Open File Report LXXV

LOCATIONS OF OUTCROPS FOR THE MOST PART WITH AREAS MAPPED AS MARSHALL, BUT AT OR NEAR WHICH COLDWATER EXPOSURES MAY BE FOUN

by

G. M. Ehlers

Undated

LOCATIONS OF OUTCROPS, FOR THE MOST PART WITH AREAS MAPPED AS MARSHALL, BUT AT OR NEAR WHICH COLDWATER EXPOSURES MAY BE FOUND

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Locations of outcrops, for the most part with areas mapped as Marshall, but at or near which Coldwater exposures may be found.

Hillsdale County.

1. Jonesville.
2. Hillsdale
3. At Moscow, N.W.¼, N.W.¼, Sec.4 (Jefferson))
4. " " S.W.¼, S.W.¼, Sec. 26, Allen.) Chonetes pulchella.
   Note. These localities (3 and 4) are all in the lower part of the Marshall ss(sandstone) (Winchell - Proc.Acad.Nat.Sci.Phila,1862,p.411)
5. S.E.¼,S.W.¼,Sec.23, Adams, Hillsdale Co.
6. N.W.¼, N.W.¼, Sec. 4, Jefferson, Hillsdale Co.(Pleurotomaria stella and exigua).
7. Germain's Quarry, Hillsdale, Hillsdale Co.
8. Alan's quarry, Hillsdale, Hillsdale Co.
9. Osseo, Hillsdale Co.

Dr. Girty said he did not visit a number of the above localities.
C. M. Ehlers

Jackson County.

1. Look up, Sec. 27, Columbia, Jackson Co.
2. Look up Sec. 19 & 26, Liberty, Jackson Co. (Bellerophon rugosiusculus).
3. Southwest of Napoleon at Stoney Point, a station on the Jackson and Hillsdale R.R. Sandstones entirely similar to the Napoleon are quarried. 35 to 40 ft. of strata exposed. Fauna identical to that of Battle Creek and Marshall.

Calhoun County.

1. Homer, Calhoun Co.
2. Condit, south of Albion. Sandrock exactly similar to Napoleon(destitute of fossils).Beds of quarry about amounto to 20 feet. Important. Below them(sandstones I suppose - Ehlers) are a bluish colored micaceous sandstones alternating with shale beds and from this seam issue copious springs.

Locations of Coldwater outcrops, obtained from Literature.

Huron County

Geologic section for Coldwater and Marshall	Thickness	
Napoleon (Upper Marshall)ss	300	300
Lower Marshall(Original Marshall) Hardwood Point shales,sandy flags,fossiliferous,typical marshall Fauna	85	385
Port Austin ss	23	408
Sandy shale	68	476
Point aux Barques ss.	18	494
Shales and flags with Romingeria Julia	41	535
Grindstones with bands of peanut conglomerates and broken goniatite shells	25	560.

Blue sandy shales of Willow R. & Secs. 2 & 3. Huron Tnshp	172	172
Black Hard of Ohio ? inpart Light house Pt.conglomerate Herricks I, large fauna	4	176
Directly under should come the raccoon,Herricks Waverly shale fauna, Blue shale with carbonate of iron of Port Hope, Harbor Beach, White Rock to Forestville, with chonetes,scitulus, cf.pulchella,common throughout	720	896
Black Sunbury shale with Lingula,melie and Orbiculoidae newberryi in Ohio	103	999

Huron Co. Outcrops. See Lane vol. VII (Pt.2),Plate VII.
Location of outcrops will be found by numbers upon outline map of Mich.

Locality

1. South of old grindstone quarries on Sec. 30, T.19 N. R.14 E.Blue shales (Top of Coldwater).Formation becomes sandier- 30 ft. from top.New port well.
2. Crest of bluffs S. of Huron City. Seem to be formed by same flags.
3. Willow Creek, Huron City. Section exposed about 89 ft. below top of Coldwater. The lower part is blue shale with compressed lamellibranchi, while the upper part has several sandier seams of dark greenish blue flags, which show their high per cent of carbonates of iron, etc, by weathering very rusty. The section in as follows:
   - 6 inches dirt at top.
   - 3 inches red ss. seam which Rhynconella sp. 19036, Productus and Pleurotomaria sp. 19039 etc.
   - 3 inches barren.
   - 6 inches sandy.
   - 3 ft. blue shales, sparingly fossiliferous, sp.19043.
   - 2 ft. blue shale, no fossils found.

Below we have arenaceous shales with small seams of a sandier nature,fairly continuously exposed, until we come to the section given below at the bluffs south of the lighthouse. See next locality.

Cooper. The lower Logan or middle Waverly is represented in Michigan from the Pt. aux Barques Lighthouse (Conglomerate I) to the Rominger ia julia stratum west of Grindstone City, and perhaps 20 ft. of the strata resting upon the latter. The total thickness of above approximately 215 ft This includes 40 ft. or so of the Marshall as defined by Winchell. At Pt aux Barques Lighthouse the horizon is 935 ft. and more below the Bayport or Maxville ss. as exposed on Wild Fowl Bay, northeast of Bay City. Within this greatly increased thickness of sedimentation there are at least 4 horizons, each with their characteristic fauna.
(See pp. 280-295, Vol.7, Pt. 2).

4. Bluffs S. of Pt. Aux Barques Lighthouse. Section taken about where E. line of Sec. 11, T. 18 N. R. 14 E. strikes bluff. Lane considers this section of 32 ft. to be from 156 to 188 ft. below top of Coldwater. Winchell's section slightly different. See Lane. See Winchell 1860 Report, p. 75.
   A. 11 ft. 3 in. blue shale.
   B. 3 inches narrow band of calcareous sandstone, brown in weathering
   C. 3 ft. blue sandy shales
   D. 14 ft. 6 in. to 14 ft. 10 in. a compact brown very fossiliferous ss. the Schizodus ss which seems to be the principal source of the extensive fauna here collected, spec. no. 19044-69; at 170 feet from top of the group (Coldwater)
   E. 1 ft. 3 in. blue shale
   F. From 16ft. 1 in. to 19 ft. 9 in. the main bed of ss., conglomeratic (pebbles of coal ?) pyritic, especially the top which is almost a solid layer of pyrite, enclosing and replacing many fossils; at times very calcareous, and again appearing as a white ss., the pebbles appearing as small rounded grains of quartz. Sp. 19074 shows the pyritic facies, and sp. 19068 the conglomerate, and sp. 19073 the ss. facies, from 173 to 176 from the top of the group.
   G. About 12 feet of blue shale to 188 ft. below the base of Marshall, fossils very rare, but occasional Productí, and spirifers and minute forms (trilobite larvae ?) are to be seen, as illustrated by specimens.

Conglomerate (I?) at lighthouse contains a brachiopod fauna - shales below a lamellibranch fauna. Evidence in Ohio that the conglomerate (I?) was deposited by river action coming from north or northwestward.

Cooper has been unable to correlate the Raccoon shales(which contain an abundant lamellibranch fauna in Ohio) in Huron Co. stratigraphically and lithologically the Raccoon shales in Huron Co. correspond to 196 ft. of shales outcropping below conglomerate at Pt. aux B. lighthouse and southward almost to Harbor Beach.

Nos. 19076 - 19084. We may compare the fauna with that of the Rominger-ina julia zone etc. and find corresponding forms but in the upper zones they are all smaller.

Through this stratum (Lane means 12 ft. stratum - G. above) is so thin, the richness of its fauna and its apparent persistence and thickening under cover(found in well records 336 ft. under Port Austin and 750 - 800 feet under Caseville) make it important and suggest its correlation with one of "Herricks zones", viz; Conglomerate I.

Note. In geologic section for Huron Co. see page 1 of note book, Lane gives Herricks Conglomerate I a thickness of 4 ft. and places its base 176 ft. below top of Coldwater.

Below this (Lane probably means Herricks Conglomerate I, or he may mean stratum G) the formation grows more and more shaly, with fewer sandy streaks.

In the Pt. aux Barques section going N. and N.W., the beds run downward from 15 feet at the S. end of the bluffs to 8 feet above lake, near the lighthouse. Just beyond the lighthouse the calcareous conglomerate disappears and is replaced by another layer farther down, the exact and critical point not being exposed when we were there. The neighborhood of the fault would account for the abnormal dip of 1° to 1½° to the N.E.

Sketch.

5. Outcrops on N.E. side of Ridge road about 1½ miles S.E. of Pt. aux Barques Light Station. (From opposite page).

5. Shales of this section (Pt. aux Barques lighthouse) are also visible farther south in a number of ravines in Secs. 12 & 13, Huron, cutting the bluffs which are at an altitude of 30 to 39 feet above lake and overlook the Algonquin terraces.

6. Port Hope. A sandy shale occurs along shore and 50 paces south of mill at the waters edge, also in the bed of Diamond Creek for a few feet above its mouth.

7. According to Rominger the above sandy shales (Loc.6) occurs 1½ miles north of the town.

8. According to Rominger the above sandy shale (loc.6) occurs in the lake bottom close to the dock (Port Hope).

Notes. The above beds (at 6-7-8) appear to be palientologically equivalent to those at Harbor Beach (p.83,vol VII). This statement (p.26, vol.VII) probably equals above. The outcrops along shore and south of the mill at Port Hope, of sandy shales has a fauna like that at Sandy Beach. (? Harbor Beach).

The horizon of the top of the sand Beach (Harbor Beach) well may be placed 400 ft. below the top of the Coldwater.

9. Harbor Beach. frequent outcrops for 2 miles south, practically continuous with exposure at Rock Falls.

10 North. of town(Harbor Beach) in trenches and ditches up to the town line, N. line of Sec. 1, T. 16 N. R. 15 E. Shales and bands of arenaceous shales heavily charged with carbonate of iron are exposed.

11. Exposure in wayside ditch on the line between Secs. 30 and 31, T. 16 N. R. 16 E.

Note. The most widespread form in all this section from Port Hope to the above (Loc.11 above) is chonetes pulchella Hall. ? scitulus. Other forms are Productus laevicosta and conularia gracilis.

12. Rock Falls. The same beds with chonetes and impression of goniatites are well exposed at Rock Falls, the ripple marked surface of the ledges being covered with candagalli fucoides in relief, as well as other singularly shaped prominences of organic origin". Rominger . 76.
I.
Lanes localities.
1. At the mouth of the stream (N.E.¼ Sec. 9, T. 16 N. R. 16 E.) The H 20 flows over a ledge of shale and shaly ss. in alternating beds, with a fall of 3 feet. Full section exposed 10 feet.

Locs. 13-2. A similar exposure was observed about 1 mile below this. (Gorden). The fossils from this locality are said to be paleontologically equivelent by Mr. Cooper to the Moots' Run section in Ohio.
Note; The same strata as exposed in the Rock Falls section appear at Goldwater p. 288. Moot's Run faune (Cuyahoga).

Locs.14-3. Same beds (? 2 13 Ohlers) occur obscurely at the base of the Algonquin bluffs on and near the north line of Sec. 31, T.16 N.R.16 E.

Loc. 15. S. of White Rock for about a mile occur arenaceous shale beds in steep bluffs of 25 ft. elevation above the lake. The same beds are beautifully exposed for about 1/8th of a mile in the creek near the centerline of Sec. 32, T. 15 N. R. 16 E. and are finely jointed; one set strikes S. 52° W. dip to N.N.W. and a poorer set S. 70° E.

Indistinct cast of fossils among them goniatites, are found on the surface of the arenaceous flags (Rominger loc. cit. p. 76).

Loc. 16. S. of Harbor Beach at mouth of Allen Creek a section at Rock Falls (See Loc. 12). Cooper collected Chonetes scitulus, Productus shumardianus, Productus newberryi, var. annosus, Streblopteriamedia, conularie gracilis and Rhaetonides spirosus.

Sanilac Co. Outcrops. See Sanilac Report Vol.7, Pt. 3.

Locality

17 Three hundred paces S. of the landing at Richmondville. Ten ft. of shales outcrops in a vertical escarpment at the water's edge. The shales are blue, thinly laminated and contain occasional thin beds of ss. The ss. is fine grained, blue and micaceous. The layers of ss. vary from a fraction of an inch to 2 or 3 inches in thickness. Exposure extends for half a mile along the shore. The only fossils observed were indistinct markings and casts. About 2 miles S. of this point, rock appears under water along the shore. At this point it is decidedly arenaceous, the ss. occurring in layers about 6 in. thick. The ss. exposed here known as the Richmondville sandstone was correlated with the Berea ss. of the Ohio reported in vol. V of the Mich. Geol. Survey. This is clearly an error (proof- well records), as the rocks exposed at Richmondville cannot be lower than the middle of the Coldwater shales and are probably within 100 or 200 ft. of the top of that formation.

18. Forestville exposure. Ries. "Excellent exposure of Coldwater shales occur along Lake Huron at Forestville but they have not yet been utilized. The shale forms a line of cliffs and when fresh appears brittle and gritty. In places, however, it has mellowed down to a tough clay". The Forestville outcrop represents an horizon somewhat higher in the series than that at Richmondville and is characterized by a diminution in the amount of arenaceous material.

31. Carsonville. Black R. There are places along Black R. where many shallow wells were sunk into Coldwater shale, rocks being struck from 10 to 20 feet below the surface. Information given to R.A. Smith by people from Carsonville.

Quarry exists near Huron- Sanilac line, about 6 miles S.W. of Ubley. Eureka Grindstone Co. Sheaper & Leach.

Lenawee Co. Outcrops

Localities

19 Near Adrian. Winchell, 1860 Mich. G.S.

? 3 miles E. of Rollin village. Was told that outcrop occurred here. Did not visit this locality.

Branch Co. Outcrops.

22. Bronson. Ries. Prof. Paper No. 11

34. Shales of Branch Co. have considerable abundance of kidney iron ores. Winchell.

21 Near Coldwater. Winchell, 1860, Mich. G.S. see below.

A few miles west of Coldwater, near Branch Station a boring was made C.D. Bennett of Coldwater). A ½ mile east of this boring a 25 ft. exposure occurs. No fossils.(Rominger, Vol. III, p. 88).

Similar shales as above uncovered in brickyard north side of city of Coldwater. Fossiliferous iron geodes, including chonetes, illinoisensis, etc. (Reference above).

Look up Mr. C.V. Bennett of Coldwater. Lane got drill cores from Mr. Bennett of Bromo-Hygiea well - 2600 ft.

Coldwater, Mich. Moot's Run fauna (Cuyahoga) similar to that at Rock Falls, Huron Co. (Cooper, Huron Co. Report).

Shales out cropping south of Richmondville, Sanilac Co. are similar to the beds of the same formation used in Branch Co. for the manufacture of cement. (Cooper - Huron Co. Report).

Don Snowalter, 88 Montgomery St., Coldwater. Tubular well man. Will be glad to give well records if blanks are supplied.

Locality 28. Near Union City. Winchell, 1860, Mich. G.S.

(a) In brickyard of Mr. Merritt, 2 miles S. of Union City, Town 5, R. 17 W. Sec. 16, the surface beds are sandy shales with seams of calcareo-ferruginous rock, containing many small cylindraceous nodules composed of compact carbonate of iron, besides a number of partially very finely preserved fossils. Below these are yellowish gray, soft shales, used for brick making, which also contain numerous kidney-ore concretion of lenticular form. (Rominger Vol. III, p. 88).

(b) Half a mile N. from the brickyard on Mr. Kendall's farm, the shale beds are seen in outcrops along the banks and in the bed of Coldwater Creek, amounting in the exposure to about 30 or 40 ft. The lowest strata seen in the bed of the river are dark blue hard shales, with gray carbonate of iron geodes and concretions of iron pyrites; above them some arenaceous seams pervade the shale beds, following which are the beds seen in the brickyard. The fossiliferous calcareo-ferruginous bed, and to some extent also the kidney-ore geodes contained the following species of fossils: Chonetes illinoisensis, strophomena rhomboidalis, Terebratula oudora ?, several spirifers not accurately determined, spirigera lamellosa, Lingula, various species of Nucula, Hyalina, Platyceras, Pleurotomaria, Loxonema, Bellerophon galericulatus, Bellerophon tyrtolites, Goniatites oweni, Nautilus, Proetius, some Bryozoa, and others not yet properly determined. (Rominger Vol. III, p. 88)

See C.T. Huxley and Vanschick - well drillers, Union City.

35. South of Coldwater, in the town of Algansee, on Pencil Creek, in the ravines of drift-covered hills, the shale formation, with its intermediate seams of ss. and of kidney ore geodes can be seen nicely exposed. Some of the iron geodes are fossiliferous.(Rominger Vol. III, p.89).

Quincy. Get Vol. 8

Calhoun Co. Outcrops.

Locality
22. Athens. Winchell, 1860, Mich. G.S. Robert Lewis, well driller.

23. Leroy. Winchell, 1860, Mich. G.S.
Argillaceous beds at Leroy present the character of a black bituminous shale. Winchell

S.& W. of Bellevue, Eaton Co. Corner ? T. in Calhoun Co.

24. Newton, Winchell, 1860, Mich. G.S.

32. Verona Mills near Battle Creek. In Hillsdale Co.(see page 59) and at Vernon Mills, near BattleCreek, the Raccoon shales (Coldwater) are apparently represented by a coarse grained yellowish somewhat friable sandstone, which contains in great abundance Palaeonilo concentrica and P. attenuata. (Cooper pp.288- 290, Vol. 7, Pt. 2, Mich. Geol. Sur.) (A Verona Mills also occurs in Huron Co.).

Mr. Brigham. Curator of Battle Creek High School Museum.
Fred Wells of Wells Mfg. Co. Pres. Board of Education.
Alex. McKay, County Surveyor.
Look up Bedford.

St. Joseph Co. Outcrops.

25 Mendon. Winchell, 1860, Mich. G.S.
Argillaceous beds at Mendon present the character of a black bituminous shale. Winchell.

26. Leonidas. Winchell, 1860, Mich. G.S.

Van Buren Co. Outcrops.

27. Bangor. Winchell, 1860, Mich. G.S. (lines drawn thro this).
No bedrock exposure at this locality. G. M. Ehlers.

Ottawa Co. Outcrops.

29 Several points on Sec. 21, T. 5 N. R. 15 W. Township Holland. (Winchell Mich. Report, 1860). Outcrop probably base of Marshall(Ehlers). Some but no "several points" where exposures occur.

30. T. 5 N. R. 16 W. near shore of Lake Michigan. (Winchell, Mich.Report 1860). Nothing doing.

Outcrops in flats bordering Black R. about 4 miles north of Holland. Lithological character nearly the same as grindstone s in quarries on the Lake Huron Shore. A greenish, fine grained micaceous sandrock. Usual fossils of Marshall ss. ? (Rominger vol. III, p. 84) (Lines drawn thro this

Did not visit. Was told by number of people including two Professors of Hope College who were interested in Geology and who had fished and hunted along this stream that no outcrops occurred at Rominger's locality.

33. Waverly Junction near Holland.

At Waverly Junction, the same strata (as at Verona Mills, near Battle Creek and Millsdale counties - see pp. 43 and 59) are extensively quarried. At this place over 35 ft. of rock (coarse ss. - Raccoon shales) are exposed which is abundantly fossiliferous, almost all the species, being lamellibranchi, sanguinolites flavius, Palaeoncilo concentrica, P. attenuata, Nucula iowaensis, Nuculana similis, Athyris lamellosa and Bellerophon galericulatus were the only species identified which are characteristic of the Raccoon shales in the Ohio basin. The almost entire absence of brachiopods rather tends to emphasize the relationship, but the cepha lopods are relatively much more abundant than in Ohio. (Lines drawn thro the entire paragraph).

Millsdale Co. Outcrops.

In Millsdale Co. and at Verone Mills (see p.43). near Battle Creek, the Raccoon shales are apparently represented by a coarse grained yellowish, somewhat friable sandstone which contains in great abundance, Palaeonillo concentrica, and P. attenuate. (Cooper, pp. 288-289, vol. 7, Pt.2, Mich. G.S.)

36. In the town of Reading, the shale formation is everywhere found undera thin cover of drift when digging wells etc; natural outcrops in the ravines and beds of creeks are also often encountered. The shale is sometimes considerably arenaceous and pervaded by regular sandstone ledges. These latter often contains fossils, but the best preserved are always found in the calcareous or ferruginous seams or in geodes. Besides the other forms mentioned as found near Union City, Branch Co.(see pp. 37 & 39) Rominger also found at Reading a large nautilus digonus.(vol. III,p.89).

he drift deposits of this region contain in many places large quantities of fragments of the Marshall sandstone, inclosing an abundance of fossils; one of these localities is near Round Lake in Sec. 32, of Allen Township, where by the excavation of a road bed, masses of this sandrock was thrown out.

Look for outcrops along road out through from Millsdale to Allen.

Look up Mr. Smith's cousin, who is engineer at Stock's Flour Mill, Hillsdale.

Informed that outcrop occurred about ½ mile North and little west of Allen, Hillsdale Co. Did not visit.

Look up Highway Commissioner at Jonesville, Bert Marvin.

Mr. Charles C. Cox, County surveyor, at Hillsdale.

Berrien Co. Outcrops.

34 Brown's Station, Lake Township. Location, 12 miles N. of New Buffalo and about 1½ miles east from the shore line. A brownish or violet-colored sandrock is found under a drift cover only a few feet in thickness. By exploring ditches about 4 or 5 feet of the rock ledges have been laid open, which contain some of the most characteristic forms of the sandrock at Marshall; Nucula hubbardi, allorisma etc.(Rominger Vol.III, p.83) (Line drawn thro entire paragraph).

Lane (vol. 5, p.21) thinks this exposure might be Richmondville ss.

Nothing doing. R. A. Smith.

Did not visit. Talked with people who knew the above region and who said that bedrock was not near the surface.

Possibility of Outcrops

1. Near Rochester, Oakland Co. along Clinton R. See map.

Brigham, Battle Creek Museum.

WELL RECORDS

by G. M. Ehlers

Well Records. New well records may be found with my notes. See road map of Branch County.

G. M. Ehlers.

St. Joseph County.

A. Leonidas Township. T. 5 S., R. 9 W. *

1. N.W. ¼ of N.W. ¼ Sec. 2.
   well 57 ft. deep.
   20 ft. - drift
   37 " - Blue shale (Coldwater).

   Note. This well and 2 others in Kalamazoo Co. (Secs. 35 & 34) are all drilled within 40 rods of one another.

2. Leonidas Village well; well situated in angle made by intersection of E.-W. and N.E.-S.W. roads. Well is close to E. line of Sec.21.
   Well 250 ft. deep.
   20 ft. - Drift
   230 ft. - Blue shale (Coldwater)

* Records given by Mr. Robert Lewis, well driller, Athens, Mich. When drilling in the "blue shale or clay" (Coldwater), Mr. Lewis often strikes "hard layers". "Sometimes the drill will only go a half inch a forenoon". Mr. Lewis.
Comment. These "Hard layers" are either clay ironstones, thin sandstone or hard conglomerate seams.

B. Centerville, St. Joseph Co. Driller, Mr. Charles Cox, Mendon, Mich.

Top.	20 ft.	- sand and gravel
	3 "	- stoney red clay
	48 "	" blue "
	7 "	" red "
	12 "	sandy blue clay
	9 "	Blue shale(pretty-like).
	1 ft. 2 in.	- Dark brown shale rock(Shells on under side)
	10 ft. 4 in.	-Blue shale (pretty-like)
Bottom	7 ft.11 in.	Dark brown or chocolate shale rock. Hard.

Depth of well - 118 ft. 5 inches.

Calhoun County.

A. Athens Township . T. 4. S. R. 8 W. *

1. S. E. ¼. Sec. 30
Drift about 30 ft.) 115 ft. well depth.
Blue clay (shale) - 85 ft.)

2. S.E.¼ of N.E.¼ Sec. 30)
Drift. about 30 ft.) 80 ft.
Blue clay(Coldwater shale) 50 ft.)

3. S.W. ¼ of N.W. ¼ Sec. 29.)
Drift - about 30 ft.) 73 ft.
Blue Clay (Cold. shale) - 160 ft.)

4. S.E. ¼ of N.E. ¼ Sec. 21)
Drift - about 25 ft.) 185 ft.
Blue Clay(Cold. shale) - 160 ft.)

5. N.W. ¼ of S.W.¼ Sec. 22)
Drift - about 25 ft.) 125 ft.
Blue clay (Cold.shale) - 100 ft.).

6. S.W. ¼ of S.W. ¼ Sec. 23)
Drift - about 30 ft.) 60 - 65 ft.
Blue clay (shale) - 30 to 35 ft.)

7. N.W. ¼ of S.W. ¼ Sec. 23.
Record same as above (6)

8. S.W. ¼ of S.E. ¼ Sec. 13)
Drift - about 30 ft.) 116 ft.
Blue clay (shale) - 86 ft.)

* Drillings made by Mr. Robert Lewis, Athens, Mich. "Hard layers" struck in "blue clay". See * under A. Leonidas Township. St. Joseph County.

B. Leroy Township. T. 3 S. R. 8 W. *

1. S.E. ¼ of N.E. ¼ Sec. 35)
25 ft. - Drift) 60 ft.
35 ft. - Blue clay (Coldwater))

2. N.W. ¼ of Sec. 36.
Dug well - 45 ft. or more
Blue clay (Coldwater) struck at bottom.

C. Burlington Township T. 4 S. R. 7 W.

1. N.W. ¼ Sec. 23 *)
30 ft. or - - Drift) 150 ft.
120 ft. Blue clay (Coldwater))

C. 2. S.E. ¼ Sec. 34 **
20 ft. Drift
185 Ft. Blue clay(Coldwater) } 205 ft.

3. S.W. ¼ of S.W. ¼ Sec. 35 **
20 ft. Drift
64 Ft. Blue shale(Coldwater) } 84 ft.

Flowing well

* Drillings made by Mr. Robert Lewis, Athens, Mich.

** Well records given by Mr. Huxley, Union City, Branch Co., Mich.

Mr. Huxley likewise strikes "hard layers" in shale, which are probably clay ironstone or thin seams of sandstone or conglomerate.

D. Newton Township. T. 3 S. R. 7 W. *

1. S.W. ¼ of S. W. ¼ Sec. 31
20 ft. drift
20 ft. Blue clay (Coldwater) } 40 ft.

2. N.E. ¼ of S.W. ¼ Sec. 31
25 ft. drift
155 ft. Blue clay (Coldwater) } 40 ft.

3. S.E. ¼ of S.E. ¼ Sec. 30
Well 80 ft. deep - passed through blue clay and into 11 ft. of sandrock, rather soft at bottom. Sandstone - not passed through

4. S.E. ¼ of S.W. ¼ Sec. of Sec. 29.
Well 80 ft. deep- passed through blue clay and into 6 ft. of sandrock similar to that of 3 above, at bottom. Sandstone not gone through.

5. S. W. ¼ of S.E. ¼ Sec. 29.
Well 73 ft. deep passed through blue clay and into 6 ft. of sandrock, similar to that of 3 above, at bottom. Sandstone not gone through.

Wells 3, 4 and 5 are situated on a high hill. Well 4 is located upon highest point of hill. Sandrock of well 5 is the hardest.

6. S.E. ¼ of N.E. ¼ Sec. 26
20 ft. Drift
69 ft. 6 in. Blue clay (Coldwater)
6 inches Hard rock } 90 ft.

* Drillings made by Mr. Robert Lewis, Athens, Mich.

E. Fredonia Township. T. 3 S. R. 6 W.*

1. S. W. ¼ Sec. 30.
About 20 ft. Drift
39 ft. Blue clay (Coldwater) } 62 ft.
3 ft. Hard rock

* Drilling made by Mr. Robert Lewis, Athens, Mich.

Notes

Ottawa County

Station 43.

Location: North bank of Black River, about 300 paces E. of largest abandoned Waverly quarry which is located in the S.W. ¼ Sec. 22, T. 5 N. R. 15 W.

Section: No ledge is exposed. Drift fragments of a conglomerate are very numerous, this rock may be near surface. The conglomerate consists of rounded pebbles of greenish arenaceous and calcareous shale with a matrix of dark gray, highly ferruginous limerock. The pebbles average about 1 in. in diameter some having a longer axis of as much as 3 inches All pebbles tend to be elongate. Upon weathering, the pebbles become brown. The centers of many are brown, green unweathered zones bordering without. The matrix at times consists of a mass of finely comminuted brachiopods, crinoid stems, etc. These areas are highly calcareous and give a decided effervescence with H.Cl. The matrix weathers yellow and brown - a limonite powder forming on the surface of the rock. Numerous clay ironstones also present. Some contain calcite and siderite ? within. See specimens collected.

Fossils: Matrix abundantly fossiliferous. Spirifers, Productus like forms, large pelecypods (of Pterinopecten) crinoid stems etc. Fossils well preserved.

Station 44.

Location: Largest abandoned quarry near Waverly; about 300 paces N. and 75 paces E. of point where Grand Rapids, Holland and Chicago Electric line crosses road on Sec. line between Secs. 21 and 22, T. 5 N. R.15 W.

Section: Quarry filled with water at time of visit. The following section was given by Mr. Garrod, who last operated the quarry.

5 - 8 feet of sandy soil

Very hard layer 4-5 ft. thick
& 3 to 4 ft. below top of Sf. in quarry
Highly fossiliferous

} 18 ft. or- Of greenish colored micaceous sandstone. Rock taken from quarry resembles somewhat the grindstones of Huron Co. G.M.Ehlers.

Red clay(Mr. Garrod) at bottom of quarry. Went into it for 3 ft.

Additional information upon the quarry section may be obtained from Mr. R. B. Champion, Supt. Public Works, Holland, Mich. Mr. Champion has records of wells put down for water supply in vicinity of Holland. Could not see Mr. Champion - out of town. From what I understand, these wells are shallow and drift is not thick.

Fossils: Collections made from loose sandstone blocks about quarry. Material in main probably derived from fossiliferous zone of quarry. Some may be of drift origin. Sandstone blocks contain chiefly cephalopods and pelecypods.

Notes. Mrs. Charles Dutton, River Avenue, Holland, Mich. has a collection of fossils, arrow heads, etc. which was collected by her father, Mr. John Post. Mr. John Post had frequent correspondence with Alexander Winchell. In this collection are some good specimens from Waverly quarry - very large Orthoceras and other typical forms. Mrs. Charles Dutton has given these specimens to her son, Mr. Henry Post, a U. of Michigan graduate , who is inclined to send them to Ann Arbor. However Mrs. Dutton seems more inclined to send them to a small college- Alma in particular. She is afraid that the collection will be absorbed at Ann Arbor. Hope College at Holland is also after the material.

About 17 years or more ago (1898) a large collection was made from the Waverly quarry, according to information given by a former workman in the quarry. Look up this matter. G. M. Ehlers.

A test hole or old quarry now filled with water is to be found about 125 paces immediately south of Station 44 on the S. side of Black River. No rock now exposed.

A water filled quarry is present in Sec. 21 on S. side of Pere Marquette R.R. tracks, about 700 paces E. along track from point of intersection of track and road on E. line of Sec. 21, T. 5 N. R. 15 W. No rock now exposed.

Van Buren County.

Station 45.

Location: N.E.¼ of S.E. ¼ Sec. 17, Bangor Township, T. 2 N. R. 16 W.

Section: No bed rock exposed at this station. Two huge sandstone blocks, the larger of which is about 8 ft.x 40 ft. x 40 ft. rest upon the surface of a very pronounced recessional moraine. Small block nearly the size of the larger. Rock is massive, dull red in color and very much cross bedded. These blocks are erratics. A well located on a farm in the S.E.¼ of the N.E. ¼ Sec. 17 gives 160 ft. of sand and gravel. This well is less than a ¼ mile distant from sandstone blocks. Another well located in the S.E. ¼ of the S.E. ¼ Sec. 17 and less than ¼ mile distant from these blocks passed through 85 ft. of sand and clay. See Rock specimen - R. 23.

Note: This is probably Winchell's locality. See Mich. Geol. Sur. Report of 1860.

Station 46.

Location: S.E.¼ of N.W. ¼ Sec. 11, Hartford Township, T. 3 S. R. 16 W.

Section: No bed rock exposed. A block of limestone (Dundee ?) is included in the strong moraine at this station. The limestone smells oily when struck with hammer. Some years ago this rock was used for lime. About 15 ft.x 15 ft. x 3 ft. of limestone has been taken out. Hole now filled to large extent by material washed in by rains and hauled in by farmers.

Rock specimen - R. 24 - limestone.

A well located at a house in the S.E. ¼ of the N.E. ¼ Sec. 11, and not more than ¼ mile distant from limestone block gives 85 ft. of sand, gravel and clay.

Fossils ? : Stilobites very abundant in limestone.

St. Joseph Co.

Station 47

Location : Hillside at Factoryville, N. W. ¼ Sec. 12, T. 5 S. R. 9 W. Hillside is on E. side of N - S road at intersection of N.E. - S.W. road running parallel to Michigan Central R.R. track.

Section: The surface material of the hill is clay, which seems to be the weathered product of a grayish green shale, which lies quite near the surface. See Rock specimen R. 25. Shale obtained by digging.

Some clay ironstones are present on the surface. I was told that "slate rock" appeared in layers many years ago and that this ledge has been largely covered by road filling.

I was told that a well just N. of the top of the hill and on the W. side of the N.- S. road struck slate 18 ft. below the surface.

Notes: In the N.W. ¼ of the N.W. ¼ Sec. 12(or near by), two enterprising men tried for coal. I talked with one of these men, who told me he did not remember the record - apparently afraid I was trying to get too much information. He said that they drilled in "slate rock" but did not go very deep.

Well records of any depth in this vicinity all seem to strike "blue clay".

Numerous hillside springs in vicinity of Factoryville along Nottawa Creek may indicate the presence of a shale beneath a thin covering of drift.

Calhoun County

Station 48

Location: North side of Nottawa(Notawassippi on road map) Creek, near point where N. - S. 1/8th line W. of E. line of Sec. 23, T. 4 S. R.8 W. crosses stream.

Section : Blue clay noted at waters edge - bit of shale not softened, present. A softened shale was first encountered upon digging into stream bank. More brittle and greenish gray fragments of shale obtained upon digging about 2 ft. into bank.

See Rock specimen R. 26. Look for fossils in this materials

Shale at this locality similar to that observed at Station 47.

Station 49.

Location: North side of Nottawa Creek, about ¼ of a mile N. and ¼ of a mile E. of S.W. cor. Sec. 24, T. 4 S. R. 8 W.

Section: Conditions very similar to those at Station 48.

It is very difficult to determine the presence of an outcrop under conditions such as presented at stations 48 and 49. The shale weathers in such a way as to resemble boulder clay.

About 300 paces upstream from Station 49 and on S. side of stream, a spring of considerable volume occurs. The ground over which the water runs is covered with limonite, which may indicate that the water followed the contact between the Coldwater shale and the drift.

Station 50.

Location: Gravel pit, N. side of E.- W. road, located on 1/8th line, ¼ mile N. of E. line of Sec. 23, T. 4 S. R. 8 W.

Section and Fossils : A brown sandstone ?, Marshall age, is the most abundant rock present in the gravel deposit. Some Ostracods(cf. with those found along E. branch of Willow Creek, Huron County) and crinoid stems collected.

Branch County.

Station 51

Location: Peerless Cement Co. shale quarry about 2 miles S. of Union City Branch Co. N.E. ¼ Sec. 18, Union Township, T. 5 S. R. 7 W. Merritt's brickyard.(See Rominger, vol. III p. 88) was located here in Rominger's time.

Section:

Zone C. 8 ft.

Zone B. 1½ ft.

Zone A. 17 ft.

Abandoned part of quarry filled with water.15 ft of shale at one time exposed. Beds thicker than those above.

Zone A. - 17 ft.

The shale exposed in this zone is somewhat micaceous and arenaceous. When wet the rock is dark blue in color but when dry is greenish gray. The upper part of this one in particular seems to be sandy.

Rock specimen R. 27 was taken from this upper part. Rock specimen also shows markings? resembling spirophyton candagalli. These markings are quite abundant near top of Zone A.

Rock becomes thicker bedded upon approaching base of quarry.

Throughout Zone A, there are clay ironstones, which are arranged in seams 4 to 5 inches thick. Four prominent layers of clay ironstones are present in this zone.

The clay ironstones differ somewhat in structure. When split they are seen to be dark gray colored. Many have calcite centers, the calcite being interlined in a radial manner with thin layers of a mineral which seems to be siderite (determine in laboratory).

See rock specimen R. 28. Clay Ironstones. The surfaces of the clay iron stones often are covered with clusters of pyrite crystals.

Zone B. 1½ ft.

This bed would seem to be Rominger's " ---- seams of calcareo-ferruginous rock, containing many small cylindrical nodules composed of compact carbonate of iron, besides a number of partially very finely preserved fossils". vol. III, p. 88.

This layer is apparently an intraformational conglomerate. The rock is very hard and has a general greenish color when unweathered. The pebbles of the conglomerate are of greenish calcareous and ferruginous shale. They weather brown - often first within, a green layer remaining without. Many pebbles are elongated - cylindrical, as Rominger describes. Many others are decidedly angular, similar to fragments of a breccia. The pebbles are more abundant both near the top and bottom of Zone B. The matrix is a dark gray to greenish gray, highly ferruginous, calcareous and siliceous rock, which upon slight weathering turns a reddish brown color. When much weathered, the rock becomes very friable and brown colored, showing a high content of limonite. Upper and lower parts of Zone B contain small geodes of calcite.

Rock specimen R. 29 - Central portion of Zone B.
" " R. 30 - Showing pebbles and geodes of Zone B.

Important. Compare rock of Zone B with conglomerate found at Station 45.

Zone C. 8 ft.

The maximum thickness, 8 ft., of this zone was obtained at point photograph was taken. (just S. of center of quarry).

See Photo: - showing complete section of quarry. Clay Ironstones and blocks (angular) of Zone B. in foreground.

Rock of this zone is a sandy micaceous shale, which when dry is greenish gray. Resembles very much shale at top of Zone A. Shale of Zone C. become brown colored and readily breaks in small pieces upon weathering. Many clay ironstones are also present in Zone C.

Drift.

Where photograph was taken, drift is 3 to 4 ft. thick. It is very difficult t this point to determine the line between the drift and bedrock.

Near the S. end of the quarry, the drift lies upon the rock of Zone B. At one place at this end of the quarry, a depression in the rocks exists down to 3 to 4 ft. below the top of Zone A.

Structure.

Near N. end of quarry, a slight crumpling of the beds occurs. This is best seen in the shales of Zone C.

A low anticline is also present at this end of the quarry. Rock of Zone B. shows this best. This gentle crib (?) can best be seen by standing at some distance to the east of the quarry wall.

Fossils.

Collections made from Zones A, B, and C. Shales of Zones A and C sparingly fossiliferous, a chonetes being the most abundant fossil present. Matrix of Zone B. contains fish teeth, aviculopecten and other pelecypods, brachiopods and a few crinoids.

Collections from clay ironstones- chonetes being the most abundant fossil. Gastrods and pelecypods also present in large numbers.

Collections made from dump materials, which is in large measure clay ironstones from Zones A. and C. Dump materials also contains blocks of grey crinoidal limestone (apparently of Drift origin) which weathers a brownish red upon weathering. Rock is highly ferruginous. This rock is full of fossils chiefly crinoid stems and some brachipods, gastropods, etc. (See station 56, under Fossils)

Origin of collections indicated upon labels with specimens.

Station 52

Location.

Old Shale quarry(abandoned) of Peerless Portland Cement Co. on West bank of Coldwater River, S.W. ¼ of S.W. ¼, Sec. 10, T. 5 S.R. 7 E. This station is probably the one described by Rominger (vol. III, p.89) as a brickyard upon Mr. Randall's farm, etc. I ascertained that a brickyard was at one time located here and that the property was owned for number of years, until just recently, by a Randolph family.

Section:

The shale of this abandoned quarry has weathered into a clayey soil with many small fragments of shale, which material obscures to large degree the more solid beds of shale below. Vegetation also getting a foothold.

Shale is similar to that of Zone C, Station 51. - the same horizon. Clay ironstones also present in this zone. Rock of Zone B, station 51 not seen in outcrop - probably covered by talus of shale material from above. Lower part of abandoned quarry filled with water.

Along the west bank of the Coldwater River in the vicinity of this abandoned quarry, outcrops of shale (exposures average 6 - 10 ft.)occur. Shale also appears in bottom of stream. Shale is somewhat sandy and greenish gray colored.

Fossils:

Shale sparingly fossiliferous - typical chonetes of station 51.

Station 53.

Location:
Vicinity of abandoned shaft sunk into Coldwater shale by Bronson Portland Cement Co. S.E. ¼ of N.E. ¼ Sec. 33, Batavia Township, T. 6 S. R. 7 W. haft located in N.E. angle made by intersection of N.W.- S.E. road and New York Central R.R. track.

Section:
Shaft filled. Little dump material in vicinity. Dump material, which was seen, contained weathered bluish to greenish shale and clay ironstones. Gray, ferruginous limestone containing many crinoid stems was found in considerable quantity upon the surface about the abandoned shaft.

Fossils:
Obtained from linestone noted above.

Station 54

Location:
Vicinity of Branch County Infirmary, N.E.¼ of N.E. ¼ Sec. 9, Coldwater Township, T. 6 S. R. 6 W.

Section:
(a) About 350 paces S. of present infirmary, was told a brickyard was formerly located. This may have been Romingers"----brickyard north side of city of Coldwater. Fossiliferous iron geodes, including chonotes, Illinoisensis, etc", Vol. III, p. 88. I was informed that the pit was filled some years ago. There was no indication to be seen of a brickyard at the time of my visit.

(b) A well, which was recently dug upon the infirmary grounds, was said to have reached shale. Some fossils were obtained from material which was said to have been excavated from the well pit. It is possible that material is from the drift.

Station 55

Location:
Abandoned brickyard, N.E.¼ Sec. 34, Coldwater Township, T. 6 S.R.6 W. This abandoned brickyard on the north side of a small stream was used for ashort time after its abandonment by the Portland Cement Co. at Quincy.

Section:
Due to weathering the shale on the surface has been converted into a clayey soil. Unweathered sandy greenish shale can be reached by digging a foot or so into the weathered material. Outcrops of shale appear in the small gullies of the pit. The shale of this station is light green colored and somewhat sandy and micaceous when dry. When wet, the shale is dark blue colored. Clay ironstones are also abundant in the surface. A number of glacial boulders of gneiss, etc. are present on the surface above the shale pit.

Fossils:

Collections made from clay ironstones found in dumps and on the surface of the shale of the pit. There is a small possibility that some of the clay ironstones may have been transported a short distance by the ice.

Station 56

Location:

Vicinity of abandoned hole dug for coal (??) near S.E. corner of Sec. 14, Coldwater Township, T. 6 S. R. 6 W.

Section:

The material found in the dump beside this covered hole consists of blue clay (weathered shale), clay ironstones, thin shales of hard, gray ferruginous limestone containing an abundance of crinoid stems and a few thin slabs of sandstone of yellowish to brownish color. I am told thin seams of this sandstone appeared in the sides of the hole and that in the unweathered condition the rock was more bluish colored.

See Rock specimen R. 31. Sl. material from dump.

The blue shale, I was told, was the most predominate rock passed through; clay ironstones, limestone and sandstone occurring as thin seams.

Fossils:

Obtained from fragments of hard crinoidal limestone and clay ironstones found in dump. Upon weathering the limestone becomes brown colored (limonitic). In this weathered condition of the rock, the fossils show up to better advantage. This crinoidal limestone is very similar to that found at Station 51. Compare fossils in laboratory.

Station 57

Location:

Abandoned brickyard and adjacent shale quarry, latter at one time used by Wolverine Portland Cement Co., N.W.¼ Sec. 30, Coldwater Township, T. 6 S. R. 6 W. Shale taken out by Cement Company immediately North of shale workings of brickyard. Abandoned brickyard and shale quarry are both on the west side of N - S road. (See note below).

Sections:

In the brickyard about 15 ft. of shale is exposed. Toward the bottom of the exposure, the rock is moist, dark bluish in color and somewhat arenaceous. The upper part of the exposure shows a greenish colored, somewhat arenaceous shale, which splits into thin leaves upon weathering. The shale of this upper zone is furthermore dry. The shale of the upper portion apparently had the same characters of the lower portion before drying and weathering, which processes produced the effects noted.

In the pits made by the cement company, 10 to 15 ft. of shale are exposed. Shale of both brickyard and quarry contain some clay ironstones. The shale at this locality seems to underlie a prominent N. and S. elevation. Brickyard and quarry are located at base of eastward slope of this elevation.

Fossils:

Some collected from bluish shale at base of exposure in brickyard. A number of fossiliferous clay ironstones were collected from surface (loose material, not in situ). There is the possibility that some of this material may be drift.

Note:

This station may be site of an outcrop noted by Rominger (vol.III, p. 88) as follows; "A few miles west of Coldwater, near Branch Station, a boring was made(Dr. Bennett of Coldwater). A half mile east of this boring, a 25 ft. exposure occurs - no fossils, etc."

The station 57, here noted, is about ½ mile south and a little west of Branch station.

Station 58.

Location:

Shale quarry of Wolverine Portland Cement Co., N.W.¼ Sec. 32, Coldwater Township, T. 6 S. R. 6 W.

Section.

At top	- 9 ft. of drift.
	9 ft. of dark blue shale with clay ironstones.
(Photo shows these zones)	4 inches of bluish green, fine grained sandstone, which upon weathering splits into thin lamellae.
At bottom	14 inches sandstone, similar to that above, with thin seams of shale.

The cement company drilled to a point 200 ft. below this sandstone zone. "Blue shale" was the predominate rock passed through, though many thin "hard layers" (probably clay ironstones, calcareous and sandstone seams) were noted.

The section given above was taken near south end of quarry. At the time of my visit, extensive stripping was being done at this end of the quarry. Since the topography rises to the south, it is possible that a greater thickness of rock will be exposed as the quarrying extends in this direction.

Fossils:

The 9 ft. shale zone of the section given was more fossiliferous than shales noted elsewhere. The most abundant forms found were a small goniatite and a chonetes. These fossils, particularly the goniatites were replaced with pyrite. ? Fossil found in piece of sandstone at bottom of quarry.

Note:

An abandoned brickyard is located about ¼ mile N. of the shale quarry in S.W. ¼ Sec. 29, Coldwater Township. The shale is obscured on the sides of the shallow pit of this brickyard by wash material and weathered shale. By digging into the weathered material about 1 ft. the shale is reached. Shale is greenish when dry and bluish when wet. Clay ironstones present in shale. Brickyard is topographically higher than shale quarry to south.

The shale in this abandoned pit and shale quarry ¼ mile to south underlies a short N - S. ridge.

Station 59

Location:

Gravel pit (in lane) at N.W. cor. Sec. 15, Algansee Township, T. 7 S R. 5 W. in S.E. angle made N. and W. lines of Sec. 15.

Fossils:

Collection made from a much weathered, brown(limonitic) rock, which may have been derived from a gray, ferruginous limestone. Bryazoa found in this rock. Some material collected may not be from Coldwater.

Station 60

Location:

Along drainage ditch (Fisher Creek) between point where E. line of Sec. 16 crosses ditch, about ¼ mile S. of N.E. cor. Sec. 16 and point about ¼ mile N. of point where N. line of Sec. 16 crosses ditch, about ¼ mile W. of N.E. cor. Sec. 16, Algansee Township, T. 7 S. R. 5 W.

Section:

In dredging that portion of the ditch mentioned above, a blue, somewhat sandy shale with clay ironstones and thin hard calcareous layers was encountered. Near the north end of this station the following section was obtained in the bottom and sides of the ditch; (next page)

At top - 3 ft. Drift.
- 1 ft. Shale with clay ironstone.
- 2 ft. Hard calcareous rock.

At bottom-2 ft. Shale.

The shale of this section is bluish when wet and greenish when dry.

The hard calcareous rock is dark gray, where unfossiliferous. A reddish, fossiliferous band (3 to 4 inches thick) is present in the upper and lower portions of this bed.

See Rock specimen R. 32 - showing nature of reddish bands.

Fossils:

Some excellent material was obtained from the dump piles on each side of the ditch. The rock, particularly the clay ironstones and limestone have had a chance to weather; the fossils as a result of this action break out of the rock in a better state for study.

The only opportunity to collect from bed rock is at the north end of the station, where section was made. The water of the ditch covers the bedrock elsewhere, At the outcrop no fossils were collected, much better material having been obtained from dump material. This is one of the best collecting places for Coldwater material which I have seen in Southern Michigan.

Station 61

Location:

Along Pencil Creek between point where it crosses N - S ¼ Sec. line of Sec. 10, Algansee Township, T. 7 S. R. 5 W. and point about ¼ mile W. where stream enters larger valley of Fisher Creek. Fisher Creek has been dredged for drainage purposes. See station 60. Pencil Creek follows quite closely the E.- W. ¼ Sec. line of Sec. 10, along the portion indicated at this station. After leaving its narrow valley, Pencil Creek flows in a northwesterly direction, emptying in Fisher Creek, just E. of first bridge crossing the latter stream a short distance S.W. of the N.E. corner of Sec. 9.

Section:

The shales exposed along Pencil Creek are bluish colored when moist etc. and contain seams of sandstone and clay ironstones. At the east of the station, the shale etc. appears in the bed of the stream and as small exposures (1-3 ft.) in its S. bank. A short distance downstream is an abandoned brick and tile plant. The shale was taken out from the south bank, where about 12 ft. is exposed. In old and new meander seam downstream from this point the shale is often exposed.

A well was drilled to a depth of 116 ft. below the base of the shale exposed at the abandoned brickyard. Salt water obtained from well. Record given by Mr. Reynolds, owner of property.

Fossils:

Fossils obtained from shale and clay ironstones at abandoned brickyard. Material was also found in the clay ironstones of a dump. These clay ironstones roughly lenticular shape, some having the longest diameter of 1 foot, are similar in size etc to those of a layer in the shale exposure. There is however, a small possibility that this material may be of drift nature.

Station 62

Location:

Banks of small brook, S.W.¼ Sec. 23, close to S. line of Sec. 23, Algansee Township, T. 7 S. R. 5 W.

Section:

A greenish shale with clay ironstones comes close to the surface along the banks of the stream. Where sod is removed, fragments of shale and clay ironstones are sometimes seen. These become more plentiful upon digging about 1 ft. below the weathered zone.

Station 63

Location:
Along brook, which was dug deeper for dralnage purposes in the N.E. ¼ Sec. and N.W. ¼ Sec. of Sec. 25, Algensee Township, T. 7 S. R. 5 W.

Section:
Between point where brook crosses N.- S. ¼ Sec. line of Sec. 25 and point about 200 paces E., shale (blue color) was reached at a number of places in the stream bottom during deepening operations. By digging 6 inches to 1 ft. in bottom of the ditch, shale is easily reached. At certain points along the south bank of the brook the shale would seem to be near the surface, judging from the abundance of greenish, somewhat sandy shale fragments to be found.

West of the point where brook crosses N - S road for a distance of 400 paces, blue shale and clay ironstones were also encountered in the bottom of creek. About 350 paces west of the N-S. road, an exposure of blue shale (1½ ft.) occurs in the bank of the stream. An abundance of thin clay ironstones was seen upon the surface at this point. I was told that these were taken out of the shale at the bottom of the brook during the digging.

Station 64

Location:
Along brook, just S. of E.-W.¼ Sec. line of Sec. 24 and in vicinity of west line of Sec. 24, Algansee Township, T. 7 S. R. 5 W.

Section:
Where the sod is removed along the banks of the banks of the brook, fragments of dry, greenish colored shale and weathered clay ironstones are to be seen. The fragments of shales become more abundant upon digging into the banks of the stream. It would seem from this that the shale is quite near the surface.

Station 65

Location:
Along brook, N.W.¼ Sec. 14 and near N. line of Sec. 14, Algansee Township, T. 7 S. R. 5 W.

Section:
About 12 ft. of blue shale outcrops on the south side of brook. Shale has soapy feel. Difficult to separate shale from overlying drift, which is largely worked over shale.

Fossils:
Few poorly preserved brachiopods and pelecypods collected from shale.

Hillsdale County

Station 66

Location:
East - west road on S. line of Sec. 16, Reading Township, T. 7 S. R. 4 W.

Section:
About 18 ft. of brownish green arenaceous shale is exposed along the sides and in the center of the road. Clay ironstones are also present. Rocks splits into thin slabs. The lakes to the west of this outcrop are situated in a conspicuous valley. In fact the whole chain of lakes in the western part of Reading Township lie in this valley. It is quite possible that this valley may be of pre-glacial origin. Bedrock is at or near the surface on both sides of the valley. See subsequent stations.

Fossils:
Chonetes is abundant. ? Spirophyton caudalli markings noted.

Station 67

Location:
Along brook, which flows through N.W.¼ Section and S.E.¼ section of Sec. 21, Reading Township (T.7 S. R. 4 W.)

Section:
Due to weathering, the shale exposures take on the nature of clay banks. By digging into the weathered shale of the valley sides of the stream, less weathered shale is obtained. The shale is best exposed along the brook in the S.E. ¼ Sec. 21. At one point in this part of Sec. 21, the shale outcrops without a covering of weathering of clay on the south side of the stream. Here as elsewhere along the brook, the shale is greenish colored and somewhat sandy.

Station 68

Location:
Along brook in Sec. 15, Reading Township, T. 7 S. R. 4 W., between points about 800 and 1200 paces West of point where brook crosses E. line of Sec. 15.

Section:
(a) One of the best exposures occurs in a meander scar on the south side of the brook, near the east end of this station. A very sandy, greenish colored shale, approaching a sandstone outcrops at this point. The shale is micaceous and splits into thin slabs, resembling in all respects rock exposed at station 66. Some less sandy blue shales are also present. Clay ironstones present throughout greenish and bluish colored shale.

(b) Near the west end of the station and on north side of brook an abundance of thin slabs of greenish colored, micaceous, fine grained sandstone were found. Similar rock also brought to surface by woodchuck. It is probable that such a sandstone is quite near the surface.
See rock specimen R. 33 - unweathered, greenish, micaceous sandstone (ss)
" " " " 34 - weathered sandstone (ss), showing fossils.

Fossils:
See rock specimen R. 34 (above).

Station 69

Location:
1. Along Brook in Sec. 9, Reading Township, T. 7 S. R. 4 W. between point where brook crosses W. line of Sec. 9 and a point ¼ mile to the East. Brook crosses W. line of Section 9 near its center.
2. Road cut, immediately S. of point where brook crosses N.-S.road on W. line of Section 9.

Sections:
1. Along brook.
(a) An excellent exposure of blue shale occurs on the S. side of the brook between points 150 and 200 paces east of road. Thin seams of more arenaceous shale, clay ironstones, and thin layers of conglomerate similar to the thicker conglomerate layer (Zone B) at Station 51 are also present. The entire exposure of shale and thin seams of more sandy shale, conglomerate, etc in the large meander scar at this locality is about 25 ft.

About 10 ft. of shale is exposed in this same meander scar at its East end, about 30 paces E. of road.

(b) A 10 ft. exposure of somewhat more sandy bluish to greenish shale is exposed in the north bank of the brook about ¼ mile E. of road. Fragments of conglomerate are found loose on surface. A thin seam of this rock may be present, being covered by talus, etc.

(c) Blue shale, greenish when wet, is exposed in the bottoms of gullies on the N. side of the brook between point where stream crosses road and point 300 paces upstream (East).

2. Road Cut - Just S. of point where brook crosses road. Shales with clay ironstones etc. exposed in rock cut of road, which has a steep slope toward the brook at this point, are a continuation of the strata in the large meander scar noted under 1(a) above.

Fossils:
(a) Collection made at meander scar, 300 paces E. of road.
(b) Collection made at meander scar between points 150 and 200 paces E. of road.
(c) Collection made at road cut
Shales, clay ironstones and conglomerate are fossiliferous. Best preserved fossils obtained from conglomerate.

Station 70

Location:
Along brook, same as that noted in station 69, between point where it crosses W. line of Sec. 9, Reading Township and point 50 paces to the west.

Section:
Few low exposures of blue shale are present, perhaps 3 or 4 ft. of lower strata. Rock similar to that of Station 69.

Station 71.

Location:
Along brook, N.W.¼ Sec. 16, Reading Township, T. 7 S. R. 4 W., between point where it crosses W. line of Sec. 16 and point about ¼ mile upstream (east).

Section:
Blue shale, with some thin arenaceous shale layers and clay ironstones are exposed chiefly in the meander scars of the brook. At one point on the south side of the stream, a 20 to 25 ft. exposure occurs.

A photograph was taken of an exposure in a small meander scar on the N. side of the brook near the road on the W. line of Sec. 16. This picture shows quite well the character of the exposures met with along the streams in the western part of Reading Township. Above the 1 ft. zone of unweathered dark blue shale in the bottom of the brook is seen a weathered shale zone which very much resembles boulder clay. The color of the weathered shale is brownish green. Upper part of this weathered shale zone may be drift, which is composed of worked over shale.

Station 72

Location:
South bank of brook, S.E.¼ Sec. 16, Reading Township, T. 7 S.R.4 W. about 1/8th mile W. of E. line of Sec. 16.

Section:
15 ft. of rock is exposed in a meander scar. The lower 10 ft. is a blue shale similar to blue shale of quarry at Coldwater and shale pit south of Union City. The upper 5 ft. is a brownish green, more arenaceous shale, which splits in thin leaves. Clay ironstones present. Water issued from many points in outcrop. Water probably seeps in from drift.

Fossils:
Collection made from blue shale.

Station 73

Location:
North bank of brook on S.W. ¼ Sec. 15, Reading Township, T. 7 S. R. 4 W., about ½ mile E. of W. line of Sec. 15 and 1/8th mile N. of S. line of Sec. 15.

Section:
A bank about 36 ft. high occurs on the outside of a meander of the brook at this station. Bedrock is at or near the surface but weathered rock to a great extent hides the underlying strata. At least 30 ft. of rock is poorly exposed except for thin covering of weathered material, in the steep bank.

Very near the top of the section is a sandstone of buff color. See Rock specimen R. 35, of little weathered rock from this zone. Thickness not determined.
Below follows brownish green arenaceous and micaceous shales, which split in thin leaves. Clay ironstones present.
Nearer the base of the bank, blue, somewhat sandy shales are present. Springs issue from shales.

Fossils:
Fossils found in fragments of sandstone, apparently talus from sandstone at top of bank.

Station 74

Location:
Along brook in S.W.¼ Sec. 15, Reading Township, between Station 73 to S. line of Sec. 15.

Sections:
(a) A 20 ft. exposure occurs on the S. side of the valley of the brook and on the outside of a meander of the brook, about 10 paces upstream from Station 73. The rock near the base is a bluish and not very sandy shale. Higher up in the outcrop, there is a very arenaceous shale, which approaches a sandstone. In the talus from the arenaceous shales or perhaps even higher, fragments of sandstone were seen. Compare Stations 72, 73, etc. A large quantity of water issues from the rock at this locality. The upper more arenaceous layers seem to be the water bearing zone.

(b) Between this point on the brook and the S. line of Sec. 15, the shale seems to be near the surface in the banks of the stream. Wherever meander scars occur, the shale is seen to be at or near the surface.

Station 75

Location:
Along road, immediately S.of point where brook mentioned in stations 72 and 73, crosses W. line of Sec. 15, Reading Township, T. 7 S.R. 4 W.

Section:

Rock appears in road to height of 30 ft. above brook. Highest point in road 55 ft. above brook. Near the top of the exposure is a sandstone, which is similar to that at Station 73. It is probable that this is the same bed. The exposure at this station is very poor. Thickness not determined. Below the sandstone are arenaceous, greenish colored shales in which are sandy clay ironstones.

Judging from the amount of loose rock, chiefly sandstone, but some arenaceous shale, on the surface at the highest point in the road, it would seem that bedrock is quite near the surface at that point.

Important:

This is the nearest locality to the Marshall-Coldwater contact which I visited. The sandstone of the last three stations should be run down. It is significant that the beds at these stations (73,74,and 75) become decidedly more sandy towards the top of the exposures, etc.

Fossils:

Collections made from clay ironstones and sandy shale layers at top.

Station 76

Location:

Along brook, immediately S. of N. line of Sec. 31 and in N.W.¼ and N.E.¼ Sec. 31, Reading Township, T. 7 S. R. 4 W.

Section:

Brownish green, micaceous and arenaceous shale exposed in brook bottom and valley sides. Rock in outcrops upstream, N.W. ¼ Sec. 31, more consolidated and a little sandier than that at lower levels downstream.(N.E. ¼ Sec. 31). Clay ironstones present in shale.

Fossils:

(a) Collection from clay ironstones in N.E.¼ sec. 31.
(b) Collection from more sandy shale N.W.¼ Sec. 31
From Tracks ? Lingula, pelecypods.
(c) Collection from shale in N.E.¼ Sec. 31. Lingulas, gastropods, pelecypods etc.
Fossils very poorly preserved.

Station 77

Location:

Along brook and N-S road, S.W.¼ Sec. 32, Reading Township, T. 7 S. R. 4 W. See section below.

Section:

Greenish colored, arenaceous and micaceous shale is exposed along N.-S.road, particularly in ditches at side of road, located on N.-S.1/8th line, ¼ mile E. of W.line of Sec. 32, about 1/3rd mile N. of S. line of Sec. 32. The road passes over a high point of land at this point.

A brook of intermittent flow, crosses the N.-S. road at this point. Greenish, sandy shale is exposed in its steep valley sides to the east of the road. The brook head is in or nearly in the S.E. ¼ Sec. 32.
8 - 10 ft. of shale poorly exposed in few places.