what has already been noted in connection with the general discussion of these districts.

*Gagetown.* This town with a population of 400, is near the northern county line, upon the crest of the western moraine. Dug wells with a depth of 10 to 40 feet, or occasionally more, are the most common source of supply for domestic use. The water comes from sand or gravel beds in the clay, is hard, of sufficient quantity for ordinary demands, and is said not to be affected by the seasons. It rises in some of these wells to within 10 feet of the surface.

Wells are occasionally drilled to rock, but no records of the depth were available. The deepest well in Gagetown is reported to be 140 feet.

*Kingston.* This village, with a population of 350, is located on a morainal ridge, 30 to 40 feet above the bottom of the valley in which the railroad runs. The wells are generally dug, and range from 20 to 50 feet in depth, with an average of 35 feet; the water is hard but of good quality, and of sufficient quantity for domestic use, and is said not to vary with the season. The supply comes from sand or gravel beds in some of the wells.

A waterworks system owned by the village was installed in 1902, the water being pumped from a 4-inch drilled well 217 feet deep, which reaches rock at about 150 feet. The water comes from sandstone and rises to within 10 to 12 feet of the surface, giving ample supplies. It is distributed from a standpipe, and is used for fire protection, sprinkling and boilers. There is also a well 215 feet deep, in rock, at the schoolhouse, having the same characteristics as the waterworks well.

Along the railroad, and at the bottom of the valley west of it, both of which lie 15 to 20 feet below the water level in the waterworks well, it is probable that water from the same source would be reached at about 185 feet or a little more, and would flow with strong head. In the valley is a small stream, and along the margin of it are seepage springs, the water from which is sometimes used.

*Mayville.* This town with a population of 750, is the most elevated in Tuscola county, the moraine rising to nearly 1,000 feet above the sea level within its limits. As a result of this situation, the wells for domestic supply are often deep, but do not reach the rock surface. There is no waterworks system; one was projected some years ago, but was abandoned on account of the difficulty of getting water in sufficient quantities.

A test well was drilled 400 feet and bed rock was reached at 285 feet. In this well, water rose from sandstone about 300 feet, or to within 100 ft. of the surface.

The dug wells are often shallow, from 15 to 20 ft. deep, the shallowest being only 10 ft., but driven wells in the higher parts of the town often go down nearly or quite 100 feet to reach water in sufficient quantity. The water in the shallow wells is said to come from sand or gravel beds in the till, is hard, and never large in amount; yet the supply is fairly constant, so that moderate demands on it are met, except in very dry weather, when it may fail.

Bed rock is the most available source for a large supply for the town, but the great depth to which it is necessary to go to reach rock, and the depth from which the water must be pumped makes it an expensive



source. If, however, wells were put down in the lowest part of a town, or, better still, in the valley north, and pumped from these to a reservoir in the highest part of the town, from which it could be distributed, it seems probable that a satisfactory supply may be had. Nearly 100 feet in the depth of the wells could be saved by locating them in the lowest part of the valley, which runs through the eastern part of the town.

*Millington.* Millington with a population of 632, is situated on a broad gently-sloping, sandy, and gravelly plain, which is on the edge of the rolling country, and is morainal in origin. The surface soil is permeable enough to take in a considerable amount of rainfall, and this accumulates in the underlying gravels, which lie from 15 to 20 feet below the surface. This supply is easily reached by open dug wells, and is largely drawn upon, the majority of the houses of the town depending on wells about 20 feet deep for their supply for domestic uses. This supply is uncertain and effected by drought. Persons requiring larger supplies drill down to bed rock for water, reaching it at from 90 to 112 feet. In this rock which is sandstone, water may be found at varying depths in good quantity and of excellent quality.

In 1904, the village completed its public waterworks, the water being obtained from two 4-inch drilled wells 187 feet and 200 feet deep, respectively, located near the center of the town. The rock surface is about 110 feet down, and the rock was reported as sandstone the whole distance until water was struck. The water rises to within 17 feet of the surface and is said to be of excellent quality and abundant. It is distributed from an elevated tank or standpipe, into which it is pumped from the wells.

*Fostoria.* This village lies on a slope from the high moraine to the north and, so far as learned, gets its supply for domestic use from dug wells 20 to 40 feet in depth. A stream flows through the edge of the town, and from this some water is taken for use in boilers.

### CASS RIVER VALLEY REGION.

*Cass City.* This village, with a population of 1,212, has for its site a broad gravel terrace about 40 feet above the bed of Cass river and has behind it, to the north, a well-marked morainal ridge. The gravel gives abundant water in dug wells about 20 feet deep, some going deeper, and these are the common sources of supply for domestic use.

*Caro.* This town, with a population of 2,268, is located at the foot of a well marked morainal ridge upon a gently sloping or nearly flat gravel terrace of the river valley. It is well situated for the development of a system of waterworks, depending on gravity for distribution of the water from a properly located standpipe. For several years such a system, owned and operated by a private company, has been in use, the water being pumped, in part, at least, from springs located across the stream, opposite the town. Recently the supply has been augmented by drilling wells in the rock. The standpipe is situated in the northern part of the town upon morainal ridge about 100 feet above the principal business street. The water is of good quality and that from the springs is relatively soft. The springs have their catchment areas to the east of the river in the gravel and sand terraces, the town standing on the west bank, the water percolating through the gravel and sand down

to a dense substratum, upon which it finds its way until it reaches some place where the streams cut this in running to the river, when it flows out as springs. The water is used for all purposes, including domestic and drinking, but there are many dug wells in the town from 16 to 20 feet deep which, upon the gravel flat, reach through the gravel to the top of the clay and intercept some of the water moving along upon it. This water is reported as soft and pure, but unless care is taken to dispose of sewage, eventually the gravel will become so contaminated that the wells in the more thickly settled parts of the town may be unsafe to use and will afford breeding places for the germs of various diseases.

The following is the record of the deep well of the Peninsular Sugar Company; the altitude of the mouth is 15 feet above Cass river, and about 645 or 650 feet above the sea level:

RECORD OF PENINSULA SUGAR COMPANY'S WELL, CARO.

| | Thickness, feet. | Total feet. |
|---|---|---|
| Drift (sand, gravel, hardpan and boulders) | 113 | 113 |
| Limestone | 7 | 120 |
| Shale (blue) | 25 | 145 |
| Sandstone (very soft; first flow of water, 50,000 gal. in 24 hours, soft; rose 5 feet above derrick floor) | 40 | 185 |
| Limestone | 5 | 190 |
| Sandstone | 50 | 240 |
| Shale, black | 2 | 242 |
| Sandstone | 10 | 252 |
| Shale | 1 | 253 |
| Sandstone | 29 | 282 |

Streak of sandy limestone.

At 275 feet a flow yielding 350,000 gallons in 24 hours was struck. The water has a slight mineral taste, leaving a sweet aftertaste, probably of magnesium sulphate. The well is 8 inches in diameter; temperature, 47 degrees F.

*Vassar.* This village, with a population of 2,032, is the third important valley town to be considered, and like Caro is located on the terraces of Cass river, but unlike that town reaches across the stream to the eastern bank. A considerable part of the town also lies upon the morainal ridge, here relatively low and inconspicuous. The ridge is covered with gravel, and hence is more permeable than such ridges usually are.

The village owns its waterworks system, the water being derived from seven drilled flowing wells, which average about 200 feet deep. The deepest well is 230 feet, but it is cut off at 200 feet. At the depth of about 125 feet a small flow was struck, and this increased with the depth until it reached its greatest volume at 175 feet, when the flow was about 100 barrels an hour. The total depth of one of the other wells is 207 feet, with the rock surface at about 50 feet. The water rises about 4 or 5 feet above the surface and is pumped to a standpipe on the ridge, from which it is distributed. It is relatively soft, giving only a slight powdery scale after prolonged use in boilers. The following analysis by Dr. R. C. Kedzie, of the agricultural college, was made about the time the system was installed:



ANALYSIS OF VASSAR PUBLIC WATER SUPPLY.[1]

| | Parts per million. |
|---|---|
| Total solids | 271.43 |
| Volatible at red heat | 71.43 |
| Total mineral matter | 200 |
| Mineral compositions: | |
| Calcium (Ca) | 65.49 |
| Carbonate radical ($CO_3$) | 100.82 |
| Sulphate radicle ($SO_4$) | 20.16 |
| Magnesium (Mg) | 6.17 |
| Chlorine (Cl) | 4.32 |
| Sodium (Na) | 2.82 |
| | 199.78 |
| Nitrates and nitrites | None |
| Free ammonia | 0.05 |
| Albuminoid ammonia | 0.04 |
| Hardness by soap test | 85.71 |
| Permanent hardness | 57.14 |
| Total hardness | 142.85 |

The amount of water yielded by these wells is about 110,000 gallons a day. Two deep wells were put down in Vassar; one near the railroad junction, which has a depth of about 600 feet, flows a considerable quantity of brackish water, which has been bottled and sold for medicinal purposes; the other, which was put down as a test well about the time the waterworks were established, is 467 feet deep, and gave salt water of 6 degrees saltness. This well was reported to be plugged and abandoned.

Dug wells from 20 to 30 feet deep are frequently used, furnishing sufficient water for domestic use, and private drilled wells from 45 to 200 feet deep are not uncommon. Most of the latter flow when located on the lower terraces of the river. The rock water is generally softer than that from the drift, especially that from sandstone, the most common source.

*Tuscola.* This village, with a population of 275, lies a few miles southwest of Vassar, on the lower terraces of the river valley, here somewhat sandy and relatively narrow. The town is spread over both banks, the parts being connected by a narrow bridge. The general sources of water for domestic use and for stock, are shallow dug wells from 12 to 40 feet deep, the most common depth being about 20 feet. The water usually comes from gravel strata in the clay which underlies the shallow surface sand, and rises within 6 feet of the surface in some of the wells. It is hard and the supply constant and sufficient in most cases for the needs of the owners.

A few drilled wells on the higher slopes of the valley yield excellent supplies of somewhat brackish water from the rock at a depths of about 175 feet. A drilled well at the north side of the village is reported to be 175 feet deep, in sandstone, the rock surface being struck at 49 feet.

[1] Expressed by analyst in grains per gallon and hypothetical combinations; recomputed to ionic form and parts per million at United States Geological Survey.

This well flows several gallons a minute, with a head of 2 feet. It is situated on land 30 feet above the level of the river, higher than most of that on which the village is located, hence it would seem probable that other flows could be developed by going down into the rock. The rock surface was reported as 70 feet down in another well, but as it appears in the bed of the river, a short distance north of the town, it is probable that this well was on the higher ground than the flowing wells above cited.

*Wilmot.* This small village is situated on the southern edge of the broad sloping plain which rises to the morainal region on the south. The generally sandy or loamy character of the soil, and the fact that it is underlain by clay at moderate depths, makes the water supply good and easily obtained. The wells average about 20 feet in depth and give a good supply of hard water, which is not easily exhausted. No rock wells have been put down in this vicinity.

*Deford.* This is the next station north of Wilmot on the Pontiac, Oxford and Northern Railroad, and is in much the same situation as Wilmot. The plain is slightly flatter and somewhat sandier. Water is obtained from shallow dug wells at about the same depth as at Wilmot.

*Silverwood.* This is a small village on the Pere Marquette railroad, on the southern border of the county, and is interesting from the fact that a part of the water supply is obtained from flowing wells from the drift. The area extends southward into Lapeer county, forming a good sized district. A few wells that flow in the village are about 40 feet deep. Dug wells from 15 to 30 feet deep are also common sources of water for domestic uses. The water tank at the railroad station is filled with water from a flowing well 40 feet deep.

## SYSTEMATIC CATALOGUE OF WELLS AND TEST BORINGS.

The following records have been collected from many sources, among which are the personal, detailed study of the wells and waters by the writer, who also gathered many records of depth and other pertinent facts from the owners of wells by a house-to-house canvas, carried on as a part of the field work. A most important contribution has been made by the well drillers, among whom may be mentioned Mr. John Russell of Unionville, and his brothers and Mr. Charles Van Wormer of Millington, who permitted their carefully kept records to be used and cheerfully answered numerous questions relating to their borings. Mr. Charles Montague of Caro and Handy Brothers of Bay City and a number of other land holders, who have sunk exploratory test holes in various parts of the county, in search of coal and other minerals, have kindly permitted the use of their records, some of which are here published, and which, in the aggregate, have involved the expenditure of thousands of dollars. Mr. Alfred C. Lane procured most of the data from Elmwood and Elkland townships, and has also rendered much assistance at other points. The order of description of wells is usually as follows:

(1) Location.
(2) Name of owner, when known.
(3) Depth of well, in feet.



(4) Depth to rock, or length of casing, in feet.
(5) Quality of the water, including notes on the mineral matter found in it.
(6) Head, or height to which the water rises.
(7) Elevation above sea level or tide. (A. T.) (Lake level 581 ft. A. T.)
(8) Remarks.
(9) Driller's record and name of driller.

The records are given by townships and locations by section quarters and more accurately when possible.

Regarding the quality of the water it may be said that during the field investigations, chemical tests were made of nearly every flowing well and many of the pump wells, to determine the mineral constituents of the water.

These tests were simple but reliable, and were qualitative, although in a measure they became quantitative as well, since the promptness with which the reactions took place and the amount of the precipitate which appeared, were indicators of the quantity of the mineral sought, which was present in the sample. Hence, a rough system of classification was possible and the same one was adopted as that used in Huron county.[1] The tests made included a search for common salt, sodium chlorid, (NaCl), sulphates, or sulphuric acid, in composition ($H_2SO_4$ or $SO_4$) calcium in composition or "lime," (Ca.); magnesium in composition, (Mg) and iron, (Fe.) The tests were made at the well, by means of a pocket testing outfit, using concentrated solutions of the reagents employed. The results were recorded as follows: Where the mineral matter was present in large quantity, it was said to be strong (str.); where in moderate amount, it was called medium (med.); and when present in small quantity the record is (low), or still less, traces (tr.). If no precipitate was formed, the record was (0).

The reagents used were identical with those with which tests were made in Huron county, and the methods of work the same and are fully described in the passage already referred to above.

Where the elevation of the ground at the mouth of the well is given "A. T." it will be remembered that generally this has been determined by barometric observations and is only approximate, the difference between sea level and the level of Saginaw bay is about 581 ft., so that the latter number must be subtracted from the figures given to obtain the elevation above the bay.

The townships are given in order beginning with the northeastern, thence westward, across the county, and this order is continued throughout the list. In general no special order was observed in the given section of a township, but the wells are listed about in the order visited.

### ELKLAND TOWNSHIP.

Sec. 5.

S. W. of S. E; 30 ft.; hard; 789 A. T.; no rock.

Sec. 6.

N. W. of N. W.; P. Gage; 40 ft.; very hard; A. T. 751; 20 ft. dug and 20 ft. driven.

[1]Lane, A. C., Loc. cit., pp. 138-142.

Sec. 9.
N. E. of N. W.; 50 ft.; soft; Ca., tr., Cl, tr., $SO_4$ none; dug 25 ft., bored with auger, 25 ft.; no rock.
Sec. 11.
Near W. ¼ post, School District No. 2; 72 ft.; 767 A. T.; 72 ft. to rock. Wells east side Sec. 11 and W. side Sec. 12, all from 25 to 45 ft. deep.
Sec. 18.
S. W. of N. W.; O. Austen; 180 ft.; 783 A. T.; rock 130 ft.; good. Water from quicksand at 84 ft.; well put down to 180 ft.; last 50 in very hard rock; a show of oil. Miles King, driller.
Sec. 19.
N. W. of S. W.; 104 ft.; slightly hard; 799 A. T.; water rises about 50 ft.
Sec. 36.
Near center; 179 ft.; rock, 150 ft.; good; 760 A. T.; all in grindstone, with little slate at bottom.

ELMWOOD TOWNSHIP.

Sec. 1.
S. W. of N. W. of S. E.; J. Wilson; 70 ft.; soft and fresh; Ca., low, $SO_4$ none, Cl, none; 766 A. T.
Sec. 2.
N. W.; 106 ft.; 40 ft. to rock; slightly hard, Ca., tr., $SO_4$ none, Cl, tr. head 3 ft. above ground; A. T. 674. Temperature 49° F.
N. W. of S. E.; S. Calley; (1) 50 to 60 ft.; good; A. T. 675; water rises nearly to level of ground. (2) 89 ft.; rock, soft; quite soft; head—3; A. T. 715.
N. E. of S. W.; S. Calley; 90 ft.; rock, 50; quite soft; A. T. 673; last 5 ft. a heavy brownish rock, some blue rock and sandstone.
S. W. of N. E.; Wm. Kehoe; 117 ft.; rock, 40 ft.; good; head—1½ ft.; A. T. 670; much blue rock, 7 ft. of freestone at 60 ft; 1 ft. of rock made water green as Paris green.
N. W. of N. W.; 86 ft.; rock, 34 ft.; good; A. T. 668.
S. W. of N. W.; 38 ft; good; head—8 ft.; A. T. 670 ft.
Sec. 3.
N. W. of N. E.; 64 ft.; rock, 30 ft.; soft, Ca., slight tr., Cl, none, $SO_4$ none; head 4 ft.; A. T. 654.
N. E. of N. W.; L. Hurd; 88 ft.; rock, 44 ft.; good; head, 2 ft.; A. T.; 647; first stream at 44 ft.; flow at 55 ft.
N. W. of N. W.; 89 ft.; rock, 40 ft.; good; head, 3 ft.; A. T. 664.
N. W. cor.; 60 ft.; rock 40 ft.; good; head, 6 ft.; strong; A. T. 662.
N. E. of N. E. 9 ft.; rock, 34 ft.; good; head 3 ft.; A. T. 668.
S. E. of N. E.; 42 ft.; good; head 1 ft., formerly 6 ft.; A. T. 668 ft.
S. E. cor.; Jas. Wills; (1) 118 ft.; rock, 35 ft.; good; A. T. 678; near surface, formerly flowed. (2) 130 ft.; good; lower than No. 1, white sandrock and blue rock passed through.
S. W. of S. E.; 60-70 ft.; good; A. T. 678; used to flow.
N. W. of S. E.; 60 ft.; good; head, 1 ft.; A. T. 665.
Sec. 4.
N. E. of S. E.; T. J. Walsh; 50 ft.; good; head—10 ft.; A. T. 665; light supply of water at 40 ft., not so good at 50 ft.



N. E. of N. E.; H. Howell; 62 ft.; rock, 40½ ft.; slightly hard; head 5 ft.; A. T. 662 ft.; good flow, used for washing but growing harder.
S. E. of S. E.; 90 ft.; good; A. T. 670; rises to near surface; used to flow; water at 45 ft. cased off.
N. W. ¼; 90 ft.; rock, 40 ft.; very pure, Ca, none, Cl, none, $SO_4$, none, head, 2-3 ft.; A. T. 655; three wells on farm; all flow.
S. W. of N. W.; W. Brandon; 93 ft.; rock, 93 ft.; good; A. T. 652 ft.
S. W. of S. E.; 42 ft.; good; A. T. 668; slate, sandstone.
S. E. of S. W.; M. J. Kehoe; 44 ft.; rock, 40 ft.; good; head—5 ft.; A. T. 660; 17 ft.; dug, 27 ft., drilled; sand rock, then black mineral bed.
Sec. 5.
S. E. of S. E.; S. A. Merritt; 98 ft.; rock, 48 ft.; softer than surface water; head, 2 ft.; A. T. 652.
S. E. of N. E.; W. W. Campbell; 45-6 ft.; rock. 45-6 ft.; good; A. T. 652.
S. W. of S. W.; J. Belnap; 1st well, 119 ft.; rock, 55 ft.; A. T. 645.

RECORD.

| | | |
|---|---|---|
| Red clay | 12 ft. | |
| Blue clay | 32 " | 44 ft. |
| Hard pan | 11 " | 55 " |
| Hard limerock | 22 " | 77 " |
| Light slate rock | 11 " | 88 " |
| Lime with soft streaks | 9 " | 97 " |
| Sand rock | 22 " | 119 " |

2nd well; 140 ft.; rock, 55 ft.; A. T. 645; this well had just gone dry when visited.

RECORD.

| | | |
|---|---|---|
| Red clay | 16 ft. | |
| Blue clay | 34 " | 50 ft. |
| Hard pan | 5 " | 55 " |
| Limerock | 20 " | 75 " |
| Slate rock | 17 " | 92 " |
| Hard flint rock | 2 " | 94 " |
| Very hard, dark sand rock | 9 " | 103 " |
| Water sand rock | 35 " | 138 " |
| Slate | 2 " | 140 " |

J. Russell, Driller.

Sec. 6.
S. E. of N. E.; at saw mill of W. H. Brown; 137 ft.; rock, 80 ft.; soft water Ca, none, Cl, none, $SO_4$ none; A. T. 638; did flow 3 ft. above surface; 20 ft., blue shale, below which other shales, mostly blue were found; water from white sand rock; Moses Thrash, Driller.
S. E. of S. W.; C. Shulaw; 70 ft; nearly soft, Ca, low, $SO_4$, none, Cl, none; A. T. 648; first "soapstone" (soft shale); water flows into 16 ft. basin.
N. W. of S. W.; F. Bosley; 93 ft.; rock, 80 ft.; fresh; A. T. 652; water flows into dug basin and is clouded by clay.
Sec. 7.
N. E. of N. W.; G. Carolon; 98 ft.; rock, about 60 ft.; nearly soft, good; Ca, low $SO_4$ none, Cl, none, head 2 ft.; A. T. 648; flow from

88 ft. Casing 60-70 ft.; blue soap rock and black slate at top of the rock.

S. E. of N. E.; 49 ft.; rock, 40 ft.; good; A. T. 648.

Sec. 8.

N. W. of S. W.; G. Corbat; 64 ft.; rock, 34 or 38 ft.; good; A. T. 650; rises nearly to surface.

S. W. of N. W.; J. Lefave; 47 ft.; rock, 42 ft.; good; A. T. 648; flowed barely a trickel, 1 ft.

N. E. of N. W.; L. Stack; 72 ft.; rock, 56 ft.; good; head—1 ft.; A. T. 645. Hard slate, then soft slate, then bluish sand rock.

N. E. of S. E.; McDonnell; 70 ft.; rock, 30 ft.; good; A. T. 648; used to flow.

Sec. 9.

N. E. of N. E.; 73 ft.; good; head—6 ft.; A. T. 668.

Sec. 10.

S. E. of N. E.; R. E. Wills; 164 ft.; rock, 51 ft.; good; A. T. 690; no water struck above bottom of well.

Sec. 11.

N. W. of N. W.; P. Phalen; 67 ft.; good near surface; A. T. 678; used to flow.

Sec. 15.

S. W. of N. W.; 90 ft.; rock, 54 ft.; good; A. T. 703.

N. W. of N. W.; 113 ft.; rock, 52 ft., good; A. T. 700.

Sec. 16.

N. E. of N. E.; 54 ft.; good; A. T. 702; used to flow.

S. W. of S. W.; 117 ft.; rock, 66 ft.; soft; A. T. 708; 75 ft. to shell rock, then sandrock, with 3 ft. very hard, and few inches chalky. Water used to come up milk white.

S. E. of N. E.; 75 ft.; rock, 40 ft.; good; A. T. 708.

Sec. 17.

S. E. of N. E.; R. Godfrey; 160 ft.; rock, 40 ft.; good; head, 1 ft.; A. T. 695, used to flow good stream to 4 ft.; rock mostly hard limestone, with streaks of blue shale.

S. E. of S. W.; L. Fournier; 80 ft.; hard; A. T. 695; case leaked; roily and harder in windy weather.

N. W. of S. W.; E. Lafave; 70 ft; good; A. T. 687; water rises to surface.

S. W. of N. W.; 46 ft.; rock, 44 ft.; good; head,—2 ft.; A. T. 685; 2 ft. slate then hard rock; water rose and filled basin to within 2 ft. of surface.

Sec. 19.

N. W. of N. E.; A. Rochlean; 110 ft.; rock, 56 ft.; good; A. T. 686; at 70 ft. 9 ft. white sandstone, below blue, hard rock, no more water.

Sec. 20.

N. E. of N. W.; W. Carr; 56 ft.; rock, 50 ft; A. T. 693.

S. E. of S. W.; E. Geron; 56 ft.; soft and fresh; A. T. 708; surface well has hard water.

Sec. 21.

N. W. of S. W.; J. Winchester; 50 ft.; soft; head, 2 ft.; A. T. 715; flows a little but casing filled with sand.



Sec. 22.

N. W. of N. W.; C. Kennedy; 96 ft.; rock, 70 ft.; slightly hard, Ca, low; A. T. 715; Miles King, driller.

N. E. of S. E.; G. Wald; 191 ft.; rock, 175 ft.; quite soft; Ca, tr., $SO_4$ none, Cl, none; A. T. 785; temperature, 51½°.

Sec. 24.

N. W. of N. W.; J. W. Bingham; 164 ft.; rock, 146 ft.; soft, Ca, med., Cl, none, $SO_4$ none; A. T. 756; water rises to 47 ft. from surface from white sandstone "like powdered glass."

N. W. of S. W.; J. Anker; 71 ft.; good; A. T. 785; plenty of water.

Sec. 26.

N. E. of N. E.; A. Hunter; 196 ft.; hard; Ca, med., A. T. 800.

Sec. 30.

N. E. of N. W.; N. Andrew; 220 ft.; soft; A. T. 687; last 20 ft., shell rock.

Sec. 36.

S. W. of S. W.; W. Walters; 75 ft.; hard; A. T. 763.

N. E. cor.; M. Perry; 43 ft.; hard; A. T. 776.

### COLUMBIA TOWNSHIP.

Sec. 1.

S. E. of N. E.; Sawmill; 85 ft.; water fresh and good; A. T. 648.

Sec. 2.

N. E. of N. W.; 203 ft.; rock, 92 ft.; soft and fresh; Cl, low, Ca, tr., $SO_4$ low; A. T. 638; never flowed; water from sandstone; well on north side of road, in Huron county.

Sec. 3.

N. W. Cor.; F. Sting; 53 ft.; rock?; fresh and good; Cl, low, Fe, low, $SO_4$ low; head, 3 ft.; A. T. 632.

N. W. of N. E. of N. E.; A. Knack; 99 ft.; rock, 68 ft.; soft and fresh; Cl, low, Ca, tr., $SO_4$ tr.; A. T. 635; water from white sand at about 64 ft.

S. W. of N. E.; H. Gaul; 150 ft.; rock, 50 ft.; fresh and soft; Cl, tr., Ca, tr., $SO_4$ tr.; A. T. 635.

S. E. of N. W.; F. Morgan; 150 ft.; rock, 52 ft.; fresh and good; Cl, tr., Ca, tr., $SO_4$ low; A. T. 635.

N. W. of S. E.; J. Irion; 91 ft.; fresh and good; Cl, low, Ca, tr., $SO_4$ low; A. T. 635.

Sec. 4.

N. W. Cor., J. Bauer; 140 ft.; fresh and soft; head, 2 ft.; A. T. 632.

S. W. of N. W.; J. Roser; 175 ft.; fresh and soft; sandstone quality; head, 2 ft.; A. T. 617; good flow.

N. W. of S. W.; A. Mencel; 85 ft.; no rock; fresh and soft; head, 6 ft.; A. T. 620; flows ½ inch stream.

S. W. of N. W. of S. W.; J. Stock; 65 ft.; rock, 60 ft.; fresh and soft; Cl, tr., Ca, tr., $SO_4$ tr.; head, 4 ft.; temp. 50° F.; A. T. 627; flow good; from sandstone. J. Russell, Driller.

S. W. of S. W.; H. Kuehne; 84 ft.; rock, 76 ft.; fresh and soft; sandstone quality; head, 3 ft.; A. T. 637; flow good; used for washing.

S. W. of S. E.; C. Kuehne; about 60 ft.; rock, 60 ft.; fresh and soft; Cl, tr., Ca, tr., $SO_4$ tr.; head, 4 ft.; A. T. 630; flows ½ in. stream.

S. E. of S. E.; School No. 1; 65 ft.; rock, 65 ft.; fresh and soft; head, 3 ft.; A. T. 632; flow good from shelly sandstone.

Sec. 5.

S. W. of S. W.; John Bitzer; 138 ft.; rock, 120 ft.; good; Cl, low, Ca, low, $SO_4$ low; head, 6 in.; A. T. 620; small flow.

N. W. of S. W.; J. J. Bitzer; 149 ft.; rock, 80 ft.; good; Cl, low, Ca, tr., $SO_4$ low; head, 2 ft.; A. T. 618; fair flow.

S. W. of N. W.; G. Brady; 168 ft.; good; Cl, low, Ca, tr., $SO_4$ low; head,—6 ft.; A. T. 615; used to flow.

N. W. of N. W.; H. Wagner; 100 ft.; rock, 97 ft.; good; Cl, low, Ca, low, $SO_4$ low; head—1 ft.; A. T. 615; used to flow. Russell Bros., Drillers.

S. E. of N. E.; Lang and Bohn; 184 ft.; rock, 68 ft.; soft and fresh; Cl, tr., Ca, tr., $SO_4$ tr.; head, 4 ft.; A. T. 615; small vein of water in the coal seam; most of the water from last 12 ft of the sandstone at bottom; good flow.

RECORD.

| | | | | |
|---|---|---|---|---|
| Clay | 58 ft. | | | |
| Hardpan | 10 " | | 68 ft. | |
| Slate | 50 " | | 118 " | |
| Coal | 1 " | 10 in. | 119 " | 10 in. |
| Black slate | 2 " | | 122 " | |
| Slate and sand mixed | 18 " | | 140 " | |
| Sand rock | 44 " | | 184 " | |
| Water in last 10 feet. | | | | |

J. Russell, Driller.

N. E. of N. E.; W. J. Davis; 144 ft.; rock, 53 ft.; fresh and soft; Cl, tr., Ca, tr., $SO_4$ tr.; A. T. 618; white sandstone whole distance from the top of rock.

N. E. of S. E.; G. Irion; 134.5 ft.; rock, 80 ft.; fresh and soft; sandstone quality head, 3 ft.; A. T. 615; small flow; 15 ft. in sandstone.

Sec. 5.

S. E. of S. E.; M. Henman; 81 ft.; rock,, 70 ft.; fresh and soft; good flow; Cl, slight tr., Ca, tr., $SO_4$, tr.; head, 4 ft.; A. T. 630; from sandstone; soft enough for washing.

Sec. 6.

N. W. of N. W.; M. Zimmer; 273 ft.; salty and bitter; Cl, str., Ca, med., $SO_4$ med.; A. T. 612; used to flow but stopped after the Sebewaing coal mines were opened. Not as salt as it was; good water at 180-190 ft.; coal at about 200 ft.; only a few feet in sandstone. C. Hofmeister, Driller.

S. E. of S. W.; (Unionville); G. E. Merry; 148 ft.; no rock; fresh and good; A. T.; 625; Cl, low, Ca, tr., $SO_4$ low; head, 2 ft.

S. E. of S. W.; (Unionville); Cy. Lozer; 137 ft.; no rock; fresh and soft; Cl, tr., Ca, tr., $SO_4$ low; A. T. 623; used to flow.

S. E. of S. W. (Unionville); 155 ft.; rock, 90 ft.; fresh and soft; Cl, low, Ca, tr., $SO_4$ low, head, 2 ft.; A. T. 625.

S. W. of S. E. (Unionville); Planing Mill; 199 ft.; rock, 140 ft.; good; A. T. 625; cobble stones above bed rock.

Sec. 7.

N. E. of N. E.; O. Pingree; 60 ft.; rock, 60 ft.; fresh; Cl, tr., Ca, low, $SO_4$ low; head, 3 ft.; A. T. 618; small flow of good water; possibly just to rock.



S. W. of N. W. of N. W.; A. Marshall; 222 ft.; rock, 90 ft.; fresh and good; Cl, low, Ca, low, $SO_4$ low; A. T. 625; formerly flowed 3 ft. above surface but the flow was affected by Hess' well nearly ½ mile south.

RECORD.

| | | | | |
|---|---|---|---|---|
| Clay | 85 ft. | | | |
| Quicksand | 5 " | | 90 ft. | |
| Slate | 50 " | | 140 " | |
| Coal | 4 " | | 144 " | |
| Slate | 56 " | | 200 " | |
| White sandstone | 22 " | | 222 " | |

N. W. ¼ (Unionville); 310 ft.; good and fresh; A. T. 625; at 125 ft., water flowing to top of ground was shut off; some coal; sandrock from 295 to 310 ft.

N. W. of N. W.; Hotel at Unionville (Kaesemeyer); 140 ft.; rock, 96 ft; fresh and good; Cl, low, Ca, tr.; A. T. 625.

RECORD.

| | | | | |
|---|---|---|---|---|
| Clay | 76 ft. | | | |
| Hardpan | 20 " | | 96 ft. | |
| Lime rock | 16 " | | 112 " | |
| Sand rock | 27 " | | 139 " | |
| Dark lime rock | 1 " | | 140 " | |

J. Russell, Driller.

N. E. of N. W. (Unionville); 204 ft.; rock?; soft and fresh; Ca, tr., Cl, low, $SO_4$ low; A. T. 625.

S. ½ of S. ½; Test well; 172 ft.; rock 169 ft.; A. T. 635.

RECORD.

| | | | | |
|---|---|---|---|---|
| Clay | 90 ft. | | | |
| Sand and gravel | 12 " | | 102 ft. | |
| Quicksand | 67 " | | 169 " | |
| Soft, scaley sand rock | 3 " | | 172 " | |

E. Christman, Driller.

N. W. ¼. (Unionville); H. Cobin; 240 ft.; rock, 140.5 ft.; fresh and good; A. T. 625.

RECORD.

| | | | | |
|---|---|---|---|---|
| Clay | 70 ft. | | | |
| Hardpan | 15 " | | 85 ft. | |
| Small vein of gravel | | | | |
| Hardpan | 24 " | | 109 " | |
| Sand and gravel | 8 " | | 117 " | |
| Hardpan | 16 " | | 133 " | |
| Gravel | 7 " | 6 in. | 140 " | 6 in. |
| Lime rock | 41 " | | 181 " | 6 " |
| Sand rock | 9 " | 6 " | 191 " | |
| Soap rock | 10 " | | 201½ " | |
| Lime rock | 4 " | | 205 " | |
| Slate rock | 13 " | | 218 " | |
| Sand and slate rock | 22 " | | 240 " | |

J. Russell, Driller.

N. W. of S. E.; D. Stanton; 160 ft. 5 in.; A. T. 632; test well.

RECORD.

| | | | | |
|---|---|---|---|---|
| Clay and gravel | 30 ft. | | | |
| Clay | 58 " | | 88 ft. | |
| Gravel | 2 " | | 90 " | |
| Quicksand | 66 " | 5 in. | 156 " | 5 in. |
| Limestone | 1 " | 7 " | 158 " | |
| Sandstone | 2 " | 5 " | 160 " | 5 " |

E. Christman, Driller.

Sec. 8.

N. W. of S. W.; C. Stricter; 200 ft.; soft and fresh; Cl, tr., Ca, low, $SO_4$ low—; head, 2.5 ft.; A. T. 632; flow fills ½ inch pipe.

S. E. of S. W.; D. Thomas; soft and fresh; no record of depth; Cl, tr., Ca, tr., $SO_4$ tr.; head, 2 ft.; A. T. 632.

S. W. of S. E.; E. Archibald; 67 ft.; no rock; fresh; Ca, low, Cl, low, $SO_4$ low; head, 4 ft.; A. T. 628.

S. E. cor.; J. T. Russell; 80 ft.; rock, 75 ft.; soft and fresh; head, 4 ft.; A. T. 628; flows less than formerly.

N. W. of S. E.; H. Archibald; test well; 178 ft.; rock, 61 ft.; A. T. 627.

RECORD.

| | | |
|---|---|---|
| Clay | 15 ft. | |
| Sand and gravel | 17 " | 32 ft. |
| Clay | 29 " | 61 " |
| Limestone | 1 " | 62 " |
| Pebble rock | 5 " | 67 " |
| Sand rock | 2 " | 69 " |
| Blue shale | 10 " | 79 " |
| Sand rock | 8 " | 87 " |
| Blue shale | 2 " | 89 " |
| Sand rock | 68 " | 157 " |
| Brown shale | 6 " | 163 " |
| Brown limestone | 1 " | 164 " |
| Fire clay | 1 " | 165 " |
| Sand rock and limestone mixed | 4 " | 169 " |
| Fire clay | 5 " | 174 " |
| Pebble rock | 4 " | 178 " |

J. Burgert, Driller.

Sec. 9.

N. E. of N. E.; C. Russell; 65 ft.; rock, 65 ft.; soft and fresh; head, 3 ft.; A. T. 630; flow good; from shelly sand rock. All wells in the neighborhood similar to this.

S. E. of S. E.; L. Beitz; 100 ft.; fresh and good; A. T. 650; used to flow small stream 1 ft. above surface.

Sec. 10.

N. E. of N. W.; R. A. Lyman; 108 ft.; rock, 75 ft.; fresh and good; A. T. 645; water from sandstone.

Sec. 13.

S. E. of S. E.; D. Pine; 86 ft.; rock, 86 ft.; soft and fresh; Cl, low, Ca, tr., $SO_4$, 0; A. T. 683; formerly flowed.

Sec. 14.

S. E. of S. E.; A. Gostwick; 87 ft.; rock, 80 ft.; fresh and soft; Cl, low, Ca, tr., $SO_4$ tr., head, 2.5 ft.; A. T. 682; water from sandstone. Coal at top of rock.



Sec. 15.

N. W. of N. E.; M. Armbruster; 80 ft.; rock, 80 ft.; fresh and good; head, 1 ft.; A. T. 643. Water from gravel on top of sandstone.

Sec. 16.

N. W. Cor.; M. Russell; 72 ft.; no rock; fresh and good; head, 4 ft.; A. T. 628; flows ½ inch stream.

N. E. of N. W.; G. Schultz; 76 ft.; fresh and soft, sandstone quality; head, 4 ft.; A. T. 629; flows ½ inch stream.

N. W. of N. E.; M. Miller; between 50 and 60 ft.; no rock; fresh and good; head, 3 ft.; A. T. 630; small flow.

S. W. Cor.; A. Appleby; 76 ft.; no rock; fresh and soft; Cl, low, Ca, tr., $SO_4$, low; head, 4 ft.; A. T. 642; flows ½ in. stream, used to be more.

Sec. 17.

N. E. of N. W.; C. Johnke; 182 ft.; rock, 71 ft.; test well; A. T. 632.

RECORD.

| | | |
|---|---|---|
| Clay with small boulders | 20 ft. | |
| Clay and gravel | 30 " | 50 ft. |
| Sand | 10 " | 60 " |
| Blue clay | 5 " | 65 " |
| Sand and gravel | 6 " | 71 " |
| Sandstone | 107 " | 178 " |
| Limestone | 4 " | 182 " |

J. L. Cole, Driller.

N. E. of N. W.; C. Johnke; 75 ft.; no rock; fresh and good; head, 3 ft.; A. T. 635; flows ½ in. stream; water from gravel bed.

N. E. of N. E.; P. Zeigler; 50 ft.; no rock; fresh and good; head, 5 ft.; A. T. 630; good flow.

S. E. of S. W.; W. J. Cook; 75 ft.; fresh and good; head, 3 ft.; A. T. 632; small flow.

S. W. of N. E.; A. Krull; test well; 193 ft.; rock, 85 ft.; A. T. 637.

RECORD.

| | | | | |
|---|---|---|---|---|
| Clay | 85 ft | | | |
| White sandstone | 86 " | | 171 ft. | |
| Dark shale | 1 " | | 172 " | |
| Fire clay | | 2 in. | 172 ft. | 2 in. |
| Sandstone | 10 " | 10 " | 183 " | |
| Bastard lime rock | 10 " | | 193 " | |

J. Burgert, Driller.

Sec. 18.

N. E. of S. E.; H. Bach; 183 ft.; rock, 96 ft.; test well; A. T. 635.

RECORD.

| | | | | |
|---|---|---|---|---|
| Clay | 70 ft. | | | |
| Sand and gravel | 26 " | | 96 ft. | |
| Shale | 41 " | | 137 " | |
| Dark shale | 14 " | | 151 " | |
| Gray shale | 17 " | | 168 " | |
| Fire clay | 0 " | 2 in. | 168 " | 2 in. |
| Fine, white hard sand rock | 14 " | 10 " | 183 " | |

J. Burgert, Driller.

N. E. of S. W.; A. Bach; 167 ft.; rock 84 ft.; 2nd test well; A. T. 630.

RECORD.

| | | | | |
|---|---|---|---|---|
| Clay | 77 ft. | | | |
| Gravel | 3 " | | 80 ft. | |
| Brown sandstone | 4 " | | 84 " | |
| Blue shale | 14 " | | 98 " | |
| Light shale | 2 " | 7 in. | 100 " | 7 in |
| Slate | 1 " | | 101 " | 7 " |
| Coal | | 4 " | 101 " | 11 " |
| Light shale | 5 " | 6 " | 107 " | 5 " |
| Blue shale | 21 " | | 128 " | 5 " |
| Slate | | 3 " | 128 " | 8 " |
| Coal | | 4 " | 129 " | |
| Fire clay | | 2 " | 129 " | 2 " |
| Coal | 2 " | 8 " | 131 " | 10 " |
| Fire clay | 4 " | | 135 " | 10 " |
| Sand rock | 10 " | | 145 " | 10 " |
| Gray rock | 2 " | | 147 " | 10 " |
| Sand rock | 3 " | | 150 " | 10 " |
| Gray rock | 4 " | 6 " | 155 " | 4 " |
| Sand rock | 11 " | 9 " | 167 " | 1 " |

J. Burgert, Driller.

COLUMBIA.

Sec. 18.

N. E. of N. E.; August Louis; test well; 185 ft.; rock 101 ft.; N. end of farm; A. T. 635.

RECORD.

| | | | | |
|---|---|---|---|---|
| Clay | 68 ft. | | | |
| Sand and gravel | 33 ft. | | 101 ft. | |
| White sand rock | 2 " | | 103 " | |
| Shale | 29 " | | 132 " | |
| Sandstone | 9 " | | 141 " | |
| Dark shale | 22 " | | 163 " | |
| Gray rock | 6 " | 4 in. | 169 " | 4 in. |
| Coal | | 3 " | 169 " | 7 " |
| Rock and sulphur | | 2 " | 169 " | 9 " |
| Coal | 4 " | 3 " | 174 " | |
| Black slate (rotten) | 3 " | | 177 " | |
| Gray rock | 3 " | | 180 " | |
| Fire clay | 5 " | | 185 " | |

J. Burgert, Driller.

S. W. of S. E.; A. Dahmel; 191 ft. 5 in.; rock, 75 ft.; fresh and good; head, 2 ft.; test well; A. T. 630.

RECORD.

| | | | | |
|---|---|---|---|---|
| Clay | 68 ft. | | | |
| Hard pan | 7 " | | 75 ft. | |
| Sand rock | 99 " | 4 in. | 174 " | 4 in. |
| Coal | 3 " | 1 " | 177 " | 5 " |
| Slate rock | 6 " | | 183 " | 5 " |
| Sand rock | 4 " | | 187 " | 5 " |
| Lime rock | 4 " | | 191 " | 5 " |

J. Russell, Driller.

N. E. of N. W.; F. W. Stierle; 114 ft.; soft and fresh; Ca, tr., Cl, tr., $SO_4$ tr.; A. T. 625; flow stopped after Hess' well was put down.



N. E. of N. E.; M. Louis; 192 ft.; 80 ft. casing; soft and fresh, sandstone quality; head, 2 ft.; A. T. 635; small flow.

S. W. of S. W.; J Bach; 149 ft.; rock, 80 ft.; tasteless and soft; Cl, low, Ca, tr., $SO_4$ tr.; A. T. 625.

S. E. of S. E.; L. Fittinger; 72 ft.; fresh and good; A. T. 632; used to flow, stopped by test well to N. E.

N. E. of N. E.; M. Louis; 188 ft.; rock, 132 ft.; test well; A. T. 632.

RECORD.

| | | | | |
|---|---|---|---|---|
| Clay | 15 ft. | | | |
| Gravel | 9 " | | 24 ft. | |
| Clay | 41 " | | 65 " | |
| Gravel | 12 " | | 77 " | |
| Clay and gravel | 10 " | | 87 " | |
| Clay | 7 " | | 94 " | |
| Gravel | 2 " | | 96 " | |
| Quicksand | 21 " | | 117 " | |
| Sand and gravel | 15 " | | 132 " | |
| Sand rock | 4 " | | 136 " | |
| Gray shale | 20 " | | 156 " | |
| Lime rock | 2 " | | 158 " | |
| Gray sandstone | 8 " | | 166 " | |
| Gray rock | 9 " | | 175 " | |
| Sand rock | 7 " | 9 in. | 182 " | 9 in. |
| Coal | | 1 " | 182 " | 10 " |
| Pebble rock | 4 " | 8 " | 187 " | 6 " |
| Lime rock | | 6 " | 188 " | |

E. Christman, Driller.

Sec. 19.

N. W. of N. W.; J. Gould; 183 ft.; rock 74 ft. 6 in.; test well; A. T. 634.

RECORD.

| | | | | |
|---|---|---|---|---|
| Sandy clay and gravel | 34 ft. | | | |
| Blue clay and gravel | 40 " | 6 in. | 74 ft. | 6 in. |
| White sandstone | 55 " | 6 " | 130 " | |
| Sandy shale | 6 " | | 136 " | |
| Sandstone | 7 " | | 143 " | |
| Sandy shale | 8 " | | 151 " | |
| Clay shale | 5 " | | 156 | |
| Black shale | 18 " | 8 " | 174 " | 8 " |
| Coal | 3 " | 8½ " | 178 " | 4½ " |
| Black shale | 2 " | 7½ " | 181 " | |
| Fire clay | 2 " | | 183 " | |

J. L. Cole, Driller.

N. E. of N. E.; E. Dickinson; 77 ft.; no rock; fresh and good; head, 4 ft.; A. T. 632; when first put down water rose to 12 ft. above surface.

N. W. of N. W.; J. Gould; 154 ft.; rock, 78 ft.; fresh and soft; Cl, low, Ca, tr., $SO_4$ low; head, 1 ft.; A. T. 630.

S. W. of N. W.; J. Leyerer; 100 ft.; rock, 88 ft.; Cl, tr., Ca, tr., $SO_4$ tr.; A. T. 630; used to flow.

S. E. of S. E.; J. Eckfelt; 125 ft.; rock, 80 ft.; fresh and soft; head, 3.5 ft.; A. T. 638; small flow.

Sec. 20.

S. E. of S. E.; Church; 85 ft.; rock, 90 ft.; fresh and good; A. T. 663.

N. E. of N. E.; C. Ewald; 118 ft.; rock, 88 ft.; fresh and good; A. T. 662; water from sandstone.

S. E. of N. E.; F. Sie; 84 ft.; no rock; fresh and good; A. T. 655; used to flow 3 ft. above the surface.

N. W. of N. W.; A. Dehmel; 204 ft.; rock 97 ft.; test well; A. T. 635.

RECORD.

| | | | | |
|---|---|---|---|---|
| Clay | 15 ft. | | | |
| Sand and gravel | 10 " | | 25 ft. | |
| Clay | 25 " | | 50 " | |
| Clay and gravel | 25 " | | 75 " | |
| Creek sand | 18 " | | 93 " | |
| Gravel | 4 " | | 97 " | |
| White sand rock | 14 " | | 111 " | |
| Sand rock | 75 " | | 186 " | |
| Pebble rock | | 6 in. | 186 " | 6 in. |
| White sand rock | 5 " | 6 " | 192 " | |
| Limestone | 12 " | | 204 " | |

E. Christman, Driller.

N. W. of N. W.; A. Dehmel; 178 ft.; rock, 76 ft.; test well; A. T. 635.

RECORD.

| | | | | |
|---|---|---|---|---|
| Clay | 76 ft. | | | |
| Sandstone | 42 " | | 118 ft. | |
| Soapstone | 22 " | | 140 " | |
| Sandstone | 28 " | 7 in. | 168 " | 7 in. |
| Gray rock | 6 " | | 174 " | 7 " |
| Coal | 1 " | 8 " | 176 " | 3 " |
| Sand rock with sulphur and fire clay mixed | 2 " | 1 " | 178 " | 4 " |

J. Burgert, Driller.

N. E. of N. W.; J. Wagoner; 74 ft.; no rock; fresh and good; head, 3 ft.; A. T. 632; flows ½ in. stream from quicksand.

S. W. of S. W.; A. Cook; 127 ft. rock 80 ft.? (120 ft. casing); fresh and soft, sandstone quality; head, 3 ft.; A. T. 635.

S. W. of S. E.; L. Eckfelt; 250 ft.; soft and fresh; Cl, tr., Ca, tr., $SO_4$ tr.; head 3 ft.; A. T. 660; flows ½ in. stream.

Sec. 21.

S. W. of S. E.; D. Colling; 140 ft.; rock, 116 ft.; fresh and soft; Cl, tr., Ca, tr., $SO_4$ low, A. T. 645; used for washing.

RECORD.

| | | |
|---|---|---|
| Clay | 80 ft. | |
| Hardpan | 30 " | 110 ft. |
| Sand and Gravel | 6 " | 116 " |
| Coal | 2 " | 118 " |
| Soapstone | 16 " | 134 " |
| Sand rock | 6 " | 140 " |

J. Russell, Driller.

S. W. of S. W.; Columbia, P. O.; 140 ft.; rock, 85 ft.; fresh and good; A. T. 668; windmill pump.

Sec. 22.

S. E. of S. E.; G. Colling; 151 ft.; rock, 68 ft.; soft and fresh; A. T. 662; used for washing; never flowed.



Sec. 23.

N. E. of N. E.; W. Lockwood; 66 ft; rock, 66 ft.; good, fresh; head, 1.5; A. T. 685; flow very small.

N. W. of N. W.; W. Abke; 193; rock, 60 ft.; soft and fresh; Cl, tr., Ca, tr., $SO_4$ tr., A. T. 655; flows ½ in. stream at surface; lowered from 18 in. to present level in about a month. First rock, sandstone, then 35 ft. shale, 3 ft. coal at about 125 ft.

S. W. of S. W.; M. Rample; 96 ft.; no rock; fresh and good; head, 5 ft.; A. T. 660; flowed full size of 3 in. pipe.

S. W. of S. E.; M. Hyde; 130 ft.; rock. 80 ft.; sandstone water; head, 3 ft.; A. T. 667; small flow.

Sec. 23.

S. E. of S. W. of S. E., F. Stone; 102; rock, 60 ft.; sandstone water; head, 2 ft.; A. T. 667; small flow from sandstone.

S. E. Cor.; A. Phelphs; 95 ft.; rock, 60 ft.; sandstone water; A. T. 612; flows at surface; coal found in drilling.

Sec. 24.

N. E. of S. E.; T. McCarthy; 130 ft.; rock, 94; nearly soft; Ca, tr., A. T. 682.

RECORD.

| | | | | |
|---|---|---|---|---|
| Blue clay without stones | 84 ft. | | | |
| Sand rock, whiter at bottom | 10 " | | 94 ft. | |
| Coal | 3 " | | 97 " | |
| Bluish clayey shale | 32 " | 6 in. | 129 " | 6 in. |
| To water at 125 ft., very hard, then softer to | | | | |
| Black slate | 10 " | | 130 " | 4 " |

Water rises to 4 ft. of surface.

Wm. Lockwood, Driller.

S. E. of N. E.; T. M. McCarthry; 110 ft.; rock, 82 ft.; good; A. T. 683ffi pyrites in the rock; 7 or 8 ft. white sandstone, Black shale or coal, also light slate.

S. E. Cor.; Colwood P. O.; 173; rock, 60-70 ft.; good; A. T. 675; coal at 100; hard rock then softer, then sandrock, some black shale.

S. W. of S. W.; H. Grice; 225 ft. rock, 160 ft.; soft and good; A. T. 670; formerly flowed 1 ft. above surface; from Sandstone.

S. E. of S. E.; L. Longeway; 126 ft.; rock, 60-65 ft.; fresh and good; A. T. 673.

Sec. 25.

S. E. of S. W.; E. F. Kader; 115 ft. rock, 65 ft.; fresh and soft; A. T. 675.

Sec. 26.

N. W. of N. W.; D. Colling; 91 ft.; no rock; soft and fresh; head, 2 ½ ft.; A. T. 662; ½ in. flow from gravel.

Sec. 26.

S. E. of N. E.; L. Remington; 75 ft.; no rock; fresh and good; A. T. 680.

Sec. 27.

N. W. of N. W.; J. C. Colting; 130 ft.; cased 130 ft.; soft and fresh, sandstone quality; A. T. 658.

Sec. 28.

N. W. Cor.; 118 ft.; no rock; fresh and good; A. T. 668.

Sec. 29.

N. W. Cor.; H. Steiner; 115 ft.; rock, 110 ft.; fresh and soft; head, 4 ft.; A. T. 640; flows ¾ stream, Temp. 50° F.

N. E. of N. W.; H. Steiner; 90 ft.; no rock; fresh and good; head, 3 ft.; A. T. 650; small flow.

N. W. of N. E.; H. Steiner; 200 ft.; rock, 90 ft.; sandstone quality; head, 18 in. A. T. 658; small flow.

S. E. of S. W.; C. Neubeuer; 143 ft.; rock, 90 ft.; fresh and good, sandstone quality; A. T. 667; formerly flowed 1 ft. above surface.

S. W. of S. W.; P. Holler; 78 ft.; no rock; fresh and good; head, 3.5 ft.; A. T. 660 flows ¾ in. stream.

Sec. 30.

N. W. of N. W.; Bush; 182 ft.; rock, 80 ft.; fresh and soft; A. T. 630; water from sandstone.

N. W. ¼; H. Bush; test well; 200 ft.; 81 ft. 10 in.; A. T. 635.

RECORD.

| | | | | |
|---|---|---|---|---|
| Clay | 81 ft. | 10 in. | | |
| Sand rock | 31 " | | 112 ft. | 10 in. |
| Shale | 2 " | | 114 " | 10 " |
| Gray rock | 9 " | | 123 " | 10 " |
| Sandstone | 9 " | | 132 " | 10 " |
| Gray rock | 7 " | | 139 " | 10 " |
| Shale | 2 " | | 141 " | 10 " |
| Gray rock | 10 " | | 151 " | 10 " |
| Dark shale | 14 " | | 165 " | 10 " |
| Coal | 1 " | 5 " | 167 " | 3 " |
| Fire clay | 4 " | | 171 " | 3 " |
| Dark shale | 11 " | | 182 " | 3 " |
| Black chip slate | 2 " | | 184 " | 3 " |
| Coal | 4 " | 4 " | 188 " | 7 " |
| Fire clay | " | 4 " | 188 " | 11 " |
| Sandstone | 11 " | 6 " | 200 " | 5 " |

J. Burgert, Driller.

N. W. of S. E.; L. Schultz; 204 ft; rock, 139 ft.; test well; A. T. 635.

RECORD.

| | | |
|---|---|---|
| Clay, sand and gravel | 22 ft. | |
| Clay | 44 " | 66 ft. |
| Gravel | 22 " | 88 " |
| Quicksand | 27 " | 115 " |
| Sand and gravel | 15 " | 130 " |
| Quicksand | 6 " | 136 " |
| Gravel | 3 " | 139 " |
| Dark sand rock | 26 " | 165 " |
| White Sand rock | 39 " | 204 " |

Sec. 31.

S. W. of S. E.; C. Fisher; 126 ft.; rock, 86 ft.; fresh and good; A. T. 650.

N. E. of N. E.; G. Reber; 118 ft.; rock, 85 ft.; soft and fresh; head, 3 ft.; A. T. 655; flows ½ in. stream.

N. W. of N. E.; G. Bauer; 160 ft.; rock, 90 ft.; fresh and good; head, 3 ft.; A. T. 650; used to flow more formerly.

Sec. 32.

S. W. of S. E.; C. Matthews; 135 ft.; rock, 90 ft.; fresh and good; A. T. 662; used to flow 3 ft.



S. E. of S. E.; W. Staley; 160 ft.; rock, 80 ft.; fresh and good; A. T. 672.

N. E. of N. E.; A. Greenfield; 200 ft.; rock, 80 ft.; soft and fresh; head, 2 ft.; A. T. 668; flows ½ in. stream.

N. E. of N. W.; A. Staats; 190 ft.; rock, 80 or 90 ft.; soft and fresh; head, 1 ft.; A. T. 673; flows ½ in. stream; formerly rose higher.

Sec. 33.

N. W. of N. W.; Brandmair; 100 ft.; fresh and good; A. T. 668.

S. W. of S. W.; 149 ft.; rock, 80 ft.; fresh and soft, sandstone quality; A. T. 677; coal reported.

Sec. 36.

S. W. of N. W.; J. Donahue; 128 ft.; rock, 78 ft.; water fresh and good; A. T. 690.

AKRON TOWNSHIP.

T. 15 N., R. 8 E.

Sec. 12.

S. E. of N. E.; W. L. Webber; 93 ft.; rock, 51 ft. 6 in. Test hole; 584 A. T.; 46 ft. clay, 1 ft. sand, and gravel 43 ft. sandstone, 3 ft., 9 in., coal.

Sec. 13.

S. W. ¼; Bullock and Co.; test well; 155 ft. 4 in.; rock, 52 ft.; A. T. 585.

N. W. ¼ Likens and Co.; test well; 126 ft.; rock, 44 ft.; A. T. 585.

RECORD.

| | | | | |
|---|---|---|---|---|
| Clay | 36 ft. | | | |
| Hard pan | 8 " | | 44 ft. | |
| Loose sand rock | 4 " | | 48 " | |
| Sand rock | 40 " | | 88 " | |
| Coal | | 3 in. | 88 " | 3 in. |
| Lime rock | 8 " | | 93 " | 3 " |
| Sand rock | 7 " | | 100 " | 3 " |
| Lime rock | 21 " | 9 " | 122 " | |
| Sand rock | 4 " | | 126 " | |

N. W. ¼ Likens; test well; 154 ft. 1 in.; rock, 42 ft.; A. T. 589 ft.

RECORD.

| | | | | |
|---|---|---|---|---|
| Clay | 37 ft. | | | |
| Hardpan | 5 " | | 42 ft. | |
| Sand rock | 67½ " | | 109½ " | |
| Coal | ½ " | | 110 " | |
| Slate rock | | 11 in. | 110 " | 11 in. |
| Sand rock | 9 " | 1 " | 120 " | |
| Slate or soap rock | 20 " | | 140 " | |
| Coal, poor | 8 in. | | | |
| Coal, good | 3 ft. 6 " | 5 " | 9 " | 145 " 9 " |
| Coal, poor | 1 " 7 " | | | |
| Slate rock | 4 " | 9 " | 150 " | 6 " |
| Hard, fine, sand rock | 3 " | 7 " | 154 " | 1 " |

N. E. of S. E.; H. Heintz; 250 ft.; brackish and bitter; Cl, str., Ca, med., $SO_4$ med., Fe., pres.; A. T. 602; used to flow.

Sec. 22.

S. E. of N. E.; C. A. Beadle; 180 ft; rock, 60 or 62 ft.; salty to taste; Cl, str., Ca, med., $SO_4$ med.; A. T. 587; coal reported.

Sec. 23 N. E. ¼; Lickens; test hole; 260 ft., 4 in.; rock, 52 ft.; A. T. 585.

RECORD.

| | | | | |
|---|---|---|---|---|
| Clay | 44 ft. | | | |
| Sand and gravel | 8 " | | 52 ft. | |
| Little coal and slate mixed. | | | | |
| Coarse sand rock | 28 " | | 80 " | |
| Fine sand rock | 15 " | | 95 " | |
| Sandy flint rock | 8 " | | 103 " | |
| Hard white lime rock | 3 " | 6 in. | 106 " | 6 in. |
| Fire clay | 1 " | 6 " | 107 " | 6 " |
| Hard gray lime rock | 8 " | 6 " | 116 " | |
| Fire clay | 1 " | | 117 " | |
| Gray lime rock | 26 " | | 143 " | |
| Sand | 8 " | | 151 " | |
| Sand and slate rock mixed | 22 " | | 173 " | |
| Light slate rock | 9 " | | 182 " | |
| Dark slate rock | 21 " | | 203 " | |
| Light slate rock | 10 " | | 213 " | |
| Sand rock | 7 " | | 220 " | |
| Slate rock | 3 " | | 223 " | |
| Hard sand rock | 5 " | | 228 " | |
| Soft sand rock | 32 " | 4 " | 260 " | 4 " |

J. Russell, Driller.

Sec. 24.

N. W. of N. E.; M. Weldner; 206 ft.; rock, 110 ft.; brackish; Cl, str., $SO_4$, str., Fe; A. T. 600; used to flow but stopped when Sebewaing mines were opened.

N. W. of N. E.; Aug. Wilder; 168 ft.; salty and bitter; Cl, str., Ca, med., $SO_4$ med.; used to flow, now flows into basin; A. T. 600. Depth to rock unknown.

Sec. 25.

S. E. cor.; J. T. Layer; 206 ft.; rock, 110 ft.; salty and bitter; Cl, str., Ca, str., $SO_4$ str.; A. T. 592.

N. W. ¼; C. Jones; 229 ft.; rock, 75 ft.; salty; Cl, str., $SO_4$, str., Ca, str.; head 3 ft.; A. T. 596.

S. E. of S. E.; J. Layer; 218 ft.; rock, 80 ft.; A. T. 615; too salt to use.

Sec. 26.

S. W. ¼; J. Wilson; 170 ft.; rock, 85 ft.; A. T. 593; test well.

RECORD.

| | | | | |
|---|---|---|---|---|
| Clay | 71 ft. | | | |
| Hardpan | 14 " | | 85 ft. | |
| Small vein sand. | | | | |
| Hardpan | 2 " | | 87 " | |
| Soap rock | 21 " | | 108 " | |
| Sand | 15 " | | 123 " | |
| Slate | 9 " | | 132 " | |
| Coal, about | | 4 in. | 132 " | 4 in. |
| Fire clay | 3 " | 8 " | 136 " | |
| Black slate | 3 " | | 139 " | |
| Fire clay | 3 " | | 142 " | |
| Black slate | 2 " | | 144 " | |
| Fire clay | 1 " | | 145 " | |
| Black slate | 22 " | | 167 " | |
| Light slate or soap rock | 3 " | | 170 " | |

J. Russell, Driller.



N. W. of S. E.; C. Luther; 289 ft.; rock, 66 ft.; brackish and bitter, with some taste of Epsom salts (Mg $SO_4$); Cl, str., $SO_4$ str., Ca, str.; small flow, losing head; A. T. 595. Reported to flow 1 ft. higher in 1896 than in 1897.

RECORD.

| | | |
|---|---|---|
| Clay and sand | 66 ft. | |
| Soapstone | 124 " | 190 ft. |
| Sandstone | 99 " | 289 " |
| Passed through small streaks of coal. | | |

S. W. of N. W.; M. Thrash; 119 ft.; no rock; A. T. 587; no water.

Sec. 27.

S. W. of S. E.; Hofmeister and Co.; 203 ft.; rock, 63 ft.; salty and bitter; Cl, str., $SO_4$, low, Ca, med.

RECORD.

| | | | | |
|---|---|---|---|---|
| Clay | 63 ft. | | | |
| Soapstone | 40 " | | 103 ft. | |
| Slate | 6 " | | 109 " | |
| Coal | 1 " | 8 in. | 110 " | 8 in. |
| Soapstone | 5 " | 4 " | 116 " | |
| Sandstone | 6 " | | 122 " | |
| Soapstone | 81 " | | 203 " | |
| Coal quite soft. | | | | |

C. Hofmeister, Driller.

N. E. of N. E.; C. Luther; 80 ft.; no rock; fresh, good; A. T. 585; formerly flowed.

Sec. 32.

S. E. of S. W.; M. Howse; 91 ft.; rock, 70 ft.; brackish; Cl, str., Ca, med., $SO_4$ med.; A. T. 592; small flow into basin of old dug well; formerly flowed 2 ft. above surface.

N. E. of S. W.; L. Austin; 91 ft.; rock, 70 ft.; A. T. 592; flows into basin, small stream, 10 ft. down.

S. E. of S. E.; D. Bull; 70 ft.; no rock; fresh, good; A. T. 592.

Sec. 33.

S. E. cor.; E. Reynolds; 210 ft.; rock, 70 ft.; fresh, nearly soft; Cl, low, Ca, tr., $SO_4$ low, Fe, pres.; head—2 ft.; A. T. 593; 3 ft. vein of coal under hard pan; at about 90 ft. drill dropped 2 ft.; water from sandstone.

S. E. of S. W.; R. H. Fletcher; 300 ft.; Brackish and bitter; Cl, str., Ca, low, $SO_4$ med. Fe; water cathartic if used freely.

Sec. 34.

S. W. ¼; A. Reynolds; 210 ft.; rock, 70 ft.; rock, 70 ft.; brackish; head 6 in. Cl, str., Ca, low $SO_4$ med.; A. T. 593.; sandstone with good water at 70 ft., with slate and coal below. Water turns tea black.

"Williams Farm;" 181 ft.; rock, 71 ft.; A. T. 596; Test well.

RECORD.

| | | | | | |
|---|---|---|---|---|---|
| Sand | 6 ft. | | | | |
| Clay | 65 " | | 71 ft. | | |
| Gray rock | 17 " | 2 in. | 88 " | 2 in. | |
| Coal | | 8 " | 88 " | 10 " | |
| Fire clay | 1 " | | 89 " | 10 " | |
| Gray shale | 4 " | 6 " | 94 " | 4 " | |
| Gray rock | 7 " | 6 " | 102 " | | |
| Fire clay | 1 " | | 103 " | | |
| Coal | | 4 " | 103 " | 4 " | |
| Sand rock | 8 " | 8 " | 112 " | | |
| Gray rock | 3 " | | 115 " | | |
| Black shale | 23 " | | 138 " | | |
| Light shale | 4 " | | 142 " | | |
| Black shale | 3 " | | 145 " | | |
| Gray rock | 24 " | 6 " | 169 " | 6 " | |
| Black slate | 1 " | | 170 " | 6 " | |
| Coal | 1 " | | 171 " | 6 " | |
| Fire clay | 2 " | 7 " | 174 " | 1 " | |
| Coal | | 5 " | 174 " | 6 " | |
| Fire clay | | 8 " | 175 " | 2 " | |
| Rotten black slate | 3 " | | 178 " | 2 " | |
| Sandy shale | 2 " | 11 " | 181 " | 1 " | |

J. Burgert, Driller.

Williams Farm; 190 ft.; rock, 6 ft.; A. T. 595; second test well, center of farm.

RECORD.

| | | | | | |
|---|---|---|---|---|---|
| Clay, sand and gravel | 20 ft. | | | | |
| Clay | 41 " | | 61 ft. | | |
| Gray sand rock | 5 " | | 66 " | | |
| Gray shale | 2 " | 4 in. | 68 " | 4 in. | |
| Coal | | 2 " | 68 " | 6 " | |
| Sand rock | 11 " | 6 " | 80 " | | |
| Gray shale | 8 " | | 88 " | | |
| Coal | | 5 " | 88 " | 5 " | |
| Fire clay | 4 " | 1 " | 92 " | 6 " | |
| Gray shale | 11 " | 6 " | 104 " | | |
| Slate | | 4 " | 104 " | 4 " | |
| White sand rock | 24 " | 8 " | 129 " | | |
| Gray shale | 27 " | | 156 " | | |
| Slate | 2 " | | 158 " | | |
| Fire clay | 4 " | | 162 " | | |
| Gray shale | 6 " | | 168 " | | |
| Slate | | 6 " | 168 " | 6 " | |
| Coal | | 9 " | 169 " | 3 " | |
| Fire clay | 2 " | 9 " | 172 " | | |
| Gray shale | 4 " | | 176 " | | |
| Black chip slate | 1 " | | 177 " | | |
| Gray shale | 1 ft. | | 178 ft. | | |
| Fire clay | 4 " | | 182 " | | |
| Black shale | 5 " | | 187 " | | |
| Coal | | 6 " | 187 " | 6 " | |
| Slate | | 6 " | 188 " | | |
| Coal | | 5 " | 188 " | 5 " | |
| Fire clay | 1 " | 7 " | 190 " | | |

E. Christman, Driller.

Sec. 35.

S. W. of S. W.; H. Gilbert; 187 ft.; rock, 60 ft.; soft; A. T. 602.

S. E. cor.; J. Phelps; 85 ft.; no rock; fresh, not hard; Cl, low, Ca, tr., $SO_4$ low, Fe; A. T. 610; used to flow 3 ft., but stopped after coal mines were opened at Sebewaing. Rock said to be 200 ft. from surface.



Sec. 36. 15-8 (Columbia, included for political reasons).

S. E. of S. W.; J. Wilson; 400 ft.; rock, 87 ft.; slightly brackish and very bitter; Cl, very str., Ca, med., $SO_4$ str., Fe; A. T. 624; used to flow 7 ft. C. Hofmeister, Driller.

2nd. Well; 100 ft.; not in use; coal in small quantity and oil; J. Russell, Driller.

3rd. Well; test hole; 170 ft.; rock, 87 ft.; water.

RECORD.

| | | | | | |
|---|---|---|---|---|---|
| Clay | 71 ft. | | | | |
| Hardpan | 14 " | | 85 ft. | | |
| Small vein of sand. | | | | | |
| Hardpan | 2 " | | 87 " | | |
| Soap rock | 21 " | | 108 " | | |
| Sand rock | 15 " | | 123 " | | |
| Slate rock | 9 " | | 132 " | | |
| Coal, about | | 4 in. | 132 " | 4 in. | |
| Fire clay | 3 " | 8 " | 136 " | | |
| Black slate | 3 " | | 139 " | | |
| Fire clay | 3 " | | 142 " | | |
| Black slate | 2 " | | 144 " | | |
| Fire clay | 1 " | | 145 " | | |
| Black slate | 22 " | | 167 " | | |
| Light slate or soap rock | 3 " | | 170 " | | |

J. Russell, Driller.

S. W. of S. W.; G. Phelps; 138 ft.; no rock; fresh and sweet; Cl, low, $SO_4$ low, Ca, low, Fe; A. T. 613; used to flow, but stopped when Sebewaing coal mines were opened.

S. W. ¼; J. Bitzer; 148 ft. 9 in.; rock, 82 ft.; good; A. T. 615.

RECORD.

| | | | | | |
|---|---|---|---|---|---|
| Clay | 74 ft. | | | | |
| Hardpan | 8 " | | 82 ft. | | |
| Soap and slate rock | 32 " | | 114 " | | |
| Lime rock | 22 " | | 136 " | | |
| Sand rock | 12 " | | 148 " | | |
| Lime rock | 1 " | 9 in. | 149 " | 9 in. | |

J. Russell, Driller.

S. E. ¼; Likens and Co., Flour Mill; 156 ft.; rock, 94 ft.; good; A. T. 625.

RECORD.

| | | | |
|---|---|---|---|
| Clay | 69 ft. | | |
| Hardpan | 21 " | 90 ft. | |
| Sand and gravel | 4 " | 94 " | |
| Soap rock or shale | 42 " | 136 " | |
| Black slate | 5 " | 141 " | |
| Sand and slate mixed | 8 " | 149 " | |
| Light slate | 7 " | 156 " | |

J. Russell, Driller.

(Columbia) Sections 1 of 14-8 and 36 of 15-8 are included in Columbia Township for political reasons.)

Sec. 1.

S. E. of S. E.; A. S. Hayes; 200 ft.; rock, 120 ft.; fresh good; Cl, low, Ca, low, $SO_4$ low; head—1 ft.; A. T. 615; water used to have oily taste; coal float in drilling.

S. W. of S. W.; P. VandeMark; 100 ft.; fresh and good; A. T. 623.
N. W. of N. W.; Zimmerman; 80 ft.; no rock; fresh and sweet; A. T. 621.
N. E. of S. W.; E. Hover; 192 ft.; rock, 91 ft.; fresh and hard; Cl, low, Ca, med., $SO_4$ med.; head, 1 ft.; A. T. 625.
Well at house and would flow 1 ft. above; water from 177 ft.

RECORD.

| | | | | |
|---|---|---|---|---|
| Red clay | 16 ft. | | | |
| Blue clay | 66 " | | 82 ft. | |
| Hardpan | 9 " | | 91 " | |
| Soapstone or slate | 35 " | | 126 " | |
| Sand or slate | 3 " | | 129 " | |
| Slate | 10 " | | 139 " | |
| A little coal here. | | | | |
| Bottom slate | 4 " | | 143 " | |
| Dark sand rock | 5 " | | 148 " | |
| White sand rock | 44 " | 6 in. | 192 " | 6 in. |

Hover's 2nd well, at old saw mill site, north of house; 245 ft.; rock, 125 ft.; A. T. 625; abandoned.
Hover's 3rd well, 30 rods north of No. 1; 177 ft.; rock, 100 ft.; good; head, 2 ft.; A. T. 625.

Sec. 2.
N. W. ½; C. Hofmeister; 87 ft.; fresh, formerly flowed; A. T. 601; water from quicksand; well abandoned.
N. W. ¼; C. Hofmeister; 60 ft.; fresh; water from quicksand.
N. W. of N. E.; C. Hofmeister; 168 ft.; rock, 72 ft.; slightly brackish; Cl, med., Ca, low, $SO_4$ str., Fe; head, 2 ft.; A. T. 605; flow small.

RECORD.

| | | | | |
|---|---|---|---|---|
| Clay | 72 ft. | | | |
| Hard limestone | 15 " | | 87 ft. | |
| Very soft coal | | 12-14 in. | 88 " | |
| Fine sandstone | 28 " | | 116 " | |
| Limestone(?) | 6 " | | 122 " | |
| Soapstone | 8–9 " | | 131 " | |
| Gray sandstone becoming white | 37 " | | 168 " | |

S. E. cor.; P. Clancy; 87 ft.; rock, 200 ft.; fresh; formerly flowed; A. T. 618; water from quicksand. Wells along line between secs. 1 and 12 reported to be from quicksand with rock about 200 ft. deep, rising a mile to the west of the corners of secs. 1, 2 and 12.

Sec. 3.
N. E. ¼; 160 ft.; slightly brackish; Cl, med., $SO_4$ str., Ca, med., Fe, present; A. T. 595.
N. W. of S. W.; G. Yahrmarkt; no record except "to rock"; bitter, slightly brackish and astringent tasting; Cl, str., Ca, low, $SO_4$ med., Fe; A. T. 595.
S. W. of S. W.; H. Eynon; 197 ft.; rock, about 80 ft.; bitter and astringent; Cl, med., Ca, low, $SO_4$ low, Fe; A. T. 595; passed through coal.

Sec. 4.
N. W. of N. E.; J. Bell; 170 ft.; rock, 60 or 70 ft.; slightly brackish; Cl, med., Ca, low, $SO_4$ med.; formerly flowed 4 or 5 ft. above; A. T. 592.



N. E. of N. W.; A. Shearer; Cl, med., Ca, low, $SO_4$ med., Fe; A. T. 595; iron in the water, turns tea black; used to flow 4 or 5 ft.

Sec. 5.
N. W. of N. W.; E. Forbes; 64 ft.; rock, 60 ft.; salty; A. T. 598.
S. W. ¼; G. Nelson; 89 ft.; rock, 61 ft.; salty and bitter; A. T. 594.
N. E. of N. W.; W. Branscombe; 70 ft.; rock, 70 ft.; salty; Cl, str., Ca, med., $SO_4$ med.; A. T. 595.

Sec. 7.
S. E. of N. E.; J. J. Dennis; 104 ft.; rock, 64 ft.; salty; A. T. 592; coal at 95 ft.
S. E. of S. E.; 74 ft.; rock, 74 ft.; brackish; Cl, str., Ca, low, $SO_4$ low.

Sec. 8.
N. W. cor.; D. J. Yeomans; 89 ft.; rock, 61 ft.; salty and bitter; Cl, very str., Ca, med., $SO_4$ str.; A. T. 592; soapstone and shale and some coal.
N. E. of S. E.; W. W. Briggs; 113 ft.; rock, 72 ft.; hard, bitter and salty; head, 4 ft.; A. T. 595; small flow rising 4 ft. above, but casing cut off in basin 9 ft. below surface; head lowered 2 ft.; supply very small; a little soft, fresh water at top of rock.

RECORD.

| | | | |
|---|---|---|---|
| Red stony clay | 68 ft. | | |
| Sand and gravel | 4 " | 72 ft. | |
| Sand rock and blue rock with slate at bottom | 30 " | 102 " | |
| Coal with much slate | 4–5 " | 107 " | |
| Flinty rock and pyrites | 3 " | 110 " | |
| Hard shale and pyrites | 3 " | 113 " | |

Sec. 9.
N. E. cor.; G. W. Hubbell; 153 ft.; rock 73 ft.; fresh and good; Cl, low, Ca, low, $SO_4$ low; head, 2 ft.; A. T. 595.
S. E. of N. E.; D. Lagrow; 73 ft.; rock, 73 ft.; fresh and good; Cl, low, Ca, low, $SO_4$ low; A. T. 598; water from top of rock.

Sec. 10.
N. W. of S. W.; C. Moore; 73 ft.; rock, 69 ft.; slightly brackish; Cl, med., Ca, low, $SO_4$ med., Fe; A. T. 612; water from sandstone.
N. W. Cor.; S. W. Hubbell; 73 ft.; rock, 73 ft.; good and fresh; iron taste; Cl, med., Ca, low, $SO_4$ low; A. T. 595; water from top of rock.
S. W. of S. W.; F. Mills; 130 ft.; rock, 110 ft.; slightly brackish; Cl, str., Ca, low, $SO_4$ low, Fe; head 2 ft.; A. T. 592; water from white sandstone; some coal reported.

Sec. 11.
N. W. of N. W.; C. Schermerhorn; 65 ft.; rock, 65 ft.; hard, fresh; Cl, low, Ca, low, $SO_4$ low; used to flow; A. T. 610; water too hard for washing.
N. E. of N. E.; Hover Est.; about 100 ft.; no rock; fresh and good; A. T. 620; used to flow.

Sec. 12.
S. E. of N. E.; C. Hess; test well; 164 ft. rock 72 ft. 6 in.; A. T. 625.

RECORD.

| | | | | |
|---|---|---|---|---|
| Sand, clay and gravel | 30 ft. | | | |
| Clay | 42 " | 6 in. | 72 ft. | 6 in. |
| Gray shale | 24 " | | 96 " | 6 " |
| Hardpan | 1 " | 6 " | 98 " | |
| White sand rock | 6 " | 6 " | 104 " | 6 " |
| Gray shale | 9 " | 3 " | 113 " | 9 " |
| Black shale | 19 " | 3 " | 133 " | |
| Gray shale | 26 " | | 159 " | |
| Coal | 3 " | 2 " | 162 " | 2 " |
| Slate streaked with fire clay | 1 " | 10 " | 164 " | |

E. Christman, Driller.

S. E. cor. of S. E. of N. E.; C. Hess; 155 ft.; rock 68 ft.; test well; A. T. 625.

RECORD.

| | | | | |
|---|---|---|---|---|
| Clay | 67 ft. | | | |
| Sand and gravel | 1 " | | 68 ft. | |
| Gray shale | 18 " | | 86 " | |
| Sand rock | 6 " | | 92 " | |
| Shale | 11 " | | 103 " | |
| Hardpan | 1 " | | 104 " | |
| Shale | 2 " | | 106 " | |
| Coal | | 4 in. | 106 " | 4 in. |
| Slate | | 4 " | 106 " | 8 " |
| Fire clay | 8 " | 4 " | 115 " | |
| Gray shale | 30 " | | 145 " | |
| Black shale | 3 " | 4 " | 148 " | 4 " |
| Coal | 3 " | 1 " | 151 " | 5 " |
| Fire clay | 1 " | | 152 " | 5 " |
| Sand rock | 2 " | 7 " | 155 " | |

E. Christman, Driller.

S. E. of N. E.; H. Hess; 90 ft.; rock, 90 ft.; fresh and good; Cl, low, Ca, tr., $SO_4$ low, A. T. 615. Located on slope of creek valley below general level. Reported to have thrown out lumps of worn coal when first drilled; stopped the flow of Marshall's well which is deeper and in sandstone ½ mile north.

S. E. of S. E.; John Schmidt; 264 ft.; rock, 85 ft.; good; A. T. 628.

RECORD.

| | | | | |
|---|---|---|---|---|
| Old well | 85 ft. | 4 in. | | |
| Sand rock | 20 " | | 105 ft. | 4 in. |
| White rock | 25 " | | 130 " | 4 " |
| Light slate rock | 61 " | | 191 " | 4 " |
| Sand | 72 " | | 263 " | 4 " |
| Fire clay | | 8 " | 264 " | |

N. W. of N. W.; A. Zimmer; 108 ft.; fresh; A. T. 623; no record of rock; well not in use when visited.

S. W. of S. W.; C. Beatonhead; 202 ft.; rock, 60 ft.; fresh, good; Cl, low, Ca, low, $SO_4$ low.

S. E. of S. E.; E. Scmidt; 196 ft. 8 in.; rock, 88 ft.; test well; A. T. 625.



RECORD.

| | | | | |
|---|---|---|---|---|
| Clay and gravel | 20 ft. | | | |
| Clay | 68 " | | 88 ft. | |
| Shale | 5 " | | 93 " | |
| Sandstone | 16 " | | 109 " | |
| Gray shale | 12 " | | 121 " | |
| Brown shale | 21 " | 6 in. | 142 " | 6 in. |
| Fire clay | 4 " | | 146 " | 6 " |
| Brown shale | 2 " | 6 " | 149 " | |
| Black shale | 4 " | | 153 " | |
| Gray shale | 5 " | | 158 " | |
| Coal | | 10 " | 158 " | 10 " |
| Fire clay | 3 " | 8 " | 162 " | 6 " |
| Slate | | 8 " | 163 " | 2 " |
| Coal | | 3 " | 163 " | 5 " |
| Fire clay | 3 " | 3 " | 166 " | 8 " |
| Hardpan | | 4 " | 167 " | |
| Light shale | 6 " | 7 " | 173 " | 7 " |
| Fire clay | 2 " | 5 " | 176 " | |
| Gray shale | 5 " | | 181 " | |
| Black shale | 2 " | 3 " | 183 " | 3 " |
| Coal | | 7 " | 183 " | 10 " |
| Shale | 9 " | 8 " | 193 " | 8 " |

Ed. Christman, Driller.

Sec. 13.

S. E. of S. E.; L. Greanya; 190 ft.; no rock; test well; A. T. 627.

RECORD.

| | | |
|---|---|---|
| Clay | 85 ft. | |
| Sand and gravel | 10 " | 95 ft. |
| Clay | 12 " | 107 " |
| Sand and gravel | 30 " | 137 " |
| Shale | 2 " | 139 " |
| Sand and gravel | 15 " | 154 " |
| Clay | 33 " | 187 " |
| Clay and gravel | 3 " | 190 " |

E. Christman, Driller.

S. W. of N. W.; J. Roller; 90 ft; rock, 90 ft.; good; A. T. 628.

S. E. of N. E.; M. Ziegler Est.; about 80 ft.; fresh and good; A. T. 633; used to flow.

N. E. of S. E.; J. Eckfeld; 140 ft.; rock?; fresh and good; head, 2 ft.; A. T. 628.

S. E. of S. E.; J. Childs; 170 ft.; rock, 120 ft.; fresh and good; head 1 ft.; A. T. 629; small flow.

S. E. of S. E.; 2 wells; (1) 75 ft.; fresh and good; head, 1 ft.; A. T. 630; small flow.

(2) 80 ft.; fresh and good; head, 1 ft.; A. T. 630; small flow.

N. E. of S. E.; J. Eckfield; 190 ft.; rock, 72 ft.; test well; A. T. 628.

RECORD.

| | | | | | | |
|---|---|---|---|---|---|---|
| Clay | 72 | ft. | | | | |
| Gray sandrock | 37 | " | | 109 | ft. | |
| Gray shale | 7 | " | | 116 | " | |
| Brown shale | 7 | " | 6 in. | 122 | " | 6 in. |
| Gray shale | 3 | " | 6 " | 127 | " | |
| Coal | 0 | " | 2 " | 127 | " | 2 " |
| Fire clay | 1 | " | 10 " | 129 | " | |
| Shale | 2 | " | | 131 | " | |
| Black shale | 6 | " | | 137 | " | |
| Black slate | 1 | " | | 138 | " | |
| Fire clay | 2 | " | | 140 | " | |
| Dark shale | 3 | " | | 143 | " | |
| Fire clay | 1 | " | 6 " | 144 | " | 6 " |
| Dark shale | 2 | " | | 146 | " | 6 " |
| White sand rock | 26 | " | | 172 | " | 6 " |
| Coal | 0 | " | 6 " | 172 | " | 8 " |
| White sand rock | 26 | " | 4 " | 199 | " | |

E. Christman, Driller.

Sec. 14.

S. W. Cor.; P. Butterfield; 190 ft.; rock, 75 ft.; salt and bitter; Cl, str., Ca, low, $SO_4$ med.; A. T. 620; first rock shale.

N. E. of S. E.; P. Beck; 290 ft.; fresh and good; Cl, low, Ca, low, $SO_4$ low, Fe; A. T. 625.

S. E. of N. E.; P. Prime; 336 ft.; rock, 90 ft.; fresh and soft; Cl, low, $SO_4$ low, Ca, tr.; A. T. 620.

N. E. of N. E.; Donovan Est; 190 ft.; rock, 90 ft.; fresh and good; A. T. 618.

N. E. ¼; D. J. Beck; 247 ft.; rock, 71 ft.; fresh and good; A. T. 615; white rock, last few feet sandstone; D. Youmans, Driller.

Sec. 15.

N. E. of N. W.; A. R. Wilson; 141 ft.; some in rock; brackish and bitter; Cl, str., Ca, low, $SO_4$ med., Fe; stopped flowing when other wells were drilled in neighborhood; formerly flowed; A. T. 602.

Sec. 16.

N. E. of N. W.; E. D. Cook; 3 wells (1) 130 ft.; rock, 60 ft.; water salt and bitter; Cl, str., Ca, str., $SO_4$ str.; A. T. 603; through sandstone to soapstone. (2) 58 ft.; no rock; salty. (3) 55 ft.; no rock; water salty; Cl, str., Ca, low, $SO_4$ med.

Sec. 18.

S. E. of N. E.; H. A. Nichols; 95 ft.; rock, 80 ft.; brackish; A. T. 602.

S. W. of N. W.; 93 ft.; salty and bitter; Cl, str., Ca, med., $SO_4$ med.; A. T. 605. 2nd, well; 173 ft.; salty and bitter; Cl, str., Ca, med., $SO_4$ med.; A. T. 605; depth to rock not known.

Sec. 20.

S. E. of S. E.; Shingle mill; 122 ft.; rock, 67 ft.; salt and bitter; Cl, str., Ca, med., $SO_4$ med.; A. T. 610; sandstone first rock with shales below; water too salt for boiler use.

Sec. 21.

N. E. Cor.; E. A. Dickey; 77 ft.; rock, 72 ft.; slightly brackish; Cl, str., Ca, low, $SO_4$ med., Fe; A. T. 612; 1 ft. below surface of rock was 1 ft. seam of coal; water from white sandstone.

N. E. of S. E.; Chas. Ziegler; 126 ft.; rock, 66 ft.; salty and bitter; Cl, str., Ca, med., $SO_4$ med.; head, 3 ft.; A. T. 615; small flow; 3 in., coal, soapstone and hard sandstone above the soapstone at 116 ft.



S. E. of S. E.; J. Horst; 69 ft.; rock, 69 ft.; salty; Cl, str., Ca, low, $SO_4$ med.; Head, 2 ft.; A. T. 616. Flows small stream, 2 ft.; Temp. 52 degrees.

Sec. 23.

S. W. of N. W.; Mrs. A. J. Tobias; 210 ft.; rock, 60 or 70 ft.; fresh and soft; Cl, low, Ca, tr., $SO_4$ low, Fe; A. T. 628; used to flow; stood at level of ground; rock was soapstone all the way to sandstone; said to be near limit of east "border of the soapstone."

S. W. of S. W.; N. Lehman; 90 ft.; fresh and good; Cl, low, Ca, low, $SO_4$ low; A. T. 640; drilled some in soft rock.

S. W. of N. E.; S. J. Bell; 204 ft.; rock, 60 ft.; fresh and good; A. T. 625; water from 149 ft.; last 60 ft. shale; D. J. Youmans, Driller.

S. E. of S. E.; C. L. Hover; 204 ft.; rock, 105 ft.; fresh and good; A. T. 635.

N. W. of S. E.; J. Nutt; 77 ft.; rock, 73 ft.; fresh and good; A. T. 635 in sandstone.

Sec. 24.

S. E. of N. E.; C. J. Graham; 175 ft.; rock, 93 ft.; A. T. 635; well not completed when visited.

N. E. of S. E.; E. P. McCollum; 215 ft.; cased 115 ft.; fresh and good; A. T. 635; stopped flowing when a well to the north was drilled.

S. E. ½; MacCollum; 192 ft.; 2 in.; rock 109 ft.; test well; A. T. 635.

RECORD.

| | | | | | | |
|---|---|---|---|---|---|---|
| Clay | 60 | ft. | | | | |
| Sand and gravel | 49 | " | | 109 | ft. | |
| Sandstone | 39 | " | | 148 | " | |
| Dark shale | 3 | " | | 151 | " | |
| Sand rock | 7 | " | | 158 | " | |
| Dark shale | 3 | " | | 161 | " | |
| Gray rock | 11 | " | | 172 | " | |
| Dark shale | 11 | " | 4 in. | 183 | " | 4 in. |
| Coal | | | 6 " | 183 | " | 10 " |
| Pebble rock | | | 9 " | 184 | " | 7 " |
| Black slate | 2 | " | 4 " | 186 | " | 11 " |
| Coal | 4 | " | 3 " | 191 | " | 2 " |
| Bottom slate | 1 | " | | 192 | " | 2 " |

J. Burgert Driller

S. E. Cor.; U. Hoover; 170 ft.; rock, 80 ft., soft and fresh; head, 2 ft.; A. T. 650; small flow; formerly water rose 6 ft. above surface.

S. W. of S. E.; S. Bell; 180 ft.; rock, 80 ft.; fresh and good; head, 1 ft.; A. T. 628; small flow.

S. E. of S. W.; A. Dehmel; 60 ft.; no rock; fresh and good; head, 2 ft.; A. T. 625; flows ½ in. stream.

N. E. of S. E.; H. McCallum; 137 ft.; no rock; test well; A. T. 630. Record; Clay, 110 ft.; quicksand, 27 ft.; 137 ft.

N. W. Cor.; I. Fehn; 150 ft.; rock about 100 ft.; fresh; A. T. 630.

S. W. of S. W.; J. Juber; 190 ft.; rock, 169 ft.; fresh and soft; A. T. 632; "slate, then coal, then white sand rock."

Sec. 25.

N. E. Cor.; A. H. Bathry; 145 ft.; fresh and irony; head 18 in.; A. T. 630; small flow.

N. W. of N. E.; L. Rosenberger; 200 ft.; 120 ft. casing; fresh and good; head, 2 ft.; A. T. 628.

N. E. of N. W.; F. Aschenbach; 100 ft.; no rock; fresh and good; A. T. 625.

Sec. 26.

S. E. of S. W.; A. Preston; 165 ft.; rock, 75 ft.; fresh and soft; A. T. 645; used to flow 7 ft., but was closed up by owners.

S. E. of S. E.; 180 ft.; rock, 90 ft.; soft and fresh; A. T. 640; water from sandstone.

S. W. of S. E.; J. Gilmore; 136 ft.; rock, 83 ft.; soft and fresh; Ca, tr., Cl., low, $SO_4$ low; A. T. 638; water from sandstone.

N. E. of S. W.; S. Britton; 186 ft.; soft and fresh; Cl, low, Ca, tr., $SO_4$ low; head 3 ft.; A. T. 638; in test hole 40 rods west, 2-3 ft. of coal was struck at something over 100 ft.

Sec. 27.

N. W. of S. W.; J. Morrow; 77 ft. 5 in.; rock, 77; slightly brackish; head, 2 ft.; A. T. 623; Coal on top of rock. A well on same place 160 ft. gave water too salt to use.

N. E. of N. W.; E. G. Mathews; 88 ft.; rock, 65 ft.; fresh and good; Cl, low, Ca, low, $SO_4$ low; head, 2 ft; A. T. 620; small flow. 65 ft. clay, 1 ft. sandstone, 3 or 4 ft. slate, remainder sandstone; bottom of well in coal.

S. E. of N. W., near center; John Roe; 70 ft.; rock, 67 ft.; fresh; head, 3 ft.; A. T. 623; flows ¾ in. stream; in the woods.

N. E. of S. E.; R. Cook; 145 ft.; rock, 85 ft.; slightly bitter, fresh; Cl, med., Ca, low, $SO_4$ low; A. T. 638; black shale, sandstone, then shale below.

Sec. 28.

S. E. of S. W.; W. Partlo; 3 wells; (1) 68 ft.; slightly brackish; Cl, str., Ca, low, $SO_4$ med, Fe; A. T. 621; water from shale. (2) 130 ft.; rock, 68 ft.; too salt to use; Cl, very str., Ca, med., $SO_4$ med., Fe; head, 3 ft.; A. T. 621; water from a coal seam. (3) 188 ft. or 208 ft.; too salt to use; A. T. 621; now abandoned; passed through coal, ended in white sandstone; 3 tea-spoonsfuls salt obtained by evaporation a common kitchen kettle of water.

N. E. of S. E.; M. Kelly; 98 ft.; brackish; Cl, str., Ca, low, $SO_4$ med., Fe; A. T. 623. Some in rock.

N. E. of N. E.; D. Randall; 100 ft.; rock, 60 ft.; brackish; Cl, str., Ca, med, $SO_4$ med., Fe; A. T. 617.

Sec. 33.

S. E. of S. W.; E. Forbes; 274 ft.; rock, 80 ft.; bitter and salty; Cl, str., $SO_4$ med., Ca, low, Fe; head 2 ft.; A. T. 615; water used for washing.

S. W. of S. E.; D. L. Spencer; 150 ft.; rock, 71 ft.; fresh and good; Cl, low, Ca, low, $SO_4$ low; A. T. 620; 3 ft. or 3 ft. 6 in. coal, 6 ft. below surface of rock; water from sandstone.

S. E. of S. E.; S. Smith; 60 ft.; rock, 60 ft.; hard, irony and with disagreeable taste; Cl, med., Ca, low, $SO_4$ low; head, 2 ft.; A. T. 625; small flow.

S. E. of N. E.; S. Smith 60 ft.; rock, 60 ft.; hard and irony; A. T. 618; used to flow.



N. E. of N. W.; R. Partlo; 150 ft.; rock, 70 ft.; salty; Cl, str., Ca, med., $SO_4$ med.

Sec. 34.

N. W. of S. W.; W. Bell; 100 ft.; rock, 60 ft.; hard, irony; Cl, low, Ca, med., $SO_4$ low; head,—4 ft.; A. T. 623; water flowed into clay basin and was dipped out.

S. W. of S. W.; M. Beach; 192 ft.; soft, fresh, bitter; head, 3 ft.; A. T. 638; small flow.

S. E. Cor.; I. Freeman; 265 ft. ; rock, 70 ft. soft, fresh, slightly bitter; head 3 ft.; A. T. 650; small flow.

S. W. of S. E.; A. Broderick (Akron village) 175 ft.; rock, 90 ft.; fresh and soft; head,—11 ft.; A. T. 653; 10 ft. sand, 80 ft. clay, to slate and sandrock, "16 ft. coal."

Sec. 35.

N. W. of N. E.; R. Peck; 176 ft.; rock, 90 ft.; soft and fresh; Cl, low, Ca, tr., $SO_4$ low; head, 2 ft.; A. T. 640; small flow. Water from sandstone.

S. W. of S. W.; G. Dutcher; 75 ft.; hard and irony; Cl., low, Ca., med., $SO_4$ low; A. T. 652.

S. E. of S. W.; I. Waldo; 227 ft.; rock, 88 ft.; soft and slightly bitter; Cl, low, Ca, med., $SO_4$ low; A. T. 652.

S. W. of S. E.; J. Osborne; 240 ft.; rock, 89 ft.; soft and tasteless; head, 2 ft.; A. T. 662; good flow but used to be larger.

Sec. 36.

S. E. of S. W.; Liken and Bach; 200 ft.; soft and fresh; A. T. 662.

S. W. of N. W.; G. Turner; 175 ft.; rock, 130 ft.; soft and fresh; A. T. 658; white sand rock at 170 ft.; black shale above this, near top of rock.

## WISNER TOWNSHIP.

Sec. 14.

S. W. of S. W.; W. E. Conger; 90 ft.; rock, 78 ft.; very salt; used to be fresher; Cl, very str., Ca, med., $SO_4$ med.; A. T. 590; used to flow 5 ft. above surface; coal; salty water at 19 ft.; salt licks used to exist about here.

Sec. 21.

S. E. of S. E.; J. W. Neal; 87 ft.; rock, 85 ft.; salty; Cl, very str., Ca, med., $SO_4$ med.; A. T. 588; flows to surface.

Sec. 25.

N. W. of N. E.; H. Cosens; 87 ft.; rock 80 ft.; fresh and good; Cl, med., Ca, low, $SO_4$ low; A. T. 602.

Sec. 26.

S. W. of N. E.; N. B. Bradley; 70 ft.; R. 70 ft.; brackish; A. T. 603 ft. Record of Hole for N. B. Bradley with Bullock.

Record Core Drill (3 inch) near Bay City, Mich., (See T. 14 N., R. 6 E., near head waters of Quanicassee).

RECORD.

| Date, 1889. | Time worked, hrs. | Formation. | Amt. Drilled. | | Core saved, | | |
|---|---|---|---|---|---|---|---|
| 6-7 to 6-13 | | Driving casing | 80 ft. | (Boulder core) | 4 ft. | 6 in. | |
| 6-15 | 10 | Drilling and churning | 5 " | 85 ft. | 1 " | | |
| 6-17 | 10 | Drilling and churning | 3 " | 88 | 2 " | | |
| 6-18 | 10 | Drilling with bit | 17 " | 105 | 10 " | | |
| 6-19 | 10 | Drilling with bit | 15 " | 120 | 11 " | | |
| 6-20 | 10 | Drilling pipe | 10 " | 130 | 8 " | | |
| 6-21 | 10 | Dark shale | 10 " | 140 | 8 " | | |
| | | Light shale | 3 " | 143 | 2 " | | |
| 6-22 | 10 | Sandstone | 12 " | 155 | 10 " | | |
| | | Dark shale | 3 " | 158 | 2 " | | |
| | | Sandstone | 3 " | 161 | 2 " | | |
| 6-14 | 10 | Sand and shale | 12 " | 173 | 10 " | | |
| 6-25 | 10 | Sandstone | 6 " | 179 | 4 " | | |
| | | Black shale | 4 " | 183 | 3 " | | |
| | | Gray slate rock | 8 " | 191 | 7 " | | |
| 6-26 | 10 | Gray slate rock | 4 " | 195 | 3 " | | |
| | | Black shale | 4 " | 199 | 3 " | | |
| | | Black shale and sand | 9 " | 208 | 8 " | | |
| | | Drove 7 ft. 4-in. pipe. | | | | | |
| 6-27 | 10 | Black shale and sand | 7 " | 215 | 6 " | 6 " | |
| | | Sandstone | 2 " | 217 | 2 " | | |
| 6-28 | 10 | Sandstone mixed | 13 " | 230 | 12 " | 6 " | |
| 6-29 | | Black shale and fire clay | 7 " | 237 | 6 " | | |
| 7-1 | 10 | Black shale | 3 " | 240 | | | |
| | | Fire clay | 3 " | 243 | 13 " | | |
| | | Sand and shale | 5 " | 248 | | | |
| | | Dark shale | 2 " | 250 | | | |
| 7-2 | 10 | Dark shale | 6 " | 256 | | | |
| | | Coal | 1 " | 257 | | | |
| | | Sand, white mixed | 4 " | 261 | | | |
| | | Fire clay | 5 " | 266 | 16 " | | |
| 7-3 | 10 | Dark shale | 18 " | 284 | 18 " | | |
| 7-4 | 10 | Dark shale | 8 " | 292 | | | |
| | | Coal | 1 " | 293 | | | |
| | | Dark shale | 2 " | 295 | | | |
| | | Sandstone | 8 " 9 in. | 303 ft. 9 in. | 19 " | | |
| 7-5 | 10 | Fire clay and shale | 4 " | 307 " 9 " | | | |
| | | Coal | 6 " | 508 " 3 " | | 4 " | |
| | | Sand and shale | 6 " | 314 " 3 " | 11 " | | |
| 7-6 | 10 | Black shale | 5 " 6 " | 319 " 9 " | | | |
| | | Black shale and clay | 4 " | 323 " 9 " | | | |
| 7-8 | 10 | Black jack | 3 " | 326 " 9 " | | | |
| | | Coal | 6 " | 327 " 3 " | | | |
| | | Soft white clay | 5 " | 332 " 9 " | 8 " | | |
| 7-9 | 10 | Black shale | 10 " | 342 " 9 " | | | |
| 7-10 | 10 | Sand and shale mixed | 3 " | 345 " 9 " | 12 " | | |
| | | Dark shale | 11 " | 356 " 9 " | 10 | | |
| | | Black jack | 3 " | 359 " 9 " | | | |
| | | Coal | 1 " | 360 " 9 " | | | (480 at alkali.) |
| | | White sand-stone | 3 " | 363 " 9 " | | | |
| 7-13 | 10 | Blue shale and sand | 3 " | 366 " 9 " | 2 " | | |
| | | Iron pyrites | 1 " | 367 " 9 " | | | |
| | | Blue sand with grit | 6 " | 373 " 9 " | 9 " | | |
| 7-15 | 10 | Sand | 13 " | 386 " 9 " | 10 " | | Parma base-ment sand-stone |
| 7-16 | 10 | Sandstone pins | 20 " | 406 " 9 " | 12 " | | |
| 7-17 | 10 | Same | 20 " | 426 " 9 " | 12 " | | |
| 7-18 | 10 | Hard quartz | 23 " | 449 " 9 " | 16 " | | |
| 7-19 and 7-20 | 10 | Setting bit and replacing rods | | | | | Brine upper salt rock. |
| 7-22 | 10 | Sandstone | 10 " | 459 " 9 " | 7 " | | |
| 7-23 and 7-24 | 10 | Sandstone | 4 " | 463 " 9 " | 3 " | | |
| 7-26 | | Repairing pump. | | | | | |
| 7-27 | 10 | Sandstone | 10 " | 473 " 9 " | 9 " | | |
| 7-29 | 10 | Lime and quartz | 10 " | 483 " 9 " | 9 " | | |
| 7-30 | 10 | Same | 12 " | 495 " 9 " | 11 " | | |

Sec. 27.

S. W. of N. E.; N. B. Bradley; 90 ft.; rock 72 ft.; brackish; Cl, str., Ca, med., $SO_4$ med.; A. T. 602 ft.

N. W. of N. E.; N. B. Bradley; 240 ft.; rock, 75 ft.; very salt; not used; H. 2 ft.; A. T. 607. Coal and gas affected this water; Coal at 83 ft.

N. W. of S. W.; W. Rees; 83 ft.; rock, 81 ft. 6 in.; brackish; A. T. 602.

Sec. 28.

N. W. of S. E.; J. Bradford; 113 ft.; brackish and bitter; Cl, str., Ca, low, $SO_4$ low; A. T. 598.



Sec. 32.

N. ½, near quarter line; "Half Way House"; 190 ft.; rock, 80 ft.; salt; Cl, str., Ca, med., $SO_4$ low; H.—1 ft.; A. T. 588; a very little coal.

N. W. of N. E.; Post Office, Quanicassee; 134 ft.; rock, 80 ft.; brackish; Cl, str., Ca, med, $SO_4$ low; A. T. 588; flows into basin 4 or 5 ft. below surface.

N. ½, "Hazen Place;" 113 ft.; rock, 80 ft.; brackish; A. T. 588 ft.; coal at 104 ft.

Sec. 36. T. 15 N. R. 7 E.

S. E. of S. E.; Bay Park; 120 ft.; rock, 70 ft.; salty; A. T. 588 ft.; formerly flowed strong stream 9 ft., but later ceased; water at 116 ft., from white sandstone below soapstone; cased 96 ft.; no coal; water from near the top of the rock salter than that below.

ALMER TOWNSHIP.

Sec. 4.

N. W. of N. W.; Chappel, Graves, and Clever.

Test well; 208 ft.; R. 75 ft.; A. T. 665 ft.

RECORD.

| | | | | |
|---|---|---|---|---|
| Red clay | 11 ft. | | 60 ft. | |
| Blue clay | 49 " | | 75 " | |
| Hard pan | 15 " | | 89 " | 6 in. |
| Soap rock | 14 " | 6 in. | 90 " | |
| Hard streak | | 6 " | | |
| Water here. | | | | |
| Slate rock | 27 " | | 117 " | |
| More water. | | | | |
| Black slate rock | 11 " | | 128 " | |
| Light slate rock | 2 " | | 130 " | |
| Dark sand rock | 5 " | 6 " | 135 " | 6 " |
| Hard black slate rock | | 6 " | 136 " | |
| Sand rock | 4 " | | 140 " | |
| Black and white rock mixed | 1 " | | 141 " | |
| Fire clay or white rock | 3 " | | 144 " | |
| Black and white rock mixed | 1 " | | 145 " | |
| Sand rock | | 9 " | 145 " | 9 " |
| Coal | 1 " | 8 " | 147 " | 5 " |
| Dark slate rock | 1 " | | 148 " | 5 " |
| Fire clay or white rock | 1 " | 2 " | 150 " | 7 " |
| Light slate | 1 " | 10 " | 152 " | 5 " |
| Dark slate rock | 6 " | 7 " | 159 " | |
| Light slate rock | 11 " | | 170 " | |
| Lime rock | 20 " | | 190 " | |
| Sand rock | 18 " | | 208 " | |

J. Russell, Driller.

Sec. 5.

N. E. cor.; 200 ft.; rock, 90 ft.; fresh and good; A. T. 668.

Sec. 7.

S. W. of N. W.; 180 ft.; rock, 100 ft.; fresh and good; A. T. 662.

Sec. 8.

N. E. of N. W.; H. Post; 170 ft.; rock, 130 ft.; fresh, soft; A. T. 658; coal about 150 ft.

Sec. 9.

N. W. of N. E.; C. Parsell; 118 ft.; fresh and soft; sandstone quality; A. T. 655; some in rock; coal reported.

Sec. 16.

N. W. of S. E.; Charles Montague; 267 ft.; rock, 88 or 101 ft.; fresh and good; A. T. 695.

RECORD.

| | | |
|---|---|---|
| Hard clay with small gravel | 70 ft. | |
| Sand | 10 " | 80 ft. |
| Sand and gravel | 8 " | 88 " |
| Sandstone and conglomerate | 13 " | 101 " |
| Blue shale | 28 " | 129 " |
| Black shale | 21 " | 150 " |
| Soft sandstone | 37 " | 187 " |
| Limestone and shale | 4 " | 191 " |
| Limestone | 3 " | 194 " |
| Sandy shale | 4 " | 198 " |
| Black shale | 3 " | 201 " |
| Sandstone | 10 " | 211 " |
| Hard sandstone | 10 " | 221 " |
| Soft sandstone | 46 " | 267 " |

J. J. Cole, Driller.

Sec. 17.

N. W. of N. W.; N. Vandecar; about 100 ft.; fresh and good; A. T. 655.

Sec. 18.

S. W. of N. W.; 305 ft.; rock, 96 ft.; very pure, soft, fresh; Cl, slight tr., Ca, slight tr., $SO_4$ tr.; A. T. 670; 7 ft. vein coal.

N. W. of S. W.; 280 ft.; rock, 80 ft.; very pure, soft and fresh; A. T. 670.

Sec. 32.

S. W. of S. E.; F. Smith; 284 ft.; rock, 135 ft.; fresh and soft; Cl, tr.; Ca, tr., Ca, tr., $SO_4$ tr.; A. T. 725; from white sandstone; 6 in. of coal reported; Horning, Driller.

FAIRGROVE TOWNSHIP.

Sec. 1.

S. E. of N. E.; W. Bross; 99 ft.; rock, 100 ft.; fresh and soft; A. T. 662.

S. E. of S. W.; C. Genet; 247 ft.; fresh and soft; H. 1 ft.; A. T. 668; flow small; coal at 140 ft.

Sec. 2.

N. E. of N. W.; 237 ft.; rock, 88 ft.; soft, fresh, and slightly bitter; Cl, tr., Ca, tr., $SO_4$ low; H. 3 ft.; A. T. 652; water from soft, white sandstone; coal from below shale; used to flow 3 ft. higher.

N. W. of N. E.; 212 ft.; rock, 87 ft.; soft and tasteless; H. 3 ft.; A. T. 662; used to flow 3 ft. higher; good stream; from sandstone, with shale above.

Sec. 3.

N. W. of N. E.; Akron Village; no record; soft, slightly bitter; H. 3 ft.; A. T. 655; small flow.

Sec. 4.

S. E. of N. W.; flowing well; water fresh; no record.

Sec. 5.

N. E. of N. W.; J. E. Evans; 100 ft.; rock, 70 ft.; salt and bitter; Cl, str., Ca, low, $SO_4$ low; H. 1 ft.; A. T. 615.



N. E. of N. E.; J. McCreedy; (1) 360 ft.; rock, 75 ft.; no water; A. T. 623. (2) 265 ft.; rock, 75 ft.; salty and bitter; A. T. 623; 2 ft. coal reported in one hole at 200 ft.

S. W. of S. E.; S. Smith; 264 ft.; rock, 60 ft.; soft, slightly brackish, and bitter; Cl, str., Ca, slight tr., $SO_4$, tr., Fe; A. T. 625, used to flow.

S. E. of S. W.; S. Wolvertine; about 80 ft.; rock about 70 ft.; fresh, with astringent mineral taste; Cl, low, Ca, str., $SO_4$ str.; A. T. 622.

S. W. of S. E. of S. W.; School No. 7; 72 ft.; rock, 72 ft.; fresh, slightly sweetish and astringent; Cl, low, Ca, med., $SO_4$ str.; A. T. 620.

Sec. 6.

S. W. of N. W.; R. McAlpine; 75 ft.; no rock; fresh and good; Cl, low, Ca, med., $SO_4$, med; H. 3 ft.; A. T. 612.

N. W. of S. W.; J. Misner; 82 ft.; rock, 77 ft.; fresh and good; Cl, med., Ca, low, $SO_4$ low; H. 3 ft.; A. T. 612. Coal at top of rock; sandstone below; flow good.

S. W. of S. W.; A. Gadney; 82 ft.; rock, 77 ft.; fresh and good; Cl, med., Ca, low, $SO_4$ low; H. 3 ft.; A. T. 612; water from sandstone.

S. W. of S. E.; J. Ellison; 135 ft.; rock; soft, fresh, and slightly bitter; Cl, low, Ca, low, $SO_4$ low; A. T. 615.

Sec. 7.

S. E. of S. E.; J. Davison; 133 ft.; slightly bitter but fresh; A. T. 624.

S. W. of S. W.; L. Ellison; 135 ft.; soft and fresh with slightly bitter taste; H. 2 ft.; A. T. 620; flow good.

Sec. 8.

S. E. cor.; G. Bartlo; 43 ft.; rock, about 65 ft.; fresh with slight irony taste; Cl, tr., Ca, low, $SO_4$ med.; A. T. 638; rock soft.

S. E. of S. E.; G. Partlo; 91 ft.; rock, 80 ft.; fresh with astringent taste; A. T. 638.

N. E. of S. E.; G. Partlo; 184 ft.; rock, about 80 ft.; soft but bitter; Cl, str., Ca, 0, $SO_4$, tr.; A. T. 635; water abundant.

Sec. 9.

S. W. of N. W.; G. Pelton; 200 ft.; brackish and bitter; Cl, str., Ca, tr., $SO_4$ med.; A. T. 632.

Sec. 10.

N. E. of N. W.; A. Hazen; 250 ft.; rock, about 80 ft.; soft, slightly bitter; Cl, low, Ca, 0, $SO_4$ med.; H. 3 ft.; A. T. 650; small flow.

N. W. of N. E.; G. Bell; 225 ft.; rock, 85 ft.; soft, slightly bitter; H. 3 ft.; A. T. 655.

S. E. of S. W.; G. W. Pelton; 160 ft.; rock, 80 ft.; fresh and soft; Cl, tr., Ca, tr., $SO_4$ tr.; A. T. 650; from sandstone.

S. E. of S. E.; S. Sutter; 160 ft.; rock, 80 ft.; fresh and soft; A. T. 650; from sandstone.

Sec. 11.

N. W. cor.; J. Bell; 200 ft.; rock, 98 ft.; soft and fresh; Cl, tr., Ca, tr., $SO_4$ tr.; A. T. 662 ft.

Sec. 12.

N. E. of N. W.; W. R. Bross; 108 ft.; rock, about 100 ft.; slightly hard and irony; H. 2 ft.; A. T. 667; from sandstone.

S. E. of N. E.; A. Lewis; 190 ft.; rock about 100 ft.; soft and fresh; Cl, tr., Ca, tr., $SO_4$ tr.; A. T. 670; used to flow.

N. E. of S. E.; O. Forshee; 310 ft.; rock, 80 ft.; very pure, soft, and fresh; Cl, 0, Ca, slight tr., $SO_4$ tr.; A. T. 670.

S. E. of S. E.; D. Hanna; 264 ft.; rock, 80 ft.; fresh and good; Cl, tr., Ca strong tr., $SO_4$ low; A. T. 672.

S. W. of S. E.; I. Rockwell; 200 ft.; rock, 80 ft.; irony, and astringent, fresh; A. T. 680.

Sec. 13.

N. W. of N. E.; G. Ingles; 180 ft.; rock, 80 ft.; fresh and soft; Cl, tr., Ca, tr., $SO_4$ low, Fe; H. 2 ft.; A. T. 680; small flow, used to be more.

S. W. of S. W.; F. Montei; 285 ft.; rock 80 ft.; fresh and somewhat hard; Cl, 0, Ca, med., $SO_4$ med.; A. T. 673.

Sec. 14.

N. E. of N. W.; 102 ft.; rock, 98 ft.; fresh and good; A. T. 665.

Sec. 15.

N. W. of N. E.; I. Everett; 160 ft.; rock, 80 ft.; soft and fresh; Cl, tr., Ca, tr.; $SO_4$ tr.; A. T. 652; from sandstone.

N. W. of N. W.; H. Day; 138 ft.; rock 75 ft.; fresh, slightly hard; Cl, tr., Ca, str., $SO_4$, low; A. T. 648. Flows at bank of creek some below the general level.

S. W. of S. E.; O. Harding; about 186 ft.; rock, 80 or 90 ft.; fresh and soft; Cl, tr., Ca, tr., $SO_4$ low; A. T. 658.

S. E. cor.; W. Brinkman; 200 ft.; rock, about 80 ft.; fresh and soft, has slight taste of iron; Cl, tr., $SO_4$ tr., Fe; A. T. 662.

S. E. of S. W.; E. McReedy; 230 ft.; rock, about 80 ft.; H. 1 ft.; fresh and soft; A. T. 655.

A well on Sec. 15, not located was reported to be 275 ft. deep and passed through "red paint rock" 3 ft. thick; and that mud-like balls were brought up from 200 ft. deep.

Sec. 16.

N. W. of N. E.; J. Parker; 318 ft.; fresh and good, with slight sweetish taste; Cl, low, Ca, low, $SO_4$ med., A. T. 652.

S. E. cor.; 388 ft. 10 in.; rock, 103 ft.; fresh and good; H. 1 ft.; A. T. 661; at 160 feet, cased to shut out bad water; some sandstone and limestone; 31 ft.; water bearing sandstone at bottom.

S. W. of S. W.; E. J. Otis; Fairgrove Village; 200 ft.; rock, 80 ft.; fresh and good; A. T. 660.

S. W. of N. E.; T. Horning; 225 ft.; rock, 90 ft.; fresh and soft; A. T. 655. Gray sandstone at 150 ft.

N. E. of S. E.; A. Holmes, 355 ft.; rock, 87 ft.; fresh and soft; A. T. 650.

S. W. of S. W.; R. R. well, Fairgrove Station; 388 ft.; rock, 98 ft. 4 in.; rather fresh, hard; A. T. 658 ft.



RECORD.

| | | | | |
|---|---|---|---|---|
| Earth and clay, etc | 98 ft. | 4 in. | | |
| Lime rock, solid and hard | 2 " | | 100 ft. | 4 in. |
| Sand and gravel, cemented | 4 " | | 104 " | 4 " |
| Gray shale | 11 " | | 115 " | 4 " |
| Plenty of water under lime rock from sand and gravel; rises to within 12 feet of surface. Tubing down to 98 ft. 4 in. No water till below lime rock. | | | | |
| Light shale | 13 " | | 128 " | 4 " |
| Dark colored shale | 7 " | | 135 " | 4 " |
| Black shale | 26 " | | 161 " | 4 " |
| To this point boring has been 5⅝. Here off-set. Below this drilling is 4 3-16 in diameter. | | | | |
| Gray shale | 54 " | | 215 " | 4 " |
| Hard flinty sandstone | 10 " | | 225 " | 4 " |
| Gray shale | 18 " | | 243 " | 4 " |
| Black shale | 34 " | | 277 " | 4 " |
| Soapstone | 6 " | | 283 " | 4 " |
| Dark shale | 16 " | | 299 " | 4 " |
| Fire clay | 6 " | | 305 " | 4 " |
| Hard gray lime rock | 7 " | | 312 " | 4 " |
| Gypsum | 3 " | | 315 " | 4 " |
| Very hard gray lime rock | 10 " | | 325 " | 4 " |
| Brown sandy shale | 8 " | | 333 " | 4 " |
| Gray lime rock | 12 " | | 345 " | 4 " |
| Fire clay | 2 " | | 347 " | 4 " |
| Gray lime rock | 10 " | | 357 " | 4 " |
| Gray sandstone | 31 " | | 388 " | 4 " |
| Brown lime rock | | 6 " | 388 " | 10 " |

Drilled by McMillan, Feb. 15, 1895.

April 13, '95, Mr. Keeler reports the water good and pump not to exhaust it.

Sec. 17.

S. E. of S. E.; J. Crosby; 190 ft.; rock, 102 ft.; fresh and good; A. T. 660.

Sec. 18.

N. W. of N. W.; 220 ft.; rock, 78 ft.; very soft and entirely tasteless; Cl, tr., Ca, 0, $SO_4$ tr., H. 18 in.; A. T. 630. Coal on top of rock; small flow.

S. W. cor.; R. Kinter; 200 ft.; rock, 60 or 70 ft.; tasteless and soft; H. 1 ft.; A. T. 632; used to flow 8 ft. above the surface; flow now small.

Sec. 19.

N. E. of N. W.; 200 ft.; soft and tasteless; Cl, tr., Ca, tr., $SO_4$ tr., A. T. 635 ft.; used to flow; depth of rock forgotten.

S. W. of S. E.; A. Dant; 86 ft.; rock, 85 ft.; 6 in.; hard and fresh.

Sec. 20.

S. W. of S. E.; A. Gardner; 200 ft.; rather hard, fresh; A. T. 660.

S. W. of S. W.; C. Johnson; 208 ft.; rock, 80 ft.; fresh, soft; A. T. 678.

N. E. cor.; F. Bostworth; 205 ft.; rock, 100 ft.; fresh, somewhat irony; A. T. 662.

Sec. 21.

N. W. of N. W.; D. Campbell; 101 ft.; rock, 90 ft.; soft and fresh; A. T. 655.

S. E. cor.; C. Brebner; 168 ft.; rock, 86 ft.; water from white sandstone, below shale.

S. W. of S. E.; 208 ft.; rock, 80 ft.; rather hard, tasteless; A. T. 660; supply abundant.

Sec. 22.

N. E. of N. W.; W. Stoddard; 150 ft.; fresh, soft, slightly bitter; Cl, tr., Ca, 0, $SO_4$, tr.; A. T. 673.

N. E. cor.; W. Brinkman; 180 ft.; rock, 80 ft.; fresh and soft, with slight taste of iron; A. T. 661.

S. W. of S. E.; J. Mitchell; 137 ft.; soft with slight irony taste; A. T. 675.

N. W. of N. E.; W. Harris; 225; soft with some iron; A. T. 660 ft.

Sec. 23.

N. W. of N. W.; A. H. Jones; 250 ft.; rock, 85 ft.; fresh, soft, with slight taste of iron; A. T. 665; 1 ft. of coal found in drilling.

N. W. of N. E.; C. E. Rolfs; 193 ft. rock, 70 ft.; fresh and rather hard; Cl, 0, Ca, med., $SO_4$ med.; A. T. 665.

S. E. of S. W.; E. Marr; 140 ft.; rock, 85 ft.; rather hard, tasteless; A. T. 680.

Sec. 24.

N. E. of N. E.; F. Montei. 130 ft.; rock, 100 ft.; soft and tasteless; A. T. 680; coal seam 3.5 ft (?).

Sec. 26.

N. W. of N. E.; H. Lane; 192 ft.; rock, 80 or 90 ft.; soft and fresh; A. T. 683 ft.; 3 or 4 ft. of coal reported.

N. E. of N. W.; W. Scott; 144 ft.; rock 86 ft; slightly hard, tasteless, Cl, tr., Ca, low, $SO_4$ low; A. T. 680.

Sec. 27.

S. E. cor.; P. Campbell; 210 ft.; very soft and tasteless; Cl, 0, Ca, very slight tr., $SO_4$ slight tr.; A. T. 672.

Sec. 29.

N. E. of N. W.; D. Parish; 170 or 180 ft.; rather hard with irony taste; A. T. 670.

Sec. 30.

N. W. of N. W.; J. VanBuskirk; 175 ft.; rock, 73 to 75 ft.; fresh and good; H. 2 ft.; A. T. 638 ft.; water from sandstone; coal on top or rock; used to flow 15 ft. above the surface, but constantly lowering.

S. E. of S. E.; J. Adams; 192 ft.; rock, 75 ft.; soft and fresh; Cl, tr., Ca, tr., $SO_4$ tr.; A. T. 659.

Sec. 31.

S. W. of S. W.; 226 ft.; rock, 75 ft.; fresh and soft; A. T. 662; used to flow; soapstone and sandstone to 150 ft.; then hard rock.

S. W. of N. W.; 3 wells on place; 2 about 140 ft.; 3d 296 ft.; rock, about 80 ft. in all; all fresh and good; A. T. 660; water from sandstone.

N. W. of N. W.; L. Sheldon; 100 ft.; fresh and soft; A. T. 652.

S. E. cor.; J. Brate; 220 ft.; rock, 90 ft.; soft, fresh, somewhat irony; A. T. 663.

S. W. of S. E.; L. Reeso; 100 ft.; rock, 80 ft.; soft, fresh, somewhat irony; A. T. 665.

S. E. of S. W.; E. Wilson; 256 ft.; rock, 74 ft.; fresh and soft.; A. T. 662; used to flow; good water at 135 ft.; sand rock from top; coal.



S. W. cor.; H. Miller; 230 ft.; no rock; good water; A. T. 660; quicksand and gravel at bottom.

Sec. 32.

N. W. cor.; J. Camfield; 123 ft.; rock, 80 ft.; fresh and soft; A. T. 657.

S. E. of S. E.; 230 ft.; rock, 80 ft.; very soft and good; A. T. 648.

Sec. 33.

N. E. of N. W.; E. Jennings; 280 ft.; fresh and soft; sandstone quality; A. T. 660.

N. W. of N. E.; C. Annibal; 218 ft.; rock, 82 ft.; tasteless and very soft; A. T. 665; coal reported.

S. W. of S. W.; W. Hunsperger; 216 ft.; rock, about 90 ft.; soft and fresh; A. T. 663.

Sec. 34.

N. W. of N. W.; 138 ft.; rock, 85 ft.; fresh and good; A. T. 678; water from 115 or 116 ft.

Sec. 36.

S. E. of S. W.; 103 ft.; rock, 100 ft.; very hard, fresh; A. T. 705 ft.; water in small quantity and often fails in dry seasons.

GILFORD TOWNSHIP.

Sec. 1.

S. E. cor.; James Misner; 292 ft.; rock, 72 ft.; bitter and with marked mineral taste; Cl, low; Ca, low, $SO_4$ low. Rises to surface; A. T. 615; Formerly flowed at 5 ft. above surface; sandstone at top, shale and limestone below; water from 254 ft.; J. Misner, driller.

S. E. of S. W.; J. Mahnke; 78 ft.; rock, 78 ft.; fresh and good; Cl, med., Ca, low, $SO_4$ low; H. 18 in.; A. T. 612.

Sec. 2.

N. E. of S. E., sawmill; 70 ft.; rock, 70 ft.; fresh and good; Cl, low, Ca, med., $SO_4$, low; H. 3 ft.; A. T. 610.

Sec. 8.

S. W. of N. W.; Geo. Grashaw; 180 ft.; rock, about 100 ft.; salty; A. T. 612. Very little water; well not in use.

Sec. 11.

S. E. of S. W.; R. Hickey; 85 ft.; rock, 85 ft.; fresh and good; Cl, low, Ca, low, $SO_4$ low; A. T. 625.

S. E. of S. E.; B. Pickert; 240 ft.; rock, 80 ft.; slightly brackish and bitter; Cl, med., $SO_4$, med., Ca, tr.; H. 2 ft.; A. T. 637.

S. E. cor.; W. Sherwood; 200 ft.; rock, 78 ft.; soft and fresh; Cl, low, Ca, tr., $SO_4$, tr.; H. 2.5 ft.; A. T. 640; good flow.

S. E. of N. E.; S. Benson; 206.5 ft.; rock 75 ft.; fresh and soft; Cl, low, Ca, tr., $SO_4$, tr.; H. 3 ft.; A. T. 620; flowed full size of inch pipe; from white sandstone; passed through 35 ft. shale and coal.

N. E. of S. E.; A. Hutton; 195 ft.; rock 75 ft.; soft and fresh; Cl, low, Ca, tr., $SO_4$, tr.; H. 3 ft.; A. T. 625; flows 1 in. stream.

Sec. 12.

S. W. of N. W.; J. Hickey; 76 ft.; rock 76 ft.; brackish, A. T. 620.

S. W. of S. W.; M. Hill; 200 ft.; rock about 80 ft.; soft and fresh; H. 2 ft.; A. T. 640; passed through coal and shale; small flow.

S. E. of S. W.; M. Hill; 109 ft. (?); some in rock; soft, fresh, slightly bitter; Cl, tr.; Ca, O, $SO_4$, slight tr.; A. T. 640.

Sec. 13.
N. W. cor.; E. Martin; 225 ft.; soft and fresh; A. T. 640; no record of rock.
N. E. of N. W.; W. Sherwood; 193 ft.; rock, 80 ft.; soft and fresh; Cl, low; Ca, tr., $SO_4$, tr.; H. 3 ft.; A. T. 640; small flow.
N. W. of N. E.; M. Rose; 253 ft.; rock 80 ft.; fresh and soft; H. 1 ft.; A. T. 640 ft.
N. E. of N. E.; M. Hill; 160 ft. rock; fresh and soft, with iron taste; H. 18 in.; A. T. 630; small flow.
N. E. of S. E.; J. Bracley; 153 ft.; rock 80 ft.; soft and fresh; H. 3 ft.; A. T. 640.
Sec. 14.
S. E. of S. E.; A. Stewart; 263 ft.; rock 85 ft.; brackish; H. 1 ft.; A. T. 652.
N. E. of N. W.; R. Hickey; 80 ft.; rock 80 ft.; fresh and good; Cl, low, Ca, low, $SO_4$, low; A. T. 625.
N. E. of N. W.; J. Chase; 130 ft.; rock 80 ft.; brackish; Cl, str., Ca, low, $SO_4$, low; A. T. 630.
N. W. of N. W. of N. E.; M. Davidson; 98 ft.; rock 85 ft.; bitter and fresh; Cl, low, Ca, low, $SO_4$, med.; roily; A. T. 634; small supply, from white sandstone, below black shale.
N. E. of N. W. of N. E.; Davidson; 346 ft.; rock 84 ft.; salty and bitter; Cl, str., Ca, med. $SO_4$, str.; H. 20 ft.; A. T. 635. At 130 ft. vein of brackish and bitter water; at 200 ft. vein of salty water; at bottom white sandstone with fresher water; flow large; full size of in. pipe, but too salty to use. Later cased down inside the hole to below 200 ft. and got much fresher, usable water.
N. E. cor.; D. Prime; 200 ft.; rock 78 ft.; fresh and sweet; Cl, low, Ca, tr., $SO_4$ tr.; H. 2.5 ft.; A. T. 640; good flow.
Sec. 15.
S. E. of N. E.; B. Godkin; 320 ft.; rock 89 ft.; strongly salt; A. T. 635. Another here 360 ft. rock, 80 ft.; salt.
Sec. 16.
S. W. of S. W.; L. Slater; slightly brackish; Cl, str., Ca, med., $SO_4$ med.; H. 2 ft.; A. T. 600; no record of depth, flows ½ in. stream.
Sec. 17.
S. E. cor.; B. Godkin; 108 ft.; rock 85 ft.; brackish and some bitter; Cl, str., Ca, med., $SO_4$, med.; A. T. 598.
Sec. 19.
N. E. of N. E.; A. Haske; 140 ft.; rock 85 ft.; brackish and slightly bitter; Cl, str., Ca, med., $SO_4$, str.
Sec. 20.
S. W. cor.; W. Spiekerman; 140 ft.; rock, 90 ft.; brackish; Cl, str., Ca, low, $SO_4$ low; A. T. 614.
S. W. of S. E.; W. Spiekerman; 85 ft.; fresh; A. T. 608.
Sec. 21.
N. E. of N. E.; D. Baird; 80 ft.; rock, 80 ft.; slightly bitter, not brackish; Cl, med., Ca, low, $SO_4$, med.; A. T. 610.
S. E. of N. E.; N. Malburg; 75 ft.; slightly bitter, not brackish; Cl, med., Ca, low, $SO_4$, med.; A. T. 610.



S. E. of S. E.; W. Jones; 100 ft.; fresh, Cl, med.; Ca, low, $SO_4$ tr., Fe; A. T. 635; rock shale; water from above the rock; well at barn some in rock; water salty.
S. W. of S. E.; W. Greely; 90 ft.; rock, 90 ft.; fresh and slightly bitter; A. T. 625; 40 rods off road.
S. E. of S. W.; N. Hall; 90 ft.; rock, 90 ft.; fresh and slightly bitter; Cl, med., Ca, low, $SO_4$ med.; A. T. 620.
Sec. 22.
S. W. of N. W.; S. Catlin; 2 wells; house well, 75 ft.; rock, 75 ft.; fresh and soft; Cl, med., Ca, tr., $SO_4$ tr.; A. T. 610.
Barn well; 100 ft.; rock, 75 ft.; fresh and soft; Cl, low, Ca, tr.; $SO_4$ tr.; A. T. 610; clay 75 ft.; shale 16 ft.; sandstone 9 ft.; 2 or 3 small veins of coal.
S. W. of S. W.; T. Murphy, str.; 80 or 85 ft.; slightly brackish and bitter; Cl, str., Ca, low, $SO_4$ low; A. T. 620.
N. W. of N. W.; I. Letson; about 80 ft.; rock 80 ft.; brackish; Cl, str., Ca, low, $SO_4$, low; A. T. 612.
S. E. of S. W.; T. Murphy Jr.; 89 ft.; rock 70 ft.; nearly fresh, slightly bitter; H. 2.5 ft.; A. T. 625.
S. E. of S. E.; W. Webb; 75 or 80 ft.; just to rock; fresh and good; H. 1 ft.; A. T. 640; small flow.
N. E. of S. E.; D. Webb; 100; rock, 80 ft.; brackish; A. T. 640 ft.
S. E. of N. E.; J. Russell; 300 ft.; rock ? 80 ft.; brackish; A. T. 642; cut off at top of rock; fresh; deep water too salt to use.
Sec. 23.
N. E. of N. W.; J. Campbell; 100 ft.; slightly brackish; H. 2 ft.; A. T. 645.
Sec. 24.
N. W. of N. E.; J. Broadworth; fresh and good with slight irony taste; 178 ft.; rock 80 ft.; H. 2 ft.; A. T. 632; flows ½ in. stream from soapstone.
N. E. of N. W.; A. Hall; 160 ft.; fresh and good with irony taste; A. T. 636.
Sec. 25.
S. E. of N. E.; 70 ft.; rock, 70 ft.; fresh but slightly irony taste; A. T. 640.
Sec. 26.
S. E. of S. E.; J. Orr; 152 ft.; rock, 78 ft.; soft and fresh; H. 2 ft.; A. T. 640.
S. E. of S. W.; M. Way; 220 ft.; rock, 100 ft.; soft and fresh; H. 1 ft.; A. T. 642; used to flow more.
S. W. of S. W.; Gilford P. O.; about 200 ft.; rock, about 100 ft.; soft and fresh; H. 1 ft.; A. T. 640 ft.; small flow.
Sec. 27.
S. E. cor.; 132 ft.; rock, 80 ft.; brackish and bitter; Cl, str., Ca, low, $SO_4$, med.; A. T. 633 ft.
S. W. of N. W.; 240 ft.; rock, 83 ft.; salty and bitter; H. 3 ft.; A. T. 632 ft.; small flow.
N. W. of N. E.; J. Barker; 325 ft.; rock, about 80 ft.; soft and fresh, but slightly bitter; Cl, low, Ca, tr., $SO_4$ low; A. T. 637 ft.

S. E. to S. E.; Gilford P. O., 2 wells 80 ft.; no rock, fresh and good; A. T. 640.

S. E. of S. W.; F. Johnson; 76 ft.; rock, 76 ft.; fresh and good; H. 1 ft.; A. T. 635 ft.; small flow.

Sec. 28.

N. W. of N. E.; J. Hannan; 104 ft.; rock, 100 ft.; fresh, slightly bitter; Cl, low, Ca, tr., $SO_4$ low; A. T. 628.

N. E. of N. W.; F. Dawson; 80 ft.; no rock; fresh; A. T. 625.

N. W. of N. W.; A. Stewart; 170 ft.; rock, 90 ft.; salty; Cl, str., Ca, low, $SO_4$ low; A. T. 615. In well 309 ft., water was very salt, and above fresher. Record: Surface, 70 ft.; clay-hard-pan to 90 ft., 1 ft. layer very hard, then soapstone below, where the rock was harder. on this place 13 holes had been put down in hopes of getting fresh water, but none was found. Probably casing through the shales to the underlying sandstone would give fresh water here. "Water to the west of this corner all brackish or salty."

N. E. of S. E.; F. Grenia; 200 ft.; rock, 85 ft.; brackish and bitter; Cl, str., Ca, low, $SO_4$ med.; A. T. 633.

S. W. of S. E.; J. Richards, Sr.; 110 ft.; rock, 80 ft.; brackish and bitter; A. T. 630.

Sec. 29.

N. E. of N. W.; N. Sylvester; 100 ft.; rock, 95 ft.; fresh and soft; Cl, low, Ca, tr., $SO_4$ low, A. T. 605.

S. W. of S. W.; P. Jansen; 220 ft.; rock, 75 or 80 ft.; salty and slightly bitter; H. 2.5 ft.; A. T. 612; good flow.

Sec. 30.

N. W. cor.; 190 ft.; rock, 80 or 90 ft.; salty and slightly bitter; Cl, str., Ca, low, $SO_4$ med.; located across road in Bay Co.; A. T. 597.

Sec. 31.

N. E. of S. E.; J. Waltz; 140 ft.; rock, 80 ft.; brackish and slightly bitter; Cl, str., Ca, low, $SO_4$ med.; A. T. 610 ft.

N. W. of N. E.; C. Barthel; about 200 ft.; H. 2 ft.; very salty; Cl, very str.; Ca, low, $SO_4$, low; A. T. 605; small flow.

Sec. 32.

N. W. of S. W.; G. Palm; 230 ft.; rock, 80 ft.; brackish, slightly bitter; Cl, str., Ca, low, $SO_4$, med.; H. 2 ft.; A. T. 612 ft.; small flow.

S. W. of N. W.; H. Lunenburg; 235 ft.; rock, about 80 ft.; brackish and slightly bitter; H. 18 in.; A. T. 613 ft.; small flow.

Sec. 33.

S. W. of S. W.; A. Hoeft; 200 ft.; rock, ?; brackish and bitter; Cl, str., Ca, low, $SO_4$, med.; A. T. 632 ft.

N. E. of S. E.; J. Findlay; 302 ft.; rock, 85 ft.; fresh and soft; A. T. 698 ft.; formerly flowed to surface, but stopped when wells to west were put down; water at first salty but became fresh; well deepened from top of rock when flow failed.

S. E. of N. E.; W. Hase; 80 ft.; no rock; fresh and good; H. 2 ft.; A. T. 638 ft.

N. W. of N. E.; C. Marcell; 82 ft.; rock, 82 ft.; fresh and good; A. T. 632 ft. Used to flow.

N. W. of N. E.; J. Richards; 95 ft.; rock, 90 ft.; fresh and soft; A. T. 630 ft.



Sec. 34.

S. W. of S. E.; 75 or 80 ft.; rock, about 75 or 80 ft.; fresh and soft; H. 2 ft.; A. T. 645 ft.

S. E. cor.; W. Warren; 280 ft.; rock, 80 ft.; brackish and bitter; Cl, str., Ca, tr.; $SO_4$, tr.; H. 2 ft.; A. T. 645 ft. Surface clays 80 + ft.; shale 30 or 40 ft.; Sandstone with hard streaks below; some coal.

N. W. of N. W.; O. Bryant; 240 ft.; rock, 90 ft.; fresh and soft, but bitter; A. T. 633 ft.; flows small stream at surface; used to be salty but by deepening got fresher water.

Sec. 35.

S. W. of S. W.; I. Dore; 236 ft.; rock, 90 ft.; slightly brackish and quite bitter; soft; Cl, strong; Ca, tr., $SO_4$, tr.; A. T. 647; coal on top or rock; used to flow.

S. E. of S. W.; M. Shaver; 194 ft.; soft, fresh and slightly bitter; H. 4 ft.; A. T. 653; flows ½ inch stream.

S. W. of S. E.; C. Dove; 164 ft.; soft, fresh, and slightly bitter; H. 2 ft.; A. T. 655 ft.; flows ½ inch stream.

S. E. of S. E.; J. Gaunt; 100 ft.; soft and tasteless; Cl, tr., Ca, tr., $SO_4$, tr.; H. 4 ft.; A. T. 660 ft.; small flow.

N. E. of N. W.; C. Spencer; 90 ft.; rock, 88 ft.; soft and fresh; H. 3 ft.; A. T. 642 ft.

N. W. of N. W.; Gilford, P. O.; 200 ft.; rock, 100 ft.; soft and fresh; H. 2 ft.; A. T. 640 ft.; small flow.

Sec. 36.

S. W. of S. W.; R. Caldwell; 136 ft.; no rock; fresh and good; H. 4 ft.; A. T. 663 ft.

S. W. of S. W.; R. Caldwell; 70 ft.; no rock; fresh and good; H. 3 ft.; A. T. 653 ft.

S. W. of S. E.; J. Young; 200 + ft.; rock, 170 ft.; salty; A. T. 658 ft.

N. E. of S. E.; A. Miller; 175 ft.; fresh and good; A. T. 662 ft.; used to flow.

S. E. of N. E.; M. Hobert; 136 ft.; fresh, with irony taste; A. T. 660 ft.; coal at about 100 ft.; another well of same depth and quality on the place.

### KINGSTON TOWNSHIP.

Sec. 28.

N. W. ¼; Test well for Huston and Montague, Kingston; 211 ft., 6 in.; rock, 77 ft.; A. T. 765.

RECORD.

| | | | | |
|---|---|---|---|---|
| Red clay | 10 ft. | | | |
| Water sand | | 6 in. | 10 ft. | 6 in. |
| Dry quick-sand runs with water | 14 " | | 24 " | 6 " |
| Hardpan of sand and gravel | 3 " | 6 " | 28 " | |
| Soft clay and sand | 20 " | | 48 " | |
| Sand and gravel | 17 " | | 65 " | |
| Hardpan and boulders | 9 " | | 74 " | |
| Blue clay | 3 " | | 77 " | |

UPPER GRAND RAPIDS OR (BAYPORT) MAXVILLE LIMESTONE[1].

| | | | | | | |
|---|---|---|---|---|---|---|
| Sand rock | 19 | ft. | | 96 | ft. | |
| Gray lime rock | 4 | " | | 100 | " | |
| Sand rock | 9 | " | 6 in. | 109 | " | 6 in. |
| Gray lime and flint rock | 3 | " | 6 " | 113 | " | |
| Sand lime and flint rock | 3 | " | | 116 | " | |
| Gray lime rock | 7 | " | | 123 | " | |
| Gray lime rock | 3 | " | 9 " | 126 | " | 9 " |

LOWER GRAND RAPIDS OR MICHIGAN FORMATION[1].

| | | | | | | |
|---|---|---|---|---|---|---|
| Sand rock | 16 | ft. | 3 in. | 143 | ft. | |
| Sandy fire clay | 14 | " | 4 " | 157 | " | 4 in. |
| Sand rock | 8 | " | 8 " | 166 | " | |
| Fire clay | 13 | " | | 179 | " | |
| Slate rock | 4 | " | | 183 | " | |
| Lime rock | 5 | " | | 188 | " | |
| Sand and slate mixed | 8 | " | | 196 | " | |
| Fire clay | 4 | " | 6 " | 200 | " | 6 " |
| Sand and slate mixed | 11 | " | | 211 | " | 6 " |

J. Russell, Driller.

Record furnished by Charles Montague, Caro.

JUNIATA TOWNSHIP.

Sec. 5.

N. E. of N. E.; 130 ft.; rock, 80 ft.; very soft and fresh; A. T. 665.

S. E. of S. E.; 230 ft.; A. T. 668; gas at 114 ft.; after reaching rock the drill went entire depth to bottom through a dry, soft putty-like substance; no water at any point.

S. W. of S. W.; J. Gibson; 84 ft.; rock, 84 ft.; fresh, not very soft; A. T. 670; bored just to rock. A second well here about 500 ft. east, is 90 ft. deep to rock.

Sec. 6.

S. E. of S. W.; P. Gibson; 90 + ft.; rock, about 90 ft.; quite soft and fresh; A. T. 665; used to flow.

Sec. 7.

N. E. of N. W.; G. Schram; 90 ft.; rock, about 90 ft.; fresh and quite soft.; H. 1 ft.; A. T. 665; flows less than formerly.

Sec. 18.

S. W. of N. W.; E. Knight; 176 ft.; rock, 102 ft.; fresh and slightly brackish; A. T. 668; coal reported.

S. E. of S. E.; R. Hall; 157 ft.; rock, 112 ft.; fresh and rather hard; A. T. 673.

Sec. 30.

N. W. of S. W.; J. Wellemyere; 200 ft.; rock, 140 ft.; fresh and soft; A. T. 720.

Sec. 31.

S. W. of S. W.; E. Belknap; 200 ft.; fresh and soft; A. T. 692.

N. W. of N. W.; S. Perkins; 220 ft.; fresh and soft; A. T. 708.

[1] Correlations by A. C. Lane.



DENMARK TOWNSHIP.

Sec. 1.

N. E. of N. W.; L. McCallum; 116 ft.; rock, 100 ft.; fresh and good; head, 3 ft.; A. T. 658; had head of 14 ft. when first put down; flows less than formerly.

N. W. of N. E.; E. Wilson; 172 ft.; no rock; fresh and good; head, 3 ft.; A. T. 660.

S. W. of S. E.; J. Bottimer; 270 ft.; rock, 90 ft.; fresh and soft; A. T. 663; 2nd well of same character on the place.

Sec. 2.

S. W. of S. E.; C. Baker; 200 ft.; slightly brackish; Cl, str., Ca, tr., $SO_4$, tr.; A. T. 655.

S. E. of S. W.; M. DeCoe; 156 ft.; rock, 60 ft.; slightly bitter, fresh and roily; Cl, low, Ca, tr., $SO_4$, low; A. T. 650; used to flow.

S. W. of N. W.; A. E. Pomeroy; 198 ft.; rock, 73 ft.; fresh and good; A. T. 640; hardpan at 78 ft.

Sec. 3.

N. E. of N. E.; 202 ft.; slightly brackish and bitter; Cl, str., Ca, tr., $SO_4$, tr.; A. T. 642.

S. E. of S. E.; J. Sizbury; 96 ft.; rock, 91 ft.; rather hard but fresh; A. T. 645.

S. W. of S. E.; 200 ft.; rock, 90 ft.; fresh and soft; Cl, low, Ca, 0, $SO_4$, tr.; A. T. Used to flow 18 in. above surface, but has to be pumped now.

Sec. 4.

S. W. of N. W.; G. E. Fox; 147 ft.; rock, 80 ft.; brackish, roily; Cl, str., Ca, low, $SO_4$, low; A. T. 633; first shale, then sandstone at bottom; some coal reported.

N. E. of N. W.; C. Thurston; 228 ft.; rock?; brackish and bitter; A. T. 633.

N. E. cor.; 160 ft.; rock, 80 ft.; fresh and good; A. T. 642; rock all shale.

Sec. 5.

S. W. of N. W.; F. Bitner; 148; rock, 80 ft.; not in use; A. T. 612; just completed.

N. W. of N. W.; J. Beyer; 260 ft.; rock, 80 ft.; salty; Cl, str., Ca, low, $SO_4$, low; head, 2 ft.; A. T. 613; small flow; too salty to use unmixed with fresh water.

S. E. of S. W.; D. A. Smith; 208 ft.; rock, 90 ft.; slightly brackish; Cl, str., Ca, low, $SO_4$, low; head, 3 ft.; A. T. 645; water comes from 145 ft.; lower salt water cut off below this.

S. E. of S. E.; H. Humphert; 180 ft.; rock, 180 ft.; fresh and soft; Cl, low, Ca, tr., $SO_4$, tr.; A. T. 638.

N. E. of N. E.; G. W. Ellithorp; 210 ft.; rock, 70 ft.; salty; Cl, str., Ca, low, $SO_4$, low; A. T. 633.

Sec. 6.

S. W. of N. W.; J. Ryan, 100 ft.; slightly bitter; A. T. 615 ft.; water flows into old dug basin.

N. W. of N. W.; J. Webber; 86 ft.; rock, 84 ft.; fresh and soft; Cl, low, Ca, tr., $SO_4$, tr., A. T. 615.

Sec. 7.

S. W. of N. W.; A. Mathews; 80-90 ft.; brackish and slightly bitter; Cl, str., Ca, med., $SO_4$, med.; A. T. 620.

WELLS AT REESE.

Central House Well; 432 ft.; rock, 82 ft.; too salt to use; A. T. 635; used to flow; salt water struck at 121 ft.; affects the surface wells near it to some extent; coal at 117 ft. and 200 ft.; sand rock first struck.

Sec. 7.

R. R. Station Well; 90 ft.; rock, 90 ft.; fresh and soft; Cl, low, Ca, tr., $SO_4$, tr.

Well at Stark hotel, near county line; 165 ft.; rock, 90 ft.; salty; Cl, str., Ca, tr., $SO_4$, tr.; A. T. 643.

DENMARK.

Sec. 8.

N. W. of N. W.; W. Muzzy; 120 ft.; rock, 110 ft. or 115 ft.; slightly brackish; Cl, str., Ca, tr., $SO_4$, tr.; A. T. 645.

N. E. of N. W.; D. Stone; 148 ft.; rock, 100 ft.; brackish; Cl, str., Ca, low, $SO_4$, low; A. T. 645.

S. W. of S. W.; F. Scherum; 156 ft.; brackish and bitter; A. T. 640; water flows into basin and is mixed with surface water.

S. E. of S. W.; G. Roth; 85 ft.; no rock; fresh; A. T. 640; water from gravel; used to flow.

Sec. 9.

S. W. of N. W.; coal test hole; 172 ft.; rock, 84 ft.; A. T. 655.

RECORD.

| | | | | |
|---|---|---|---|---|
| Clay | 73 ft. | | | |
| Hard sand | 1 " | | 74 ft. | |
| Hard pan | 10 " | | 84 " | |
| Gray shale | 3 " | | 87 " | |
| Sandstone | 4 " | | 91 " | |
| Gray shale | 3 " | | 94 " | |
| Slate | 3 " | | 97 " | |
| Fire clay | 3 " | | 100 " | |
| Gray slate | 5 " | | 105 " | |
| Slate | 2 " | | 107 " | |
| Fire clay | 3 " | | 110 " | |
| Sand rock | 9 " | | 119 " | |
| Coal | | 4 in. | 119 " | 4 in. |
| Sandy shale | 8 " | | 127 " | 4 " |
| Hard slate | 9 " | | 136 " | 4 " |
| Sandstone | 8 " | | 144 " | 4 " |
| Slate | 1 " | | 145 " | 4 " |
| Coal | | 5 " | 145 " | 9 " |
| Sandstone | 3 " | | 148 " | 9 " |
| Gray shale | 6 " | | 154 " | 9 " |
| Shale | 1 " | | 155 " | 9 " |
| Coal | | 6 " | 156 " | 3 " |
| Fire clay | 2 " | | 158 " | 3 " |
| Sandstone | 14 " | | 172 " | 3 " |

Peter Mosner, Driller.



S. W. of S. W.; 125 ft.; rock, 85 ft.; head, 10 ft.; brackish; A. T. 650 ft.; water rises to old dug basin and is mixed with surface water.

N. W. of N. W.; T. Randall; 160 ft.; slightly brackish and bitter; Cl, Str., Ca, low, $SO_4$, low; A. T. 640.

S. E. of S. E.; 120 ft.; fresh and good; A. T. 655.

N. E. of N. E.; N. Lewis; 225 ft.; rock, 80 ft.; fresh, soft, slightly bitter; A. T. 650; coal 5 or 6 ft., at about 90 ft.; this does not agree with the test hole record, below.

N. E. ¼; N. Lewis; test well; 196 ft., 10 inches; rock, 80 ft.; A. T. 650.

RECORD.

| | | | | |
|---|---|---|---|---|
| Clay | 71 ft. | | | |
| Sand | 1 " | | 72 ft. | |
| Hardpan | 8 " | | 80 " | |
| Slate | 2 " | | 82 " | |
| Coal | | 6 in. | 82 " | 6 in. |
| Fire clay | 16 " | | 98 " | 6 " |
| Sandstone | 12 " | | 110 " | 6 " |
| Slate | 2 " | | 112 " | 6 " |
| Fire clay | 4 " | | 116 " | 6 " |
| Slate | 4 " | | 120 " | 6 " |
| Fire clay | 4 " | | 124 " | 6 " |
| Gray shale | 3 " | | 127 " | 6 " |
| Slate | 5 " | | 132 " | 6 " |
| Fire clay | 2 " | | 134 " | 6 " |
| Sand rock | 13 " | | 147 " | 6 " |
| Slate | 11 " | | 158 " | 6 " |
| Light gray shale | 7 " | 10 " | 166 " | 4 " |
| Fire clay | 6 " | 6 " | 172 " | 10 " |
| Slate | 20 " | | 192 " | 10 " |
| Fire clay | 2 " | | 194 " | 10 " |
| Sand rock | 2 " | | 196 " | 10 " |

Peter Mosner, Driller.

Sec. 10.

S. W. of S. E.; E. Bauer; 160 ft.; rock, 95 ft.; soft and fresh; A. T. 655.

N. W. of S. W.; T. Gulliver; 125 ft.; soft, fresh and slightly bitter; A. T. 655; passed through 2 veins of coal; sometimes roily.

N. W. of N. W.; E. Griggs; 200 ft.; rock, 84 ft.; soft and fresh; Cl, low, Ca, 0, $SO_4$, tr.; A. T. 650; flows to surface; 70 feet of shale with some coal, below which was sandstone to bottom of well; at 250 ft.; 1 mile east of here salt water was struck in rock well.

N. E. of N. E.; 250 feet.; rock, 83 ft.; soft, fresh, somewhat bitter; A. T. 645.

N. E. of S. E.; 102 ft.; rock, 95 ft.; fresh and good; A. T. 650.

Sec. 11.

S. E. of S. W.; J. Kells; 151 ft.; rock, 85 ft.; soft and fresh; A. T. 657.

N. E. of N. W.; W. Findlay; 130 ft.; slightly brackish and bitter; A. T. 650.

N. W. of N. W.; C. Leonard; 136 ft.; fresh and soft; head, 18 in.; A. T. 648.

Another flow, with no record, across road, same character as above.

Sec. 12.
S. E. of S. W.; R. Alexander; 213 ft.; fresh and somewhat hard; A. T. 672; depth to rock not known.
N. E. of S. E.; C. Reifenberg; 313 ft.; rock, 90 ft.; fresh and soft; A. T. T. 670.
N. W. of N. W.; W. Wilkinson; 250 ft.; rock, 87 ft.; soft and fresh; A. T. 657.
Sec. 13.
N. E. of N. W.; W. Baker; 236 ft.; fresh and soft; A. T. 672; depth to rock unknown.
S. E. of S. W.; J. Booth; over 100 ft.; soft and fresh; A. T. 668.
S. W. of S. W.; C. Thompson; 75 ft.; fresh and somewhat hard; A. T. 665.
N. E. of S. E.; 170 ft.; rock, 102 ft.; fresh and slightly hard; A. T. 665.
Sec. 15.
N. W. of N. W.; H. Greenleaf; 163 ft.; rock, 100 ft.; fresh and soft; Cl, low, Ca, tr., $SO_4$, 0; A. T. 655.
2nd well 500 ft. west; 260 ft.; 94 ft.; fresh and soft; Cl, low, Ca, tr., $SO_4$, 0; A. T. 657.
N. E. Cor.; A. Humbert; 205 ft.; rock, 90 ft.; fresh, with slight bitter taste, and soft; A. T. 655; water from white sandstone below blue soapstone; no coal.
Sec. 16.
S. W. of S. W.; J. Murray; 218 ft.; rock, 93 ft.; slightly brackish and bitter; A. T. 650.
Sec. 17.
N. W. of N. W.; E. Titsworth; 175 ft.; slightly brackish; Cl, str., Ca, low, $SO_4$, low; A. T. 639.
N. E. of N. W.; J. Thompson; 156 ft.; rock, 85 ft.; slightly brackish and bitter; Cl, str., Ca, low, $SO_4$, low; A. T. 640; 4-5 ft. coal on top of rock; well at house struck very hard rock at 93 ft. and was abandoned; water from white sandstone.
2nd well; 85 ft.; no rock; fresh; used to flow; from gravel below clay.
S. W. of S. W.; C. Benton; 200 ft.; rock, 80 ft.; slightly brackish; Cl, tr., Ca, tr., $SO_4$, 0; A. T. 648.
Sec. 18.
N. E. Cor.; J. Veitengruber; 360 ft.; rock, 100 ft.; brackish; Cl, str., Ca, low, $SO_4$, med.; A. T. 638; shut off at 198 ft.
N. E. of S. E.; J. McCary; 175 ft.; rock, 100 ft.; fresh and soft with irony taste; A. T. 648.
Sec. 18.
N. W. ¼; Near Reese; 150 ft. 6 in.; R. 80 ft.; A. T. 637.
2nd test well:



RECORD.

| | | | | |
|---|---|---|---|---|
| Red clay | 12 ft. | | | |
| Blue clay | 66 " | | 78 ft. | |
| Gravel and sand | 2 " | | 80 " | |
| Hard lime or gray rock | 6 " | | 86 " | |
| Soft brown soap rock | 3 " | | 89 " | |
| Hard white chalk rock | 9 " | | 98 " | |
| Soft soap rock | 13 " | | 111 " | |
| Hard white sand rock | 4 " | | 115 " | |
| Quite hard soap rock | 2 " | 6 in. | 117 " | 6 in. |
| Gray flint rock | | 6 " | 118 " | |
| Quite black soap rock | 9 " | | 127 " | |
| Black slate | 2 " | 6 " | 129 " | 6 " |
| White chalk or soap rock | 1 " | | 130 " | 6 " |
| Hard sand rock | 3 " | | 133 " | 6 " |
| White chalk rock | | 6 " | 134 " | |
| Hard sand rock | 3 " | 9 " | 137 " | 9 " |
| Dark slate | | 9 " | 138 " | 6 " |
| Sand rock | 4 " | 6 " | 143 " | |
| Dark slate rock | 2 " | 6 " | 145 " | 6 " |
| Brown slate rock | 5 " | | 150 " | 6 " |

J. Russell, Driller.

N. W. ¼; test well; near Reese; 150 ft. 3 in.; R. 79 ft.; A. T. 635 ft

RECORD.

| | | | | |
|---|---|---|---|---|
| Stiff blue clay | 45 ft. | | | |
| Soft blue clay | 27 " | | 72 ft. | |
| Sand and small sand stone | 7 " | | 79 " | |
| Soft soap rock | 7 " | | 86 " | |
| Harder soap rock | 3 " | | 89 " | |
| Soft soap rock | 14 " | | 103 " | |
| Soft or white chalk rock | 2 " | | 105 " | |
| Sand rock | 1 " | | 106 " | |
| Quite hard slate rock | 1 " | | 107 " | |
| Black soap rock | 4 " | | 111 " | |
| Soft soap rock | 3 " | 6 in. | 114 " | 6 in. |
| Hard slate rock | 1 " | 6 " | 116 " | |
| White soap rock | 1 " | | 117 " | |
| Black soap rock | 4 " | | 121 " | |
| White soap rock | 3 " | | 124 " | |
| Sand rock | 4 " | | 128 " | |
| Coal, 3 or 4 in | | 4 " | 128 " | 4 " |
| Sand rock | 5 " | | 133 " | 4 " |
| Brown soap rock | 9 " | 8 " | 143 " | |
| Gray sand rock | 4 " | | 147 " | |
| Brown soap rock | 3 " | 3 " | 150 " | 3 " |

J. Russell, Driller.

Sec. 19.
S. W. of S. E.; G. Buchinger; (1) 80 ft.; rock, 80 ft.; fresh and good; A. T. 650.
(2) 300 ft.; rock, 80 ft.; brackish and bitter; A. T. 650.
S. E. of S. E.; J. Benton; 310 ft.; rock ?; salty and bitter; Cl, str., Ca, low, $SO_4$, tr.; A. T. 648.
Sec. 20.
S. E. of N. E.; F. Bernthal; 220 ft.; rock, 100 ft.; brackish; Cl, str.; Ca, tr., $SO_4$, 0; A. T. 662; used to flow 2 ft. above surface.
S. W. of S. E.; 110 ft.; no rock; fresh and good; A. T. 649.

Sec. 21.
S. W. of N. W.; J. Bierlein; 200; nearly 100 ft.; to rock; quite brackish; A. T. 662.
Sec. 22.
S. E. of S. E.; J. G. Laux; 173 ft.; rock, 90 ft.; fresh and soft; A. T. 680.
Sec. 24.
S. E. of S. W.; 200 ft.; fresh and soft; Cl, tr., Ca, tr., $SO_4$, tr.; A. T. 692.
S. E. of N. E.; R. Hall; 200 ft.; rock, 70 ft.; soft and fresh; good supply; A. T. 676.
Sec. 27.
S. E. of S. W.; J. Haight; 170 ft.; rock, 90 ft.; fresh and good; A. T. 658.
Sec. 30.
S. E. of S. W.; E. Schultz; about 100 ft.; slightly brackish and bitter; A. T. 650.
Sec. 31.
S. W. of S. W.; 229 ft.; rock, 200 ft.; slightly brackish and bitter; head—25 ft.; A. T. 655; head much lower than formerly, when it was but 4 ft. below the surface; coal reported at 175 ft.; water from just below the coal.
Sec. 32.
N. E. of N. W.; Richville; 202 ft.; rock, 90 ft.; fresh and soft; Cl, low, Ca, tr., $SO_4$, tr.; A. T. 650.
Sec. 34.
N. E. of N. W.; L. Schnell; 270 ft.; rock, 90 ft.; soft and fresh; head,—3 ft.; A. T. 655.
Sec. 35.
N. E. of N. E.; W. Ridgman; 100 ft.; soft and fresh; A. T. 680. Some in rock.
N. W. of N. E.; J. Keinath; 100 ft.; soft and fresh; A. T. 675; water from the bed rock.

DAYTON TOWNSHIP.

Sec. 35.
S. E. of S. E.; R. R. Station; Silverwood; 40 ft.; no rock; fresh and good; H. 2 ft.; A. T. 816; supplies water-tank for Pere Marquette R. R.
Other flowing wells about same character near here, especially to the south in Lapeer county.

FREMONT TOWNSHIP.

S. E. ¼; Mayville town well; 400 ft.; rock, 285 ft.; fresh, soft and good; H.—100 ft.; A. T. 918; never used.

VASSAR TOWNSHIP.

Sec. 5.
S. W. of S. W.; W. Perry; 100 ft.; rock, 45 ft.; fresh and medium soft.; H. 18 in.; A. T. 645; water from hard sandstone; flow affected by dry weather.



WELLS IN VASSAR CITY.

Sec. 7.
Well at Cider Mill; 75 ft.; rock, 45 ft.; soft and fresh; Cl, 0; Ca, 0; $SO_4$ 0; Fe tr.; H. 10 ft.; A. T. 633; flows ½ in. stream; first at 45 ft.; 6 in. second at 65 ft.; larger; from sandstone.
G. Burgess; 239 ft.; rock, 180 ft.; (?); fresh and somewhat hard; Cl, med., Ca, low, $SO_4$ tr.; H. 2 ft.; A. T. 642; 20 rods west of Cider Mill.
(For records of Vassar Water Works Well see p. 238.)
Sec. 18.
N. W. of N. E.; Park well, east of M. C. R. R. and P. M. R. R. crossing, Vassar; about 600 ft.; brackish; Cl, very str., Ca, str., $SO_4$, str.; H. 2 ft.; A. T. 640; flows 2 in. stream into pond.
Sec. 31.
N. W. of N. W.; E. Lourlier; 135 ft.; rock, about 80 ft.; fresh and soft, and has irony flavor; A. T. 665.

TUSCOLA TOWNSHIP.

Sec. 1.
Wells in the northwest part of this section and in the region near by are all dug or bored; or dug 25 or 30 ft. then bored to about 60 ft.; where a vein of water is stuck, which gives a fair supply.
Sec. 2.
S. W. of S. E.; J. Zielliger; 155 ft.; rock, 75 ft.; soft and fresh; H. 30 ft.; A. T. 675; 8 in. of coal reported.
S. E. of S. W.; H. Gohsman; 160 ft.; rock, 75 ft.; soft and fresh; A. T. 675.
N. E. of S. E.; H. Gohsman Sr.; 200 ft.; rock, 180 or 200 ft. (?); fresh but rather hard; A. T. 679.
Sec. 3.
N. E. of N. W.; A. A. Ferrier; 200 ft.; soft and fresh; A. T. 666.
Sec. 4.
N. W. of N. W.; 206 ft.; rock, 90 ft.; fresh and soft; A. T. 662.
Sec. 5.
N. E. of N. E.; J. Winkler; 276 ft.; rock, 90 ft.; A. T. 660.
S. W. of S. E.; G. Enzer; 229 ft.; rock, 108 ft.; fresh, soft, bitter, some iron taste; A. T.. 657.
Sec. 8.
S. E. of S. E.; W. Ash; 175 ft.; soft and fresh; A. T. 665.
N. W. of N. W.; G. Englehardt; 240 ft.; rock, 108 ft.; bitter, soft, fresh; Cl, med., Ca, 0, $SO_4$, 0; A. T. 654.
Sec. 10.
S. W. of S. W.; W. Wood; 120 ft.; fresh and somewhat hard; A. T. 662.
N. W. of S. W.; J. Bierlein; 175 ft.; rock, 90 ft.; fresh, somewhat hard; A. T. 663; good supply.
S. E. of S. E.; G. Bierlein; 160 + ft.; fresh, somewhat hard; A. T. 670.
Sec. 18.
S. E. of S. W.; M. Schmaut; 175 ft.; rock, about 100 ft.; water fresh, but badly contaminated by running into old dug basin; A. T. 676.

Sec. 20.
S. W. of S. E.; J. Bickel; nearly 200 ft.; rock, 75 ft.; slightly brackish; A. T. 673.

Sec. 28.
S. W. of S. E.; J. Bickel; nearly 200 ft.; rock, 75 ft.; slightly brackish and bitter; Cl, str., Ca, low, $SO_4$, low; H. 2 ft.; A. T. 642; good flow.

S. ½; test well for Saginaw Board of Trade; near Tuscola Village; "Test Hole No. 8;" 224 ft.; rock, 47 ft.; no record of water; A. T. 640 ft.

RECORD OF TEST WELL.

| | | | | |
|---|---|---|---|---|
| Surface | 47 ft. | | | |
| Blue shale | 7 " | | 54 ft. | |
| Light gray shale | 2 " | | 56 " | |
| Dark gray shale | 21 " | | 77 " | |
| Sand rock | 122 " | | 199 " | |
| Gray shale with layers of coal | 3 " | | 202 " | |
| Soft fine clay | | 6 in. | 202 " | 6 in. |
| Hard fine clay | 3 " | | 205 " | 6 " |
| Red sandstone with layers of fire clay | 18 " | 6 " | 224 " | |

I. Slanker, Driller.

Sec. 29.
N. W. of N. W.; L. Hart; 200 + ft.; slightly bitter, but scarcely brackish; Cl, str., Ca, low, $SO_4$, low; A. T. 694; in rock last 60 ft.; no water.

Sec. 36.
N. E. of N. E.; About 180 ft.; rock, 80 ft.; somewhat hard, fresh; Cl, 0, Ca, tr., $So_4$ 0; A. T. 667.

MILLINGTON TOWNSHIP.

Sec. 30.
N. W. of S. W.; H. Horning; 100 ft.; rock, 120 ft.; fresh, hard; A. T. 754; water from gravel.

ARBELA TOWNSHIP.

Sec. 6.
N. W. cor.; 167 ft.; slightly brackish, but soft; Cl, str., Ca, tr., $SO_4$ tr.; A. T. 647.

Sec. 10.
S. W. of S. W.; L. D. Haines; 206 ft.; rock, 74 ft.; fresh and good; H.—17 ft.; A. T. 670.

RECORD.

| | | |
|---|---|---|
| Surface | 16 ft. | |
| Quick-sand | 58 " | 74 ft. |
| Gray rock | 3 " | 77 " |
| Slate | 2 " | 79 " |
| Sand rock | 50 " | 129 " |

Then gray slate, gray rock, etc.; stopped in blue slate; water abundant.

Sec. 13.
N. E. of N. E.; C. Bowsen; 56 ft.; no rock, fresh and hard; H. 2 ft.; A. T. 685; small flow from gravel.



Sec. 30.
S. W. of N. W.; S. Nelson; 270 ft.; rock, 210 ft.; A. T. 684; reported by well driller.

INDIANFIELDS TOWNSHIP.

Sec. 3.
Center of section; test well at Caro; 400 ft.; rock, 150 ft.; A. T. 718.

RECORD.

| | | |
|---|---|---|
| Dry sand | 30 ft. | |
| Quick-sand | 40 " | 70 ft. |
| Soft clay | 10 " | 80 " |
| Sand and gravel | 8 " | 88 " |
| Clay and hardpan | 62 " | 150 " |
| Lime rock | 12 " | 162 " |
| Black shale | 23 " | 185 " |
| Light shale | 15 " | 200 " |
| Sand rock | 90 " | 290 " |
| Light slate | 30 " | 320 " |
| Dark slate | 23 " | 343 " |
| Lime and fine sand rock | 35 " | 378 " |
| Hard lime rock | 22 " | 400 " |

Furnished by Charles Montague, Caro.

Sec. 5.
N. E. of N. W.; F. Smith; 250 ft.; rock, 160 ft.; fresh and good; A. T. 725.

N. W. corner; F. Allen; 160 ft.; fresh and soft, good; sandstone quality; A. T. 710.

Sec. 10.
N. W. of N. E.; Peninsula Sugar Refining Co., Caro; 282 ft.; rock, 113 ft.; fresh with "sweetish after-taste;" H. 3 ft.; A. T. 670; 8 in. diameter to bottom; at 275 ft. the well flowed 350,000 gallons, by test, in 24 hours; temp. 47° F.[1]

DRILLERS' RECORD.

| | | |
|---|---|---|
| Drift (sand, gravel, hardpan, boulders) | 113 ft. | |
| Lime | 7 " | 120 ft. |
| Shale (blue or green) | 25 " | 145 " |
| Sandstone | 40 " | 185 " |
| Limestone | 5 " | 190 " |
| Sandstone | 50 " | 240 " |
| Shale (black) | 2 " | 242 " |
| Sandstone | 10 " | 252 " |
| Shale | 1 " | 253 " |
| Sandstone | 29 " | 282 " |

Streaks sandy limestone.

J. J. Mason & Co., Drillers.

[1] See Vol. VIII, Mich. Geol. Survey, Part II, p. 192.

## CHAPTER VIII.

## THE NATIVE VEGETATION OF TUSCOLA COUNTY. NOTES ON THE FACTORS AFFECTING PLANT DISTRIBUTION.

*Introduction.* The study of plants in relation to their environment to determine the effects of the peculiar combinations of the factors encountered by them that influence their growth in the places they inhabit, is a most interesting phase of the science of Botany, and one that has many practical applications. In a limited political area, such as that forming the subject of this series of studies the chief causes for the grouping together of the native plants into the societies in which they are found, are not local, but have their origin in remote regions, or are cosmic, so that it will not be possible to go far into the reasons for the observed facts, from local investigation, even if it were desirable to do so in a discussion of this kind.

It is hoped, however, that the observations recorded will, perhaps, enable some of those who read the report to take up the work where this discussion leaves off and carry it on to a satisfactory conclusion.

On the factors affecting plant life that must be taken into account in considering the distribution of the native plants in Tuscola county, some have already been discussed in the section devoted to the origin of peat, and these will scarcely require more than mention in this place.

The most important of these factors are the complicated resultant of atmospheric and solar forces called climate, the soil, the amount of water in the soil and its permanent position in relation to the surface of the ground, the exposure of the soil to winds and the direct rays of the sun, or what is sometimes termed its aspect, and the amount and length of insolation or exposure to the sun's rays during the growing season.

Under climate are included the daily and average temperatures of the air, precipitation of meteoric water, the amount of cloudiness and the force and direction of the winds, in fact the sum of all these external and atmospheric phenomena which, taken day by day, we call weather.

*Temperature.* In another place will be found the records of weather observations made within the limits of the county, while records of temperature observations made at Bay City and Saginaw have been published by Cooper[1] and Lane[2] in previous reports of this Survey. These show that the average annual temperature at Bay City for the period covered by the record, 1896-1903 inclusive, was 46.3° F., that July is the warmest month and February the coldest, of the mean year with an average temperature of 71.1° F. for the former and 20.4° F. for the latter; the growing season is from early May to late September or early October, varying from year to year, this period being measured from the last killing frost in the spring to the first one in the fall. It is largely the temperatures of this growing season which have effect

[1] Cooper, W. F., Report on Bay county, Mich. Geol. Surv., Ann. Report, 1905, pp. 356-358.
[2] Lane, A. C., Report on Huron county, Mich. Geol. Surv., Vol. VII, Part 2.



in controlling the distribution of plants, as while they are dormant, even very severe freezing does little injury to many species which would be killed by moderately low temperatures when they are active. For this reason localities subject to very late or very early freezing, or to summer frosts, are occupied by frost-resistant or northern species, while the more frost sensitive kinds are confined to sheltered areas, or to districts which are visited by hard frosts only during the dormant, or resting period of the plants.

The depth and kind of soil, the form of the land surface, the exposure to certain kinds of winds, and nearness to large bodies of water tend to locally modify the air temperatures in a given district, so as to produce local, unseasonable frosts, and also to give exemption from them. Thus shallow and sandy soil, while usually warmed up quickly during the day radiate heat more rapidly at night than clay, and killing frosts may occur on sandy land, when surrounding clay lands escape entirely. It is also a well known fact that cold air flows down hill and accumulates in depressions often causing them to become filled with mist or fog on warm still nights in summer, when the air in the hollows is full of moisture, which the cold condenses by lowering the water holding capacity of the air. Depressions without good air drainage are often the coldest spots in a given region and for this reason often support "islands" of northern plants, in a sea of more southern species, which are kept from overflowing the "island" chiefly because of summer frosts. On the other hand, ridges or hills, unless very high, are not subject to such frosts and rarely support northern plants except where the soil is very thin, and underlain by rock, or is very sandy, when apparently nocturnal radiation and dryness together produce a cold environment.

*Temperature effects of Saginaw Bay.* Water absorbs heat from and gives it back to the air very slowly, hence it is usually cooler than the air above it in the spring and early summer, and warmer in the fall and winter; therefore the air flowing over large bodies of water has its temperature modified to such an extent that it exerts a considerable influence in equalizing the temperature of the adjacent land masses over which it passes after leaving the water. Thus the great general air currents or winds of the northern hemisphere of the earth are from west to east, and in passing over the oceans, these currents are warmed and give the western coasts of the continents a considerably milder and more uniform climate than is possessed by the eastern ones of the same continents in the same latitudes.

In less degree smaller bodies of water have a similar effect, and the records from year to year show that the western part of Michigan has a considerably milder winter climate than eastern Wisconsin, and a cooler summer temperature, because the cold winter winds from the west and northwest are warmed and the hot southwest ones of July and August are cooled to an appreciable extent in their passage across Lake Michigan.

To a much less extent the small area of water in Saginaw Bay must have modifying effects on the parts of Tuscola county that are near it, although since the water is frozen over for the greater part of the winter, the effects are most manifest in late summer and in the

fall when the season of frosts is probably somewhat postponed in the vicinity of the Bay, because of the nearness of this body of water. The direct effect of such modification or prolongation of the growing season would be to make the district over which it extends habitable to plants of more southern range than could otherwise exist in it. Such an effect apparently may be seen in the extension northward along the western shores of Michigan of a considerable number of species of plants of distinctly more southern distribution than those found a few miles inland in the same latitude, and in a like manner the "prairie" flora of the area immediately adjacent to the marshes of Saginaw Bay is far to the north of any similar group of plants known to exist in the region, and it seems more than probable that the modifying effects of the Bay are responsible for this extension of range.

Cooper's[1] observations, while covering but a short period, and made on the west side of the Bay, indicate quite clearly the general summer condition of the relations of land and water temperatures; the effects noted by him doubtless would be emphasized on the eastern shore, as the prevailing winds are westerly, and air currents have their temperature more or less modified by passing across the Bay.

*Effects of exposure, or aspect, on temperature.* The main ridges in Tuscola county run generally northeast and southwest, which makes them face the northwest and southeast. Their low altitude and gentle slopes make the effects of the direction which the slopes face of minor importance although it is probable, even under the existing feeble character of these factors, that careful observation would show that the average temperature was higher during the growing season on the southeastern side of the ridges than on the northwestern, and that this would be reflected in a slight difference in the flora of the two sides. The effect would be indicated in a practical way, now that the greater part of the land is under cultivation, by the somewhat earlier dates at which crops can be planted on the southeast aspect, as compared with the other, while in the fall the cold northwesters shorten the season on the slopes which are fully exposed to their biting touch. These effects were probably reflected to some extent in the native vegetation, but if they were, the records are now practically all gone.

*Precipitation.* The rainfall of the region is generally ample for the needs of most kinds of plants that grow in it, and averages not far from 32 inches, quite evenly distributed throughout the year. There are, however, here, as elsewhere in the region of the Great Lakes periods of several years at a time when the rainfall is less than the average by several inches, and at such times the soil in the sandier districts becomes very dry and only the most drought-resistant or xerophytic plants are able to persist. Such dry times are uncommon, however, and generally the amount of rain and snow falling through the year was enough to make the region in its primitive condition a well-watered one and capable of supporting on most kinds of soil a dense, or at least fairly good, growth of vegetation.

During the growing season there is an abundance of sunshine for all of the needs of plant life. The relation of light to growing vegetation is so well known as to need but little consideration here; it may be

[1] Cooper, W. F., op. cit., pp. 358-363.



said that many kinds of plants are now so used to growing in the shade of taller kinds that they are confined to such places as are partly shaded, while others must have full light, and they soon become enfeebled and finally die when over shaded. All gradations of types of plants are found from those which only grow where they receive the full light of the sun, to those which are always found in the shade of other plants; but the number of kinds which will grow in the deepest shade is few compared with that found only in the open.

*Soil.* The influence of soil on the distribution of trees and other plants is a very marked one, and is exerted in several ways, the most important of which are the following:

(1). The capacity of the soil to hold water. This in turn is governed by the depth of the soil, by the coarseness and uniformity in size of the grains of mineral matter which it contains, and by the character, uniformity and compactness of the subsoil.

(2). The kinds of mineral matter which are abundant in the soil, and whether these are beneficial or injurious to plants.

(3). The degree to which the rock particles composing the soil are broken up so that they hold the water in contact with them and permit enough of the minerals which they contain, and which are essential to the growth of plants, to be dissolved and taken by the vegetation as it is needed.

(4). The relation of the ground water level, or the top of the zone of permanent ground water, to the surface of the soil is also of great importance, and the position of this is largely determined by the size and shape of the soil particles and their relation, or position with regard to each other. Thus in deep, sandy soils the ground water surface is generally far below the surface of the soil, while in clay, or fine silty soils it may be just below the top of the ground. In the sandy soil the spaces between the grains are large and the size of the grains is also relatively uniform and large, so that the water falling as rain on the surface is quickly absorbed and usually sinks as quickly down into the deep layers of the ground out of the reach of the roots of plants. In times of drought, the water level in such soils is lowered still farther, and, air filling the interstices gives still greater dryness to the soil.

In clayey soils not only are the grains of mineral matter of uniformly small size, but the spaces between them are correspondingly small so that water neither penetrates nor flows through them as readily as it does through the sand. The result is that such soils retain water in quantity near the surface of the ground and are commonly much less affected by subsidence of the level of the ground water during droughts. If, however, air once gets into clay soils in abundance it remains much more stubbornly than in sandy soils, and may prevent to a considerable extent the entrance of water from above when rains begin again.

Since the interspaces of the soil are practically continuous, they form capillary tubes through which the soil water rises from below, as it is evaporated from the surface, and as water rises much farther by the force of capillarity in small tubes than in larger ones, the fine grained soils are much moister from this cause than coarser ones; a factor which gives vegetation growing on clay soils a large supply of available

water long after that which can be used by plants located on sandy soils is entirely unavailable.

*Effect of elevation and relief.* The mean elevation of Lake Huron is not far from 581 feet above the average or mean tidal level of the Atlantic Ocean, and at no point in Tuscola county is the surface of the land much over 400 feet higher than the lake level, since in but a few small areas in the southeastern part of the county is the elevation of 1,000 feet above sea level reached, while the average elevation is probably less than 100 feet above the lake or below 700 feet above tide.

The primary effects of elevation are to reduce the temperature of the air as higher altitudes are reached, and by careful comparison of many observations it is known that the average temperature of the air decreases one degree Fahrenheit for each 300 feet, approximately, in elevation as one goes from the sea level upward. Hence the total average elevation of the county above the sea level is not enough to produce effects on its temperature that would be significant.

The principal prominent relief features of the county are the two morainal ridges on either side of the Cass valley, running nearly northeast and southwest. Between these is the shallow valley now occupied by the Cass river, and to the west of the lower ridge is the broad, gently sloping plain, extending to Saginaw Bay, with very insignificant and scarcely noticeable breaks in the form of slight ridges or undulations and very shallow stream valleys. None of those relief features give sufficient differences in altitude to cause any marked variations in average temperature during the year, as already shown and if they were all composed of a uniform type of soil they would affect the distribution of the plants growing on them but little, except so far as they controlled the movements of the surface water.

*Distribution of soils in relation to plant distribution.* They are not uniform in their soils, however, as is apparent when the chapter on the soils of the county is consulted, or the following brief resumé is examined. The dominant soils of the morainal ridges on either side of the Cass river valley are typically a stoney or gravelly loam, in places nearly pure gravel, in others more nearly true clay. In the valley between these ridges are great tracts of sand or light sandy loam, while across it run low, irregular ridges of light, fine grained sand, or well sorted gravels, the wind and wave formed dune and beach lines marking former levels of the water of lakes which preceded Lake Huron.

The same types of ridges of sorted soils occur in numbers on the plain between the western ridge, the Saginaw-Port Huron moraine, and the bay, but here the surrounding soil is principally clayey loam or near Saginaw Bay nearly pure clay, although stones scattered through it gave indications of its glacial origin. Parts of this plain, where for any reason the drainage is poor, are covered by shallow layers of organic matter, muck or peat, and over quite extensive areas the soil was formerly of this character. Smaller tracts of the same sort are found scattered in the valley of the Cass river and to the south of the moraine forming its eastern border.

These differences in soil constitute the most strikingly variable features of the environment of plants that may be found in this county and they are still farther accentuated by the differences in surface drainage and in the downward percolation of water, which are to be considered with them as making the important and significant differences of plant habitat. Thus sandy soils on steep slopes, or of considerable depths, make dryer conditions for plants to overcome than loams or clays under the same conditions, because the water penetrates them more quickly than it will other kinds and to greater depths; the sand is of such coarse texture that it absorbs the rainfall rapidly and permits it to sink so far below the surface that its permanent level may be beyond the reach of even the deepest rooted plants.



In general it is true that the ground water level or surface of the zone of saturation in the soil follows the irregularities of the surface of the ground, but its contours are flatter, and its slopes more gentle than those of the soil itself, so that while the ground water level is higher under the crest of even a narrow ridge than it is in the adjacent plains it is not proportionately high when the altitude of the ridge is compared with that of the plains, and it will generally be found that permanent ground water is considerably farther from the surface on the crest of the ridge than it is on the adjoining low land. If the ridge is of sand or gravel, moreover, the difference is much more marked than where it is of clay or glacial till. It thus happens that the ridges are not only dryer than the plains because the water in them is normally farther from the surface, even when the soils are the same on both ridges and plains. On the other hand a plain of deep sand may be more arid than a ridge of clayey loam, which, while it does not absorb water so quickly as the sand, retains it near the surface longer because percolation takes place in it more slowly.

Since water is of paramount importance to all plants, and without it they either cease to grow and become dormant, or die, and also since practically the whole flora of the temperate regions of the earth gets the water necessary for its existence from the soils which support it, it seems clear that those soils which are best watered should support the greater number of plants, both of species and individuals, provided that it is understood that, with the abundance of water there is enough air supplied the roots to keep them healthy and vigorous, enough of the essential mineral foods for healthy growth, and no substances that are poisonous dissolved in the water. The most favorable soil condition seems to be that which enables plants to get all the water they require, but does not permit the saturation of the zone in which their roots spread out. This is expressed in another way by the statement that those soils in which the ground water level is very far from the surface of the ground, or very near or at it, are unfavorable for the growth of most kinds of plants.

It must also be considered that almost daily our knowledge of the interdependence of the more highly organized plants and of the lowest types is being extended, and that in most very wet or very dry soils the bacteria and similar plant organisms find unfavorable conditions and are few in numbers, and it is not improbable that the absence of such forms in places of these kinds may, in some degree, account for their apparent sterility, the higher kinds of plants being absent because the low ones on which they depend for the preparation of parts of their food, are unable to exist there. Whether this is so or not, more species

and individual plants flourish on the moist, well-drained loamy soils, than on any other kind. Moreover the plants of the given region can be classified according to their normal relation to the soils, and especially to the ground water level in the soils, as: (1) Hydrophytes, or water plants; those whose roots, and even their stems and leaves grow normally below the water level and which seem to require, or at least tolerate, an excess of water about their roots and other vegetative organs. (2) Mesophytes, or intermediate plants; those requiring a well watered, but not too wet, soil, and whose roots are usually, if not invariably, found above the ground water level, but do not thrive far from it. (3) Xerophytes, or drought plants; those which are capable of getting along with small amounts of water and can flourish where the ground water level is far below the surface, in arid climates, in dry places, or during times of little rainfall.

As in other cases in nature, however, these lines of differentiation are not drawn as sharply as would be desirable for convenience in classifying, for as every gradation of habitat is found between water of the maximum depth to which the light can penetrate to enable plants to grow, and soil so shallow that it is very dry the greater part of the time, or sand so coarse and deep that little water stays near enough to the surface to be within the reach of plants, so plants are found that will grow in each of the great variety of conditions thus presented, and many kinds are known that can not be closely brought into either of the three great groups mentioned, but more properly might be classed as intermediate between two of them.

Generally speaking, however, the vegetation of moist climates which grows on sand dunes, and on deep sandy soils, or on very thin ones underlain by rock or impervious subsoils, and in regions of small rainfall, that growing in any kind of soil, is properly classed with the xerophytes, and on examination will be found to be provided with some of many devices to protect it from loss of water, or to enable it to gather water from wide areas, or even to store water in times of plenty, against the periods of less abundance.

In the area under consideration the dryest soil conditions are found on the sandy soils and especially on the exposed tops of some of the sand ridges which are of too recent formation to be covered and protected by trees and other enduring types of vegetation.

The conditions favoring the growth of mesophytes were found most often on the loamy soils of the slopes of the ridges and on the better drained parts of the plains where the soils were not so fine grained that swamp conditions developed from lack of downward percolation and surface drainage. Habitats suitable for the growth of aquatic types of hydrophytes were found in the river and other permanent streams, in the numerous ditches in which water stood during long periods, in the ponds and lakes scattered in various townships, and, on a much greater scale, in the shallow water of Saginaw Bay adjacent to the western shores of the county. The hydrophytes of the marsh and shallow water types were also found widely distributed over the county but were most noticeable in the western part of the county in Akron and Wisner townships, in the so-called prairie district, where there were formerly many hundreds of acres of nearly treeless, flat, marsh land, most of



which was very wet throughout the growing season. The region is well named prairie because of the flatness and the absence of any heavy tree growth.

This district is rarely more than three miles wide, is bordered on the side toward the bay by low sand dunes bearing a sparse growth of trees, and on the landward side by a dense forest of tall, old, hardwood trees, while scattered over it are low sandy islands which are sometimes several acres in area, and often but a small fraction of an acre, but arranged in lines which run somewhat irregularly parallel the shore of the bay. The water level on the prairies was so near the surface the greater part of the time that marsh conditions prevailed over the greater part of them and they are still often wet enough to be termed marshes, although drainage has been provided by an extensive system of artificial drains.

At this point attention may again be called to the fact that a most notable feature of the surface deposits, the soils, of the county is the arrangement of different soil types into a series of long narrow strips, often very sharply defined, extending side by side in such a way that their long axes run in a northeasterly and southwesterly direction parallel to the shore of Saginaw Bay and to the higher morainal ridges. In these strips will be found many types of soil, from coarse bouldery gravel to fine clay, and from dry, barren, porous sands through rich, black loams, high in organic matter and mineral plant food, to wet clay and the pure organic soils, built up by the growth and decay of generations of plants in places too wet to permit thorough oxidation and destruction of vegetable matter.

This peculiar arrangement of the different soils in strips and ridges across the normal slope of the land affected the drainage materially by creating swamp conditions between low ridges of porous soils, and often made the ground water level in more permeable types of soil higher than it would have been under other conditions, and gave to them a better vegetation than they should have had from purely theoretical considerations.

Before its settlement the whole region, except the low-lying prairies already mentioned, was heavily timbered. A dense forest of elm, black ash, soft maple, with some sycamore, swamp oak, white ash, basswood and other water tolerant trees, occupied the heavy undrained, or poorly drained clay soils adjoining the prairie region near the bay and extended inland nearly to the foot of the Saginaw-Port Huron moraine. This type of forest is still poorly represented by several tracts reserved for wood lots and by large ones which occupy swamps that are still undrained and uncleared. It is characterized by the large size of the white elms growing on the wet soil and by the sparseness of undergrowth and herbaceous plants growing beneath the dense shade of the trees. This may be termed the broad leaved swamp forest, and was the most impressive as it was apparently the most extensively represented type of plant association found within the limits of the county.

Penetrating this type of forest on the ridges and in such places as the soil drainage was good, as on the strips of sandy loam crossing the higher parts of the swamps, as well as occupying the greater part of

the higher morainal ridges, was the beech and maple forest, the beech often dominant, or associated with elms, bur and red oaks on the moister areas, and the hard maples more numerous on the dryer ones.

In general, however, these two species were found in quite uniform mixture and with their associates, the basswood and hop hornbeam or ironwood, made a type of forest distinct from that of the swamps, and which formed the broad leaved forest of the moist uplands, or the mesophytic forest.

Where the coarser soil constituents, such as sands and gravels appeared in the areas occupied by this type of forest, it became mixed with white and black oak, or more frequently with white pine, which became the dominant tree when the sandy elements of the soil were present in excess. The great body of the pine forest disappeared before the ax of the lumbermen before the county was thoroughly settled, and now but few small groves remain. On many of the old beach ridges and dune lines at the time the region was examined were to be seen the still undecayed stumps left by the lumbermen, the sole reminder of the great forest which formerly covered the land.

While there is probably not a township in the county where some white pines did not grow, so thoroughly distributed throughout the region are the soils suitable for its growth, the sandy plains and ridges which cover the townships in the Cass valley, supported a pure white pine forest, which was the nearest approach to a xerophytic coniferous forest occurring in the region.

The other forest types occurred over more limited areas, the swamp coniferous type, represented by relatively small tracts of tamarack, arbor vitae and black spruce which were found here and there in springy or very poorly drained places, such as wet swamps and the margins of lakes. The tamarack was most often found and in the largest tracts, while the spruce was noted but once or twice in the central part of the county in morainal depressions. The arbor vitae or white cedar formed nearly pure growth along one of the older beach lines from which a large number of springs issued, and in other places around small lakes. It was of frequent occurrence also as undergrowth in swampy wood lots in the vicinity of the prairies, most of the individuals observed in such places being but a few feet high and evidently but recently established, although some old trees were still left. The last distinct type of forest to be considered was that in which oaks were dominant, the xerophytic, broad-leaved forest. The best examples of continuous forest of this type were found in western Watertown and southern Dayton townships and were made up chiefly of small trees which had established themselves on cut-over pine lands. The type may never have been able to maintain itself in competition with the white pine and form the forest cover over extensive areas in this region as it does in the southern part of the state. Oak groves were common on the dunes along the bay and on the larger "islands" of sand and gravel on the prairies but these were too small in area to give forest conditions.

On the cut-over and burned pine lands was a dense growth of shrubs and a lighter one of small oaks and poplars, but these were not of sufficient density or size to be considered forests.



As has been pointed out, the forest types are now represented by rapidly decreasing and much mutilated remnants of the original woods and at the present rate of cutting it will be only the matter of a few years before even these remnants will have vanished.

The second great type of plant associations represented in Tuscola county is that found on the prairies, and is essentially a meadow, or grass-land type, as the dominant plant forms are all grass-like, herbaceous, with marked slender stems, and long narrow leaves. The plants of these associations are characteristically turf formers, spreading from point to point in their habitat by means of long, tough, fibrous, horizontal underground stems, which interlace and mat together, and together with the roots that grow from them, form a dense firm structure that entirely covers the ground. The aerial parts of the plants, both stems and leaves, die down to the ground at the end of each season's growth, and by disintegration and partial decay, are added to the soil. This they enrich, and at the same time increase its water holding power by adding humus and by forming a protecting cover that prevents evaporation, thus tending to keep wet soil wetter than it would be if without such protection. In the region under consideration such a type of vegetation indicates either very wet or very dry soil conditions, that is, the soil is either too wet to permit trees to grow, or so dry that they are unable to establish themselves, and in this prairie district the high ground water level and the frequent spring overflows made the habitat a very wet one.

Several causes may have combined to prevent trees from invading the prairies but the paramount influence was undoubtedly water, because the forest came down to a perfectly clear sharp border of tall old trees to the edge of the grass land with no zone of scattered trees and of young trees intervening. Shrubs grew under the shade and about the roots of the trees along the border, but they too did not invade the marsh. The limit of the tree growth seemed to be marked by the upper limit of the winter and spring floods. It seems probable that these floods acted as the controlling factor to prevent the growth of the trees on the prairies by drowning such seedlings as appeared and by destroying the seeds which must have found their way to them in great numbers during spring and fall, for as is well known, several of our forest trees mature their seeds before putting out their leaves.

The conclusion that the high water of winter and spring was the important agent in inhibiting tree growth is strengthened by observations made before the ditching of the prairies had proceeded far, and again five years after the main drains across them had been completed. In 1897 there were few shrubs, and no young trees along the borders of the prairies, and only here and there a shrub in the open parts, but in 1902, shrubs had appeared in numbers not only on the borders of the woods but were abundantly scattered over the prairies, and considerable tracts of the most open parts had become covered with dense thickets of young poplars and willows, the pioneer trees largely because of the fact that their downy, light seeds are borne far and wide by the winds at the season when soil, moisture and temperature conditions are most favorable, that is, the spring. At the same time these notes were made, it was observed that in the parts of the prairies adjacent

to the forest border, great numbers of young seedling trees of the kinds most abundant in the woods, elms, ashes and similar species, had started up and formed a well marked zone several hundred feet wide along the margins of the woods.

There were several types of habitat on the prairies despite the fact that to casual observation they presented a dead level and an exceedingly monotonous surface. This came about from the genetic history of the area, which may be briefly outlined here, as it has a clearly defined bearing on the distribution of the plants growing on the area, as well as explains the variations in the kinds of habitat mentioned. These flat areas were formerly bay bottom and have been recovered from the bay by natural processes, among the most important of which may be mentioned: (1) the cutting down of old, or opening new channels for the outlet of the lake; (2) the deposition of material in the bay by the streams flowing into it, and the accumulation of this in the shallows by the action of wind and wave formed currents; and (3) the action of plants and the formation of deposits from their remains.

The irregularities in soil structure and composition, reflected and indicated by the plants now growing on the prairies doubtless came about somewhat in the following way:

At some distance from the existing shore, waves and currents formed a submerged reef of sand. The same forces built the reef to the surface and the winds then took hold of the work, and, aided by stranded drift material, built it higher. As the height was increased, the other dimensions were also added to. After a time the little island thus formed would be connected with the main shore, and perhaps form a sand point or spit by landward extension, and the enclosed bay thus cut off from the main body of water would relatively soon fill up with sand and finer debris that would sink to the bottom in the quiet water under the protection of the point. Before very long the water would become shallow enough to favor germination of seeds and the growth of plants and these, ever ready to occupy new ground, would establish themselves and greatly aid in the filling of the bay by their own growth and decay, and by entangling and holding such suspended matter as is brought to them by waves and currents; they would also act to retard the water movements and would thus diminish its carrying power and in this way deposition of transported sediments would be favored. That such action actually occurs can be demonstrated by the examination of any mass of plants growing in moving water.

Through such agencies the small bay assumed to be formed above would, in time, become a wet marsh, and as vegetable debris accumulates rapidly in such places, and other conditions are favorable, peat would quickly form and the wet marsh would become a dry one. In places in the bay more exposed to winds and to consequent wave action, and bars and sand flats would form where inequalities of the bottom favored, and when these were appearing above the surface, either by being built up or by recession of the water, even when they were covered by plants, but little or no peat would be formed, because the porous character of the soil permitted rapid draining away of the water and dessication of the surface.

Even if the supposed bar did not connect with the main land, or



if, as is often the case, the bar began to build at the shore behind some point, the results of the protection afforded the space behind it are the same, and shoaling will inevitably follow behind it, so that if a supply of sand and other suspended material is constantly available, parts of the shores of any body of water are likely to develop such deposits as those described, their extent depending on factors which need not be discussed here, but among them vegetation is important, both because it mechanically hastens sedimentation and also contributes directly to all deposits.

If added to these actively constructive agencies, we have the slow subsidence of the water level, or periods of more sudden lowering the outlet, or even a long period of diminished rainfall producing temporary lowering of the water level and attendant active building by the plants, it is apparent that parts of the bottom of the lake affected by these agencies will become reclaimed and made into land.

As the result of the combined action of these agencies, there may be differentiated three kinds of habitat in the prairies that correspond to three soil types with the following general distribution: (1) Black vegetable accumulations of variable depth and underlain by clay or clayey gravel and forming the greater part of the prairie soil. (2) Broad, more or less extensive tracts of sand, or sandy loam, slightly higher than the general level, but usually not more than two or three feet above the general level and often not exceeding 1 foot. (3) Ridges of light sand, often continuous for considerable distances, and varying from a few inches to three or four feet in height above the general level, and rarely more than a few rods in width. These ridges are often discontinuous and sometimes two will join, but more frequently they are roughly parallel with each other and with the dunes of the present bay shore.

These sandy strips often have small groves of trees upon them and form the "islands" in the prairies. In the light of the history just discussed, they evidently represent dune and sand spit, or temporary shore lines of the days of former bay occupation, at the time when the areas of sandy loam were shallows and submerged bars, and the peat and black soils were the deeper places that were filled up by the growth and partial decay of generations of plants.

The main and most positive evidence that these different types of habitat are really unlike, must be gathered from the study of the plants growing in them, and no amount of theorizing will convince an observer that such conditions as they present are efficient in limiting the growth of plants, if he finds upon careful study that the same plants, in about the same relative numbers and in the same grouping with regard to each other are found on all of the soils and over all types of surface formations that have been described.

With this point in mind, and in spite of the fact that it is common knowledge, widely spread in the agricultural regions of Michigan, that the kind of timber growing on a piece of land is good indication of its fertility and general quality, the writer made a few studies of the plant associations found on typical soil areas in portions of the western side of the county. It was the original plan to continue this work to include all of the important soil types throughout the county in this

examination, but this plan could not be carried out; the results here given are furthermore incomplete because they give only those plants that are practically permanently present in the localities visited including the more enduring perennial herbs, the shrubs, and the trees, while many of the annual plants and those whose activities are limited to the spring and early summer are not noted because the work was done in the late summer and fall.

The method of making the notes was simple, consisting in reporting in the briefest possible manner the names of the species of plants seen in the tract visited, their relative abundance, their relations to each other, and their location with regard to light and shade. Care was taken to select such places as furnished the nearest approach to the natural conditions that could be found, but in all but a few of the places visited there was abundant evidence of the removal of timber, of pasturing or of fires, and on the prairie of the disturbance of the relation of the ground water level to the surface of the ground by ditching.

In spite of the fact that it was evident that all of these factors of destruction of the primitive conditions had been operative in most cases for some time when these studies were made, there was no good evidence in the sites selected for study of any very considerable disturbance in the balance established between the significant plants. Even if no allowance is made for these disturbances, the records show that there is a marked difference in the dominant or leading species of plants to be found on the different kinds of soil, and that the accompanying species are also usually different.

What can not be expressed in a report of this character is also true, namely, that often where the same species are present in a given association of plants, the numbers of individuals in the two associations will be so very unlike that the type of the association and its significance will be quite different. For example the arbor vitae, *Thuya occidentalis*, L., and white elm, *Ulmus Americana*, L. may grow together in the same habitat; in one case the conifer forming the major part of the tree growth with the deciduous tree growing isolated here and there on the margin of the area; in the other, as was sometimes the case in Akron township, the elm would be the characterizing species, forming a forest of tall, large trees, while the arbor vitae appeared as scattered undergrowth.

Another feature of the study of the plant associations should not be overlooked, namely, that in examining them the fact that none of them is more permanent than the conditions which brought it into being is constantly enforced on the attention. This is manifested in many ways, but in no place so clearly as on the prairies, where conditions were rapidly changing because of man's interference in draining out the water from the soil, and where the record of significant change in the plant associations would naturally be so conspicuously recorded. Attention is called to this in other places, however, and only mention need to be made of it here. Another feature of scientific interest to which the records of the plant associations call attention, is the fact that the sand ridges nearest the bay have simpler plant associations with fewer species than those more remote and that even the same ridge, if it is not so accessible to a varied flora in one part as another, will have a larger



number of species on the most accessible part than on that farther away. This is especially well shown in the list of species found on the outer dune line at Fish Point, as compared with that 3 miles farther south, where the islands bring the forest flora much nearer the shore.

With these preliminary remarks the following typical plant associations are presented:

*Mesophytic type of forest.* A beech and maple woodlot in Almer township. This area was somewhat disturbed by the removal of some of the older trees for timber and firewood, and by having from time to time served for pasture. The damage done by cattle was not large, however, as the number pastured had evidently been small in proportion to the amount of food available and many parts of the area were in practically an undisturbed condition. The removal of some of the large trees had had the effect of encouraging the reproduction of some species by giving an abundance of light and young trees were more numerous and more vigorous than in the undisturbed forest.

The dominant species were the hard maple, *Acer saccharinum*, Wang., beech, *Fagus ferruginea*, Ait., white pine, *Pinus Strobus*, L., American elm, *Ulmus Americana*, L., black cherry, *Prunus serotina*, Ehrh., hop hornbeam, *Ostrya Virginica*, Willd., basswood, *Tilia Americana*, L., hemlock, *Tsuga Canadensis*, Carr., and white birch, *Betula papyrifera*, Marshall. The old trees were chiefly maples and beeches, but mixed with them there were a few tall, old white pines, three feet or more in diameter four feet from the ground, and numbers of stumps of the same species. A freshly cut stump of this species, cut off three feet from the ground was 33 inches in diameter inside the bark, and had 120 rings, outside of a hollow 1½ inches wide in the center, so that the age of the tree was not far from 150 years when it was cut two or three years before. In open spots were large numbers of young pines which, however, formed dense clumps even in the shade of the maples. These young trees were 20 to 30 feet high and were making good growth in spite of the shade. With them were also young hemlocks and, in places where the conifers were not too dense, very numerous young hard maples, while young beeches were rather infrequent.

Seedlings of the white oak, *Quercus alba*, L., white ash, *Fraxinus Americana*, L., red maple, *Acer rubrum* L., and more rarely of the red oak, *Quercus rubra* L., and of the swamp white oak, *Quercus bicolor*, Willd. were also seen occasionally.

Associated with these forest trees were many lesser plants, shrubs and herbs, most of them characterized by their broad thin leaves, and spreading branches which may be considered as adaptations to suit the plants to the dim light under the canopy of the dense crowns of the broad leaved trees. Some of the most common of these shade loving species were the mandrake, or May apple, *Podophyllum peltatum*, L., wild sarsaparilla, *Aralia nudicaulis*, L., sweet cicely, *Osmorrhiza brevistylis*, DC., wild geranium, *Geranium maculatum*, L., early meadow rue, *Thalictrum dioicum*, L., partridge berry, *Mitchella repens*, L., wild liquorice, *Galium circaezans*, Michx., Hepatica, *Hepatica acutiloba*, DC., sweet-scented bed-straw, *Galium triflorum*, Michx., bloodroot, *Sanguinaria Canadensis*, L., golden rod, *Solidago latifolia*, L., wild ginger, *Asarum Canadensis*, L., small wild strawberry, *Fragaria*

*vesca*, L., avens, *Geum album*, Gmelin., small enchanter's nightshade, *Circaea alpina*, L., white snakeroot, *Eupatorium ageratoides*, L.f. common blue violet, *Viola palmata*, L., var. *cucullata*, Gray, wild lily of the valley, *Maianthemum Canadensis*, Desf., sedges, *Carex communis*, Bailey, *Carex gracillima*, Schwein. A few shrubby plants were also growing in the woodlot, but some of these were clearly just beginning to occupy the small clearings and open spots. The most abundant species were the thorns, *Crataegus Spp.*, the red raspberry, *Rubus strigosus*, Michx., which were numerous in open spots, the elderberry, *Sambucus Canadensis*, L., was found as seedling plants near the paths, while another shrub, the leatherwood, *Dirca palustris*, L., grew in the deeper shadows. The Virginia creeper, *Ampelopsis quinquefolia*, Michx., was a representative of the climbing plants, that by the aid of their short tendrils are able to climb into the tops of the trees and there spread their leaves in better light than was available on the ground below. Several ferns, characteristic plants of the mesophytic forest associations grew in profusion in the moist rich shaded soil, and included the maidenhair fern, *Adiantum pedatum*, L., the Christmas fern, *Aspidium achrostichoides*, Swartz., the crested shield fern, *Aspidium cristatum*, Sw., the spinulose wood fern, *Aspidium spinulosum* Swartz, the sensitive fern, *Onoclea sensibilis*, L., the common brake, *Pteris aquilina*, L., and the rattlesnake fern, *Botrychium Virginianum*, Swartz.

One other flowering plant grew here that merits special notice, since it was one of the peculiar degenerate plants that had lost the green leaves and with them the power of carbon assimilation possessed by most plants and was parasitic on the roots of the beech. This was the peculiar brownish beech drops or cancer root, *Epiphegus Virginiana*, Bart., which could grow in abundance in the densest shade of the beeches, because it had no need for light.

The soil in which this association of plants grew was clayey loam which was covered in undisturbed places with a two-inch layer of black humus, on top of which, to further add to its water-holding power was a covering of fallen leaves.

In another pastured wood lot in Akron township a mile north and a quarter of a mile west of Unionville a similar association was noted. The wood lot was a part of the old forest and had not been cut into enough to destroy the balance of the species as they had established themselves, after a long struggle for supremacy. The growth was a dense one lying on a slight elevation, and running down into the clayey valley of Craugan creek. At the top of the low, flat ridge the dominant trees were: Hard maple, *Acer saccharinum*, Wang., and beech, *Fagus ferruginea* Ait., while on the slope and at the foot of it were the following species: Red oak, *Quercus rubra*, L., white oak, *Quercus alba*, hop-hornbeam, *Ostrya Virginica*, Willd., common thorn, *Crategus sp.*, prickly ash, *Xanthoxylum Americanum*, Mill., white elm, *Ulmus Americana*, L., black cherry, *Prunus serotina*, Ehrh., cottonwood, *Populus monilifera*, Ait., white ash, *Fraxinus Americana*, L., shadbush, *Amelanchier Canadensis*, slippery elm, *Ulmus fulva*, Michx., black ash, *Fraxinus sambucifolia*, Lam. In the clayey stream bottom, besides the elms and the cottonwoods, were the bur oak, *Quercus macrocarpa*, Michx., the swamp white oak, *Quercus bicolor*, Willd., and the butternut, *Juglans cinerea*, L. The herbs noted here were wild liquorice, *Galium circaezans*, Michx., rattlesnake root, *Prenanthes altissima*, L., wild aster, *Aster paniculatus*, Lam., self heal, *Brunella vulgaris*, L., fire weed, *Erechtites hieracifolia*, Raf., besides a scant growth of sedges and grasses.



*A plant association on the old dune line near the county line road between Tuscola and Huron counties, north of Unionville.* The trees here were red, white, black and swamp white oaks, *Quercus rubra*, L., *Q. alba*, L., *Q. coccinea*, Wang., var. tinctoria, Gray, and *Q. bicolor*, Willd., white ash, *Fraxinus Americana*, L., black ash, *F. sambucifolia*, Lam., young white pine, *Pinus Strobus* L., American elm, *Ulmus Americana*, L., red, or slippery elm, *Ulmus fulva*, Michx., shadbush, *Amelanchier Canadensis*, T. & G., black cherry, *Prunus serotina*, Ehrh., thorn tree, *Crataegus tomentosa*, L., and wild crabapple, *Pyrus coronaria*, L. The shrubs noted here were prickly ash, *Xanthoxylum Americanum*, Mill., sweet wild rose, *Rosa blanda*, Ait., high bush blackberry, *Rubus villosus*, Ait., black raspberry, *Rubus occidentalis*, L., red raspberry, *Rubus strigosus*, Michx., witch hazel, *Hamamelis Virginiana*, L., round-leaved and silky cornels, *Cornus circinnata*, L'Her., and *C. sericea*, L., and the wild grape, *Vitis riparia*, Michx. The herbs accompanying these were equally mixed in their relationship to habitat but were, however on the whole, those of the mesophytic forest, adapted to endure, or to need shading and moist soil. The more prominent species were wild columbine, *Aquilegia Canadensis*, L., small flowered crowfoot, *Ranunculus abortivus*, L., hooked crowfoot, *Ranunculus recurvatus*, Poir., early meadow rue, *Thalictrum dioicum*,, L., mandrake or May apple, *Podophyllum peltatum*, L., blue violet, *Viola palmata*, L., var. *cucullata*, Gray., chickweed, *Stellaria media*, Smith, wild geranium, *Geranium maculatum*, L., wild strawberry, *Fragaria vesca*, L., and *F. Virginiana*, Mill., common agrimony, *Agrimonia Eupatoria*, L., and many flowering agrimony, *A. parviflora*, Ait., common cinquefoil, *Potentilla Canadensis*, L., small enchanter's nightshade, *Circaea alpina*, L., common enchanter's nightshade, *Circaea Lutetiana*, L., sweet cicely, *Osmorrhiza brevistylis*, DC., black snakeroot, *Sanicula Marylandica*, L., northern bedstraw, *Galium boreale*, L., three flowered bedstraw *Galium triflorum*, Michx., fleabane, *Erigeron annuus*, Pers., and daisy fleabane, *Erigenon Philadelphicus*, L., shin leaf, *Pyrola elliptica*, Nutt., catnip, *Nepeta cataria*, L., wild lily of the valley, *Maianthemum Canadense*, Desf., false Solomon's seal, *Smilacina racemosa*, Desf., carrion flower, *Smilax herbacea*, L., trillium, *Trillium grandiflorum*, Salisb, sedges, *Carex rosea*, Schkuhr. *C. Deweyana*, Schwein, *C. straminea*, Willd., and the June grass, *Poa pratensis*, L.

*A swamp conifer association* was noted in the northeast part of Almer township, in the last remnant of what had formerly been a cedar or arbor vitae swamp of considerable size. When visited the ground was not wet and swamp conditions no longer existed. The trees noted were arbor vitae, *Thuya occidentalis*, L., tamarack, *Larix Americana*, Michx., black ash, *Fraxinus sambucifolia*, Lam., red maple, *Acer rubrum*, L., American elm, *Ulmus Americana*, L., and aspen, *Populus tremuloides*, Michx. With these species grew the shrubs, smooth sumac, *Rhus*

*glabra,* L., willows, *Salix spp.,* alder, *Alnus incana,* Willd., winter berry, *Ilex verticillata,* Gray, common elder, *Sambucus Canadensis,* L., red osier dogwood, *Cornus stolonifera,* Michx., and black raspberry, *Rubus occidentalis,* L. The herbaceous plants were wild strawberry, *Fragaria vesca,* L., Joe Pye weed, *Eupatorium purpureum,* L., throughwort, *Eupatorium perfoliatum,* L., *Aster sp.,* golden rods, *Solidago Canadensis,* L., and *S. rugosa,* Mill., common milkweed, *Asclepias Cornuti,* DeCaisne, swamp milkweed, *Asclepias incarnata,* L., vervain, *Verbena hastata,* L., bugle weed, *Lycopus Virginicus,* L., June grass, *Poa pratensis,* L., red top, *Agrostis alba,* L., meadow muhlenbergia, *Muhlenbergia Mexicana,* Trin., royal fern, *Osmunda regalis,* L., and marsh shield-fern, *Aspidium Thelypteris,* Swartz.

*Swamp type of forest.* As conditions were most favorable for the study of the hydrophytic type of forest in Akron township and especially since the contiguity of this type of forest and the open prairies made their examination most interesting to the student of plant distribution, several studies were made in then uncleared areas northwest of Unionville where the land was still incompletely drained. These woods were not quite in their original condition because they had been used for pasture, but because the density of the crown cover of the trees was so great there was but little temptation for cattle to go into them except for shade. The trees had not been thinned, and were crowded in a rather dense stand. The following species were dominant: White, slippery and rock elms, *Ulmus Americana,* L., *U. fulva,* Michx., *U. racemosa,* Thomas, cottonwood, *Populus monilifera,* Ait., bur, swamp—white and red oaks, *Quercus macrocarpa,* Michx., *Q. bicolor,* Willd., *Q. rubra,* L., black and white ash, *Fraxinus sambucifolia,* Lam., and *F. Americana,* L., white maple, *Acer dasycarpum,* Ehrh., basswood, *Tilia Americana,* L., white birch, *Betula papyrifera,* Marshall, butternut and black walnut, *Juglans cinerea,* L., and *J. nigra,* L., shagbark hickory, *Carya alba,* Nutt., black maple, *Acer saccharinum,* Wang., var. *nigrum,* T. & G., black willow, *Salix nigra,* Marsh, and blue beech, *Carpinus Caroliniana,* Walt. The shrubs noted here were gooseberry, *Ribes oxyacanthoides,* L., red currant, *Ribes rubrum,* L., and prickly ash, *Xanthoxylum Americanum,* Mill. The herbs were found chiefly in small openings in the wood around places so poorly drained that pools of water stood in them until late in the summer; besides there were scattered clumps of grass and sedges, and sparse, broad-leaved, herbaceous plants in the shade of the trees and often growing best on the low elevations formed around their roots. The most abundant herbs noted in the openings were smartweed, *Polygonum hydropiper,* L., false nettle, *Boehmeria cylindrica,* Willd., plantain, *Plantago Rugellii,* Decaisne, blue flag, *Iris versicolor,* L., beggar-ticks, *Bidens frondosa,* L., bugle weed, *Lycopus Virginicus,* L., nightshade, *Solanum nigrum,* L., selfheal, *Brunella vulgaris* L., wild strawberry, *Fragaria Virgina,* Mill., wild aster, *Aster sp.,* and bittersweet, *Solanum Dulcamara.,* L. A wild grape, *Vitis riparia,* Michx., the poison ivy, *Rhus toxicodendron,* L., and Virgin's bower, *Clematis Virginiana,* L., were also noted climbing the trees and over shrubs.

The tension zone, between marshy treeless prairie and heavy swamp forest was, as has been stated, very narrow, and the grass land came close up to the forest with practically no intergrading area. In one of the places northwest of Unionville where the timber line was examined, the woods covered a low sandy ridge rising two or three feet above the marsh level, with a pebbly clay below. The ridge was one of the ancient shore lines of the bay and was covered with red, white and bur oaks, *Quercus rubra,* L., *Q. alba,* L., and *Q. macrocarpa,* Michx., basswood, *Tilia Americana,* L., and among these a single small white pine, *Pinus Strobus,* L. On either side of the ridge the forest was made up of white elm, *Ulmus Americana,* L., black ash, *Fraxinus sambucifolia,* Lam., white or soft maple, *Acer dasycarpum,* Ehrh., shagbark hickory, *Carya alba,* Lam., and basswood, *Tilia Americana,* L., with an undergrowth of shrubs including the blue beech, *Carpinus Caroliniana,* Walt., swamp wild rose, *Rosa Carolina,* L., prickly ash, *Xanthoxylum Americanum,* Mill., elder, *Sambucus Canadensis,* L., round-leaved dogwood, *Cornus circinnata,* L'Her., and young arbor vitae, *Thuya occidentalis,* L. The characteristic herbs of the association were small-flowered crowfoot, *Ranunculus abortivus,* L., blue violet, *Viola palmata,* L., var. *cucullata,* Gray, yellow violet, *Viola pubescens,* Ait., wild geranium, *Geranium maculatum,* L., wild aster, *Aster macrophyllus,* L., and *A. paniculatus,* Lam., several species of sedges, *Carex spp.,* selfheal, *Brunella vulgaris,* L., Wild liquorice, *Galium circaezans,* Michx., night shade, *Solanum nigrum,* L., and rattlesnake root, *Prenanthes altissima,* L. These plants are called characteristic because they usually form a part of the plant associations growing in rich moist soil under the shade of dense tree growth; a few of the species mentioned grow in the open when the conditions are favorable.

Marshward of the margin of the woods, was another low sandy ridge somewhat lower than the one just described, probably not exceeding 3 feet above the marsh at its highest point and having sedgy areas on both sides. Here the trees were much less numerous and formed groves, while shrubs constituted an important part of the plant association; the herbaceous plants were chiefly species that are seldom, if ever, found growing in moist shady places.

The trees noted were growing along the broad low top of the ridge and some of them were of large size, 2½ to 3½ feet through. The largest trees were bur oaks, *Quercus macrocarpa,* Michx., and black oaks, *Quercus coccinea,* Wang., var. *tinctoria,* Gray. Other trees were white oak, *Quercus alba,* L., at the top of the ridge, and aspen, *Populus tremuloides,* Michx., and black willow, *Salix nigra,* Marsh., near the prairie level. There were also numbers of young ashes, elms and white birches along the edge of the prairie where the sand ran down into the muck. The shrubs, which formed thickets of considerable extent, were staghorn sumach, *Rhus typhina,* L., red osier dogwood, *Cornus stolonifera,* Michx., panicled dogwood, *Cornus paniculata,* L'Her., low willow, *Salix humilis,* Marsh., huckleberry, *Gaylussacia resinosa,* T. & G., low blue berry, *Vaccinium Pennsylvanicum,* Lam., scarlet fruited thorn, *Crataeous coccinea,* L., black raspberry, *Rubus occidentalis,* L., frost weed, *Helianthemum Canadense,* L., in dry sandy soils that constitute its usual habitat.

Other herbaceous plants found in the plant association under discussion, were the smooth aster, *Aster laevis,* L., low golden rod, *Solid-*

*ago nemoralis*, Ait., wild bergamot, *Monarda fistulosa*, L., wild strawberry, *Fragaria Virginiana*, Mill., many flowered agrimony, *Agrimonia parviflora*, Ait., fern-leaved foxglove, *Gerardia pedicularia*, L., yarrow, *Achillea millefolium*, L., yellow pimpernel, *Pimpinella integerrima*, Gray, hog peanut, *Amphicarpaea monoica*, Nutt., and colonies of rush, *Juncus Balticus*, Dethard. var. *littoralis*, Engelm. This, and the silverweed, are usually characteristic plants of the associations found along the strand just above the high water mark, and their presence so far from the present shore is worthy of remark, and may be taken as an indication that the conditions existing on the abandoned shore lines are comparable with those of the present day.

*Intermediate association.* At the base of the ridge was a zone of soil rich in organic matter, but slightly higher than the general prairie level, in which an association of plants had developed of quite different aspect from that on the ridge. The trees were entirely wanting, or represented by very young specimens of swamp species, and shrubs were not common, although the red osier dogwood, *Cornus stolonifera*, Michx., and panicled cornel, *Cornus paniculata*, L'Her., were growing in the more open, sterile places on the highest parts of the ridge, with the pin weed, *Lechea major*, Michx., and the sweet wild rose, *Rosa blanda*, Ait. On the gentle slopes grew dense patches of the shrubby cinquefoil, *Potentilla fruticosa*, L., while the grape, *Vitis riparia*, Michx., and Virginia creeper, *Ampelopsis quinquefolia*, Michx., in some places festooned the trees and bushes.

The ground was covered with a thin turf of dry ground sedges and grasses, which grew in tufts or bunches after the habit of the xerophytic species of these types. The grasses noted were Canadian blue grass, *Poa compressa*, L., the wild oat grass, *Danthonia spicata*, Beauv., *Koeleria cristata*, Pers., and the forked beard grass, *Andropogon furcatus*, Muhl. There were also considerable patches of the silver weed, *Potentilla Anserina*, L, with its fern-like leaves densely covered with shining white hairs on both surfaces where it grew exposed to the full light of the sun, but in places where it was shaded the upper surfaces of the leaves were distinctly greener and less hairy. The dense white tomentum or silky hairs covering the leaves of this plant are apparently an adaptation to enable it to live in the exposed situations. The hairy covering of the leaves entangles the air, which acts as a blanket and becoming saturated with moisture prevents excessive transpiration, as well as tempers the heat and light which pours down upon the plant in the entirely unshaded places in which it usually lives.

Many plants growing in very dry exposed situations have similar hairy coverings to leaves and stems and this is perhaps the most common and easily recognized adaptation to the xerophytic habitat. Low willows, *Salix spp.*, and the shrubby cinquefoil, *Potentilla fruticosa*, L., occurred in the zone.

Herbs were the dominant plants here, as elsewhere on the prairies, many of them tall, branching, strong-growing plants quite different in habit of growth from the forms found on the top of the ridge or in the shade of the mesophytic and low ground forests already described. Here grew the tall sunflower, *Helianthus giganteus*, L., several goldenrods, *Solidago Canadensis*, L., *S. Ohioensis*, Riddell, *S. Riddelli*, Frank.,



and *S. serontina*, Ait., thoroughwort, *Eupatorium perfoliatum*, L., purple-stem aster, *Aster puniceus*, Ait., sneeze-weed, *Helenium autumnale*, L., blazing star, *Liatris spicata*, Willd., black-eyed Susan, *Rudbeckia hirta*, L., grass of Parnassus, *Parnassia Caroliana*, Michx., tall meadow rue, *Thalictrum purpurascens*, L., wild bergamot, *Monarda fistulosa*, L., New England aster, *Aster Novae-Angliae*, L., fringed gentian, *Gentiana crinita*, Froel., self heal, *Brunella vulgaris*, L., blue flag, *Iris versicolor*, L., bindweed, *Convolvulus sepium*, L., purple gerardia, *Gerardia purpurea*, L., var. *paupercula*, Gray, purple loose strife, *Lythrum alatum*, Pursh., silver weed, *Potentilla Anserina*, L., nerved manna grass, *Glyceria nervata*, Trin., and a few other grasses, and the marsh shield fern, *Aspidium Thelypteris*, Swartz.

A small area of sandy soil in the prairie at some distance from the edge of the forest was found to have but a slight elevation, 1 to 2 feet, above the general level, but was an excellent example of the small islands that are scattered over the prairies as already described. There were but two trees of any size, both black oaks, *Quercus coccinea*, Wang., var. *tinctoria*, Gray, about 2 feet in diameter, although there were large numbers of small oaks, as well as young aspens, *Populus tremuloides*, Michx., and willows, *Salix spp.*

A number of species of shrubs grew here including the red osier dogwood, *Cornus stolonifera*, Mx., panicled cornel, *Cornus paniculata*, L'Her., service berry, *Amelanchier Canadensis*, T. & G., sheep berry, *Viburnum Lentago*, L., choke cherry, *Prunus Virginiana*, L., sweet wild rose, *Rosa blanda*, Ait., tall blackberry *Rubus villosus*, Ait., running blackberry, *Rubus Canadensis*, L., dwarf cherry, *Prunus pumila*, L., and shrubby cinquefoil, *Potentilla fruticosa*, L. A notable thing about all these shrubs with the exception of the last is the fact that they have edible fruits, or at least such as are attractive to birds, which accounts in a very large measure for their presence on the island, since in the marshy parts of the prairies are the breeding places of great numbers of redwing and crow blackbirds, as well as the haunts of great flocks of crows in the fall and spring. It is well known that the redwing blackbird after the breeding season gathers in flocks and lives largely on the fruits of shrubs of species found on this and similar islands, and the fact that the trees and shrubs on the islands serve as their resting places accounts in large measure for the abundance of the fruit-bearing shrubs in such places, and especially of those with seeds having a hard resistant seed coat.

The herbaceous plants found on this island were round-headed bush clover, *Lespedeza capitata*, Michx., hawkweed, *Hieracium Canadense*, Michx., wild bergamot, *Monarda fistulosa*, L., goldenrods, *Solidago nemoralis*, Ait., *S. lanceolata*, L., and *S. Canadensis*, L., prairie dock, *Silphium terebinthinaccum*, L., smooth aster, *Aster laevis*, L., yarrow, *Achillea Millefolium*, L., plantain-leaved ever-lasting, *Antennaria plantaginifolia*, Hook., black-eyed Susan, *Rudbeckia hirta*, L., strawberry, *Fragaria Virginiana*, Mill., tall sunflower,, *Helianthus giganteus*, L., blazing star, *Liatris spicata*, Willd., tall meadow-rue, *Thalictrum purpurascens*, L., tick trefoil, *Desmondium Canadensis*, D. C., Kentucky blue grass, *Poa pratensis*, L., Canadian blue grass, *Poa compressa*, L., rough hair grass, *Agrostis scabra*, Willd., tall panic grass, *Panicum*

*virgatum*, L., fresh water cord grass, *Spartina cynosuroides*, Willd., Indian grass, *Chrysopogon nutans*, Benth., forked beard grass, *Andropogon furcatus*, Muhl., and blue joint grass, *Calamagrostis Canadensis*, Beauv.

It will be noted that there is a considerably larger number of grasses present in this association than in any of the others described. This was apparently due to the nearness of the entire surface to the level of the prairie and to the fact that the area was only slightly shaded, so that the grasses had not been displaced of other plants more tolerant of shade.

In the vicinity where these observations were made, drained parts of the prairie became quickly covered by thickets of aspens, *Populus tremuloides*, Michx., and willows, *Salix spp.*, while in the ridges of earth thrown out from the ditches the white elm, *Ulmus Americana*, L., and the black ash, *Fraxinus sambucifolia*, Lam., often appeared in great numbers, and even more quickly these banks grew up to a dense growth of goldenrods, *Solidago spp.*, asters, *Aster spp.*, thoroughwort and Joe-pye weed, *Eupatorium perfoliatum*, L., and *E. purpureum*, L., and milkweeds, *Asclepias spp.* as tall as a man's head. Areas that had been drained and plowed also became covered by similar temporary associations, which eventually would be displaced by more stable tree growths.

On another island a long distance out in the prairie, the basswood, *Tilia Americana*, L., and white elm, *Ulmus Americana*, L., were the principal old trees, with a single black ash, *Fraxinus sambucifolia*, Lam.; associated with these was a growth of sumach, *Rhus typhina*, L., and the cock-spur and scarlet-fruited thorns, *Crataegus Crus-galli*, L., and *C. coccinea*, L. var. *macracantha*, Dudley, one tree of the former species being 38 inches in circumference 2 feet above the ground, which is very large for a thorn tree. Another shrub noted here was the red osier dogwood, *Cornus stolonifera*, Michx. The herbs seen were June grass, *Poa pratensis*, L., yarrow, *Achillea Millefolium*, L., blue vervain, *Verbena hastata*, L., Canada golden rod, *Solidago Canadensis*, L., common mullein, *Verbascum Thapsus*, L., the tall thistle, *Cnicus altissimus*, Willd., var. *discolor*, Gray, Canada thistle, *Cnicus arvensis*, Hoffm., and pasture thistle, *Cnicus lanceolatus*, Hoffm., white basil, *Clamintha clinopodium*, Benth., tall sunflower, *Helianthus giganteus*, L., silver weed, *Potentilla Anserina*, L.

Still another island one mile north of the south line of the upper half of Akron township had a large area and there was a good grove of the following trees growing on it; bur oak, *Quercus macrocarpa*, Michx., white oak, *Quercus alba*, L., swamp white oak, *Quercus bicolor*, Willd., red oak, *Quercus rubra*, L., black oak, *Quercus coccinea*, Wang., var. *tinctoria*, Gray, white elm, *Ulmus Americana*, L., white ash, *Fraxinus Americana*, L., aspen, *Populus tremuloides*, Michx., cottonwood, *Populus monilifera*, Ait., and thorn trees, *Crataegus spp.* Below these and in the open spaces between the groups of trees were thickets of shrubs, among which the most important were panicled cornel, *Cornus paniculata*, L'Her., the red osier dogwood, *Cornus stolonifera*, Michx., the silky cornel, *Cornus sericea*, L., sumach, *Rhus glabra*, L., elder, *Sambucus Canadensis*, L., common hazel, *Corylus Americana*, Walt., swamp wild rose, *Rosa Carolinina*, L., and the sheep berry, *Viburnum Lentago*, L. There were also numbers of grape vines, *Vitis riparia*, Michx., either clambering over the shrubs or climbing high into the trees. A much greater variety of herbs were noted here than in either of the other island associations, the most abundant of which were iron weed, *Vernonia altissima*, Nutt. var. *grandiflora*, Nutt., prairie dock, *Silphium terebinthinaceum*, L., mountain mint, *Pycnanthemum lanceolatum*, Pursh, swamp lousewort, *Pedicularis lanceolata*, Michx., *Aster junceus*, Ait., *Aster laevis*, L., *Aster Novae-Angliae*, L., low golden rod, *Solidago nemoralis*, Ait., tall lettuce, *Lactuca hirsuta*, Muhl., tall sunflower, *Helianthus giganteus*, L., closed gentian, *Gentiana Andrewsii*, Griseb., wild bergamot, *Monarda fistulosa*, L., hog peanut, *Amphicarpæa monoica*, Nutt., agrimony, *Agrimonia Eupatoria*, L., wild geranium, *Geranium maculatum*, L., pearly everlasting, *Anaphalis margaritacea*, Benth. and Hook., tall anemone, *Anemone Virginia*, L., columbine, *Aquilegia Canadensis*, L., grasses and sedges and common brake, *Pteris aquilina*, L.



It will be seen by comparing this list with those made in the same type of habitat at other points that the species are nearly the same, the chief difference being that the larger area has a more extensive series of plants, as might be expected.

*Prairie Associations.* In the broad area of marshy prairie forming the northern part of Akron township, the following notes were made. The upper levels that could be considered as a part of the prairie were covered with silver weed, *Potentilla Anserina*, L., low golden rod, *Solidago nemoralis*, Ait., rush, *Juncus Balticus*, Dethard, var. *littoralis*, Engelm., red top, *Agrostis alba*, L., June grass, *Poa pratensis*, L. This level was so little above the prairie proper that the line of change was expanded into a broad zone in which plants of both habitats intermingled and in about equal numbers. In what was undoubtedly the prairie association the most conspicuous plants were the blazing star, *Liatris spicata*, Willd., sneeze weed, *Helenium autumnale*, L., asters, *Aster junceus*, Ait., *A. Novæ-Angliae*, L., self heal, *Brunella vulgaris*, L., bugle weed, *Lycopus sinuatus*, Ell., basil, *Pycnanthemum lanceolatum*, Pursh., narrow leaved golden rod, *Solidago lanceolata*, L., rush, *Juncus nodosus*, L. var. *megacephalus*, Torr., Canadian June grass, *Poa compressa*, L., red top, *Agrostis alba*, L., sedges, *Carex spp.*, spike rush, *Eleocharis spp.*, and the shrubby cinquefoil, *Potentilla fruticosa*, L. The level slightly lower or less drained than this was a grassy marsh in which blue joint grass, *Calamagrostis Canadensis*, Beauv., fresh water cord grass, *Spartina cynosuroides*, Willd., a panic grass, *Panicum sp.*, sedges, *Carex spp.*, spike rush, *Eleocharis spp.*, rushes, *Juncus nodosus*, L., and *Juncus Canadensis*, J. Gay., narrow-leaved golden rod, *Solidago lanceolata*, L., Indian hemp, *Apocynum cannabinum*, L., and purple loosestrife, *Lythrum alatum*, *Pursh*, were the characterizing plants.

A sandy ridge running across this lower area was from 12 to 18 inches above the marsh level and was well turfed with Canadian blue grass, *Poa compressa*, L., and red top, *Agrostis alba*, L., while growing with the grasses were the low golden rod, *Solidago nemoralis*, Ait., very abundant, ladies tresses, *Spiranthes cernua*, Richard, rush, *Juncus Balticus*, Dethard, var. *littoralis*, Engelm., wild rose, *Rosa humilis*, Marsh., shrubby cinquefoil, *Potentilla fruticosa*, L., Florida

milkweed, *Acerates longifolia*, Ell., purple gerardia, *Gerardia purpurea*, L. var. *paupercula*, Gray, and small St. John's wort, *Hypericum Canadense*, L.

Intruding into this association as indicated by the limited areas occupied and the small size of the plants, were the fresh water cord grass, *Spartina cynosuroides*, Willd., tall panic grass, *Panicum virgatum*, L., Canada thistle, *Cnicus arvensis*, Hoffm., the staghorn sumach, *Rhus typhina*, L., wild strawberry, *Fragaria Virginiana*, Mill., basil, *Pycnanthemum lanceolatum*, Pursh., and the Indian grass, *Chrysopogon nutans*, Benth. Along the borders of the marsh was a faintly defined zone in which the white heath aster, *Aster cricoides*, L., was a common plant, while in the slightly wetter marsh along the sides of this ridge there were added to the association the sedges, *Carex flava*, L. var. *viridula*, Bailey, and *Scleria verticillata*, Muhl., rush, *Juncus sp.*, Kalm's lobelia, *Lobelia Kalmii*, L., fringed gentian, *Gentiana crinita*, Froel, silver weed, *Potentilla Anserina*, L. sneeze weed, *Helenium autumnale*, L., very abundant, rough hair grass, *Agrostis scabra*, Willd., panic grass, *Panicum scoparium*, Lam., a few plants of marsh coreopsis, *Coreopsis trichosperma*, Michx., var. *tenuiloba*, Gray, purple gerardia, *Gerardia purpura*, L. var. *paupercula*, Gray, here very abundant, and the mermaid weed, *Proserpinaca palustris*, L. The presence of the last named species shows conclusively that in the zone where it grew wet marsh or shallow water conditions prevail during the early part of the growing season, as the plant is a semi-aquatic or palustrine species and may be seen in the early summer standing half submerged in the shallow water in which it grows, and on examination the submerged leaves will be found to be finely dissected, while those above the water are merely toothed along the edges; apparently these differences in leaf form are adaptation to enable the plant to live in the peculiar habitat in which it grows.

A vertical section cut in the bank of a ditch in the vicinity where the last given plant association was found showed:

Turf of matted rootstocks and roots.....6 to 8 inches.
Stiff bouldery clay till to bottom of ditch.....2 ft. 6 inches.

Water level in September about two feet below the ground surface but the ditch had been dry during the summer as shown by the condition of the bottom; surface of the soil wet.

The rootstocks of the lake bulrush, *Scirpus lacustris*, L., were common in the turf, but the plant was only sparingly present on the marsh at the time it was visited, clearly indicating that there had been a change from wet to dryer conditions.

The wetter parts of the marsh in this vicinity were covered by a dense growth of the slender sedge, *Carex filiformis*, L., or where it was slightly less wet, a mixture of this plant and blue joint, *Calamagrostis Canadensis*, Beauv., and where there was more water the lake bulrush took the place of the blue joint.

Some interesting observations were made in the shallow bay 6 inches to 1½ feet deep, where crossed between Fish Point and the main shore, and along the dunes forming the point southward nearly to Bay Park, and in the course of the examination the sequence of plants in occupying newly available ground space was worked out.



In the water was a quite dense growth of lake bulrush, *Scirpus lacustris*, L., growing a long distance out into the bay, while nearer shore the species was mixed with the three square, *Scirpus pungens*, Vahl., another bulrush which formed a nearly pure growth in the shallower parts of the small inlet.

Growing in the water below the taller plants were stoneworts *Chara spp.*, and a sparse growth of a small pond weed, apparently a stunted form of *Potamogeton heterophyllus*, Schreb. On approaching the shore on the west side of the inlet it was found that the plants were arranged in zones, or broad belts, beginning several hundred feet from the margin of the dryer part of the marsh. In the water the three square, *Scirpus pungens*, Vahl., gave place to the lake bulrush, *S. lacustris*, L., which in turn was bordered near the shore by a zone of nearly pure twig rush, *Cladium mariscoides*, Torr., and this where the soil was still saturated with water, to a dense broad zone of the tall reed grass, *Phragmites communis*, Trin., growing to a height of more than six feet, and so thickly were the individual plants placed that but little other vegetation was growing in company with it, the only plant at all conspicuous in the zone being the blue joint, *Calamagrostis Canadensis*, Beauv. After passing through the zone of reed grass which extended along the shore as far as it was examined, some hundreds of yards at least, a narrow zone of "islands" of young aspens, *Populus tremuloides*, Michx., and willows, *Salix spp.* that had apparently seeded in during the dry period of a few years earlier, when the level of the bay had been more than a foot lower than at the time when these studies were made. Westward of this was a broad sedge marsh extending nearly or quite over to the dune lines along the shore of Fish Point.

The plant covering of this marsh was chiefly the slender sedge, *Carex filiformis*, L., with spaces between the areas of denser growth, that were covered with moss. Other plants were growing scattered over the marsh, often forming small islands in the places where they had become established, or where slight elevations or depressions favored their growth. These plants were small willows, *Salix spp.*, three square, *Scirpus pungens*, Vahl., reed grass. *Phragmites communis*, Trin., both scattered and covering large tracts of the marsh; the Canada rush, *Juncus Canadensis*, J. Gay, marsh St. John's-wort, *Elodes campanulata*, Pursh., and bugle weed, *Lycopus sinuatus*, Ell., were frequent but as scattered individuals. On the other hand blue joint grass was quite as common, but grew in islands, that could be distinguished some distance away, as they were approached. Other plants noted as occurring frequently in this association were *Aster paniculatus*, Lam., fire weed, *Erechtites hieracifolia*, Raf., northern willow herb, *Epilobium adenocaulon*, Haussk., marsh bell flower, *Campaula aparinoides*, Pursh., skull cap, *Scutellaria galericulata*, L., and golden rod, *Solidago Canadensis*, L. The soil was wet, soft and spongy over most of the marsh, and the water level was a foot below the surface in the broad ditch across the marsh.

The plants that had established themselves on the bank of earth thrown out from the ditch within a year or two were chiefly weeds or plants of the species which belong to plant associations found on the higher parts of the marsh; one species, *Lobelia Kalmii*, L. was

apparently a survival from the time before the ditch was dug but it grew unusually large on the embankment. Other species were bugle weed, *Lycopus sinuatus*, golden rods, *Solidago Canadensis*, L. and *S. lanceolata*, L., ragweed, *Ambrosia artemisiaefolia*, L., fire weed, *Erechtites hieracifolia*, Raf., and blue joint grass, *Calamagrostis Canadensis*, Beauv. The last named species showed considerable adaptability in the degree of wetness which it could endure, but in the places in which the water level was estimated to be from 18 inches to 2 feet below the surface it grew best and most vigorously. In the wet prairie the plants were short and slender and may well have been survivals from the dry time when the level of the bay was lower by more than a foot.

After crossing the marsh and the low sand ridge bordering the main bay, the plant associations of the beach from the water to the dune line was examined and later the relationship between this flora, and that of the dunes and the marshes behind were studied, and many of the species seen were noted. In the water and extending out from the shore a long distance was a growth of lake bulrush, *Scirpus lacustris*, L., and large numbers of its culms, some of which had evidently grown in 4 or 5 feet of water, were piled in windrows along the shore. About the level of the water both in and out of it were the few flowered spike rush, *Eleocharis pauciflora*, Link., which formed a dense carpet in many places, the little green sedge, *Carex flava*, L. var. *viridula*, Bailey, the arrow grass, *Triglochin palustris*, L., and the rush, *Juncus nodosus*, L. While there were extensive areas where these were the principal plants, there were other places where they were wanting, or entirely replaced by other species.

The next group of plants of interest was that found about the storm-wave line, where there was an accumulation of drift material, some of which as it decayed added organic matter to the soil. Here were the bugle weed, *Lycopus sinuatus*, Ell., silver weed, *Potentilla Anserina*, L., the rough hair grass, *Agrostis scabra*, Willd., panic grass, *Panicum scoparium*, Lam., narrow leaved golden rod, *Solidago lanceolata*, L., blue vervain, *Verbena hastata*, L., Canada thistle, *Cnicus arvensis*, Hoffm., blue flag, *Iris versicolor*, L., thoroughwort, *Eupatorium perfoliatum*, L., three square, *Scirpus pungens*, Vahl., and here and there a small plant of smooth sumach, *Rhus glabra*, L. This association is manifestly a temporary one, brought together largely by the accumulation of seeds about the storm wave line, by the combined action of the winds and waves. Thus the plants are not especially significant in their grouping, as there was little competition for space, water or light, although an interesting study might be made of the probable way in which these plants established themselves to the exclusion of others whose seeds might have been brought here by the same agencies. The elevation of this wave formed association was about 2 feet above the ordinary water level.

Back of the storm-wave line, in a slight depression, was a more permanent association of plants, but one made up of several types, some of which would certainly become the leading ones if they persisted, since they would eventually become trees. The plants noted in this moist, or in parts wet, depression,, were false nettle, *Bochmeria cylindrica*, Willd., fire weed, *Erechtites hieracifolia*, Raf., red osier, *Cornus stolonifera*, Michx., goldenrods, *Solidago Canadensis*, L. and *S. nemoralis*, Ait., touch-me-not, *Impatiens fulva*, Nutt., wild asters, *Aster junceus*, Ait., and *A. Novae-Angliae*, L., marsh coreopsis, *Coreopsis trichosperma*, Michx., var. *tenuiloba*, Gray, wild strawberry, *Fragaria Virginiana*, Mill., silver weed, *Potentilla Anserina*, L., young elms, *Ulmus Americana*, L. and peppermint, *Mentha piperita*, L.



In the marsh shoreward from this area, the following association was found: Twig rush, *Cladium mariscoides*, Torr., spike rush, *Eleocharis pauciflora*, Link., beaked rush, *Rhynchospora capillacea*, Torr., low nut rush, *Scleria verticillata*, Muhl., beach rush, *Juncus Balticus*, Dethard, var. *littoralis*, Engelm., little green sedge, *Carex flava*, L. var. *viridula*, Bailey, marsh spike rush, *Eleocharis palustris*, R. Br., var., *glaucescens*, Gray, marsh arrow grass, *Triglochin palustris*, L., panic grass, *Panicum scoparium*, Lam., Kalm's lobelia, *Lobelia Kalmii*, L., Ohio golden rod, *Solidago Ohioensis*, Griseb., willows, *Salix spp.*, shrubby St. John's wort, *Hypericum Kalmianum*, L., purple gerardia, *Gerardia purpurea*, L. var. *paupercula*, Gray, and *Aster sp.*

*Flora of Fish Point.* The low wind-formed sand ridge which made up the greater part of the little peninsula distinguished on the map as Fish Point, represents the most recently formed, and at the same time the least disturbed portion of Tuscola county, since it is only accessible by boat, or by a long walk or drive across the prairies and the soft unattractive beach. A distant view of it across the prairies shows only a line of low trees and shrubs, seeming taller than they are because of the entire lack of other objects of known size with which to compare them in the field of view, and doubtless also in the summer time frequently owing to the effects of mirage.

The tree flora at the end of the peninsula is remarkably simple considering the length of time which the land must have been above the water level enough to permit trees to grow on it, and the relatively short distance that very complicated forest associations exist on much the same kind of soil, and where other conditions of growth are not essentially different. Indeed the studies on which this report is based show that the plant associations on the same shore line a few miles south are more complicated and have greater variety of trees and other types of plants than this more isolated area, although the ridges are continuous and in direct line, and there is no apparent difference in their maturity, although of this there can be no certainty because of the nature of the formation. The most acceptible hypothesis to account for few kinds of trees on Fish Point and for two miles south, is that the winds and the birds are the two principal agencies that can deposit seeds on such a place where they have a chance to grow. The waves and currents doubtless bring seeds of some species of trees that germinate in places where they are unable to establish themselves. The considerable distances across the bay, however, and the thick growth of bulrushes in shallow water probably, reduce the number of such seeds that reach the shore with vitality enough to grow, while the infrequency at the right season of the year of winds from the east, having force enough to blow the heavier kinds of seeds such a distance, accounts for

the failure of the invasion of trees from the swamp and mesophytic forests east of the prairies.

The trees which were found on Fish Point and the low dunes for at least a mile south of it were the cottonwood, *Populus monilifera*, Ait., balsam poplar, *Populus balsamifera*, L., aspen *Populus tremuloides*, Michx., and two native tree willows, *Salix amygdaloides*, Anders, and *S. nigra*, Marsh, and the white ash, *Fraxinus Americana*, L. The last named species was producing seed, and many seedlings and young trees were seen in the neighborhood of the older trees. This was the only species whose seeds could not have easily been brought by the winds from long distances, but it is not impossible the species was introduced by the winds, because its seeds remain on the trees until winter, and might easily have drifted and been blown across the prairies, or across the bay on the ice, or crusted snow by some winter gale.

The following shrubs were found here: Staghorn sumach, *Rhus typhina*, L., panicled cornel, *Cornus paniculata*, L'Her., dwarf cherry, *Prunus pumila*, L., sweet wild rose, *Rosa blanda*, Ait., and willows, among which was the prairie willow, *Salix humilis*, Marsh. Woody vines were noted on the lakeward face and top of the dune line, which was low, seldom reaching a height of more than 8 or 10 feet, and sometimes less than 6 feet, as follows: running blackberry, *Rubus Canadensis*, L., wild grape, *Vitis riparia*, Michx., climbing bitter sweet, *Celastrus scandens*, L., poison ivy, *Rhus Toxicodendron*, L., all of which were found commonly present for a mile or more south from Fish Point. The shrubs were accompanied on the lakeward face of the dune, by a number of grasses and other herbaceous plants, frequenting dry ground, and a few of these were characteristic sand dune plants. The common grasses found were the forked beard grass, *Andropogon furcatus*, Muhl., fresh water cord grass, *Spartina cynosuroides*, Willd., wild rye, *Elymus Canadensis*, L., tall panic grass, *panicum virgatum*, L., and the sea sand-reed, or dune grass, *Ammophila arundinacea*, Host., a plant found on the exposed sand beaches and dunes of the shores of the Atlantic ocean in Europe and America, as well as those of the Great Lakes, and a most important agent in keeping the sand back of the beach from blowing, and in building the dunes. Associated with the grasses, which grew chiefly in stools or isolated clumps, were other herbs, the most abundant and characteristic of which were the wormwood, *Artemisia caudata*, Michx., a common dune plant, but growing in sandy soil elsewhere, *Potentilla Anserina*, L., both of which are conspicuous for their silky, hairy covering, which as already noted, is a protection against loss of moisture from the transpiring surfaces.

Two herbaceous vines are common, spreading out in wide patches over the sand, or climbing over the shrubs, the hog peanut, *Amphicarpæa monica*, Nutt., and the wild morning glory, or bindweed, *Convolvulus sepium*, L. Other herbs seen were the coast joint weed, *Polygonella articulata*, Meisn., another plant common to both sea coast and the shores of the Great Lakes and adapted by its extensive root system and small thickened leaves to very dry soil conditions, crosswort, *Lysimachia quadrifolia*, L., false Solomon's seal, *Smilacina stellata*, Desf., germander, *Teucrium Canadense*, L., wild bergamot, *Monarda fistulosa*, L., Canada golden rod, *Solidago Canadensis*, L., and two species of scouring rush, *Equisetum hiemale*, L. and E. *arvense*, L.



*Plant Associations of the Dunes and Marsh South of Fish Point.* On the marshward side of the sand dune ridge the same plants which characterized the bay side were everywhere dominant down to a level about 3 to 4 feet above the level of the marsh at which they were replaced entirely by a zone of tall panic grass, *Panicum virgatum*, L., associated with the forked beard grass, *Andropogon furcatus*, Muhl., and the fresh water cord grass, *Spartina cynosuroides*, Willd. At a level a foot or so lower the panic grass gave place to the *Andropogon furcatus*, with a small admixture of *Spartina cynosuroides*, Willd., and at a slightly lower level, about that of the dryer parts of the marsh, these in turn are replaced by a well marked zone of blue joint grass, *Calamagrostis Canadensis*, Beauv., and golden rod, *Solidago Canadensis*, L., with a narrow fringe of tall reed grass, *Phragmites communis*, Trin., near the marsh level where the lake bulrush, *Scirpus lacustris*, L., covered the ground. In places along the ridge where they had become established, the zone of Canada golden rod and blue joint grass was found to have some tall bush clover, *Lespedeza polystachya*, Michx., the field thistle, *Cnicus altissimus*, Willd., var. *discolor*, Gray, the tall sunflower, *Helianthus giganteus*, L., and the fragrant sumach, *Rhus Canadensis*, Marsh. By the orderly arrangement of these plants at definite distances above the level of the marsh, into nearly or quite pure zones there seems plainly indicated their preference for, or tolerance of, certain soil moisture conditions, that they grow best in places where these conditions are most nearly met, and that they are not distributed in a disorderly fashion without definite law.

The barest dunes in this series had an association made up of poison ivy, *Rhus toxicodendron*, L., wild grape, *Vitis riparia*, Michx., sweet wild rose, *Rosa blanda*, Ait., sea sand-reed, *Ammophila arundinacea*, Host., tall wormwood, *Artemisia caudata*, Michx., false Solomon's seal, *Smilacina stellata*, Desf., and coast joint-weed, *Polygonella articulata*, Meisn.; this association was so constantly found in these bare, dry dunes that it is safe to infer that its members are the most fully protected by their structure and power of adaptation to unfavorable conditions, of all the species observed in this habitat.

Many minor modifications of the principal plant associations were observed in passing back and forth from the bay to the marsh, but few of these were more significant than the ones which have been described, and repetition would only serve to emphasize the observations already recorded. A few more striking examples of the especially interesting facts that were noted need to be recorded here. A most interesting and significant plant association was found around and under a solitary white pine, *Pinus strobus*, L., standing somewhat more than a mile south of the end of Fish Point and with a few others some distance south was the only representative of the conifers occurring on the shores for a long distance in any direction. This naturally would make these trees much used roosting places for the great flocks of blackbirds, crows, red wing blackbirds and robins that either live on the marshes or visit them at certain seasons of the year, or that pass

across them and the bay in moving from one point to another in their migrations. The first of these trees were entirely surrounded by a grove of choke cherry bushes, *Prunus Virginiana*, L., with numerous other shrubs growing among them, including the panicled cornel, *Cornus paniculata*, L'Her., the red osier dogwood, *Cornus stolonifera*, Michx., the tall blackberry, *Rubus villosus*, Ait., roses, *Rosa spp.*, etc., while the wild grape, *Vitis riparia*, Michx., the Virginia creeper, *Ampelopsis quinquefolia*, Michx., and the climbing bitter sweet, *Celastrus scandens*, L., were growing over the bushes and up into the tree. In the immediate vicinity of this tree also grew the interesting evergreen, trailing shrub, the bear berry, *Arctostaphylos Uva-ursi*, Spreng., which spread out its stems over the bare sand forming dense green mats, covered at the season the observation was made, with bright red fruits. The plants of this association possessed the character in common of having fleshy colored fruits, and their presence under and around the pine tree affords a good illustration of the influence which birds have on the distribution of plants, for the seeds from which these plants had sprung could have found their way in such numbers to this tree in no other way than by means of birds.

Farther southward the trees on the dune line nearest the bay became mainly oaks, 2 and 3 feet through, and with branches and tops much broken on the side towards the bay apparently from the force of the winds which sweep down on them from the open bay. With the oaks were a few old white pine trees. The plant association in this part of the dune line was more extensive and complicated than nearer Fish Point, but it was still somewhat simple. The following plants were noted: Red oak, *Quercus rubra*, L., black oak, *Q. coccinea*, Wang. var. *tinctoria*, Gray, swamp white oak, *Q. bicolor*, Willd., bur oak, *Q. macrocarpa*, Michx., white birch, *Betula papyrifera*, Marsh., balsam poplar, *Populus balsamifera*, L., cottonwood, *Populus monilifera*, Ait., aspen, *Populus tremuloides*, Michx., and basswood, *Tilia Americana*, L. The undergrowth below the trees was choke cherry, *Prunus Virginiana*, L., staghorn and fragrant sumach, *Rhus typhina*, L. and *R. Canadensis*, Marsh, and wild grape, *Vitis riparia*, Michx. The herbs were not noted except the abundant forked beard grass, *Andropogon furcatus*, Muhl., tall panic grass, *Panicum virgatum*, L., and the Indian grass, *Crysopogon nutans*, Benth., which all had the same general relations here as noted in other places. These plants grew chiefly in open ground, not under the shade of trees or bushes.

The marsh bayward of the oak covered dunes was less wet than farther north, and was covered with the slender sedge, *Carex filiformis*, L., the brown sedge, *Carex fusca*, All., and other less abundant forms, mixed with grasses, of which the tall reed-grass, *Phragmites communis*, Trin., and blue joint, *Calamagrostis Canadensis*, Beauv., were the most noticeable. In September, when this area was last visited, it was covered with the Ohio and Riddell's golden rods, *Solidago Ohioensis*, Riddell, and *S. Ridellii*, Frank., and other showy flowered herbs of the *Compositae*.

Where there were slightly elevated areas on the surface of the prairie, the real prairie association of plants appeared, consisting of the prairie dock, *Silphium terebinthinaceum*, L., smooth aster,



*Aster laeris*, L., New England aster, *A. Novae-Angliae*, L., arrow-leaved aster, *A. sagittifolius*, Willd., low golden rod, *Solidago nemoralis*, Ait., slender golden rod, *S. lanceolata*, L., iron weed, *Vernonia altissima*, Nutt. var. *grandiflora*, Nutt., blazing star, *Liatris spicata*, Willd., brown eyed Susan, *Rudbeckia hirta*, L., golden ragwort, *Senecio aureus*, L. var. *balsamitae*, T. & G., Indian plantain, *Cacalia tuberosa*, Nutt., basil, *Pycnanthemum lanceolatum*, Pursh., fringed gentian, *Gentiana cirinita*, Froel., spiked lobelia, *Lobelia spicata*, Lam., shrubby cinquefoil, *Potentilla fruticosa*, L., purple loosestrife, *Lythrum alatum*, Pursh., (in marshy places) prairie moneywort, *Steironema longifolium*, Gray, green milkweed, *Acerates longifolia*, Ell., purple milkweed, *Asclepias purpurascens*, L., Sullivant's milkweed, *Asclepias Sullivantii*, Engelm., common milkweed, *Asclepias Cornuti*, Decaisne, painted cup, *Castilleia coccinea*, Spreng., ladies tresses, *Spiranthes cernua*, Richard, tall panic grass, *Panicum virgatum*, L., and Indian grass, *Crysopogon nutans* Benth.

*Conclusions.* The value of such studies from the practical aspect is not difficult to see when it is pointed out that many of the plants mentioned in the last list are southern in their distribution, several of them reaching their northernmost known locality in the country in this prairie region of Saginaw Bay, where they are more than a hundred miles north of the nearest stations known for them. It seems indicated by this very local occurrence of such southern plants that the climatic conditions are favorable for southern plants, and that in the prairie region crops too tender to grow in other parts of the county might be given a trial here with fair chances of success. Such trials, however, should be conducted with care and on a small scale until it is actually proven, by trial, that the conditions are as favorable for tender crops as the native vegetation seems to show.

The lessons to be learned from the distribution of species in zones along the sand ridges according to vertical elevation above the water level in the marsh, are that plants may be quite restricted in their habitat by unfavorable soil water conditions, and to types of soils, because of their water holding capacity. Draining may, therefore, render soil that was too wet before the ditches were dug too dry for the plants it was hoped to cultivate on the drained soils, so that is well to know something of the water requirements of plants that are to be grown on a piece of ground to be drained before ditches are dug.

Of the kinds of plants growing native in an undisturbed area of wild land the trees are the best indicators of the character and drainage of the soils, since they live the longest. They show plainly that in their lifetime conditions have never been so poor that they could not persist, and that they have always found moisture and mineral food enough for their needs. On the other hand a type of land that supports only a sparse growth of trees, that are not thrifty, even if it seems well watered when examined, is to be regarded with suspicion and avoided for farming, as it is certain to prove dry and sterile in the long run, and will require much more careful handling than the soil type with good original tree growth.

Again if an old dry ground forest is found with an undergrowth of

herbs and shrubs forming an association such as is commonly found in the mesophytic or moist ground forest, it may be safely inferred that the upper layers of soil have plenty of moisture for the time being, but in the long lifetime of the trees, the soil is likely to become very dry. A part of the moisture of the existing state of the soil may be due to the shade and the humus accumulations furnished by the trees, both of which will disappear with the trees and leave the soil dry again.

The scientific end aimed at in a paper of this sort is the portrayal of the conditions as they existed at the times the observations were made, and this has been done as accurately as possible, in view of the relation which this phase of the work bore to other parts of it economically of greater importance. The record is incomplete, even where most carefully made, but it will enable future students of the flora of this interesting region to reconstruct in some degree the less disturbed conditions of the plant societies in the early days of the draining. Perhaps also it will render the task of accounting for the distribution of the plants after they have adjusted themselves to the improved conditions, easier and more satisfactory, for even a few years makes a very marked change in the composition of the plant societies made up wholly of short lived shrubs and herbs. It is chiefly with this end in view that the record is submitted.

## ANNOTATED LIST OF PLANTS FOUND IN TUSCOLA COUNTY.

*Introductory Note.* The following plants were noted chiefly in the course of other work, no attempt being made to go out of the roads for the purpose of compiling a complete list of the species which grow within the limits of Tuscola county. In general it may be said that the roads present the least favorable part of the region for observing native plants, as the weeds and cultivated grasses following man take possession of the frequented places and practically exterminate such of the native plants as the traffic and the live stock do not destroy. At the time when the field work was done upon which this report is based, many new roads were being built, and in the districts which they penetrated some of the unusual plants given in the following list, were noted. It should be remembered also that but a single day was spent in the county before July 1st, hence many of the conspicuous spring flowering plants were not seen at all, or only after they were in fruit.

The localities given are generally not significant as to the limits of distribution of a species, but give the townships and kind of habitat in which the occurrence of the given species was noted for the first time, and second notes of location for most types were seldom made, because the times at which the different townships were visited were not all equally favorable for observing the species. It is obvious that if a district was traversed in early July the conspicuous plants would be quite different from those that would be found in the latter part of August, so some townships which were visited in favorable seasons are credited with many more kinds of plants than those that were gone



over in less favorable times, although in fact the same types may be equally abundant in one as the other.

The fact should not be overlooked, however, that there are definite groups of plants peculiar to the parts of the county that have soil waters and climatic conditions so different that they constitute areas of limited occurrence. This is pointed out in the discussion of the distribution of plants in the county.

*Nomenclature.* It should be noted that the nomenclature is that of the period when the field work was done, about 10 years ago. Since that time there have been several revisions of the then existing names of the plants, in some cases the name of a given plant having been changed five times in the 10 years, so that it is apparent that stability and uniformity are not yet reached. This is enforced by the fact that since this report has been in preparation, a new edition of the manual from which the names given were taken, has appeared and varies radically from the work upon which the last revision of the Michigan Flora by Dr. W. J. Beal was made in 1904; since this appearance of the revised edition of Gray's Manual (7th) it is reported that Britton's Illustrated Flora and probably his Manual are also in the process of revision, and with the revision will appear many new names to adapt the nomenclature to the latest changes of the code of revision, or to the author's latest fancies, as to what is right.

In consideration of these facts and in view also of the fact that no specimens of most of the species were saved to check up the identification of forms that have since been split up into two or more species, it is deemed best to use the names under which the original identifications were made, namely those found in the 6th Edition of Gray's Manual of Botany.

In order that this list may be compared with the last edition (1904) of the Michigan Flora, and through that with Britton's Manual of Botany of the Northeastern United States, the numbers given the species in the Michigan Flora[1] are enclosed in brackets after the name of the plant. By means of these cross references it will also be possible to learn something of the general distribution of the species given in the State at large.

### A LIST OF PLANTS FOUND GROWING WITHOUT CULTIVATION IN TUSCOLA COUNTY, WITH NOTES REGARDING THEIR COMMON HABITATS:

(Numbers in parentheses refer to the corresponding plant name in the Michigan Flora, W. J. Beal, Lansing, 1904.)

*Anemone Pennsylvanica,* L. (997)
Common on the prairies of Akron and Wisner Tps.

*Anemone Virginiana,* L. (1003)
Sandy soil, Akron Tp.

*Aquilegia Canadensis,* L. (995)
Dry stoney and sandy soil, common.

*Clematis Virginiana,* L. (1008)
Thickets along streams and in moist soil.

[1] By W. J. Beal, Sixth Report Michigan Academy of Science, Lansing, 1904.

*Hepatica acutiloba*, DC. (1004)
Beech and maple woods throughout.
*Hepatica triloba*, Chaix. (1005)
Dry, oak and pine woods throughout.
*Ranunculus abortivus*, L. (1010)
Swampy woods. Less often in open ground.
*Ranunculus acris*, L. (1011)
Roadsides and pastures. Millington and Arbela Tps.
*Ranunculus circinatus*, Sibth. (1028)
Ditches; mill ponds at Caro and Vassar.
*Ranunculus multifidus*, Pursh. (1013)
Ponds and ditches in woods, Columbia Tp.
*Ranunculus Pennsylvanicus*, L. f. (1020)
Moist and wet open soil, frequent.
*Ranunculus recurvatus*, Poir. (1022)
Rich woods, frequent.
*Ranunculus sceleratus*, L. (1026)
Ditches, Gilford Tp., etc.
*Thalictrum dioicum*, L. (1031)
"Islands" in the prairies, Akron Tp.
*Thalictrum purpurascens*, L. (1033)
Common on the borders of the prairies and in open swamps generally.
*Liriodendron Tulipifera*, L. (984)
Southern part of Fremont and in Watertown Tps.
*Menispermum Canadense*, L. (1038)
Borders of low woodlands and marshes. Akron and Columbia Tps.
*Berberis vulgaris*, L. (1034)
Roadside in Wisner Tp.
*Podophyllum peltatum*, L. (1037)
Rich woodlands throughout.
*Nuphar advena*, L. f. (977)
Ponds and ditches throughout.
*Nymphæa reniformis*, DC. (981)
Dayton township in lakes.
*Sanguinaria Canadensis*, L. (1042)
Woods, Almer Tp.
*Arabis laevigata*, Poir. (1104)
Sandy ridges and poor soil, Akron and Wisner Tps.
*Arabis lyrata*, L. (1105)
Dunes along the shore of Saginaw Bay, in Akron and Wisner Tps.
*Brassica nigra*, Koch. (1066)
Cultivated and waste land.
*Cakile Americana*, Nutt. (1061)
Sand dunes and upper strand along Saginaw Bay.
*Erysimum cheiranthoides*, L. (1107)
Roadsides and fields.
*Lepidium Virginicum*, L. (1054)
Sandy fields and roadsides, common.



*Nasturtium Armoracia*, Fries. (1073)
Ditches and waste places.
*Nasturtium palustre*, DC. (1077)
Open marshy places and along ditches, Akron Tp.
*Raphanus Raphanistrum*, L. (1067 b)
Escaped in sandy waste places, near dwellings.
*Helianthemum Canadense*, Michx. (1469)
Sandy ridges near the Bay.
*Lechea major*, Michx. (1475)
Sandy "islands," prairies, Akron Tp.
*Viola blanda*, Willd., var. *palustriformis*, Gray. (1484 a)
Cold swamps in Wells Tp.
*Viola palmata*, L., var. *cucullata*, Gray. (1479 a)
Common in rich soil.
*Viola pubescens*, Ait. (1487)
Moist rich woods.
*Arenaria serpyllifolia*, L. (967)
Sandy fields.
*Cerastium vulgatum*, L. (964)
Common in cultivated ground, also in moist woods and pastures.
*Lychnis Coronaria*, L. (945)
Escaped from cultivation around cemeteries and houses in a few places.
*Saponaria officinalis*, L. (947)
Roadsides, common.
*Silene antirrhina*, L. (937)
Sandy soil, common.
*Silene noctiflora*, L. (939)
Waste places and cultivated land.
*Stellaria media*, Smith. (957)
Moist soil, common.
*Claytonia Virginica*, L. (933)
Rich woodlands.
*Portulaca oleracea*, L. (935)
Cultivated grounds, common.
*Elodes campanulata*, Pursh. (1468)
Marshes, common.
*Hypericum Ascyron*, L. (1457)
Kingston Tp., in dry sandy soil.
*Hypericum Canadense*, L. (1459)
Along the shores of the Bay in Akron Tp.
*Hypericum Kalmianum*, L. (1461)
Prairies in Akron Tp.
*Hypericum maculatum*, Walt. (1462)
Sandy roadsides and fields.
*Hypericum perforatum*, L. (1465)
Common in poor soils.
*Althæa rosea*, Cav. (1446 a)
Common Holyhock. Escaped from cultivation along moist roadsides in Fairgrove and Columbia Tps.

*Malva moschata,* L. (1448)
Common in most parts of the county by the roadsides.
*Malva rotundifolia,* L. (1449)
Common in all waste places especially roadsides and near houses.
*Malva sylvestris,* L. (1450)
Millington Tp. by the roadsides.
*Tilia Americana,* L. (1445)
Rich woodlands.
*Geranium Carolinianum,* L. (1352)
Burned-over sandy land in the Cass river valley, Vassar Tp.
*Geranium maculatum,* L. (1354)
Rich woods, common.
*Impatiens fulva,* Nutt. (1431)
Swampy roadsides and woods, common.
*Xanthoxylum Americanum,* Mill. (1371)
Low, moist thickets and roadsides in Akron and Fairgrove Tps.
*Celastrus scandens,* L. (1418)
*Ampelopsis quinquefolia,* Michx. (1442)
Moist woods and swamps. Frequent also on the sand dunes in Wisner and Akron Tps.
*Vitis riparia,* Michx. (1441)
Sandy dune lines near the Bay, in Akron and Wisner Tps.
*Acer dasycarpum,* Ehrh. (1425)
Common in low woodlands.
*Acer rubrum,* L. (1424)
Common throughout.
*Acer saccharinum,* Wang., (1426)
Common on good soil.
*Acer saccharinum,* Wang., var. *nigrum,* Torr. & Gray. (1420 a)
Frequent in Akron and Columbia Tps.
*Negundo aceroides,* Mœnch. (1420)
Banks of Cass near Vassar. Planted generally.
*Staphylea trifolia,* L. (1419)
Cass river valley north of Vassar and in Tuscola Tp.
*Rhus Canadensis,* Marsh. (1405)
Sand ridges and dunes near the Bay in Akron Tp.
*Rhus glabra,* L. (1407)
Common throughout.
*Rhus Toxicodendron,* L. (1410 and 1412)
Very common on the sandy dune lines near the Bay.
*Rhus typhina,* L. (1408)
Common in sand ridges and poor soil throughout.
*Polygala polygama,* Walt. (1378)
Low sand ridges on the prairies and in Indianfields Tp.
*Polygala Senega,* L. (1379)
Low sandy areas on the prairies of Akron and Wisner Tps.
*Amphicarpæa monica,* Nutt. (1348)
Frequent along the edges of the prairies.
*Apios tuberosa,* Mœnch. (1350)
Moist thickets.



*Astragalus Cooperi,* Gray. (1313)
Sandy soil, Sec. 9, Koylton Tp.
*Desmodium acuminatum,* DC. (1319)
Open dry woods and oak islands in prairies of Akron Tp.
*Desmodium Canadense,* DC. (1316)
Sandy soil, prairies.
*Desmodium nudiflorum,* DC. (1323)
Oak woods and islands in the prairies.
*Desmodium paniculatum,* DC. (1325)
Oak woods and islands in the prairies.
*Lathyrus maritimus,* Bigelow. (1343)
Akron Tp. along sandy beaches.
*Lathyrus palustris,* L. (1346)
Wet meadows and prairies.
*Lespedeza capitata,* Michx. (1330)
Sandy ridges and flats, Akron and Columbia Tps.
*Lespedeza polystachya,* Michx. (1332)
Sandy ridges and flats, Akron and Columbia Tps.
*Lespedeza violacea, Pers.* (1336)
Sandy and gravelly woods, Watertown Tp.
*Melilotus alba,* Lam. (1294)
Roadsides and waste places.
*Robinia Pseudacacia,* L. (1310)
Frequently planted.
*Trifolium agrarium,* L. (1297)
Roadsides in Watertown Tp.
*Trifolium arvense,* L. (1296)
Noted in a single station in southwest Watertown and also near Vassar R. R. station.
*Trifolium hybridum,* L. (1301)
Common in fields and by roadsides.
*Trifolium pratense,* L. (1303)
The most abundant clover.
*Trifolium repens,* L. (1305)
Common in pastures and roadsides.
*Agrimonia Eupatoria,* L. (1195)
Rich low woods in Columbia Tp.
*Agrimonia parviflora,* Ait. (1197)
Columbia Tp., beech and maple woods.
*Amelanchier Canadensis,* Torr. and Gray. (1223)
Rich woods Akron and Columbia Tps. Also on dunes along the Bay shore.
*Amelanchier Canadensis,* Torr. and Gray, var. *oblongifolia,* Torr. and Gray. (1224)
Swampy woods throughout.
*Cratægus Crus-galli,* L. (1237)
Rather frequent in the prairie district of Akron and Wisner Tps. One tree about a foot in diameter noted in north part of Akron Tp.
*Cratægus coccinea,* L. (1236)
Frequent in open woods.

*Crataegus punctata*, Jacq. (1261)
Frequent by roadsides and in pastures along streams.
*Crataegus tomentosa*, L. (1268)
Moist woods and in fence rows.
*Fragaria vesca*, L. (1173)
Found rarely in cold swamps, Almer, Dayton and Fremont townships.
*Fragaria Virginiana*, Mill. (1175)
Fields and woods. Very abundant along the borders of the oak islands and sandy spots in the prairies of Akron and Wisner Tps.
*Geum album*, Gmelin. (1187)
Common in rich woods.
*Geum strictum*, Ait. (1190)
Common in rich woods and moist places.
*Geum Virginianum*, L. (1192)
Rich woodlands and wet open grounds.
*Potentilla Anserina*, L. (1177)
Frequent on the sandy tracts in the prairies of Akron and Wisner Tps. and in moist places along the dunes of the Bay; also inland in moist sand.
*Potentilla argentea*, L. (1178)
Roadsides in sandy and poor soil in Watertown, Dayton & Wells Tps.
*Potentilla fruticosa*, L. (1171)
Moist or dry sandy soil back of Algonquin beach in Akron Tp.
*Potentilla Norvegica*, L. (1181)
Waste places and fields everywhere.
*Potentilla palustris*, Scop. (1176)
Wet bogs around lakes and ponds.
*Prunus Americana*, Marshall. (1270)
Thickets and roadsides.
*Prunus pumila*, L. (1277)
Sand dunes near the Bay in Akron and Wisner Tps.
*Prunus Pennsylvanica*, L. f. (1276)
Common in old pine slashing in Indianfields and Vassar Tps. Also in Watertown and Fremont Tps.
*Prunus serotina*, Ehrh. (1278)
Rich woods, also in pine slashings and on dunes.
*Prunus Virginiana*, L. (1279)
Sand dunes in Akron and Wisner Tps.
*Pyrus arbutifolia*, L. f., var. *melanocarpa*, Hook. (1221)
Swamps in Dayton Tp.
*Pyrus coronaria*, L. (1218)
Akron Tp.
*Rosa blanda*, Ait. (1202)
Sandy soil.
*Rosa canina*, L. (1203)
Roadsides near old gardens in Columbia Tp.
*Rosa Carolina*, L. (1205)
Swamps and marshes.



*Rosa humilis*, Marsh. (1209)
Sandy soil, common.
*Rosa rubiginosa*, L. (1210)
Roadsides.
*Rosa Sayi*, Schwein. (1211)
Sand dunes along Saginaw Bay.
*Rubus Canadensis*, L. (1156)
Light sandy and gravelly soil.
*Rubus hispidus*, L. (1158)
Sandy plains, Indianfields and Vassar Tps.
*Rubus occidentalis*, L. (1162)
Frequent in the clayey parts of the county.
*Rubus setosus*, Bigel. (1165)
Borders of swamps, Dayton Tp.
*Rubus strigosus*, Michx. (1166)
Common on nearly all types of soil.
*Rubus triflorus*, Richardson. (1154)
Swamps, Dayton, Wells and Watertown Tps.
*Rubus villosus*, Ait. (1161a)
Common on sandy soil and variable.
*Spiræa salicifolia*, L. (1150)
Borders of swamps and marshes.
*Spiræa tomentosa*, L. (1152)
Borders of swamps, Dayton and Wells Tps.
*Mitella diphylla*, L. (1132)
Moist and wet woods.
*Parnassia Caroliniana*, Michx. (1135)
Wet or moist soil, prairies, Akron Tp.
*Ribes Cynosbati*, L. (1139)
Rich woodlands, Columbia, Fairgrove and Akron Tps.
*Ribes floridum*, L'Her. (1140)
Rich woodlands.
*Ribes oxyacanthoides*, L. (1143)
Roadsides.
*Ribes rubrum*, L., var. *subglandulosum*, Maxim. (1146)
Tamarack swamps, Watertown, Akron and Dayton Tps.
*Penthorum sedoides*, L. (1123)
Ditches; very common late in the season.
*Sedum acre*, L. (1121)
Roadsides in light sand.
*Hamamelis Virginiana*, L. (1147)
Common.
*Proserpinaca palustris*, L. (1533)
Common in ditches in the prairies of Akron and Wisner Tps.
*Decodon verticillatus*, Ell. (1505)
Shay Lake and other ponds in the S. E. part of the county.
*Lythrum alatum*, Pursh. (1506)
Prairies and roadsides in their vicinity in Akron, Wisner and northern Gilford Tps.
*Circæa alpina*, L. (1529)
Rich low woodlands.

*Circæa Lutetiana,* L. (1530)
Beech and maple woods.
*Epilobium adenocaulon,* Haussk. (1513)
Marshes in Akron Tp.
*Epilobium augustifolium,* L. (1512)
Common in sandy lands in central part of the county.
*Epilobium coloratum,* Muhl. (1514)
Low meadows and pastures throughout.
*Ludwigia palustris,* Ell. (1509)
Common in ditches and wet places forming dense mats on the surface of wet mud.
*Ludwigia polycarpa,* Short and Peter. (1511)
Ditches and wet marshy places in prairies of Akron Tp.
*Œnothera biennis,* L. (1520)
Sandy soil and other light soils. Abundant on the sand dunes along the Bay.
*Echinocystis lobata,* Torr. and Gray. (1959)
Possibly escaped from cultivation along streams.
*Cicuta maculata,* L. (1575)
Wet open grounds and roadsides.
*Cryptotænia Canadensis,* DC. (1576)
Low rich woodlands.
*Daucus Carota,* L. (1546)
Escaped from cultivation to roadsides in a few places.
*Osmorrhiza brevistylis,* DC. (1566)
Rich woodlands.
*Pimpinella integerrima,* Benth. & Hook. (1564)
Borders on prairies and oak islands in Akron and Wisner Tps.
*Sanicula Marylandica,* L. (1562)
Rich woods.
*Sium cicutæfolium,* Gmelin. (1569)
Borders of ponds and in ditches, etc.
*Thaspium aureum,* Nutt. (1558)
Dry grounds, Millington and Watertown Tps.
*Aralia hispida,* Vent. (1540)
Common on sandy soil in Indianfields, Vassar, Fremont and Watertown Tps.
*Aralia racemosa,* L. (1542)
Rich moist woodlands.
*Aralia nudicaulis,* L. (1541)
Common.
*Aralia trifolia,* Decsne. and Planch. (1545)
Rich moist woodlands.
*Cornus Baileyi,* Coulter & Evans. (1584)
Sand dunes near Saginaw Bay.
*Cornus Canadensis,* L. (1586)
Indianfields Tp. in old pine slashings.
*Cornus circinata,* L'Her. (1587)
Rich low woodlands, Columbia and Fairgrove Tps.
*Cornus paniculata,* L'Her. (1585)
Common especially on oak islands in the prairies.



*Cornus sericea,* L. (1582)
Common along streams.
*Cornus stolonifera,* Michx. (1590)
Common in wet places especially on the prairies of Akron and Wisner Tps., where it has spread rapidly since they were drained.
*Diervilla trifida,* Moench. (1953)
Common on dunes in Akron and Wisner Tps. and on sandy and gravelly soil in other parts of county.
*Lonicera ciliata,* Muhl. (1942)
Rich, moist or swampy woods.
*Lonicera glauca,* Hill. (1944)
Rich low grounds.
*Sambucus Canadensis,* L. (1924)
Common.
*Viburnum acerifolium,* L. (1926)
Dry woods and hillsides.
*Viburnum Lentago,* L. (1930)
Swampy brush lands.
*Galium Aparine,* L. (1911)
Thickets in low ground, Gilford and Akron Tps.
*Galium boreale,* L. (1913)
Very abundant on oak islands and other slight sandy elevations above the marsh level in the prairies.
*Galium circaezans,* Michx. (1914)
Rich woods.
*Galium triflorum,* Michx. (1923)
Rich woods.
*Mitchella repens,* L. (1910)
Rich woodlands.
*Valeriana sylvatica,* Banks. (1955)
Cold swamps in Dayton Tp.
*Dipsacus sylvestris,* Mill. (1958)
Becoming common in Tuscola county as a weed.
*Achillea Millefolium,* L. (2193)
Common in fields and by roadsides throughout.
*Ambrosia artemisiæfolia,* L. (2011)
Common by roadsides and in cultivated land.
*Anaphalis margaritacea,* Benth. and Hook. (2136)
Common in the sandy portions of the Cass valley.
*Antennaria plantaginifolia,* Hook. (2135)
This and related species are very common on oak islands in the prairies of Akron Tp.
*Anthemis Cotula,* DC. (2195)
Waste places and roadsides.
*Artemisia Absinthium,* L. (2203)
Occasional along roadsides.
*Artemisia biennis,* Willd. (2205)
Common in the western part of the county.
*Artemisia caudata,* Michx. (2207)
Sand dunes along Saginaw Bay.

*Aster corymbosus*, Ait. (2072)
Woods common.
*Aster ericoides*, L. (2074)
Prairie "islands," Akron Tp., light sandy soil.
*Aster junceus*, Ait. (2080)
Prairies, Akron Tp.
*Aster lævis*, L. (2081)
Sandy soil.
*Aster macrophyllus*, L. (2089)
Common in dry woods.
*Aster Novæ-Angliæ*, L. (2093)
Prairies, Akron Tp.
*Aster paniculatus*, Lam. (2096)
Common.
*Aster puniceus*, L. (2103)
Swamps common.
*Aster sagittifolius*, Willd. (2105)
Prairies, Akron and Wisner Tps.
*Aster unbellatus*, Mill. (2123)
Common in sandy swamps.
*Bidens connata*, Muhl. (2185)
Common in ditches and swampy places.
*Bidens frondosa*, L. (2187)
Ditches and moist places generally.
*Cacalia tuberosa*, Nutt. (2217)
Abundant in moist prairies in Akron and Wisner Tps.
*Chrysanthemum Balsamita*, L., var. *tanacetoides*, Boiss. (2196)
Frequently established by roadsides in several parts of the county.
*Chrysanthemum Leucanthemum*, L. (2197)
Roadsides and fields, occasional.
*Coreopsis trichosperma*, Michx., var. *tenuiloba*, Gray. (2188)
Marshes throughout the county.
*Cnicus altissimus*, Willd., var. *discolor*, Gray. (2231)
Cass River valley in sandy and gravelly soil; common near Wajamega.
*Cnicus arvensis*, Hoffm. (2229)
Very abundant in parts of the county, in grain fields.
*Cnicus lanceolatus*, Hoffm. (2233)
Common in pastures and by roadsides.
*Cnicus muticus*, Pursh. (2234)
Marshes and prairies.
*Erechtites hieracifolia*, Raf. (2215)
Open places in woods and in burned over areas.
*Erigeron annuus*, Pers. (2116)
Roadsides and fields, often in light soil.
*Erigeron bellidifolius*, Muhl. (2120)
Often abundant on sandy "islands" in the prairies of Akron and Wisner Tps.
*Erigeron Canadensis*, L. (2122)
A bad weed in sandy fields.



*Erigeron Philadelphicus*, L. (2119)
Common in fields and moist prairie land.
*Erigeron strigosus*, Muhl. (2121)
Common.
*Eupatorium ageratoides*, L. f. (2025)
Rich woods, Almer Tp.
*Eupatorium perfoliatum*, L. (2028)
Common in swamps and on the prairies.
*Eupatorium purpureum*, L. (2029)
Common in swamps and along ditches and water courses.
*Gnaphalium decurrens*, Ives. (2137)
Sandy soil generally.
*Gnaphalium polycephalum*, Michx. (2138)
Common in sandy soil.
*Gnaphalium uliginosum*, L. (2140)
Frequent by roadsides in sandy soil.
*Helenium autumnale*, L. (2190)
Stream valleys.
*Helianthus decapetalus*, L. (2159)
Frequent in Wells and Dayton Tps.
*Helianthus giganteus*, L. (2161)
Common on the prairies and frequent in borders of swamps elsewhere.
*Hieracium Canadense*, Michx. (1997)
Common in sandy soil.
*Hieracium Gronovii*, L. (1998)
Common on sandy plains and ridges throughout.
*Hieracium longipilum*, Torr. (1999)
Abundant on some of the older duney ridges near, and south of Bay Park. Not seen elsewhere.
*Hieracium venosum*, L. (2005)
Sandy woodlands, Indianfields and Vassar Tps.
*Inula Helenium*, L. (2142)
Roadsides in Akron, Columbia and Fairgrove Tps.
*Krigia amplexicaulis*, Nutt. (1978)
Sandy soil in prairies of Akron Tp.
*Krigia Virginica*, Willd. (1977)
Low sand ridges in the prairies of Akron Tp.
*Lactuca Canadensis*, L. (1988)
Common on sandy soil.
*Lactuca hirsuta*, Muhl. (1990)
Sandy soil near Caro.
*Lactuca Scariola*, L. (1995a)
Waste places about houses, etc.
*Liatris cylindracea*, Michx. (2035)
Sandy and gravelly ridges in the Cass valley.
*Liatris spicata*, Willd. (2038)
Abundant on prairies of Akron and Wisner Tps., on the sandy flats and borders of oak islands.
*Prenanthes alba*, L. (2006)
Common on good soil in moist places.

*Prenanthes altissima*, L. (2007)
Common in moist woodlands.
*Rudbeckia hirta*, L. (2152)
Roadsides and fields; also appearing to be native in the dryer parts of the prairies of Akron and Wisner Tps.
*Rudbeckia laciniata*, L. (2153)
Open swamps, frequent.
*Senecio aureus*, L. (2219)
Moist and wet woodlands.
*Senecio aureus*, L., var. *Balsamitæ*, T. & G. (2222)
Very abundant on sandy "islands" in the prairies and along the moist slopes on the dunes in Akron & Wisner Tps. The sandy islands often covered with the bright yellow blossoms of this form during the last of May and early June.
*Silphium terebinthinaceum*, L. (2149)
Common on the sandy islands of the prairies in Akron and Wisner Tps.
*Solidago Canadensis*, L. (2044)
Very common.
*Solidago cæsia*, L. (2042)
Rich woodlands throughout.
*Solidago juncea*, Ait. (2051)
Common in sandy soil especially in the Cass valley.
*Solidago lanceolata*, L. (2069)
Common in moist sandy soil throughout.
*Solidago latifolia*, L. (2048)
In beech and maple woods; less often in elm and ash growth.
*Solidago nemoralis*, Ait. (2055)
Abundant in dry sandy soil, especially in the old pine lands in the central and southern part of the county.
*Solidago Ohioensis*, Riddell. (2056)
Abundant on the wet parts of prairies in Akron and Wisner Tps.
*Solidago patula*, Muhl. (2057)
Open swamps and low grounds throughout.
*Solidago Ridellii*, Frank. (2060)
Common on the prairies, Akron Tp.
*Solidago rugosa*, Muhl. (2061)
Dry sandy soil throughout the county.
*Solidago serotina*, Ait. (2062)
Common in moist soil throughout.
*Solidago ulmifolia*, Muhl. (2066)
Swampy woods in Columbia and Fairgrove Tps.
*Sonchus arvensis*, L. (1985)
Roadsides in a few places.
*Sonchus asper*, Vill. (1986)
Cultivated and waste grounds common.
*Sonchus oleraceus*, L. (1987)
Cultivated and waste grounds common.
*Tanacetum vulgare*, L. (2200)
Roadsides, common.



*Taraxacum officinale*, Weber. (1984)
Common.
*Tragopogon porrifolius*, L. (1981)
Roadsides in a few places.
*Tragopogon pratensis*, L. (1982)
Roadsides near Caro and Vassar.
*Vernonia altissima*, Nutt., var. *grandiflora*, Nutt. (2019)
Prairies, Akron Tp.
*Xanthium Canadense*, Mill. (2015)
Common along ditches.
*Lobelia cardinalis*, L. (1968)
Ditches and swamps frequent throughout.
*Lobelia inflata*, L. (1971)
Sandy soil, Indianfields and Wells Tps.
*Lobelia Kalmii*, L. (1970)
Common on the muddy shores of Saginaw Bay in Akron Tp.
*Lobelia spicata*, Lam. (1972)
Very common on the edge of sandy "islands" in the prairies of Akron Tp.
*Lobelia syphilitica*, L. (1974)
Moist places in Dayton, Millington and Wells Tps.
*Campanula Americana*, L. (1961)
Rich, moist woods, Columbia and Fairgrove Tps.
*Campanula aparinoides*, Pursh. (1962)
Marshes and prairies, Akron and Wisner Tps.
*Campanula rotundifolia*, L. (1964)
Sandy ridges and dunes along Saginaw Bay.
*Arctostaphylos Uva-ursi*, Spreng. (1614)
Sand dunes near Saginaw Bay.
*Cassandra calyculata*, Don. (1611)
Boggy margins of lakes in Dayton and Watertown Tps.
*Chiogenes serpyllifolia*, Salisb. (1628)
Cedar swamps in various parts of the county.
*Gaultheria procumbens*, L. (1613)
Very abundant in the pine lands in the Cass valley.
*Gaylussacia resinosa*, T. & G. (1615)
Sandy soils, common.
*Pyrola elliptica*, Nutt. (1594)
Rich, moist woodlands.
*Vaccinium corymbosum*, L. (1620)
Abundant in a swamp in Koylton Tp. and probably in other swamps.
*Vaccinium macrocarpon*, Ait. (1629)
Sphagnum bogs in Dayton and Watertown Tps.
*Vaccinium Pennsylvanicum*, Lam. (1624)
Common in dry sandy soil throughout.
*Lysimachia nummularia*, L. (1635)
Well established by roadsides near Columbia P. O. on the banks of a ditch.
*Lysimachia quadrifolia*, L. (1637)
Sandy soil in Indianfields and Vassar Tps.

*Lysimachia stricta,* Ait. (1638)
Borders of the prairies, Akron Tp.
*Samolus Valerandi,* L., var. *Americanus,* Gray. (1634)
Sandy banks of pools in Watertown Tp.
*Steironema ciliatum,* Raf. (1639)
Marshes and other moist places common.
*Steironema longifolium,* Gray. (1642)
Very common on the prairies of Akron and Wisner Tps. and in wet places in the adjoining counties.
*Trientalis Americana,* Pursh. (1644)
Beech and maple woods, Columbia Tp.
*Fraxinus Americana,* L. (1649)
Frequent in the county generally in good well drained soil.
*Fraxinus sambucifolia,* Lam. (1651)
Swamps. Abundant in Akron, Wisner and Gilford Tps.
*Apocynum androsæmifolium,* L. (1673)
Sandy ridges and plains, Indianfields Tp.
*Apocynum cannabinum,* L. (1674)
Terraces of Cass river, south of Caro.
*Acerates longifolia,* Ell. (1689)
Abundant on the sandy islands in the prairies in Akron and Wisner Tps.
*Asclepias Cornuti,* Descaisne. (1685)
Abundant in poor soils throughout the county.
*Asclepias incarnata,* L. (1681)
Wet open swamps and marshes common.
*Asclepias phytolaccoides,* Pursh. (1680)
Good soil and moist places in Akron, Columbia & Fairgrove Tps.
*Asclepias purpurascens,* L. (1683)
Frequent on sandy islands in the prairies of Akron and Wisner Tps.
*Asclepias Sullivantii,* Engelm. (1686)
Common on the prairies of Akron Tp.
*Asclepias tuberosa,* L. (1687)
Abundant on light sand in various parts of the county.
*Gentiana Andrewsii,* Griseb. (1656)
Moist, open ground and in the prairies of Akron and Wisner Tps.
*Gentiana crinita,* Froel. (1657)
Moist meadows.
*Halenia deflexa,* Griseb. (1667)
In swampy woods by the roadsides, Fremont Tp., 3 miles north of Mayville.
*Menyanthes trifoliata,* L. (1670)
Southeastern part of Arbela Tp., in swampy margin of Mud Lake.
*Cynoglossum officinale,* L. (1716)
A common roadside weed on sandy soil throughout.
*Echinospermum Lappula,* Lehm. (1720)
Low, rich woodlands, Akron Tp.
*Lithospermum arvense,* L. (1729)
Cultivated fields and waste places. Common, especially in the western part of the county.



*Lithospermum hirtum,* Lehm. (1731)
Sandy ridges in the prairies and along the Bay shore, Akron Tp.
*Lithospermum officinale,* L. (1733)
Roadsides, Watertown Tp., about a mile south of Mayville.
*Myosotis verna,* Nutt. (1727)
Sandy islands in Prairies in Akron Tp.
*Convolvulus arvensis,* L. (1693)
Water places in the villages.
*Convolvulus sepium,* L. (1697)
Common along the sand dunes of Saginaw Bay and on the "islands" of the prairies in Akron & Wisner Tps. Also in marshes generally.
*Cuscuta Gronovii,* Willd. (1705)
Frequent as parasite on herbs and shrubs in wet places.
*Datura Tatula,* L. (1824)
Waste places at Millington.
*Lycium vulgare,* Dunal. (1820)
Roadsides in Juniata Tp.
*Physalis Virginiana,* L. (1813)
Sandy soil, Indianfields Tp.
*Solanum Dulcamara,* L. (1817)
Common along streams and in swamps.
*Solanum nigrum,* L. (1818)
Waste places and cultivated grounds common.
*Castilleia coccinea,* Spreng. (1874)
Common on sandy islands in the prairies, Akron Tp.
*Chelone glabra,* L. (1835)
Swampy places; frequent in Koylton and Dayton Tps.
*Gerardia pedicularia,* L. (1865)
Oak islands in the prairies of Akron Tp. Also on gravelly ridges in Fremont and Watertown Tps.
*Gerardia purpurea,* L., var. *paupercula,* Gray. (1869)
Moist sandy soil, Wells Tp. Also shores of Saginaw Bay.
*Ilysanthes riparia,* Raf. (1847)
Wet muddy banks of small ponds in Wells and Vassar Tps.
*Linaria Canadensis,* Dumont. (1830)
Sand dunes near Saginaw Bay.
*Linaria vulgaris,* Mill. (1831)
Roadsides throughout the county.
*Melampyrum Americanum,* Michx. (1880)
Common in the pine lands and in sandy soil throughout.
*Pedicularis Canadensis,* L. (1876)
Woods in Columbia Tp.
*Pedicularis lanceolata,* Michx. (1877)
Swamps and marshes.
*Scrophularia nodosa,* L., var. *Marilandica,* Gray. (1834)
Dry soil near Wajamega.
*Verbascum Thapsus,* L. (1828)
Abundant in sandy fields.
*Veronica Americana,* Schweinitz. (1852)
Brooks, Wells Tp.

*Veronica Anagallis*, L. (1853)
Ditches, common in the drained part of the county.
*Epiphegus Virginiana*, Bart. (1892)
Beech woods, Columbia and Almer Tps.
*Verbena hastata*, L. (1741)
Low open ground common throughout.
*Verbena urticæfolia*, L. (1746)
Common in Fairgrove Tp. along creek bottoms.
*Brunella vulgaris*, L. (1765)
Common throughout.
*Calamintha Clinopodium*, Benth. (1787)
Dry woods. Sand dunes near the Bay, Akron & Wisner Tps.
*Leonurus Cardiaca*, L. (1769)
Roadsides and near houses throughout.
*Lycopus sinuatus*, Ell. (1793)
Open marshes throughout.
*Lycopus Virginicus*, L. (1793a)
Moist to swampy woodlands, Akron and Columbia Tps.
*Mentha Canadensis*, L. (1798)
Common in the prairies and in other wet open ground.
*Mentha piperita*, L. (1801)
Ditches and moist, open soil near houses.
*Mentha viridis*, L. (1803)
Roadsides near dwellings.
*Monarda fistulosa*, L. (1777)
Dry soil, common throughout.
*Nepeta Cataria*, L. (1762)
Common in waste places and in swampy woods in Akron Tp.
*Nepeta Glechoma*, Benth. (1763)
Waste places; frequent in lawns in the towns.
*Pycnanthemum lanceolatum*, Pursh. (1790)
Prairies and marshes, Akron and Wisner Tps.
*Scutellaria galericulata*, L. (1755)
Open swamps and marshes throughout.
*Scutellaria lateriflora*, L. (1756)
Swamps frequent throughout.
*Stachys aspera*, Michx. (1772)
Prairies and open swamps, occasional throughout.
*Teucrium Canadense*, L. (1751)
Along the beach and margins of marshes, Akron and Wisner Tps.
*Plantago lanceolata*, L. (1900)
Cultivated fields, lawns and roadsides, common throughout.
*Plantago major*, L. (1901)
Roadsides and waste places throughout.
*Plantago Rugelii*, Decaisne. (1904)
Roadsides and waste places throughout.
*Amarantus albus*, L. (922)
A common weed.
*Amarantus blitoides*, Watson. (921)
Cultivated ground, becoming common.



*Amarantus hypochondriacus*, L. (923)
Escaped from cultivation in a few places.
*Chenopodium album*, L. (903)
Common throughout in waste and cultivated lands.
*Chenopodium Botrys*, L. (908)
Sand dunes and dry sand near Bay Park, Akron Tp.
*Chenopodium capitatum*, Watson. (915)
Frequent in moist soil throughout.
*Chenopodium hybridum*, L. (910)
Waste places about dwellings throughout.
*Cycloloma platyphyllum*, Moq. (916)
In light sand, Indianfields Tp., near Caro.
*Salsola Tragus*, L. (920)
Sandy roadside, terrace of Cass river, opposite Caro and near the railway crossing at Vassar.
*Fagopyrum esculentum*, Moench. (872)
Common by roadsides.
*Polygonella articulata*, Meisn. (902)
Sand dunes and sandy beaches near Saginaw Bay in Akron and Wisner Tps.
*Polygonum amphibium*, L. (873)
Ditches in Gilford and Wisner Tps.
*Polygonum aviculare*, L. (875)
Dooryards and roadsides everywhere.
*Polygonum cilinode*, Michx. (877)
Dry woods on the east side of Dayton Tp.
*Polygonum Convolvulus*, L. (878)
Common throughout.
*Polygonum dumetorum*, L., var. *scandens*, Gray. (898)
Sand dunes and low woods, Akron and Gilford Tps.
*Polygonum erectum*, L. (881)
Dooryards and roadsides in most villages.
*Polygonum Hydropiper*, L. (883)
Moist grounds in pastures and around houses.
*Polygonum hydropiperoides*, Michx. (884)
Streams and ditches in Akron, Wisner and Gilford Tps.
*Polygonum Muhlenbergii*, Watson. (880)
Ditches and streams frequent.
*Polygonum orientale*, L. (891)
Escaped from gardens to roadsides, etc., in a few places.
*Polygonum Pennsylvanicum*, L. (892)
Banks of ditches in Columbia and Akron Tps.
*Polygonum Persicaria*, L. (893)
Cultivated and waste grounds throughout.
*Rumex Acetosella*, L. (863)
Sandy fields, common throughout.
*Rumex Brittanica*, L. (865)
Marshes, Dayton and Koylton Tps.
*Rumex crispus*, L. (866)
A common weed.

*Rumex obtusifolius,* L. (866a)
Common by roadsides and cultivated grounds throughout.
*Rumex verticillatus,* L. (871)
Shallow water in swamps in Gilford Tp.
*Asarum Canadense,* L. (858)
Rich woods, Almer Tp.
*Saururus cernuus,* L. (752)
Occasional along streams in Columbia Tp.
*Sassafras officinale,* Nees. (1039)
Dry woodlands, Watertown and Dayton Tps.
*Dirca palustris,* L. (1503)
Rich woods, Almer Tp.
*Comandra umbellata,* Nutt. (856)
Sandy soil along Saginaw Bay and in Indianfields Tp.
*Euphorbia Cyparissias,* L. (1387)
Sandy roadsides near old houses, etc., Columbia and Akron Tps.
*Euphorbia maculata,* L. (1393)
Dry sterile soils throughout.
*Bœhmeria cylindrica,* Wild. (853)
Swampy open places frequent.
*Humulus Lupulus,* L. (847)
Noted as an escape from cultivation in a few places.
*Pilea pumila,* Gray. (852)
Swampy woods, Columbia and Akron Tps.
*Ulmus Americana,* L. (841)
A dominant forest tree on the western side of the county on poorly drained soils.
*Ulmus fulva,* Michx. (842)
Common along streams.
*Ulmus racemosa.* Thomas. (843)
Occasional in rich, moist soils.
*Urtica gracilis,* Ait. (850)
Abundant on ditch banks in Akron Tp.
*Platanus occidentalis,* L. (1148)
A few specimens noted in Akron Tp.
*Carya alba,* Nutt. (761)
Frequent in the southeastern part of the county; Akron Tp.
*Carya amara,* Nutt. (760)
Occasional in rich woodlands.
*Juglans cinerea,* L. (753)
Arbela and Millington Tps.
*Juglans nigra,* L. (754)
Along the Cass river below Vassar.
*Myrica asplenifolia,* Endl. (764)
Light sandy soils, Indianfields and Wells Tps.
*Alnus incana,* Willd. (821)
Common along streams.
*Betula lutea,* Michx. f. (817)
Swamps, Wells and Indianfields Tps.
*Betula papyrifera,* Marshall. (818)
Light sandy soil in Cass river valley.



*Carpinus Caroliniana,* Walter. (811)
Common in rich woodlands.
*Castanea sativa,* Mill., var. *Americana.* Watson. (824)
A few trees by the roadside in Millington Tp., apparently planted.
*Corylus Americana,* Walt. (813)
Common in woods and brushlands throughout.
*Fagus ferruginea,* Ait. (823)
Formerly abundant on the better drained clayey soils and on the moraines.
*Ostrya Virginica,* Willd. (812)
Common with the beech and hard maple.
*Quercus alba,* L. (826)
Abundant in sand and gravelly soil throughout.
*Quercus bicolor,* Willd. (836)
Swampy woods on clayey soils.
*Quercus coccinea,* Wang. (829)
Sand dunes and plains in Cass river valley.
*Quercus coccinea,* Wang., var. *tinctoria,* Gray. (840)
Sandy "islands" in the prairies and on the dunes along the Bay shore in Akron and Wisner Tps.
*Quercus macrocarpa,* Michx. (834)
Frequent throughout.
*Quercus Muhlenbergii,* Engelm. (825)
Watertown Tp.
*Quercus rubra,* L. (838)
Common in the vicinity of Saginaw Bay.
*Populus alba,* L. (765)
Planted as a shade tree in many places.
*Populus balsamifera,* L. (766)
Common in the sandy parts of Cass river valley, in Indianfields, Wells and Novesta Tps., etc.
*Populus grandidentata,* Michx. (770)
Common in clearings and burned lands.
*Populus monilifera,* Ait. (768)
Frequent in the vicinity of Saginaw Bay and in moist places generally.
*Populus tremuloides,* Michx. (772)
Common throughout. Forms dense thickets on the recently drained prairies in Akron Tp.
*Salix alba,* L. var. *vitellina,* Koch. (774)
Planted in many places as a shade tree.
*Salix amygdaloides,* Anders. (775)
Border of the prairies and on low sand dunes along Saginaw Bay in Akron and Wisner Tps.
*Salix candida,* Willd. (780)
In a few bogs in Watertown, Arbela and Dayton Tps.
*Salix humilis,* Marsh. (794)
Abundant in the sandy areas and gravel ridges in Fremont, Dayton and Watertown Tps., Etc.
*Salix nigra,* Marsh. (800)
Along streams and on the shores of Saginaw Bay in Akron Tp.

*Larix Americana*, Michx. (104)
Bogs in Wells, Indianfields, Dayton and Watertown Tps. Also in Akron and Gilford Tps.

*Picea nigra*, Link. (107)
In a few swamps as that on the line between Indianfields and Fremont Tps., east of the stage road between Caro and Mayville.

*Pinus Strobus*, L. (103)
Formerly very abundant in many parts of the county, now nearly all gone except as young or poor specimens. Was seen practically all over the county.

*Thuya occidentalis*, L. (110)
Frequent in swamps. In many places in Akron Tp. appearing as undergrowth in swampy woods.

*Tsuga Canadensis*, Carr. (108)
Common along the western part of Koylton Tp., and eastern part of Wells Tp.

*Elodea Canadensis*, Michx. (172)
Common in streams and mill ponds.

*Vallisneria spiralis*, L. (173)
Mill ponds at Caro and Vassar. Ditches near Saginaw Bay.

*Calopogon pulchellus*, R. Br. (733)
Bog at Cat Lake, Dayton Tp.

*Cypripedium spectabile*, Salisb. (712)
Bog at Cat Lake, Dayton Tp.

*Habenaria leucophæa*, Gray. (727)
Wet prairies, Akron Tp.

*Habenaria psycodes*, Gray. (728)
Roadsides in swamp, Koylton Tp.

*Spiranthes cernua*, Richard. (734)
Moist grassy places, Fremont Tp., also in swales between dune lines on the prairies in Akron Tp.

*Iris versicolor*, L. (698)
Low grounds common throughout.

*Sisyrinchium anceps*, Cav. (703)
Abundant on sandy "islands," Akron Tp.

*Hypoxis erecta*, L. (695)
Prairies, Akron and Wisner Tps.

*Allium Canadense*, Kalm. (659)
Moist open sandy soil, borders of prairies, Akron and Wisner Tps.

*Allium tricoccum*, Ait. (662)
Rich woodlands, Columbia and Akron Tps.

*Asparagus officinalis*, L. (672)
Roadsides in several townships.

*Hemerocallis fulva*, L. (658)
Roadsides and waste places near houses.

*Lilium Philadelphicum*, L. (665)
Dry sandy ridges near Saginaw Bay in Akron Tp.

*Lilium superbum*, L. (666)
Prairies and wet meadows frequent.



*Maianthemum Canadense*, Desf. (677)
Common in dry woods, also in swampy plains in Indianfields and Vassar Tps.

*Polygonatum biflorum*, Ell. (680)
Rich woods, Columbia and Akron Tps.

*Smilacina racemosa*, Desf. (674)
Rich woodlands.

*Smilacina stellata*, Desf. (675)
Common on the sand dunes along Saginaw Bay.

*Smilax herbacea*, L. (691)
Borders of sand dunes and oak islands in the prairies of Akron and Wisner Tps.

*Smilax hispida*, Muhl. (693)
Low rich woodlands and thickets, Columbia and Akron Tps.

*Trillium grandiflorum*, Salisb. (685)
Rich, moist woodlands.

*Pontederia cordata*, L. (619)
Shallow water in ditches and ponds throughout.

*Juncus Balticus*, Dethard., var. *littoralis*, Engelm. (624)
Moist to dry sand along the shores of Saginaw Bay, and in prairies, Akron and Wisner Tps.

*Juncus bufonius*, L. (627)
Moist roadsides and wet places along ditches, often very abundant.

*Juncus Canadensis*, J. Gay. (628)
Common on the prairies of Akron Tp.

*Juncus effusus*, L. (633)
Common in low wet pasture lands throughout.

*Juncus nodosus*, L. (639)
Abundant on the bay shore strand in Akron and Wisner Tps.

*Juncus nodosus*, L. var. *megacephalus*, T. & G. (646)
Prairies, Akron Tp.

*Juncus tenuis*, Willd. (645)
Common along roadside paths in dry moist sandy soil throughout.

*Sparganium eurycarpum*, Engelm. (119)
Ditches very common. Also in borders of mill ponds at Vassar and Caro, and in bayou of Cass river. At mouth of Quanicassee creek.

*Sparganium simplex*, Huds. (121)
Ditches, on west side of county.

*Typha angustifolia*, L. (116)
Near Caro, in shallow water.

*Typha latifolia*, L. (117)
Common in ditches and marshes. A bad weed in the ditches of the western part of the county as it checks the outflow of water and helps silt them up.

*Acorus Calamus*, L. (606)
Occasional in the marshes of Koylton and Dayton Tps.

*Arisæma triphyllum*, Torr. (602)
Rich low woods in Columbia and Fairgrove Tps.

*Calla palustris*, L. (604)
Swamps in Dayton and Arbela Tps.

*Symplocarpus fœtidus*, Salisb. (605)
Common in swampy woods, Dayton Tp.
*Lemna minor*, L. (608)
Floating on the surface of ponds, Dayton and Watertown Tps.
*Spirodela polyrrhiza*, Schleid. (607)
Common in ditches and ponds.
*Alisma plantago*, L. (164)
Ditches in Akron and Wisner Tps.
*Sagittaria heterophylla*, Pursh. (169)
In Cass river above Vassar.
*Sagittaria variabilis*, Engelm. (170)
Common and very variable.
*Sagittaria variabilis*, Engelm., var. *latifolia*, Engelm. (170)
Abundant at Quanicassee in shallow water along the creek.
*Naias flexilis*, Rostk. and Schmidt. (158)
Ditches in Akron and Wisner Tps., near the Bay.
*Potamogeton heterophyllus*, Schreb. (130)
Cass river and mill ponds at Vassar and Caro.
*Potamogeton natans*, L. (140)
Common in Cass river and in ditches near Saginaw Bay.
*Potamogeton pectinatus*, L. (143)
Mill pond at Caro.
*Potamogeton Pennsylvanicus*, Cham. (141)
Quanicassee creek.
*Triglochin palustris*, L. (162)
Common on the prairies in Akron and Wisner Tps.
*Carex cephalophora*, Muhl. (461)
Dry soil in oak islands in Akron Tp.
*Carex communis*, Bailey. (540)
Rich woods, Almer Tp.
*Carex conoidea*, Schk. (465)
Prairies Akron and Wisner Tps.
*Carex Crawei*, Dewey. (467)
Common in swales along the shores of the Bay in Akron and Wisner Tps.
*Carex Deweyana*, Schwein. (477)
Rich low woods, Fairgrove Tp.
*Carex echinata*, Murray, var. *cephalantha*, Bailey. (568)
Prairies and wet meadows throughout.
*Carex filiformis*, L. (484)
Common about lakes in Dayton and Watertown Tps., Mud Lake, Arbela Tp., also on prairies.
*Carex flava*, L., var. *viridula*, Bailey. (598)
Wet, muddy and sandy shores of Saginaw Bay, below storm wave mark.
*Carex fusca*, All. (493)
Common on the prairies of Akron and Wisner Tps.
*Carex gracillima*, Schwein. (494)
Rich woods, Almer Tp.
*Carex Grayii*, Carey. (449)
Rich woods, Denmark Tp.



*Carex hystricina*, Muhl. (503)
Low, open grounds and marshes throughout.
*Carex intumescens*, Rudge. (506)
Low, rich, woodlands, Columbia and Akron Tps.
*Carex lupulina*, Muhl. (521)
Open swamps, Akron, Gilford and Koylton Tps.
*Carex laxiflora*, Lam., var. *latifolia*, Boott. (437)
Beech and maple woods, Columbia Tp.
*Carex lurida*, Wahl. (526)
Marsh in Akron Tp.
*Carex Muhlenbergii*, Schkuhr. (534)
Dry soil, islands in prairies, Akron Tp.
*Carex Pennsylvanica*, Lam. (543)
Dry soil, common in Cass valley on sand plains.
*Carex Pseudo-Cyperus*, L. (548)
Open marshy places throughout.
*Carex Pseudo-Cyperus*, L. var. *Americana*, Hochst. (463)
Open marshy places throughout.
*Carex retrorsa*, Schwein. (552)
Swamps and marshes common throughout.
*Carex retrorsa*, Schwein. var., *Hartii*, Gray. (499)
Shaded swampy places in Akron and Columbia Tps.
*Carex rosea*, Schkuhr. (556)
Rich woods, Tuscola and Denmark Tps.
*Carex scoparia*, Schkuhr. (562)
Common in open grassy swamps.
*Carex stipata*, Muhl. (569)
Low open swamps, common throughout.
*Carex straminea*, Willd. (570)
Moist open places throughout.
*Carex teretiuscula*, Gooden. (581)
Marshes and prairies Akron Tp.
*Carex tetanica*, Schkuhr. (583)
Common in prairies of Akron and Wisner Tps.
*Carex tribuloides*, Wahl. (585)
Open grassy swamps and marshes throughout.
*Carex tribuloides*, Wahl., var. *cristata*, Bailey. (470)
Open grassy swamps and marshes throughout.
*Carex vulpinoidea*, Michx. (599)
Marshes common throughout.
*Cladium mariscoides*, Torr. (430)
Frequent in marshy parts of the prairies in Akron and Wisner Tps.
*Cyperus diandrus*, Torr., var. *castaneus*, Torr. (367)
Beaches, Akron Tp.
*Cyperus esculentus*, L. (360)
Moist, sandy soil, Columbia Tp.
*Cyperus filiculmis*, Vahl. (362)
Dry, sandy soil, frequent throughout.
*Cyperus strigosus*, L. (370)
Moist, sandy soil along the beaches in Wisner and Akron Tps.

*Eleocharis acicularis*, R. Br. (376)
Wet sandy soil along ditches, and the beach of Saginaw Bay in Akron and Wisner Tps.
*Eleocharis ovata*, R. Br. (383)
Wet mud, near the Bay in Akron Tp.
*Eleocharis palustris*, R. Br., var. *glaucescens*, Gray. (386)
Wet places along the shores of Saginaw Bay, Wisner and Akron Tps., also ditches and stream banks elsewhere.
*Eleocharis pauciflora*, Link. (410)
Wet muddy beaches of Saginaw Bay, Akron and Wisner Tps. Forms dense carpets below the storm wave line.
*Eleocharis rostellata*, Torr. (389)
Wisner Tp. in swales along the base of the dune line next to the shore of the Bay.
*Eleocharis tenuis*, Schultes. (390)
Common in marshy spots on the prairies of Akron and Wisner Tps.
*Eriophorum cyperinum*, L. (401)
Open swamps and marshes throughout.
*Eriophorum lineatum*, Benth. and Hook. (406)
Borders of prairies, Akron Tp.
*Rhynchospora capillacea*, Torr. (425)
Prairies, Akron and Wisner Tps.
*Rhynchospora glomerata*, Vahl. (429)
Prairies, Akron Tp.
*Scirpus atrovirens*, Muhl. (396)
Open swamps and marshes throughout.
*Scirpus lacustris*, L. (405)
Shallow water in ponds and streams; also growing in Saginaw Bay at a considerable distance from the shore. This is probably the species *Scirpus validus*. Vahl.
*Scirpus pungens*, Vahl. (395)
Shallow water, Saginaw Bay, Akron Tp.
*Scleria verticillata*, Muhl. (432)
Marshy prairies, Akron Tp.
*Andropogon furcatus*, Muhl. (174)
Dry soil, islands in the prairies, Akron Tp.
*Andropogon scoparius*, Michx. (175)
Dry soil, Akron Tp.
*Agrostis alba*, L. (246)
Prairies and marshes, common.
*Agrostis scabra*, Willd. (250)
Islands in the prairies in Akron Tp.
*Alopecurus geniculatus*, L., var. *aristulatus*, Torr. (237)
Rich wet soil, often in swampy woods, Columbia Tp.
*Ammophila arundinacea*, Host. (257)
Sand dunes, Akron and Wisner Tps.
*Asprella Hystrix*, Willd. (354)
Rich woodlands throughout.
*Brachyelytrum aristatum*, Beauv. (234)
Dry woodlands throughout eastern part of county.



*Bromus Kalmii*, Gray. (326)
Dry sandy soil in islands in the prairies, Akron Tp.
*Bromus secalinus*, L. (328)
Wheat fields and waste grounds, Akron Tp.
*Calamagrostis Canadensis*, Beauv. (253)
Prairies where it is abundant and borders of marshes throughout the county.
*Cenchrus tribuloides*, L. (213)
Sandy roadsides and near R. R. station at Vassar.
*Chrysopogon nutans*, Benth. (177)
Sand ridges and "islands" in the prairies, Akron Tp.
*Dactylis glomerata*, L. (290)
Cultivated and waste lands throughout.
*Danthonia spicata*, Beauv. (267)
Dry soil, sand ridges, etc.
*Elymus Canadensis*, L. (346)
Sand dunes near Saginaw Bay, Akron and Wisner Tps.
*Eragrostis reptans*, Nees. (278)
Sandy moist soil, banks of streams and ditches.
*Festuca tenella*, Willd. (314)
Dry sandy soil especially in the prairie region of Akron and Wisner Tps.
*Glyceria fluitans*, R. Br. (308)
Ditches and shallow pools in woods throughout.
*Glyceria nervata*, Trin. (309)
Marshes and wet prairies throughout.
*Koeleria cristata*, Pers. (286)
Dry ground, common.
*Muhlenbergia Mexicana*, Trin. (230)
Low meadows and marshes.
*Oryzopsis asperifolia*, Michx. (225)
Dry woods in Cass river valley. Sand ridges, Akron Tp.
*Panicum capillare*, L. (186)
Waste grounds and cultivated grounds throughout.
*Panicum Crus-galli*, L. (183)
Ditches and waste ground throughout.
*Panicum latifolium*, L. (203)
Common on sand dunes along the Bay and in dry woods throughout.
*Panicum scoparium*, Lam. (205)
Dry sandy soil along the shores of the Bay in Akron Tp.
*Panicum sanguinale*, L. (182)
Dry sandy soil in Cass valley. Cultivated and waste grounds throughout.
*Panicum virgatum*, L. (207)
Sandy areas and slopes of sand dunes, Akron Tp.
*Phragmites communis*, Trin. (272)
Marshes throughout. Covers considerable areas on the east side of Fish Point, Akron Tp.
*Poa annua*, L. (293)
Waste and cultivated soil throughout.

*Poa compressa*, L. (295)
Dry sterile soil; common throughout.
*Poa pratensis*, L. (301)
The most common roadside and pasture grass throughout the county.
*Setaria viridis*, Beauv. (212)
Cultivated and waste grounds throughout.
*Spartina cynosuroides*, Willd. (269)
Borders of oak islands in prairies, Akron Tp.
*Stipa spartea*, Trin. (224)
Sandy ridge in Wisner Tp., near Bay Park.
*Zizania aquatica*, L. (214)
Borders of marshy prairies in Akron Tp. Also in shallow water in the Bay near Fish Point.
*Equisetum arvense*, L. (68)
Common in moist, sandy soil throughout.
*Equisetum hiemale*, L. (73)
Frequent on low sand dunes and ridges near Saginaw Bay, in Akron and Wisner Tps.
*Equisetum limosum*, L. (71)
Ditches and pools in marshy parts of the prairies of Akron and Wisner Tps.
*Equisetum sylvaticum*, L. (81)
Rich woodlands throughout the county.
*Adiantum pedatum*, L. (62)
Frequent in beech and maple woods throughout.
*Aspidium acrostichoides*, Swartz. (33)
Frequent in rich woodlands.
*Aspidium cristatum*, Swartz. (37)
Rich woods and swamps.
*Aspidium spinulosum*, Swartz. (45)
Common in swampy woods.
*Aspidium Thelypteris*, Swartz. (48)
Very abundant on the wet parts of the prairies and common in swamps elsewhere.
*Asplenium Filix-foemina*, Bernh. (57)
Rich woodlands.
*Asplenium thelypteroides*, Michx. (55)
Wells and Dayton Tps., in rich woodlands.
*Cystopteris bulbifera*, Bernh. (29)
Rich cool woodlands, Wells and Indianfields Tps.
*Onoclea sensibilis*, L. (21)
Common in open marshy places throughout.
*Osmunda cinnamoma*, L. (18)
Low, wet soil both open and wooded throughout.
*Osmunda regalis*, L. (20)
Swamps frequent throughout.
*Pteris aquilina*, L. (63)
Dry woods and open sandy lands. Abundant in the Cass valley on the old pine lands.
*Botrychium Virginianum*, Swartz. (12)
Rich woodlands in Columbia Tp.

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