sup>  
 Biotite (or other reddish brown mica) 10% 0.1<sup>mm</sup>  
 Gr<sup>u</sup>nerite, varying proportions up to 30+% to  $\frac{1}{2}$ <sup>mm</sup> long.  
 Pale reddish garnets, varying " " 10% to  $\frac{1}{2}$ <sup>mm</sup>  
 Unrecognized, most likely quartz & gr<sup>u</sup>nerite 0 to 50%

Dark beds (to 15<sup>mm</sup>) Dark and light about equal proportions.  
 Predominantly biotite (or other nearly black mica) to 1<sup>mm</sup>, with  
 subordinate fine quartz and other light colored minerals under  
 $\frac{1}{2}$ <sup>mm</sup> and a few reddish garnets about  $\frac{1}{2}$ <sup>mm</sup>.

Strike NW, Dip steep NE. Top or near top of Bijiki, with Clarksburg.

#19. 690 paces South, 285 west of NE. corner September 14, 1946

Biotite (perhaps including some chlorite) 50% 0.0 to 0.5<sup>mm</sup>  
 Quartz 10% 0.1<sup>mm</sup>  
 Other light colored material 30% to 0.1<sup>mm</sup>  
 Pale reddish garnets 5%? 0.2<sup>mm</sup>

Cleavage (due to parallel arrangement of much of the biotite) at  
 10° to the faint bedding.

Strike,- in general northwesterly. Dip, near vertical. N.

Mica schist, probably from graywacke at or near the base of  
 the Clarksburg. Within a few paces of the top of the Plan  
 Bijiki iron formation, and specimen #18. 8 inches-

#20. Taken 5 paces west of #19 and apparently about 10 feet September 14, 1946  
 stratigraphically below, but formation is so contorted  
 here that the stratigraphic relations were not clear.  
 The specimen appears to be almost identical in character  
 with #19 and is most likely from the same bed. This  
 specimen #20 is almost immediately above the strong magnetic  
 belt running northwesterly. Rocks of the magnetic belt do  
 not outcrop in the immediate vicinity, this specimen being  
 taken from the extreme SW edge of the outcrop closest to the  
 belt to the SW. Strike here about 70° W of N. Dip about  
 vertical. Crumpled.

#21. 480 paces South, 220 West of NE corner. September 14, 1946

Pinkish garnets, from 10% to 60% in different  
 beds Average about 30-50% 1<sup>mm</sup>  
 Chlorite or biotite 30% 0.2<sup>mm</sup>  
 Iron hydrate, disseminated lmm spots 2%  
 Unrecognized, perhaps including some quartz,  
 but probably mostly more fine garnet, chlorite, etc. 30% 0.1<sup>mm</sup>

Strike,-N 70° W. Dip,-about vertical. (Strike varies from  
 N 60 W to N 80 W.).

Occurs as narrow belt a few inches thick only a few inches  
 above nearly pure gr<sup>u</sup>nerite phase of Bijiki iron formation.

#22. 450 paces South, 195 west of NE corner.

September 16, 1946

Angular, irregular fragments of  
 Hard, light gray, granular material (Rexled chert?) to 20<sup>mm</sup> long  
 Recrystallized rhombohedral carbonate (Ankerite?) to 3-4<sup>mm</sup>  
 " Rhomb carbonate plus amph, chlorite, etc. to 5<sup>mm</sup>  
 Dark blackish green fragments mostly of amphibole to 4x8<sup>mm</sup>  
 Amphibole, chlorite± biotite plus carbonate to 10<sup>mm</sup>  
 Matrix (?) of  $\frac{1}{2}$ <sup>mm</sup> biotite, greenish black amphibole to 1x3<sup>mm</sup>, and  
 chlorite (?) 0.1<sup>mm</sup> with subordinate amount of light colored material.

Strike,-NW. Dip, nearly vertical. Clarksburg Tuff, fine frag-  
 mental phase, interbedded with coarser tuff.

#23. 5 paces south and 40 west of #22. (i.e. about 450+ South 9-16-46  
and 230 West of NE corner.

(Most, if not  
 Irregular angular fragments of the following material,--(all to 15<sup>mm</sup> long)  
 Fine grained, granular, mostly hard, white to gray  
 perhaps mostly recrystallized chert from the  
 iron formation, grain under 0.1<sup>mm</sup>. 5-10%  
 Recrystallized rhombohedral carbonate (Ankerite?),  
 to 1<sup>mm</sup> across cleavage surfaces. to 5%  
 Blackish (greenish-black) aggregates or fragments  
 mostly amphibole with some biotite± chlorite.  
 Amphibole about 1x3<sup>mm</sup>, biotite, etc. 0.5<sup>mm</sup>. 20%  
 Mostly biotite± chlorite, 0.3<sup>mm</sup> 5-10%  
 Rhomb, carbonate plus chlorite, etc. scales or  
 crystals 5%  
 Matrix (?) of fine micaceous material, carbonate,  
 quartz, amphibole, etc.

Strike,-northwesterly. Almost vertical.  
 Clarksburg Tuff. Near axis of anticline?

#26. 655 paces South, 130 West of NE corner.

September 17, 1946

Rhombohedral carbonate (Ankerite?)	40-50%	1 <sup>mm</sup>
Biotite	5%	0.1 <sup>mm</sup>
Chlorite or Biotite	15%	to 0.1 <sup>mm</sup>
Magnetite octs	1?	under 0.1 <sup>mm</sup>
Quartz or other light colored hard mineral	1 to 5?	under 0.2 <sup>mm</sup>
Unrecognized, mostly light colored and perhaps mostly more ankerite	40%	under 0.2 <sup>mm</sup>

Rock is mottled with areas to 5-6<sup>mm</sup> diameter made up of a higher %  
 of chlorite, etc. Rock is covered on weathered surfaces with a  
 coating of iron hydrate several millimeters thick.

Strike,- N 60° E. Dip NW.  
 Recrystallized carbonate phase of Bijiki iron formation. (Probably  
 near the top).

#24. 770 paces South, 40 paces West of NE corner. September 17, 1946

Ankerite (or other rhomb carbonate)	30-50%	1 <sup>mm</sup>
Chlorite (5-10% to 0.5 <sup>mm</sup> )	30%	0.2 <sup>mm</sup>
Biotite (0.1 <sup>mm</sup> ), Amphibole (1 <sup>mm</sup> long)	Traces	
Quartz	5-10%	to 0.2 <sup>mm</sup>
Pyrite	Trace	
Greenish fragments or areas to 4 <sup>mm</sup> made up of 1 <sup>mm</sup> chlorite	10%	
Grayish material (may be more quartz, carbonate, etc.)	10-25%	under 0.2 <sup>mm</sup>

A rough, porous crust several millimeters thick in which are abundant minute (0.1<sup>mm</sup>) scales of chlorite and a few  $\frac{1}{2}$ <sup>mm</sup> scales of biotite, occurs on weathered surfaces.

Strike, NE. Dip NW. Top of Bijiki iron formation with, probably appreciable amount of Clarksburg fine ash.

#25. 740 paces South, 80 paces west of NE corner September 17, 1946

Chlorite	30-40%	to 0.1 <sup>mm</sup>
Biotite, apparently at least	5%	to 0.03 <sup>mm</sup>
Chlorite, biotite, etc.	10-20%	under 0.1 <sup>mm</sup>
Dark greenish black amphibole	1%	under 1 $\frac{1}{2}$ <sup>mm</sup> long.
Rhombohedral carbonate (Ankerite?)	20-30%	to 1 <sup>mm</sup>
Quartz	5%	to 1 <sup>mm</sup>
Light Colored minerals (Quartz, carbonate?, etc.)	10-30%	under 1 <sup>mm</sup>

A thick, rough, brownish crust (several <sup>mm</sup> thick) of iron hydrate on the weathered surfaces. This crust shows abundant 0.2-0.3<sup>mm</sup> flakes of yellow-brown biotite and much fine chlorite.

Strike, -N 60° E, Dip, -northwestward.  
Graywacke(?)

#27. 620 paces South, 215 west of East 1/4 post. September 18, 1946

Feldspar, predominantly alkalic. Some striated, but most of the striated very finely so and probably albitic. The larger feldspars nearly all alkalic and many of them pseudo-porphyrific.	50%	to 4x4x8 <sup>mm</sup> (mostly less than 3 <sup>mm</sup> long)
Quartz, a few aggregates of 1 <sup>mm</sup> grains totalling 5 to 6 <sup>mm</sup> across.	30%	to 1-2 <sup>mm</sup>
Biotite, often in aggregates 3-4 <sup>mm</sup> across.	5%	to 0.3 <sup>mm</sup>
Sericite	1-5%	under 0.05 <sup>mm</sup>
Quartz, end views of feldspar, sericite, etc.	15-20%	

Strike about E & W (varies from N 70 W to N 60 E). Dip, steep northward.

Granitized quartzite, probably Ajibik.

#28. 625 paces South, 215 West of East 1/4 post. September 18, 1946

Very much like #27 except few (if any) pseudo-phenocrysts of feldspar and feldspar mostly under 4<sup>mm</sup> and very little of it visibly striated. Quartz 1<sup>mm</sup> and less. Both #28 and #27 are cut by quartz veins, mostly about parallel to the bedding. #28 is more obviously granular in appearance than #27.

Granitized Ajibik (?) Quartzite. Dip steeply northward.

#29. 420 paces South, 40 paces West of NE corner. September 21, 1946

Ankerite (or other iron bearing rhombohedral carbonate)	60%	0.1 <sup>mm</sup>
Ankerite (or siderite) (in streaks, beds or veins)	10%	1.0 <sup>mm</sup>
Chlorite or biotite	10%	under 0.1 <sup>mm</sup>
Unrecognized, mostly light colored and including appreciable quartz or other hard material	30	under 0.2 <sup>mm</sup>

An iron hydrate coating several millimeters thick, in which are very abundant micaceous scales less than 0.1<sup>mm</sup> in diameter, covers the weathered surfaces.

Carbonate phase of the Bijiki iron formation. Strike about E & W. Dip 70° to 90° northward.

#30. 570 paces South, 135 West of NE corner. September 26, 1946

Coarser, dark beds, 10 to 30<sup>mm</sup> thick

Amphibole, dark greenish black	60%	to 3 x 6 <sup>mm</sup>
Chlorite (or biotite)	20%	under 0.1 <sup>mm</sup>
Ankerite (or other iron bearing rhombohedral carbonate)	5%	to 1 <sup>mm</sup>
Pyrite	Trace	
Unrecognized (mostly dark)	15%	

Lighter colored bed, 25<sup>mm</sup> thick. Finer grained.

Dark greenish black amphibole	5-20%	to 2 <sup>mm</sup> long.
Pale amphibole	5±%	to 1 <sup>mm</sup> long.
Quartz (Considerable?)	5-15%	to 0.1 <sup>mm</sup>
Chlorite (or biotite)	10-20%	under 0.1 <sup>mm</sup>
Unrecognized	50±%	mostly under 0.1 <sup>mm</sup>

Strike,-northeasterly, but curves (concave to the NW.)  
Dip,-rather flat to North and Northwest.

Clarksburg, in hanging (several paces) of Bijiki iron formation.

- #1. 300 paces North, 20 West of SE corner July 20, 1946
- |  |     |   |
|--|-----|---|
| Alkalic feldspar (some of it albite)<br>(Albite and microcline?, intergrown)                             | 50% | to 1 <sup>cm</sup> with a few<br>much larger. |
| Albite or low calcic feldspar  | 10% | to 4 x 3 x 8 <sup>mm</sup>                    |
| Feldspar, probably mostly alkalic  | 25% | mostly smaller or<br>end views.               |
| Quartz, almost "graphic" in places   | 20% | to 15 <sup>mm</sup> long aggre-<br>gates.     |
| Micaceous material, a little of it muscovite<br>but mostly dark. In aggregates to 15 <sup>mm</sup> diam. | 5%  | 1 <sup>mm</sup>                               |
- Strikes about NW and cutting material of Specimen #2.  
Pegmatite, irregular. From 6 inches to 2 feet wide.
- #2. 310 paces North, 10 paces West of SE corner July 20, 1946
- |   |     |  |
|---|-----|--|
| Feldspar, largely alkalic but considerable calcic<br>feldspar present. Feldspar (especially the al-<br>kalic) appears to be partly altering to (or from)<br>sericite. | 40% | to 3 x 4 <sup>mm</sup><br>(Mostly under<br>2 <sup>mm</sup> ) |
| Quartz, rather evenly sized and arranged grains<br>fairly evenly distributed.   | 40% | $\frac{1}{2}$ to 1 <sup>mm</sup>                             |
| Biotite   | 5%  | $\frac{1}{2}$ to 1 <sup>mm</sup>                             |
| Chlorite or biotite   | 10% | to $\frac{1}{2}$ <sup>mm</sup>                               |
| Unrecognized, mostly feldspar and (or) quartz   | 5%  |  |
- Strike, -NW. Dip NE. (Folded some).  
Granitized graywacke(?), probably Kitchi.
- #3. 180 paces North, 20 West of SE corner. July 20, 1946
- |  |        |                                  |
|--|--------|----------------------------------|
| Quartz grains  | 60%    | $\frac{1}{2}$ <sup>mm</sup>      |
| Feldspar (Disseminated), alkalic                                       | 5-10%  | $\frac{1}{2}$ <sup>mm</sup>      |
| Feldspar, mostly alkalic, in 1 to 2 <sup>mm</sup><br>seams or veinlets | 10%    | to 1 $\frac{1}{2}$ <sup>mm</sup> |
| Sericite   | 5%     |                                  |
| Biotite or chlorite  | 5%     | 0.1 <sup>mm</sup>                |
| Unidentified (more feldspar, sericite, quartz,<br>etc.)                | 10-15% |                                  |
- Strike, -E & W to N 75° W. Dip steep southward.  
Quartzite. Perhaps Ajibik or less likely Mesnard.

#8. 150 paces North, 80 East of SW corner

July 20, 1946

A fragment (?) of pegmatite (about 30 x 40<sup>mm</sup>)  
composed mostly of coarse microcline.

A few smaller fragments of pegmatite.

A few thin fragments (?) of biotite schist

Biotite 0.1<sup>mm</sup>

Fragment of finely granular material (mostly  
quartz, under 0.1<sup>mm</sup>) similar to matrix but lighter color.

Matrix of finely granular quartz (0.1<sup>mm</sup>) with a small  
% dark material very finely disseminated in irregular  
spots or mottlings 1 to 2<sup>mm</sup> across, and with numerous  
grains (?) about 0.5<sup>mm</sup> altered to iron hydrate.

Strike about E & W. Dip steep south. Conglomerate (or  
conglomeratic quartzite). Probably Ajibik or Mesnard.

#9. 155 paces North, 80 East of SW corner (5 paces N of #8). July 20, 1946

Fragments of pegmatite (coarse microcline and quartz),  
from 2 to 30<sup>mm</sup>. (to 2<sup>mm</sup>) (1<sup>mm</sup>)

Fragments of rock with alkalic and calcic feldspar,  
quartz and chlorite (or biotite)  $\frac{1}{2}$ <sup>mm</sup>.

Matrix much like #8 except appreciably more feldspar  
and chlorite but less quartz.

Strike E & W. Dip 80° to 90° southward.  
Conglomerate (Ajibik or Mesnard?)

#10. 250 paces North, 20 East of SW corner.

July 20, 1946

Feldspar, both alkalic and calcic	20%	to 2 x 3 <sup>mm</sup>
Quartz, fairly even sized grains	40%	$\frac{1}{2}$ <sup>mm</sup>
Biotite and (?) chlorite	20%	0.3 <sup>mm</sup>
Sericite. Much of the feldspar appears to be 5% altering to (or from) sericite.		
Unidentified. Probably includes ends of feldspars, fine quartz, edge of biotite, etc. plates and sericite.	15%	

Strike, - N 70° W, etc. (Folded). Dip 60° (etc) northeastward.  
Quartz monzonitic gneiss phase of a graywacke.  
Probably Kitchi graywacke.

- #10. 440 paces North, 30 East of South 1/4 post. June 13, 1946
- |  |        |                         |
|--|--------|-------------------------|
| Cleavage flashes abundant in specimen.   | 20-40% | under 0.1 <sup>mm</sup> |
| some may be graphite, others may be mica division (Mica, chlorite or chloritoid) |        |                         |
| Graphite, earthy. Enough to mark paper.  | ??     | earthy                  |
- Strike, - S 85° W. Dip, -about vertical.  
Bijiki (footwall) graphitic slate.
- #11. 460 paces North, 330 west of South 1/4 post. June 13, 1946  
From south edge of dump. Pit is 60 and more paces to the North.
- |   |        |                  |
|---|--------|------------------|
| Iron hydrate.   | 50-70% | earthy           |
| Quartz, disseminated in $\frac{1}{2}$ mm grains or spherules and in veins to 2 <sup>mm</sup> , the quartz completely filling the narrow ones but only lining the edges of the wider ones. | 10%    | $\frac{1}{2}$ mm |
| Hematite, in grains or spherules $\frac{1}{2}$ mm   | 2%     |                  |
| Unrecognized, disseminated through "limonite"   | 20-30% |                  |
- Ore from west pit at Dalliba (or Phoenix) Mine.
- #12. 320 paces North, 400 West of South 1/4 post. June 13, 1946
- |  |        |                         |
|--|--------|-------------------------|
| Quartz, minute grains  | 20-40% | 0.1 <sup>mm</sup>       |
| Minute cleavage flashes, a few elongated apparently not chlorite | 10%    | to 0.1 <sup>mm</sup>    |
| Chlorite   | 20?    | to 0.1 <sup>mm</sup>    |
| Unrecognized, perhaps largely chlorite                           | 40%±   | under 0.1 <sup>mm</sup> |
- A 10 to 12<sup>mm</sup> wide quartz vein cuts across the bedding at 60° to 70°. The bedding is slightly bent on either side of the quartz vein.
- Strike, - E & W. Dip, -80° north.  
Fine graywacke, probably upper Goodrich.
- #13. 40 paces North, 280 West of East 1/4 post. July 1, 1946
- |   |        |                      |
|---|--------|----------------------|
| Graphite  | 30-70% | Earthy               |
| Cleavage flashes, some of them graphite perhaps, others mica division (Mica, chlorite, chloritoid?) | 20%    | to 0.1 <sup>mm</sup> |
| Pyrite  | 5%     | $\frac{1}{2}$ mm     |
- Cleavage at 30° to bedding.
- Strike, -East and West. Dip near vertical.  
Bijiki (foot?) graphitic slate (or slaty graphite).

#14.	600 paces North, 590 East of East 1/4 post.		August 17, 1946
	Amphibole (dark greenish black) makes up the bulk of some beds, scarce in others.	15%	to 2 x 5 <sup>mm</sup>
	Chlorite, the principle mineral in the finer grained beds that lack amphibole	20%	0.1 <sup>mm</sup>
	Clinocllore or other chlorite in partial rosettes and plates lining cavities and seams.	1%	to 3 <sup>mm</sup>
	Biotite	1%	to 0.2 <sup>mm</sup>
	Quartz, mostly in veins and cavities	5%	" 1 <sup>mm</sup>
	Chlorite ± amphibole, biotite, etc.	40-60%	" 0.5 <sup>mm</sup>
	Unidentified light colored material	10-20%	

From a test pit in foot (?) of Bijiki, on north side. May be a Clarksburg dike in part.

#15. Same test pit. August 17, 1946

Like the finer grained part of #14.

Chloritic schist.

May be a sheared Clarksburg dike.

#16. 840 paces North, 360 West of SE corner. August 22, 1946  
(West side of old railroad cut).

1/2 to 1 <sup>mm</sup> rosettes of chlorite	5%	0.2 to 0.5 <sup>mm</sup>
Chlorite, mostly in parallel position along the rock cleavage surfaces.	30%	0.05 <sup>mm</sup>
Unrecognized, including considerable graphite	65%	under 0.1 <sup>mm</sup>

Chloritic schist, quite graphitic. Some beds (not showing in specimen, contain considerable pyrite.

Strike-near E. & W. Dip,-nearly vertical.

- #6. From waste dump, about 590 paces N. 280 West of South 1/4 post May 16, 1946  
Material is probably from the water filled pit that is about 520 paces N, 150 West of East 1/4 post; or a little more than 100 paces southeastward.
- Crust of rhombohedral carbonate (Calcite or dolomite?--non-rusting), lines the reiform surface of a large vug and varies from 5 to 10<sup>mm</sup> thick.
- Calcite or dolomite in narrow veins.
- Calcite or dolomite disseminated through- 10-40%  
out the specimen in rhomb cleavage flashes to 1/2<sup>mm</sup>
- Hematite and iron hydrate, intimately mixed 20-50% earthy
- Hematite spheres disseminated through upper (or outer) part of carbonate crust to 1/2<sup>mm</sup>
- May be a little Manganese oxide or hydrate present.
- Lean Bijiki ore.
- #7. Same locality as #6. May 16, 1946
- Hematite (in 10<sup>mm</sup>) beds or bands 40% earthy
- Hematite and iron hydrate ("Limonite") mixed 40% earthy
- Non-ferrous(?) rhombohedral carbonate 5% to 1/2<sup>mm</sup>
- Unidentified hematite, "limonite", carbonate perhaps manganese oxide or hydrate, etc. 15% earthy to 0.1<sup>mm</sup>
- Bijiki iron ore. Probably 55%± iron.
- #8. 540 paces North, 420 West of South 1/4 post. May 16, 1946
- Quartz, rather even grains with fine quartz in between. 70-90% to 1/2<sup>mm</sup>
- Chlorite, and (?) other dark material between the grains 5-15% under 0.1<sup>mm</sup>
- From southwest edge of exposed westward plunging anticline of Goodrich quartzite. Dark gray or "black" quartzite.
- #9. 320 paces South, 300 East of West 1/4 post. May 21, 1946  
(About 275 paces WNW of #8, and apparently on the NW edge of same anticline).
- Goodrich quartzite like #8, except probably a little more dark material between the quartz grains. Black quartzite. Dip 80° WNW.
- #5. Same location as #6 and #7. May 16, 1946
- Granular quartz (recrystallized chert?) 30% 0.1<sup>mm</sup>
- "Limonite" some in earthy yellow-brown spots and some in pseudomorphs after Grunerite rosettes 2 to 3<sup>mm</sup> diameter. 40% earthy
- Magnetite (partly altered to hematite), hematite, hard "limonite", etc. 10-30% earthy to 0.05<sup>mm</sup>
- Bijiki iron formation. Lean ore phase.

- #10. 200 paces South, 200 East of West 1/4 post. May 21, 1946
- |   |        |                      |
|---|--------|----------------------|
| Magnetite   | 10-20% | 0.05 <sup>mm</sup>   |
| Quartz (recrystallized chert?)                      | 50%±   | 0.05 <sup>mm</sup>   |
| Grünerite, mostly in rosettes 2 <sup>mm</sup> diam. | 20-30% | 1 <sup>mm</sup> long |
| "Limonite" spots 1/2 <sup>mm</sup> diameter         | 5%     | earthy               |
- Beds from 1<sup>mm</sup> to over 10<sup>mm</sup>. Some beds about 1/2 magnetite, others mostly recrystallized chert. Beds or layers of grünerite in between the magnetite rich and the more siliceous layers.
- Strike, -N. 80° W, Dip, -50° northward. Within 10 paces of a very strong magnetic belt to the north.  
Grüneritic phase of the Bijiki iron formation (foot-wall(?) side).
- #11. 490 paces North, 10 West of South 1/4 post. May 22, 1946
- |  |              |                          |
|--|--------------|--------------------------|
| Reddish brown garnets  | 1-5%         | 1 <sup>mm</sup>          |
| Chlorite or altered chloritoid plates                                  | 2%           | 1/2 x 1 <sup>mm</sup>    |
| "Limonite" coatings to 1/2 <sup>mm</sup> on joint planes and in veins. |              | earthy                   |
| Graphite   | large amount | earthy                   |
| Abundant cleavage flashes  |              | under 0.05 <sup>mm</sup> |
- Strike N 85° E, Dip, -30° northward. Interbedded with graphitic slate, slaty graywacke and recrystallized chert beds.  
Garnetiferous slaty graphite or graphitic slate.
- #12. 520 North, 240 East of South 1/4 post. June 3, 1946
- |   |  |                          |
|---|--|--------------------------|
| Abundant cleavage flashes   |  | under 0.05 <sup>mm</sup> |
| Considerable graphite   |  | earthy                   |
| "Limonite" and quartz in numerous veinlets to 1 <sup>mm</sup> wide at various angles to the cleavage. |  |                          |
- Strike, - presumably north of east. From shallow trench running north to northeasterly across the formation.  
Graphitic slate or slaty graphite. Presumably foot slate on south side of Bijiki iron formation. Northwest of Marine pit.
- #13. 620 paces North, 190 East of South 1/4 post. June 3, 1946
- Quartz veining in brecciated graphitic slate.  
A little pyrite showing, and in one cavity the quartz crystals are coated with 0.05<sup>mm</sup> crystals that may be marcasite.  
A little "Limonite" and earthy brownish-black to black material in fragments of what is probably wall rock.
- Strike, - N 80° E. Dip, -60° S. Veining or fault breccia in the footwall slate. From the north side of a pit about 250 paces NW of Marine Pit. This pit is perhaps on the north side of the same trough as the Marine Pit.

- #14. 170 paces North, 80 East of South 1/4 post June 4, 1946
- Grünerite, partly in rosettes and partly 60-80% to 1<sup>mm</sup> long  
interlaced.
- A small amount of micaceous material 0.05<sup>mm</sup>
- A little magnetite 0.05<sup>mm</sup>
- Some fine quartz (recrystallized chert?) 0.05<sup>mm</sup>
- Prominent coatings of iron rust (hematite and iron hydrate) on  
joint planes and other weathered surfaces.
- Strike,- northeasterly. Dip,-northwesterly (overturned?).  
Only a few paces north of a strong magnetic belt.
- Bijiki iron formation, grünerite phase.
- #15. 355 paces North, 5 paces West of SE corner June 6, 1946
- Quartz grains 40% to 0.5<sup>mm</sup>
- Silica and fine earthy dark material between  
the grains 20%
- "Limonite" in disseminated 0.5<sup>mm</sup> spots 2%
- Unrecognized, dark gray to black 35-40% under 0.05<sup>mm</sup>
- Strike,-South 80° west. Dip 85° northward.  
Goodrich quartzite.
- #16. 5 paces North of #15. June 6, 1946
- Similar to #15. Numerous quartz grains to 1<sup>mm</sup>, but most of them  
finer than in #15. Rock not quite so dark. Contains about 1%  
finely disseminated pyrite.
- Strike and dip the same as #15.
- Goodrich quartzite.
- #17. 430 paces North, 570 West of SE corner. June 8, 1946  
(South side of Marine Mine Pit).
- Angular slab like fragments of chlorite schist with chlorite  
from microscopic size up to 1/2<sup>mm</sup> plates.
- Angular fragments of very fine to earthy hematite.
- Strike,-North 60°-65° East. Dip,-steep northward (overturned).  
Brecciated (thrust faulted?) hanging wall of Bijiki iron formation.
- #18. 450 paces North, 580 West of SE corner. June 8, 1946  
North side of Marine Pit.
- Fragments (perhaps broken beds) of earthy hematite containing  
1<sup>mm</sup> and smaller grains (?) of quartz.
- Fragments or broken bands of recrystallized chert (quartz 0.05<sup>mm</sup>)  
Quartz, rhombohedral carbonate, hematite, "limonite" and a little  
pale greenish, earthy mineral in seams, veins and cavities.
- General strike,-ENE. Dip,-steep, almost vertical to steep north  
to steep south.  
Brecciated Bijiki iron formation.

- #19. 450 paces North, 580 West of SE corner June 8, 1946  
North side of Marine Pit.

A few fragments of earthy "limonite" and hematite, with much open space lined with reniform, hard steely hematite and gothite, and cavities partly to entirely filled with hard earthy hematite or iron hydrate.

Same location, strike and dip as #18 and #17.  
Brecciated Bijiki iron formation, ore phase.

- #20. Same location as #17, #18, and #19, but apparently a little June 8, 1946  
farther north (foot).

Minute cleavage flashes or crystal faces, most, but not all parallel to the bedding. Cleavage almost parallel to bedding. Probably mica. to 0.02<sup>mm</sup>  
"Limonite" coating on weathered surfaces and in  $\frac{1}{2}$ mm seams.  
Mostly dark gray. Some thin, more greenish beds.  
Little or no graphite.

Slate. Loose material from talus slope on north side of Pit.  
Strike, dip and exact position not available.

- #21. 470 paces North, 530 West. East end of Marine Pit. June 8, 1946

"Limonite"	60-90%	Earthy
Gothite, small blades in a few small cavities and seams	1%	$\frac{1}{2}$ mm
Rhombohedral carbonate (not ferruginous?) in cavities, to 5 or 6mm	$\frac{1}{2}$ %	1mm
Blackish irregular spots to 1 <sup>mm</sup> . Appear altered to "limonite".	5%	

Strike, -N 60 to 75° E. Dip, -65° northward.  
Bijiki iron formation. Ore

- #22. 120 paces North, 170 West of SE corner. June 29, 1946

Chlorite	30-50%	0.05 to 0.1 <sup>mm</sup>
Biotite	10+%	0.05 <sup>mm</sup>
Quartz probably more than	10%	to 0.1 <sup>mm</sup>
Elongated cleavage or crystal faces, dark, greenish black (Amphibole?, Tourmaline?)	1-%	to 0.3 <sup>mm</sup> long.

Chloritic schist. Perhaps Michigamme-Clarksburg.

Strike, -Nearly East and West. Dip, -Steep north.

Chlorite schist or chloritic slate. Bijiki or Michigamme (?) slate?.

- #23. 390 paces North, 30 West of East 1/4 post. August 31, 1946  
From northern pit of a north and south line of pits across  
the iron formation.

Quartz (recrystallized chert)	60%	0.05 to 0.1 <sup>mm</sup>
In nearly pure beds to 2 <sup>cm</sup> thick and also disseminated in darker beds with iron oxide.		
Grünerite, developed mostly perpendicular to the bedding, slightly radiated.	30%	1 <sup>mm</sup> long.
Magnetite, hematite, "limonite", etc. in darker beds with fine quartz.	10-%	Earthy to 0.02 <sup>mm</sup>

Strike probably about N 70° E and very steep. From northern strong magnetic belt of Bijiki (so called "Greenwood") that approaches here to within 40 paces of the southern strong magnetic belt labeled Bijiki, on 1930 Michigan Geological Survey map of this area. (The belts merge into one near the end of the fold about 200 paces to the west).  
Bijiki Iron Formation.

- #24. 360 north, 30 West of East 1/4 post. August 31, 1946  
From one of the southern pits of a line of pits across the  
Iron formation.

Grünerite, in rosettes and interlaced.	50%+	to 1 <sup>mm</sup> long.
Graphite, around and between the grünerite	10-30%	Earthy
Magnetite, (Considerable mixed with the graphite).		Less than 0.1 <sup>mm</sup>

Grünerite-graphite phase of the Bijiki Iron Formation.  
Strike and dip--see #23.

- #25.

#27. 45 paces South, 45 East of North 1/4 post.

August 29, 1946

Grün erite, mostly interlaced. 50-80% to 2<sup>mm</sup> long.  
 Brown, nearly spherical spots of brown streak-  
 ing scaly material. These show on the  
 weathered surface and may be an alteration  
 of similar shaped dark greenish black  
 spots throughout the specimen. 1-5%  
 Magnetite over 5% 1<sup>mm</sup> aggregates  
 0.1<sup>mm</sup>  
 Strike, -South 70° ± West. (curves). Dip, -about vertical.  
 Grades northward into grünerite schist. and South and west into  
 the material of specimens #28 and #29.  
 Bijiki Iron formation, Grün<sup>er</sup>ite phase.

#28. 70 paces South, 10 east of North 1/4 post.

August 29, 1946.

Quartz (apparently recrystallized chert). 60-80% 0.05 to 0.1<sup>mm</sup>  
 Magnetite 5+% under 0.1<sup>mm</sup>  
 Grün<sup>er</sup>ite 1% 0.5<sup>mm</sup> long  
 Unrecognized 15-35% under 0.1<sup>mm</sup>

Bijiki Iron formation, lean phase.

Strike, -North 70° East, quite closely folded (closed folds?).  
 Dip, -about vertical.

#29. 1 foot South of #28.

Fine granular material, probably mostly re-  
 crystallized chert. 95% to 0.03<sup>mm</sup>  
 "Limonite" veins 0.1<sup>mm</sup> running in various directions.  
 Narrow (0.05<sup>mm</sup>) veinlets stained greenish black or black.

Strike and dip, same as #28.

Bijiki iron formation, recrystallized cherty lean phase.

- #12. 580 paces South, 550 East of NW corner. June 14, 1946
- |   |       |                           |
|---|-------|---------------------------|
| Grünerite, some spherically radiated (in some 70% beds all in rosettes), some interlaced and in some layers developed perpendicular to the bedding. |       | to $1\frac{1}{2}$ mm long |
| Magnetite, disseminated through the grünerite bands and also forming nearly pure magnetite bands  | 5-30% | under 0.1mm               |
| Graphite, disseminated.   | 1-10% | Earthy                    |
- Strike a little north of east in general, but considerably folded and in some places crumpled. Dip, -70° to 90° overturned(?) to the northward.  
Bijiki Ironformation, Grüneritic phase.
- #13. Same locality, strike, dip and date.
- Shows one or more beds of finely recrystallized chert. Is less folded than #12.
- #14. 820 paces East, 820 South of NW corner. August 1, 1946
- |  |  |              |
|--|--|--------------|
| Grünerite, mostly interlaced and varying much in size in different layers. Probably over 50% |  | to 1mm long. |
| Magnetite, Considerable over 10%   |  | under 0.1mm  |
- Strike, locally northeast. Dip, -45° NW. About 300 paces SE of specimens #12 and #13, but at least twice that far along the strike.  
Bijiki iron formation, grüneritic phase.
- #15. 450 paces South, 300 West of North 1/4 post. June 26, 1946
- |  |        |                          |
|--|--------|--------------------------|
| Quartz (grains or recrystallized chert) More abundant in some beds, scarce or lacking in others).                | 20-50% | to 0.15mm                |
| Graphite, abundant in some beds and streaks and on slickensided surface.   | 5-20%  | Earthy                   |
| Quartz, (vein) in irregular veins, streaks or folded beds, and in lens shaped spots 2 or 3cm long and 5mm thick. | 20%    | $\frac{1}{2}$ mm "grain" |
| Unrecognized   | 10-50% | under 0.2mm              |
- Strike, -North 75-80° E. Dip, - 85° (Overturned?) South.
- Foot slate and graywacke of Bijiki. May be on north (or NW) side of anticline (or nose) as there is Goodrich quartzite to the West of this place that strikes to the south of this exposure.

- #16. From 3 feet south of specimen #15. June 26, 1946
- |  |                 |   |
|--|-----------------|---|
| Quartz grains  | 70%             | to $\frac{1}{2}$ mm                     |
| Pyrite cubes   | $\frac{1}{2}$ % | to $\frac{1}{2}$ mm                     |
| "Limonite" spots, some from weathered grains, others irregular and elongated | 5%              | $\frac{1}{2}$ mm to $\frac{1}{2}$ x 2mm |
| Gray to gray green scaly, soft   | 1-5%            | under 0.1mm                             |
| Chlorite   | 1-2%            | " "                                     |
| Magnetite  | Trace           | " "                                     |
| Unrecognized, light to dark gray and some to greenish black and black.       | 20%             | " "                                     |

Strike and dip,-same as #15. A bed, only a few feet thick in graywacke and slate. Presumably grades down into the Goodrich quartzite which is striking toward a point a few paces south of here, from an outcrop a little over 100 paces to the east.

- #17. 600 paces North, 580 East of SW corner. July 6, 1946
- |  |                     |                          |
|--|---------------------|--------------------------|
| Quartz grains                                      | 5%                  | to 1mm                   |
| Garnet dodecs, pale reddish brown                  | 1-1 $\frac{1}{2}$ % | $\frac{1}{2}$ mm         |
| Biotite  | 5%                  | to 0.2mm                 |
| Chlorite   | 10%                 | 0.1mm                    |
| Scaly material, probably mostly chlorite and mica. | 50%                 | to 0.1mm                 |
| Fine, earthy to scaly material (not identified)    | 20%                 | under 0.05 <sup>mm</sup> |

Chloritic schist. Clarksburg-Michiganne. Contains some fragments or concretions from a few millimeters to several centimeters. These have less chloritic material and more very fine sandy material.

Strike-, North 80° West. Dip,- about vertical  $\pm$  5°.

- #18. 430 North, 130 paces East of South 1/4 post. July 8, 1946
- Rounded fragments (up to several centimeters) of,-  
 Granular quartz (0.5<sup>mm</sup>) with a core (or central cavity) with coarse chlorite (or altered biotite), secondary striated feldspar (Albite?), and pyrite, etc.  
 Chlorite, mica and garnet (all to 0.5<sup>mm</sup>)  
 Quartz grains (0.1<sup>mm</sup>) finer chlorite, etc.  
 Quartz to 1<sup>mm</sup>, fine chlorite, amphibole (dark greenish black 2<sup>mm</sup> long), Hard "limonite" spots (to 2<sup>mm</sup>).

Matrix of dark greenish black amphibole, most of it about 1 x 2<sup>mm</sup>, with fine quartz packed between.

Specimen (not trimmed) is from a boulder or fragment over 2 ft. across embedded in the Clarksburg coarse tuff. Boulder may be Ajibik conglomerate. Tuff strikes near E & W but is much contorted with dips more commonly near vertical.

#19. 430 paces North, 130 East of South 1/4 post. July 19, 1946

One foot south of specimen #18

Fine gray granular material, probably

largely quartz	50%	to 0.05 <sup>mm</sup>
Chlorite	20%	to 0.1 <sup>mm</sup>
Biotite	5%	to 0.1 <sup>mm</sup>
Biotite or chlorite	15%	to 0.1 <sup>mm</sup>
Garnets (reddish brown)	1-2%	1 <sup>mm</sup>

Strike,-in general near East and west with nearly vertical dip,  
but locally closely folded or contorted.

Chlorite schist matrix of the Clarksburg Tuff.

#20. 430 paces North, 100 East of South 1/4 post. July 9, 1946

Angular fragments of

Granular quartz (grains 0.3<sup>mm</sup>)

Granular quartz and calcite or dolomite.

Fine granular quartz, chlorite and a rusting rhombohedral carbonate

Fragments mostly fine chlorite (0.05<sup>mm</sup>)

Fragments largely biotite with some chlorite and dark amphibole

Matrix, - Quartz grains to 1<sup>mm</sup>

Chlorite  $\frac{1}{2}$ <sup>mm</sup>

Biotite  $\frac{1}{2}$ <sup>mm</sup>

Garnet  $1\frac{1}{2}$ <sup>mm</sup>

Some greenish black amphibole to  $1\frac{1}{2}$ <sup>mm</sup>

Strike,-near East and west and vertical, but much contorted.

Clarksburg Tuff, near axis of syncline.

#21. 40 paces North, 20 West of SE corner July 25, 1946

Granular quartz (recrystallized chert?)	40%	to 0.2 <sup>mm</sup>
Colorless to pink quartz, in veins & dissem.	5%	to 1 <sup>mm</sup>
Brownish red garnet	5-10%	$\frac{1}{2}$ <sup>mm</sup>
Grünerite (mostly confined to light colored beds)	10%-20%	1 <sup>mm</sup> long
Chlorite	10-20%	to 0.1 <sup>mm</sup>
Greenish black amphibole (in dark bands)	1-2%	1 <sup>mm</sup> long
Balance, mostly fine quartz, chlorite, grünerite, etc.		

Strike, North 80° West. Dip,-60° southward. Crumpled.

Bijiki iron formation, near or at top with a little Clarksburg Ash.

#22. Same location as #21.

May show more garnet in some beds than #21. Specimen was supposed to have been from a few inches above (or below) #21, but formation is so badly crumpled that it appears that this is practically the same as #21.

- #23. 60 paces North, 20 West of Southeast corner. July 25, 1946
- |  |          |                  |
|--|----------|------------------|
| Grünerite, interlaced and mainly<br>parallel to the cleavage of rock | 40%      | 1mm              |
| Granular quartz (recrystallized chert?)                              | 10%      | under 0.1mm      |
| Chlorite   | 10%      | " "              |
| Garnet, brownish red   | 10-20%   | $\frac{1}{2}$ mm |
| Unidentified material finer than above<br>but likely much the same   | 25+%     |                  |
| Magnetite  | under 5% | under 0.1mm      |
- Strike,-North 60° West. Dip 70° North.  
Bijiki Iron formation, probably near the top. Much like  
specimens #21 and #22.
- #24. 240 paces North, 110 West of South 1/4 post. October 14, 1946
- |  |      |             |
|--|------|-------------|
| Muscovite, sericite (or other light mica)        | 50%  | to 0.1mm    |
| Garnet, reddish                                  | 5%   | 2mm         |
| Chlorite or other fine scaly (?) dark<br>mineral | 5%   | under 0.1mm |
| Quartz, fine granular                            | 10%? | under 0.1mm |
| Quartz, sericite or other light material         | 20%  | under 0.1mm |
- Strike,-North 60 to 70° West. Dip,-steep north.  
Mica Schist. Emergent slate above Negaunee Iron formation or  
a slaty phase of the overlying Goodrich.
- #25. 35 paces North, 20 West of SE corner. October 18, 1946
- |  |                     |                        |
|--|---------------------|------------------------|
| Grünerite                                | 10%                 | to 1mm long            |
| Quartz, granular (Recrystallized chert?) | 20%                 | under $\frac{1}{2}$ mm |
| Chlorite                                 | 10-20%              | under 0.1mm            |
| Garnet, reddish, pale                    | 20%                 | to 1mm                 |
| Magnetite                                | practically lacking |                        |
| Unidentified, fine and mostly light      | 30-40%              |                        |
- Chlorite is mostly in the dark bands. Beds up to 3-4mm thick and  
quite evenly bedded.  
Strike,-about North 50-65° West. Dip,-80° southwestward.  
From north edge of grünerite rock and a few inches southwest  
of garnet-amphibole-mica-chlorite schist.  
Bijiki iron formation at about the base of the Clarksburg.
- #26. 55 paces North, 20 West of SE corner October 18, 1946
- |  |        |                 |
|--|--------|-----------------|
| Grünerite, partly radiated   | 30%    | to 1mm long     |
| Granular Quartz (recrystallized chert?)                                  | 10%    | to 0.1 or 0.2mm |
| Granular quartz in a few broken bands or<br>fragments of beds            | 5%     | to 0.3mm        |
| Amphibole, quite dark but may be more grünerite<br>underlain by chlorite | 5%     | to 1mm          |
| Garnet, brownish, red. Abundant in some beds                             | 2%     | to 3mm          |
| Chlorite   | 10-20% | to 0.1mm        |
- Strike,-dip, etc.-same as #23. Bijiki iron formation, probably  
with fine Clarksburg Ash.

- #27. 70 paces North, 200 West of SE corner October 18, 1946

Angular fragments, up to several centimeters, of,-

Rhombohedral carbonate (Ankerite) to 1<sup>mm</sup>, quartz (recrystallized from chert?) to 0.1<sup>mm</sup>, with a little chlorite (to 0.1<sup>mm</sup>). Bijiki I.F.?  
Biotite, chlorite and quartz (all about 1<sup>mm</sup>)  
Biotite, chlorite and rhombohedral carbonate (each about 1<sup>mm</sup>)  
Dark, porous, very fine grained fragments.  
Irregular, more or less rusty holes perhaps resulting from the removal of soluble fragments like the first mentioned.

Matrix of chlorite, biotite, quartz, rhombohedral carbonate (each to 1/2<sup>mm</sup>) and greenish black amphibole to 1 x 3<sup>mm</sup>.

Strike,-northwesterly. Dip,- steep (80°?) northeasterly.  
Clarksburg Tuff.

- #28. One foot northwesterly along the strike from #27. October 18, 1946

Ankerite (or other iron bearing rhomb carbonate)	50-75%	to 1 <sup>mm</sup>
Quartz	5%±?	under 1/2 <sup>mm</sup> ?
Biotite	5%	0.1 <sup>mm</sup>
Chlorite	10%	to 0.1 <sup>mm</sup>
Chlorite or biotite or other dark mineral	5-10%	to 0.1 <sup>mm</sup>
Garnet, fayalite or other brown hard mineral with poor cleavage	0-5%	to 1/2 <sup>mm</sup>

Coating of iron rust (hydrate) & micaceous material on weathered parts.  
Strike and Dip. This is from a fragment of carbonate phase of the Bijiki Iron formation included in the Clarksburg Tuff as described under specimen #27.

- #29. 75 paces North, 215 West of East 1/4 post. October 19, 1946

Quartz grains	50%	to 0.3 <sup>mm</sup>
Chlorite	20%	to 0.1 <sup>mm</sup>
Unidentified material between grains, probably quartz, chlorite, etc.	30%	under 0.1 <sup>mm</sup>

Strike,-North 75° West. Dip,-vertical to 70° (overturned) northward.  
Black Goodrich quartzite.

- #30. 80 paces South, 440 West of East 1/4 post. October 25, 1946

Grünerite, interlaced	80%	1 <sup>mm</sup> long
Quartz (recrystallized chert, thin bed)	5%	0.1 <sup>mm</sup>
Magnetite	1%	under 0.1 <sup>mm</sup>
Chlorite	5%	0.1 <sup>mm</sup>
Quartz (recrystallized chert?) disseminated	5%	0.1 <sup>mm</sup>
Graphite	1%	earthy

Strike and Dip,- Folded and faulted, see sketch  
Bijiki Iron formation, Grünerite phase, near or at  
east end of overturned syncline.

North  
↑

Spec. #30.

#31. 5 paces North, 740 West of East 1/4 post.

October 25, 1946

Chlorite	30%	0.05 <sup>mm</sup>
Chlorite or altered chloritoid	1-2%	1 <sup>mm</sup>
Graphite, shows on some surfaces	A little	earthy
Unidentified, probably chlorite, etc.	70%	under 0.1 <sup>mm</sup>

Strike, - North 70° to (going eastward) N 60°. Nearly vertical.  
Some thin ferruginous and cherty beds interbedded with it.  
Probably Upper Bijiki (Hanging) or Michigamme Slate or schist.

#32. 540 paces North, 560 East of SW corner

November 11, 1946

Chlorite	40%	0.1 <sup>mm</sup>
Biotite	15%	0.2 <sup>mm</sup>
Chlorite or biotite	40%	under 0.15 mm

Strike, - North 60° West, Dip, - may be steep to the southwestward  
but bedding very indistinct. Cleavage of the rock is almost  
vertical.

Chlorite-Mica Schist. Fine phase of the Clarksburg.

- #1. 20 paces North, 35 East of SW corner July 30, 1946
- |  |      |                              |
|--|------|------------------------------|
| Amphibole, greenish black, sub-fibrous   | 30%  | to 2 <sup>mm</sup> long      |
| Chlorite   | 30%  | 0.05 <sup>mm</sup>           |
| Biotite  | 5%   | to 0.1 <sup>mm</sup>         |
| Quartz   | 1-5% | 0.5 <sup>mm</sup>            |
| Garnet, brownish red   | 2%   | 1 <sup>mm</sup>              |
| Chlorite, biotite and end views of amphibole,<br>and perhaps other dark minerals | 20%  | 1 <sup>mm</sup> to under 0.1 |

Strike, -North 65° west. Contorted. Dip nearly vertical and also various.

Clarksburg. Matrix or fine phase of the Tuff.

- #2. 2 paces South and 1 pace East of #1. July 30, 1946

More or less angular fragments, from a few <sup>mm</sup> to several cm, of,-

Quartz (recrystallized chert) 0.1<sup>mm</sup>, chlorite (under 0.1<sup>mm</sup>), a little fine magnetite and an appreciable amount of grünerite (to 1<sup>mm</sup>).

Granular quartz, almost pure, 0.1<sup>mm</sup>; probably recrystallized chert.

Red garnet dodecs (2<sup>mm</sup>), chlorite (to 1<sup>mm</sup>), with a little biotite and greenish black amphibole.

Gray, granular mineral (under 0.05<sup>mm</sup>) and perhaps quartz, with a little biotite and perhaps 20% fine chlorite (or biotite and chlorite).

Matrix of chlorite, greenish black amphibole and some biotite, with a small amount of quartz grains (?) and a few small garnets.

Strike and Dip as in #1. Clarksburg Tuff.

- #3. Same location as #2. Taken to show better the weathered surface. Shows more dark amphibole in some of the matrix.

- #4. 40 paces East, 190 South of the West 1/4 post. October 19, 1946

A few fragments a few cm long and a few mm thick of,-

Granular quartz to 0.3<sup>mm</sup> with a few to 1<sup>mm</sup>. These quartzose fragment show in some a few pyrite crystals (1<sup>mm</sup>) surrounded in some spots by yellowish vermiculite (or altered mica).

Rarely small fragments (to a few mm long) of graphite, earthy but with barely visible cleavage or crystal faces that may be mica.

Matrix, or bulk of the rock,-

Fine granular quartz (0.2<sup>mm</sup>) in which are a few grains of quartz to 1<sup>mm</sup>.

It may be that the "fragments" mentioned are merely broken and widely separated parts of beds.

Strike,- about North 75° East, but enough folded so strike is in question. Dip 80° northwestward, and steep in other directions.

The general strike may be northwesterly, but locally bedding was seen striking N. 75° E.

Goodrich or gradational phase into the Bijiki?.

- #10. 340 paces South, 670 West of East 1/4 post. June 25, 1946
- |  |            |                         |
|--|------------|-------------------------|
| Grünerite, a small part radiated and in rosettes, some with a core of chlorite | 60-70%     | to 1 <sup>mm</sup> long |
| Quartz, fine granular (recrystallized chert?)                                  | 20-30%     | 0.1 <sup>mm</sup>       |
| Chlorite, mica, graphite   | 5%         | under 0.1 <sup>mm</sup> |
| Magnetite  | perhaps 5% | " "                     |
- Strike,-locally N 80° ± E, but much folded in the vicinity,  
Dip,- S or SSE at varying high angles.
- Bijiki iron formation, grünerite phase.
- #11. From 1 to 2 feet above #10, same location June 25, 1946
- |   |         |                         |
|---|---------|-------------------------|
| Grünerite (or perhaps cummingtonite or other amphibole), mostly in rosettes.  | 70-80%? | to 1 <sup>mm</sup> long |
| Chbrite, occassionally as a center of a rosette of grünerite, but more often seen as spots irregularly placed in or between the rosettes. | 5%      | 0.1 <sup>mm</sup>       |
| Magnetite   | 5-10%   | to 0.2 <sup>mm</sup>    |
| Graphite, quite abundant in some narrow seams or beds   | 1-2%    | earthy                  |
- #12. From a 3 inch vein one foot above #11. June 25, 1946
- Quartz, hard earthy hematite and hard steely iron hydrate.
- Vein dips northward at varying angles, cutting the Bijiki Iron formation.
- #13. From 1 to 2 feet above #12. June 25, 1946
- |   |        |                         |
|---|--------|-------------------------|
| Grünerite, partly to mostly in rosettes   | 60-70% | to 1 <sup>mm</sup> long |
| Magnetite, octs   | 15+%   | 1/2 to 1 <sup>mm</sup>  |
| Quartz, granular (recrystallized chert?)  | 5%     | 0.1 <sup>mm</sup>       |
| Graphite, considerable in some beds and seams and some between the grünerite crystals | 1-5%   | earthy                  |
| Chlorite (?)  | 5-10%  | under 0.1 <sup>mm</sup> |
- Bijiki iron formation, grünerite phase.
- #14. 10 paces eastward along the strike from #10 to #13. June 25, 1946
- |   |      |                      |
|---|------|----------------------|
| Grünerite, much of it in rosettes           | 50+% | to 1 <sup>mm</sup>   |
| Magnetite, disseminated                     | 20%  | to 0.5 <sup>mm</sup> |
| Finer magnetite in beds with some grünerite | 20%  | 0.1 <sup>mm</sup>    |
| Chlorite, graphite, quartz, etc.            | 10%  | to 0.1 <sup>mm</sup> |
- Strike and Dip,- About same as #10-12, but dip 60° to 70° NW (overtured?)
- Bijiki iron formation, strongly magnetic grünerite phase.