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GEOLOGY

OF THE

SPRUCE RIVER AND PESHEKEE RIVER AREAS

BARAGA AND MARQUETTE COUNTIES

1944

BY

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PREPARED IN COOPERATION WITH
THE MICHIGAN COLLEGE OF MINING AND TECHNOLOGY

Geology of
The Spruce River Area
By Thomas A. Scott

The Spruce River Area lies in Township 47 North and Ranges 30 and 31 West, southwest of Lake Michigamme. Except for a few hills of moderate height it is a region of monotonously flat topography covered by hardwood slashings and extensive swamps. Very few outcrops are available and the geological mapping is almost entirely the result of dip-needle work. As most of the area has few distinguishing topographic features, it was thought advisable to map in all trails, streams and swamps with unusual care in order to expedite future mapping and possible relocation of any desired geological formation.

Work was started in this area on August 23, 1944, and continued to the close of the field season on November 25.

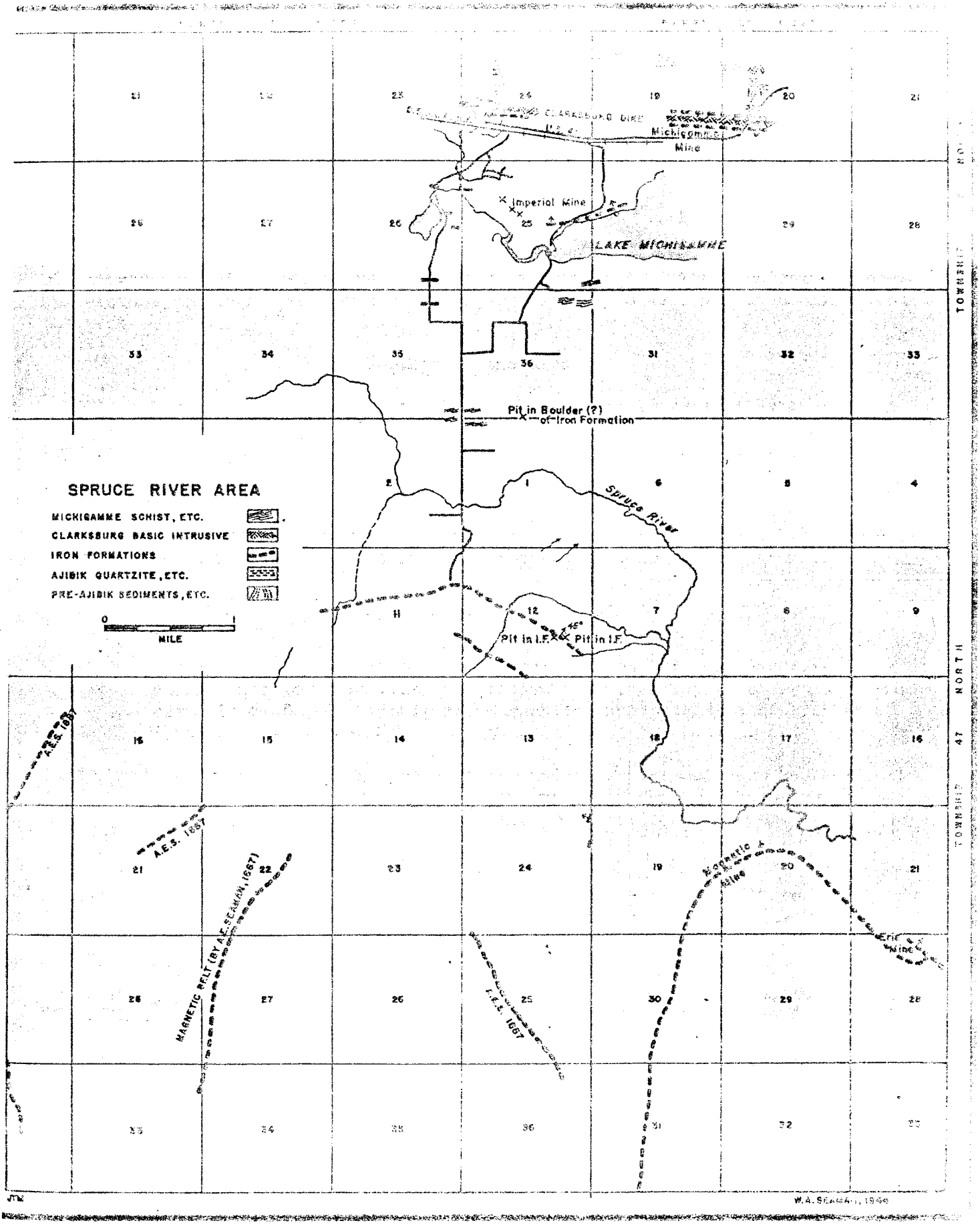
Mapping Methods

All mapping was done by dial compass and pacing survey. Lines were run at suitable intervals and roads, trails and some streams were traversed, and mapped in field books ruled six squares to the inch. The scale used was 120 paces to the inch (16 2/3 inches to the mile) except where larger scale detail work was necessary.

A true north and south line was established by Polaris observation and staked out near headquarters cabin. Compass corrections were determined from this line for each side of the thread on each dial compass for each hour of the day. Further checks were made at this azimuth sight at the start of each day's work and again, when possible, at its end. This azimuth sight was accurate to within about 5 minutes of arc and the lines run with the dial compass were probably not in error more than five or six paces, or about 15 feet, in a mile.

The pacing was carefully checked and standardized against known distances over varied topography, through different conditions of underbrush and with due consideration of other obstacles and conditions such as different footwear used. In all plotting the pacing was converted into the standard of 2,000 to the mile (or 1 pace = 2.64 feet). The pacing error was probably held below 1% and the total error in direction, distance and plotting of most of the work is probably less than 20 paces to the mile. Section corners when found were plotted where they appeared to be from the traverse, except that those corners not traversed but used for auxiliary runs were plotted with the assumption that the section was exactly true.

Lake Superior model dip-needles were used and were read as often as practical at "dip-checks" established at convenient points. The readings at each "dip-check" were frequently compared with each other and with readings taken where the rocks showed the least evidence of magnetic attraction in the gneissic area to the north. These low readings were then recorded and plotted as zero. Negative readings were often obtained, especially when approaching the iron formation from the footwall side, or when the iron formation possessed strong polarity.


SPRUCE RIVER AREA
MICKIGAMME SCHIST, ETC.
CLARKSBURG BASIC INTRUSIVE
IRON FORMATIONS
AJIBIK QUARTZITE, ETC.
PRE-AJIBIK SEDIMENTS, ETC.
0
MILE
Michigamme Mine
Imperial Mine
LAKE MICHIGAMME
Pit in Boulder (?) of Iron Formation
Spruce River
Pit in I.F.
Pit in I.F.
A.E.S. 1657
A.E.S. 1657
MAGNETIC BELT (BY A.E. SEAMAN, 1657)
A.E.S. 1657
Magnetic Axis
Eric Mine
TOWNSHIP 47 NORTH
W.A. SEAMAN, 1944

In long traverses [illegible] compared with the established [illegible] the dip-checks might be [illegible] likely that a considerable portion of the line of readings may be from ½° to 1° too high or too low. However, it is believed that adjacent readings on any one traverse are accurate, relative to each other, to the nearest ½°. Dip-needle readings were usually taken at intervals of 20 or 40 paces.

Because of the scarcity of outcrops and some uncertainty as to the exact significance of the dip-needle readings in the Spruce River Area, it was considered advisable to traverse to the area from outcrops of known character and structure north of Lake Michigamme. Two such traverses were run, one from the granitized pre-Ajibik sediments in the bluffs northeast of the Michigamme Mine, and another traverse from north of the Spurr Mine which is a couple of miles to the west.

Geology of the Area

The rock succession in the Spruce River Area is presumably nearly the same as the succession observed in the traverses to the area. This succession° from south to north (or from top to bottom) appears to be as follows:

GLACIAL till and swampy remnants of glacial lakes covering all except the higher pre-Glacial hills.

KEWEENAWAN or Lower Cambrian fresh columnar dikes striking east and west.

SUPERIOR (Killarney?) pegmatites, accompanied or preceded by extensive folding, faulting and metamorphism.

MICHIGAMME graywacke (some of it concretionary), staurolitic mica schist and slate. The lower part is interbedded with thin layers of basic volcanic tuff. The Michigamme formations show pegmatitic veins in places.

CLARKSBURG uralitic diabase and gabbro dikes and other intrusions. One east and west dike, somewhat uralitized, was seen that may have been post-Michigamme but older than the Superior pegmatites.

BIJIKI slate, some of it graphitic.

BIJIKI Iron formation, commonly the grünerite-magnetite phase.

BIJIKI-GOODRICH slate, gray to black, much of it pyritiferous some of the black more or less graphitic. In some places mica schist.

GOODRICH quartzite, 10 to 100 feet thick, apparently thinning westward and perhaps also southward. In the northernmost exposures, as at the Michigamme Mine, this quartzite grades up into the overlying Bijiki Iron formation without any appreciable amount of slate between. This may be because of near shore conditions at the time of deposition.

°(cf Geological Column and the Correlation Chart in the Preliminary Report on the Lake Michigamme Area, Progress Report No. 10 "Strategic Minerals Investigations in Marquette & Baraga Counties 1943", Michigan Geological Survey).

GOODRICH conglomerate, 1 to 20 feet [illegible] and probably [illegible] the [illegible] underlying [illegible] appears to be thinner to the west and may also thin out to the south. Near the Spurr Mine this conglomerate has thin beds or lenses of graywacke and mica schist.

UNCONFORMITY of relatively slight magnitude and probably representing a brief erosion interval. Nowhere in the area does the erosion at the base of the Goodrich appear to have cut very deeply into the underlying Negaunee Iron formation.

NEGAUNEE Iron Formation. This occurs commonly as a banded magnetite and granular quartz phase (presumably recrystallized from jaspilite similar to the jaspilite found a short distance west of the Spurr Mine and in other places in the vicinity). Grünerite or Cummingtonite is nearly everywhere present in the lower beds and in some places is the predominant constituent of the Iron formation. It appears that the original cherty siderite, very little of which is now in evidence here, was first oxidized, particularly near the top, to ferruginous chert. During one or more periods of metamorphism at a later date this oxidized portion was metamorphosed to jaspilite or still further to magnetite and chert or to magnetite and granular quartz, and the unoxidized cherty iron carbonate was converted into the grünneritic rock. Locally there is little evidence of the emergent slate above the Iron formation though the presence of a considerable amount of argillaceous material near the base of the Goodrich conglomerate indicates that such a slate was probably formed -- perhaps farther to the west or south.

HEMLOCK (?) The Negaunee Iron Formation grades downward through ferruginous slate into graywacke and interbedded slate both of which have more or less biotite and chlorite, and in some zones this basic material is quite abundant. This may represent the horizon of the Hemlock volcanics that are prominent farther south.

AJIBIK Slate, somewhat ferruginous towards the top, grades downward into the thick Ajibik quartzite which lies across the crumpled ends of pre-Ajibik granitized sediments and undifferentiated formations of the basement complex. No conglomerate at the base of the Ajibik quartzite was seen in place but a few boulders were found near the bottom of talus slopes at the foot of cliffs of the underlying pre-Ajibik. The pebbles were mostly of gneissic material such as granitized quartzite and graywacke.

CHAMPION REVOLUTION Extensive folding, faulting and metamorphism, and probably some granitization took place before the long erosion interval that preceded the deposition of the Ajibik.

MESNARD and KITCHI Quartzite, graywacke, etc., much of it highly metamorphosed, and probably somewhat granitized in places unconformably underlies the Ajibik. These older rocks are, in general, in close folds striking nearly north and south. These north and south folds have apparently been affected by later compressive stresses from the north and south

(and other rocks) resulting in the rough topographic characteristic of the area to the south of Lake Michigamme. These gneissic rocks are cut by numerous dikes, some of which are probably post-Ajibik. The more common dikes are of uralitized diabase which run in all directions and are probably not all of the same age, and pegmatites which also vary much in direction, in some places forming networks. The pegmatites seem to be of two different ages as in the Peshekee River Area.

In the traverse from northeast of the Michigamme Mine it was found that the south dipping Ajibik quartzite lies across the truncated north and south striking folds of the pre-Ajibik complex which appears to be identical in character with the pre-Ajibik in the Peshekee River Area. It is about 1500 feet across the quartzite, graywackes and slates from the northernmost exposure of the Ajibik to the Negaunee Iron Formation to the south. Much of this distance is low and swampy but four separate anticlines were mapped from outcrops within a little more than 100 paces so it is likely that these formations in the foot of the iron formation are no thicker here than usual. The true thickness is probably between 200 and 500 feet.

A large uralitic gabbro dike of Clarksburg age is nearly parallel to the Iron formation and cuts through near the base of it. Fingers of this dike also intrude the underlying Ajibik to the north and at least one finger invades the overlying Goodrich at the Michigamme Mine. Considerable shearing was noticed in this dike, especially near the contacts. A little chalcopyrite, a small amount of what is probably pentlandite, and considerable pyrite, were seen in a ten foot wide shear zone in this dike near its northern contact.

The Iron formation consists mainly of magnetite and granular quartz (probably recrystallized from chert) with varying amounts of an iron amphibole such as grünerite or cummingtonite. The dike, especially near the contacts, is in places converted into a mass of chlorite (aphrosiderite?) in which are embedded many brownish black garnets in dodecahedrons. Many of the garnets are more than two inches in diameter, and one was found that measured 4 inches between opposite dodecahedral faces. Chloritoid (masonite) in plates two inches or more in diameter, is abundant. Long black tourmaline is quite common and small octahedra of magnetite, partly altered to hematite, are generally abundantly disseminated through the chlorite matrix.

From US Highway 41 near the west line of section 19 (T 48 N, R 30 W) no outcrops were found on the southward traverse until near the north shore of Lake Michigamme just east of the west line of section 30. The dip-needle readings across this gap were generally rather high but showed minor variations that may indicate the presence of rolls or faults in the underlying Iron formations. The readings increased suddenly several degrees as an exposure of crumpled grünerite-magnetite rock was crossed just before the lake was reached. Considerable mica, graphite and small red garnets were observed in the Iron formation here, which has been usually considered to be Bijiki. The structure appears to be anticlinal with most of the dips on the south side being to the south. This formation was followed southwestward and westward toward the center of section 25 (T 48 N, R 31 W) to within about a quarter of a mile of the east pits at the Imperial Mine. The belt followed appeared likely to continue on past to the south of the pits.

[illegible] Michigamme until near the north line of section 36 where a belt of Michigamme graywacke and staurolitic mica schist a few hundred feet wide was found. The strike here was nearly east and west and all observed dips were nearly vertical although some were to the north and some to the south. Another similar belt of Michigamme formation was found between these two belts of Michigamme and the dip-needle readings were all 1° or less.

In the traverse southward from near the Spurr Mine it was found that several stringers of Clarksburg uralitic diabase or gabbro dike are sandwiched between layers of the Negaunee Iron Formation. Some of these fingers of dike are over 50 feet wide and gave dip-needle readings considerably lower than the interlaminated Iron formation. This was considered significant as the same conditions are apt to prevail in those parts of the Spruce River Area where reliance must be placed solely upon dip-needle work and it might be assumed that two or more separate iron formations are present there.

It was also noted in the Spurr Mine traverse that the Bijiki Iron Formation is so close above, or south of, the Negaunee where both are nearly vertical, that the two formations reacted as one magnetically where they were not fairly close to surface, thus giving the effect of one belt about 100 paces wider than the Negaunee formation alone. Therefore it was concluded that in the Spruce River Area, where the overburden was presumed to be of greater depth, a magnetic belt might, in places, indicate both the Negaunee and the Bijiki formations rather than either formation alone. It was also deduced that one or more narrow zones of lower readings encountered in crossing a wide magnetic belt might indicate a dike or sill approximately paralleling the formation, a strike fault, a rather close fold or even some other structures in the Iron formation rather than a belt of Bijiki-Goodrich quartzite and slates intervening between the Negaunee and the Bijiki Iron formations.

Some test pits were examined, sampled and mapped near the south quarter post of section 36 (T 48 N, R 31 W). The only pit that seemed to have reached ledge is located 90 paces west and 15 paces north of the south quarter-post which is down in a magnetite and granular quartz phase of the Iron formation that appears to strike about southeast and is nearly vertical. The magnetite showed strong polarity, both in hand specimens and in the pit. Close spaced dip-needle readings across the exposure varied within a few feet from high positive to strong negative readings and back to high positive readings with zero readings in places.

The territory adjacent to the pit was thoroughly covered by a network of close spaced traverses along which dip-needle readings were taken at 5 pace intervals but no evidence of a magnetic belt was obtained, as all of the high and the negative readings were restricted to a radius of a few feet from the pit. Another spot a few paces in diameter that gave high readings was found about 90 paces east and a few paces to the north of the pit where a small flat exposure of jaspilitic Goodrich conglomerate was found. A third small area, a few feet across, where high readings were noted was found about 60 paces southeast of the Goodrich exposure. No connecting high readings could be picked up between these spots, as low readings (practically zero) prevailed throughout the surrounding 200 pace radius.

Many large boulders of various formations, including the Goodrich and the Negaunee were seen near by. Some of these boulders are of many tons weight and farther away one boulder of Iron formation was found that measures 30 feet in length, over 20 in width and is from 8 to 12 feet high. It is thought that the high readings obtained in the spots just mentioned may have been over boulders and that the test pit itself may be partly in and partly alongside such a boulder. It was also noted that less than one half mile away, near the southwest corner of the same section, there is a belt of Michigamme formation, about 300 paces in width, striking directly towards the test pit, rendering it somewhat unlikely that any iron formation outcrop in the vicinity of the south quarterpost is present.

Another spot where high readings were observed all within a 20 pace radius, was found near the section line between sections 1 and 2 (T 47 N, R 31 W) just north of the Spruce River. It is not thought likely that any of these spots with high readings are sharply domed anticlines as the surrounding readings were practically zero in each area. Until evidence to the contrary is obtained these local anomalies are probably best explained as being caused by buried boulders.

South of the Spruce River the only outcrop found was one of Iron formation about 600 paces north and 500 west of the southeast corner of section 12 (T 47 N, R 31 W). The formation dips about 45° to the northeast and consists of grünerite, magnetite and fine granular quartz. The grünerite is quite thoroughly rusted although specimens were obtained which show all gradations from fairly fresh grünerite to material that has only vague outlines of the grünerite left, and to soft, porous lean limonitic "ore" with much of the silica apparently leached out. This alteration of grünerite rock to low grade ore may have been confined to that portion of the formation close to surface but it indicates that, contrary to expectations, grünerite rock might under favorable conditions be converted into ore, - on at least a small scale.

A number of test pits had been sunk in the vicinity of the outcrop but apparently only three of them entered ledge. The material from these pits was carefully sampled and numerous specimens were taken. Most specimens show rock like that in the outcrop and in all phases and transitions. Some dark slate, much of it pyritiferous and some of it graphitic was found. In general the same sort of material was found from a pit in the footwall of the ledge as from one farther east and apparently a little above the line of strike of the formation. No appreciable amount of rock that might be classed as ore was found, though a few small pieces could easily have been selected for an analysis that would probably have run high in iron. No indication of appreciable concentration was observed near the pits but drilling a few hundred feet to the northeast might locate ore in some roll or trough in the Iron Formation.

The Iron Formation was followed by dip-needle work both directions from the outcrop as far as time permitted. The belt was traced continuously from near the southeast corner of Sec. 12 northeasterly to a point about 600 paces south of the northwest corner and from there it was followed west-southwesterly to well past the east quarterpost of Sec. 10. Long stretches of this belt of Iron formation are fairly straight except for gentle undulations some of which may contain ore, particularly if any of the Clarksburg dikes, which are so abundant in this general region, intersect the iron formation along any of these stretches and result in structural troughs receptive to concentration.

About 600 to 700 [illegible] of this belt further but weaker magnetic belt was picked up by crossing it in a few places. This southern belt apparently rather closely parallels the northern belt. From the little evidence so far obtained from the magnetic readings it may dip southward. This southern belt has so far been traced for only about three quarters of a mile from near the south quarterpost of 12 to the west line of the section.

As shown on the accompanying map (Plate I) these belts do not seem to line up or to connect with any of the magnetic belts previously mapped, and a great deal of dip-needle work remains to be done in the area before any extensive drilling is undertaken. The accompanying map has been extended beyond the limits of the Spruce River Area in order to take in the mines along the northern edge of the general basin, the Magnetic Mine to the southeast and some magnetic belts that were mapped by A. E. Seaman in 1887.

The detailed manuscript maps from which Plate I was made are held in open file in the office of the Michigan Geological Survey in Lansing. These detailed maps are made on a scale of 10 inches to the mile. In addition to the rock outcrops and cultured features it shows the dip-needle readings and specimen numbers and localities. This map covers the area from the gneissic bluffs north of U. S. Highway No. 41 to the south lines of Sections 11 and 12, T 47 N, R 31 W. While not available for general distribution, tracings can be made of the whole or of any part of the area covered by the map and will be supplied upon request to The Michigan Geological Survey.

Hand specimens referred to in the text and shown on the manuscript map are stored at the Department of Geological Engineering, Michigan College of Mining & Technology, Houghton, Michigan, and are available there for study.

[illegible]

By [illegible]lys A. Seaman

The Peshekee River Area lies north of Lake Michigamme in Marquette and Baraga Counties, Michigan, and is mainly in Townships 48, 49 and 50 North, and Ranges 29, 30 and 31 West.

Field work in this area was started July 11, 1944, and continued for about six weeks when the work was suspended due to transfer to the Spruce River Area.

As shown in the key map, a continuous strip up the Peshekee River from its mouth at Lake Michigamme to Section 35 in T 49 N, R 30 W, a little above the Rock Dam, was mapped. Detailed work was also done in Sections 26, 27 and 28 in the same township and some work in Section 36 (T 50 N, R 31 W). The intervening gaps were not mapped before the transfer to the Spruce River Area.

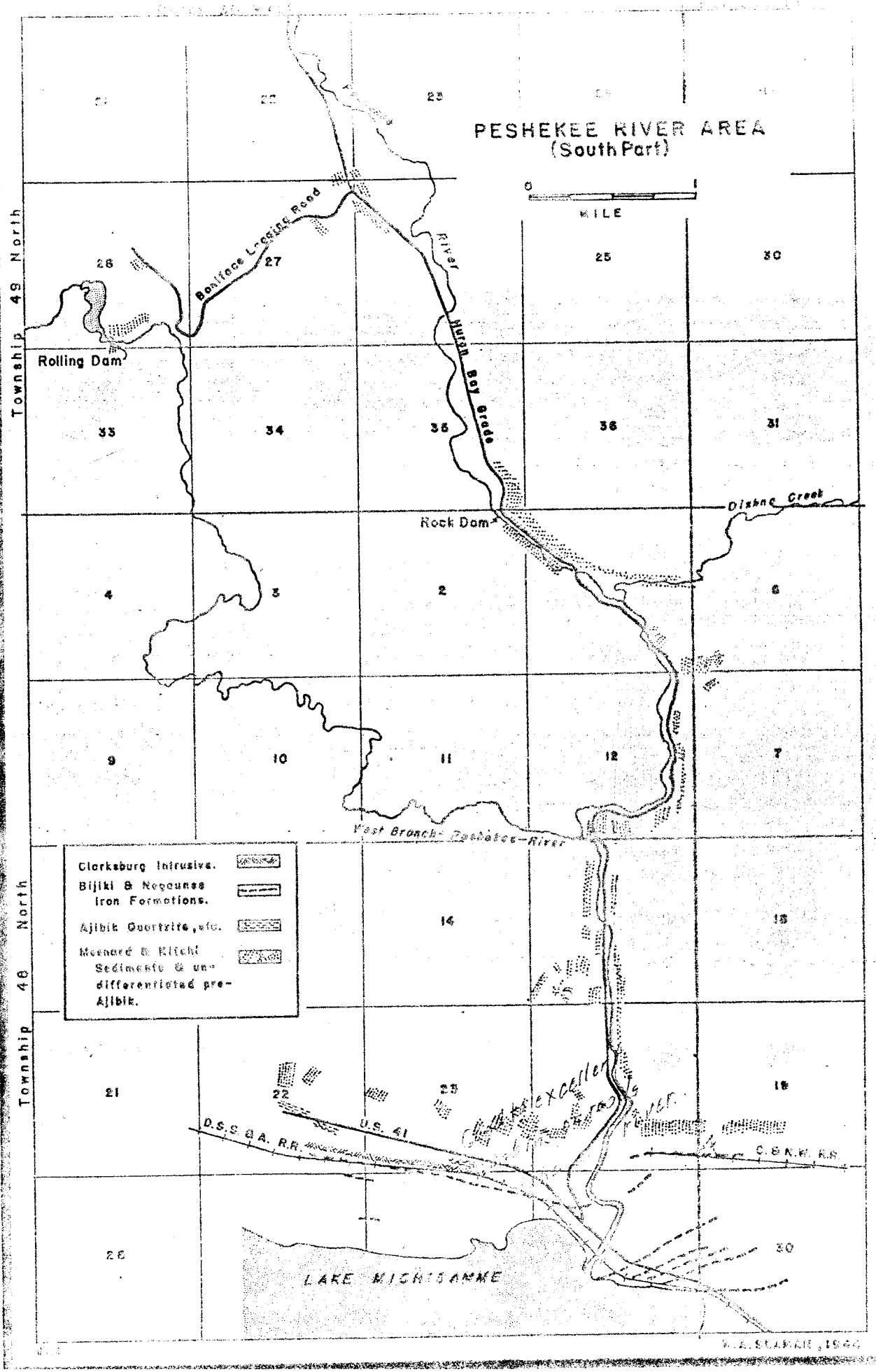
Character of the Country

Hills and bluffs of gneiss are separated by lowlands and swamps. The bluffs generally have steep rock faces or cliffs on the south sides, in many places on the east or west sides, but few rock exposures are found on the wooded northern slopes. Most of the bluffs are crowned with second growth, principally white pine, white birch, maple and poplar. The north sides are nearly everywhere covered with maple and yellow birch with a scattering of other trees, or else with mixed second growth.

Nearly all of the swamp area is timbered with black spruce, tamarack and cedar, much of which, especially the spruce, is now being logged off. The timber on the lowlands and flats between the swamps and the bluffs is mainly maple, yellow and white birch, white spruce, balsam and poplar. Norway and jack pine are not now abundant in this area. Black ash, elm, alder and willows are locally abundant along many of the streams.

Deer are quite plentiful. Black bear and red fox are common. Coyotes are present but there seemed to be few, if any, timber wolves. Beaver are fairly numerous, otter rather scarce, but smaller fur bearers seemed quite plentiful in many places. Rabbits and partridge were only moderately abundant this year. Few ducks live in the area and migrating ducks were unusually scarce in 1944.

The Peshekee River is a swift, dark colored stream that drains about 150 square miles about evenly divided in Marquette and Baraga counties. The river has long boulder rapids between long stretches of deep swift water, and in many places it broadens out into wide lake like expanses. No falls of more than two or three feet are in the mapped area except where the stream cascades through a boulder filled gorge near the Haypress Dam in Sec. 36, T 50 N, R 31 W. The total drop there was estimated at 20 feet. The river is fordable in only a few places except in very low water.


PESHEKEE RIVER AREA
(South Part)
0
1
MILE
Township 49 North
Township 48 North
Bonifice Logging Road
Rolling Dam
Rock Dam
Dishno Creek
Huron Bay Brook
River
West Branch Bonifice River
Clarksburg Intrusive.
Bijiki & Negaunee Iron Formations.
Ajibik Quartzite, etc.
Mesnard & Kitchi Sediments & undifferentiated pre-Ajibik.
D.S.S. & A. R.R.
U.S. 41
C.&N.W. R.R.
LAKE MICHIGAMME
26
27
25
30
35
34
36
31
4
3
2
6
9
10
11
12
7
14
18
21
22
23
19
28
30

It is a good fishing stream containing brook trout, rainbow trout, small mouth bass, yellow (jumbo) perch, wall-eyes, northern pike, black suckers and cisco. Some nearby lakes are reported to have large mouth bass, "white perch" and "land locked salmon trout".

No mines or farms are in the area, the sole industries are logging and trapping. The country lies north of US Highway 41 and the Duluth, South Shore and Atlantic Railroad, both of which cross the Peshekee River at its mouth. A logging spur of the Chicago and Northwestern Railroad approaches the river from the east about 3/4 of a mile above the mouth. The territory is accessible at present only by a partly gravelled road, known locally as the Huron Bay Grade, which follows the river valley for about 17 miles.

Mapping Methods

Mapping was done in the manner described in the report on the Spruce River Area except that most of the field work was originally plotted on a scale of 60 paces to the inch (instead of 120), because of the greater abundance of outcrops with complex structures.

Dip-needle traverses were run across some of the low flat or swampy areas where the outcrops are few or lacking, in an endeavor to obtain additional information. The results were entirely negative in the northern part of the area as no measurable difference in the readings was observed, as all readings were practically zero or the same as in the surrounding gneisses. Near the mouth of the river many magnetic belts were found and several were mapped as shown on the accompanying map.

Sampling

Each different appearing phase of rock was carefully examined in the field with a strong hand lens and, after careful study, a representative sample was taken. Most samples were trimmed to a uniform size of about 3 x 4½ inches. They were studied again in camp and described megascopically. Samples of the same appearing rock were also taken at considerable distances from each other, examined and reported upon as an additional check on the work. The location of all samples is shown on the large detailed manuscript map held in open file at the Michigan Geological Survey, Lansing, Michigan.° The specimens (trimmed, numbered and accompanied by detailed labels), are on file and stored at the Michigan College of Mining & Technology and are available for study. The descriptions, together with precise locations, dip, strike and other important data are in open file at the Michigan Geological Survey.

°Manuscript map on scale of 10" to the mile with inserts on scale of 2 to 50 paces to the inch.
Not printed for general distribution. Tracings and prints of the whole or any part can be ordered through the Michigan Geological Survey.

Geology of the Area

This region is shown on most maps as a large granite area approximately bisected by the Peshekee River. The plan of work was to explore the margin of what was presumed to be a batholith, and to map and sample veins common around the periphery of such a structure. The alleged granite area was not found. Instead, as shown on the accompanying map, the rocks of the area are predominantly gneisses and subordinate amounts of schist and other rocks cut by numerous dikes.

The gneisses range from granitic to quartz monzonitic gneiss with occasional hornblende or biotite gneiss. The dip is almost everywhere nearly vertical and the general structure is a series of close folds, striking about north and south. A later structure that resulted from north and south compression has been superimposed upon the north and south striking folds producing a series of domes or abrupt knobs separated by deep valleys. The gneiss is cut by one or more series of uralitized diabase dikes and by pegmatites of at least two ages. Some of the uralitic diabases cut the older of the pegmatites but the younger pegmatites displace the uralitic diabase dikes. All are cut by fresh columnar olivine diabase dikes that strike nearly east and west.

Some of the gneiss grades along the strike into easily recognizable graywacke and quartzite, probably of the Kitchi° and Mesnard° series; but much of the gneiss, especially where close to numerous pegmatites, is intricately crumpled and so highly metamorphosed that its origin has not yet been determined.

The close east and west folding and much of the metamorphism took place before the Ajibik was deposited as was apparent in the mapping of the adjacent Lake Michigamme area where the Ajibik having a southward dip lies across the truncated ends of the pre-Ajibik sediments.

The older pegmatites in the Peshekee River Area may be of Laurentian age or may be contemporaneous with the Champion° revolution, and the younger pegmatites may correlate with the Champion or with the Superior° granitization. It is possible that later work may show pegmatites, within the borders of the map area, of all three ages. The younger pegmatites are definitely post-Mesnard as they cut both the Kitchi and the Mesnard, but none have as yet been traced into the Ajibik or later sediments where similar pegmatites are common even as high in the geological column as the Michigamme formation.

A few exposures of east and west striking crumpled schist and gneiss such as those near the Rock Dam on Sec. 2, T 48 N, R 30 W, may be of Keewatin age. The crumpled schist is apparently overlain by southeastward striking quartz monzonitic gneiss similar to gneiss derived from the Kitchi graywacke.

°(See Geological Column for the Marquette Range, Table 2 Lake Michigamme Area, Progress Report No. 10, "Strategic Minerals Investigations in Marquette and Baraga Counties 1943", Michigan Geological Survey.

This probable Kitchi is in turn overlain by a rather thick quartzite that is thought to be Mesnard. The contact between the supposed Kitchi and the underlying rocks is not locally exposed, but about one half mile to the southeast, and nearly in line of strike with the base of the overlying formations, a belt of highly metamorphosed conglomeratic appearing material a few feet thick was mapped. This may be the basal Kitchi conglomerate and, if so, the underlying granitic gneiss and schist may be the older granitized Keewatin.

It is believed that when the gaps in the Peshekee River map are accurately filled in, the age and origin of the rocks just discussed will be established.

No pegmatites nor ore veins were found that seemed to give much promise of commercial possibilities, but it should be pointed out that the most favorable places for mineralization may be along the edges of the structural valleys where the overburden is deep, outcrops are scarce and important outcrops are apt to be missed in the thick underbrush unless considerable time is taken to make detailed search, preferably when the leaves are off the trees.

The pegmatites vary from a fraction of an inch to many paces in width. Some run straight for considerable distances and in places can be picked up in the direct line of strike across sizeable valleys. Many other pegmatites are very irregular in width and strike, and some form intricate networks. Nothing is visible in most of them under a hand lens except microcline or albite (one or both), quartz and a small amount of fine mica, mainly muscovite. Some pegmatites have small octahedra of magnetite with or without disseminated pyrite. The feldspar varies in size from a small fraction of an inch to slabs that can be measured in feet. A few very good specimens of graphic granite were obtained.

In general the widest and coarsest pegmatites were found low down on the sides of the hills, where the exposures can be traced for only a short distance as the main mass is under the overburden in the valleys. In several localities these coarse pegmatites formed the face of overhanging cliffs and so showed only the upper contact, with the country rock on the hanging wall side highly metamorphosed but not mineralized to a notable extent in many places.

Along the last mile of the river's course above the mouth no outcrops were found except on the north shore of Lake Michigamme just east of the mouth. Here was seen an anticline of Bijiki (presumably named after the Peshekee River), which was followed by outcrop and dip-needle work into T 48 N, R 29 W.

The mapping of the south mile of the Peshekee River valley, from the gneissic cliffs on the north to Lake Michigamme at the south, because of the lack of outcrops, is mostly the result of dip-needle work. Several strong and persistent belts of attraction were picked up and a few of them were traced for considerable distances.

The northernmost magnetic belt is strong and wide and locally strike near east and west. It was picked up about 200 paces south of the bluffs. This belt is undoubtedly the Negaunee Iron formation, though it probably includes the Bijiki if the two formations are as close together near the bluffs as they are at the Spurr and the Michigamme Mines to the west. This belt of strong

magnetics was traced from Sec. 19, T 48 N, R 29 W, to near the east bank of the river close to the south quarterpost of Sec. 24, T 48 N, R 30 W. About a quarter of a mile of river and bayous prevented tracing it any farther west for the present.

About 300 paces south of this magnetic belt another belt was found and traced eastward from the river for only a short distance to where it disappeared. On the west side of the river only one belt could be found and it lined up with the southern belt on the east side. Thus it appeared likely that a thrust fault, nearly parallel to the strike, had displaced the Iron formation and caused the repetition on the east side of the river. Such faults are very common in the area and some of them affect the large east and west Clarksburg dikes in the vicinity.

Numerous other belts of strong magnetic attraction are south of the belts just discussed. Nearly all can be traced eastward or northeastward into T 48 N, R 29 W and some of them were followed until the magnetics led to an outcrop. Many of those outcrops are of closely crumpled grunerite-magnetite rock; some have a definite anticlinal structure and also show considerable evidence of shearing and thrust faulting.

Much of the dip-needle work near the mouth of the Peshekee was done after work was started in the Spruce River Area. A considerable amount of the traversing had already been done, the roads and fire-breaks were already plotted and the work was close to camp, so dip-needle work could be done here during cloudy or threatening weather when there was not enough sun for dial compass work south of the Spruce. Additional work is contemplated for the future as there may be considerable ore in the vicinity and it is believed that the structure can be worked out quite satisfactorily.