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ALFRED C. LANE, STATE GEOLOGIST

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BY
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ACCOMPANIED BY ELEVEN PLATES AND TWELVE FIGURES INCLUDING TWO COLORED MAPS

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CHAPTER VI. WELLS AND BORINGS.

§ 1. Introduction, utility of the collection of records.

The main part of this chapter is composed of the descriptions as we have gathered them from well-drillers and owners, of the wells of the county, arranged systematically by township, range and section. It is possible that some one may say, "What is the use of this?" So far as the improvement and development of the water supply are concerned the use will be the subject of the next section. But it may be well also to call attention to the fact that without the data furnished by systematic inquiry concerning wells, such contour maps of the rock surface, or of the top of the Napoleon sandstone as given in Plate VII and Fig. 6, would be impossible. Without these maps we could have, from the few outcrops scattered over an almost plane surface, but very vague ideas as to the structure and distribution of the rocks below. And if any one should reply, why not give these maps then alone, and not the raw material, we make answer that in the maps the facts can not be distinguished from the theoretical deductions added, and are to a certain extent inaccurate. As we have seen,, even the railroad levels do not agree among themselves, and so even Plate VIII showing the altitudes of the present surface of the county is liable to be in error as much as twenty feet, though we hope that the relative accuracy is generally greater (that is to say, although for example the level of Ubly should prove to be ten feet

out, it would not effect the relative altitude of the hills and valleys around the town). But allowing that the contours of Plate VIII are liable to be 20 feet out, Plate VII and Fig. 6 which are constructed from them, and from the well records which are in parts of the county yet but few, must be still less accurate. Now, as new wells are bored and their records collected, if a more accurate contour map of the county is to be constructed with the aid of railroads or levels yet to be run, in this chapter are recorded all the data which we have toward better maps on the same lines. From our maps alone one cannot tell what part is more, what part less sure, what part observation, what part theory. To make this chapter thus a summary of recorded facts (facts which could not be collected later, as we have found how rapidly details as to the beds encountered or even the depth and casing of wells slip from the minds of owner and driller), we have added records of borings not primarily for water, and some references to outcrops in each section.

§ 2. Practical lessons.

The important things in water supply are quantity, quality and head. Head and quantity are not equivalent, though they often vary together. It sometimes happens, that a well will yield a water which will rise in a tube quite a distance and yet yield a dribbling supply, while another well may not have the water level at the surface of the ground at all, and yet cannot be lowered by pumping. A larger hole will generally give a greater quantity of water, but the diameter of the boring will not affect the initial head. Dynamiting will often improve the quantity of the yield, but will not usually make a permanent improvement in the head. In our review we will take up the question of quantity first.

(a). *Quantity*. An ideal well as to quantity will water your own and your neighbor's cattle, and run harvesters ad libitum. Four gallons a minute is generally ample for all farm uses.* The quantity of water which a well will furnish depends, first, on the beds from which it draws water never becoming dry, and second, upon their being porous. The porosity depends upon the proportion of voids, or the difference between the weight of a cubic foot dry and a cubic foot wet. Table II shows the porosity of some rocks and we see that the Napoleon sandstone, 26% of its volume being voids, is therefore an excellent water-bearing bed. Surface wells draw their water from sands and gravels. Sand is less porous than gravel, and clay is least porous of all. Shale is like clay. Limestone and gypsum are not in themselves porous, but being somewhat soluble are liable to have water channels dissolved out in them.

* = 1440 gallons a day = 100 gallons each for 10 people and 7½ gallons each for 60 head of stock.

Surface sands and gravels if not covered by clay are apt to be dried out in a hot season, and we notice that many of the surface wells ran short during the hot weather of 1895. Surface wells striking sands or gravels under clay are much more likely to be permanent so far as drying out is concerned (and are probably of better quality), and the same thing is true of sandstone or limestone under shale or clay. The boulder clay or till has in this county usually enough clay in it to count as a fairly impervious, that is, not porous bed, the coarser sand, gravel and boulders being embedded in a clayey cement. But the distribution of the sands and gravels under or in streaks within the boulder clays which may be struck by wells is quite erratic, and no general statements can be made that will apply to any large district. Belts near the old beach lines seem to be rather better favored with alternating layers of differing porosities. Very generally there is a porous bed immediately above the rock surface.

As far as rock wells are concerned, however, we can make more positive statements. In the eastern part of the county, colored Goldwater shale on the map, Plate VII, wells into rock are not successful in striking abundant water, and what water there is, is likely to be salty, as is shown in the Grindstone City and other wells. In the central part of the county, colored Upper and Lower Marshall, there is no difficulty in striking a good supply of water within a few feet after striking rock. The only exception that I know of is Wright's well on Sec. 12, Hume, the record of which is very curious. It seems as though water-bearing beds must have been overlooked, but there may be peculiar local conditions. The more westerly part of this area, that of the Upper Marshall or Napoleon sandstone, is the more freely supplied with water. Farther to the west abundant water can invariably be found by going down a few feet into the Napoleon sandstone. How far that will be may be found by subtracting the altitude of the top of the Napoleon sandstone as given on Fig. 6 from the altitudes of the surface of the point where boring is proposed, as derived from Plate VIII. For example, a well on Sec. 3, T. 17 N., R. 10 E., would be expected to have to go (600 - 400) about 200 feet to strike this horizon. *To get the best results the casing should be continued from the top of the ground nearly down to the top of the sandstone as thus indicated, and be tight.* Of course the well itself must go a ways into the sandstone.

Over the area colored as underlain by the Maxville limestone, however, it will not be needful to go down so far (unless the limestone happens to be cut through by the old river valley), for although the limestone itself is not porous, it is soluble, and the calcareous sandstones, when the cement is dissolved out, are very porous, and cavities and water channels are dissolved along the joints and fissures in the purer limestone. Throughout the northern patch of limestone around Bayport wells to rock or a few feet in it get (cf. Fig. 9.) an ample supply of water often flowing above the surface, while in the southern area it is often necessary to go a little deeper, yet not over 150 feet.

(b). *Head*. In beds, not freely porous, the question of head is of no practical importance, because even if the head were such that the water would rise above ground in a closed pipe a little pumping would soon exhaust it.

A well in shale or clay may yield a little water quite steadily, even in the dryest times, but will yield but a few bucketfuls at a time.

The general conditions of the head of wells and the circumstances that will produce flowing wells have been quite fully discussed in a valuable paper by T. C. Chamberlin in the Fifth Annual Report of the Director of the U. S. Geological Survey,* so that I shall confine my treatment and practical illustrations to conditions actually observed in Huron county, letting those who wish to study the subject in a broader way refer to the paper mentioned. The county furnishes, however, many suggestive illustrations of most of the important points made by Chamberlin.

By head we mean the pressure under which the water is in any bed. This determines of course how high it will rise and is commonly measured by the height above sea level of that water surface up to which it will rise. If the height to which it will rise is above the surface it will flow. If it is over 30 feet below the surface, a force pump must be used. The head is dependent upon the pressure of water in the bed. In a superficial porous bed, we find that the water sinks down into it and fills it up to a certain level which varies with the condition of the bed and the season. With the warm, dry months of summer this water level falls lower and lower, (Fig. 9) and wells which once penetrated it do so no more. When the well is dry to the bottom, the water level has fallen below it and there is a strong temptation to start boring from there and follow down after it, a course which as we shall soon see has objections. (Cf. Fig. 12). In a porous bed in which there is no outlet, the head is everywhere sufficient to raise the water level to that which exists where the water is taken in. If this porous bed extends off under impervious clays, to a region where the surface of the ground is lower than the water level at the point where it takes in its water, being covered by previous beds only or exposed to the air, wells down to it will find the water rise above the surface. But as the water level at the intake fluctuates the water level in the wells .will also tend to fluctuate. An excellent example of this is seen (Fig. 9) in the wells in the Bayport limestone, to the southwest of the quarry ridge along which the limestone outcrops or is covered only with gravels. Here we find wells going down through impervious clays and tills until, upon striking the limestone, they find that the water rises higher than the surface to a water level dependent on that in the limestone. We find, however, than one well that flows in spring ceases to flow later in the summer, that another fails about the Fourth of July, and the others in still lower ground last all the year around. We are thus enabled (Fig. 9) to follow the gradual fall in the water level of the limestone as the summer goes on.

*Pages 137-173, 1885.

Again, draining swamps lowers the water level. The water runs off instead of sinking in and remaining on the land. This is the general effect of bringing land under cultivation. Thus the drainage of the swamps which cover Lincoln, Colfax, and Sheridan, will tend to lower the water level, and the head in the underlying beds of the Marshall. The head in these beds is not solely dependent upon this factor, but yet it is one of the causes that we have to take into account in explaining the recent lowering of the head in all the wells of the Napoleon sandstone to the west.

If now the porous bed from which the supply of water is obtained has outcrops at different levels, and especially if it has points of discharge, either natural, as by springs, or artificial, through artesian wells and the like; the question what the water level will be for any new point becomes more complex. In general the water level in superficial porous beds slopes gradually toward the lakes and streams and repeats the modelling of the surface, but in less relief. Thus the depth to water is greater under hills than in adjacent valleys, but not quite as much as the difference of elevation would imply.

This remark applies, for example, to the wells in the dune sand or gravelly regions. The Napoleon sandstones, and in fact all the porous beds of the county so far as we know have outcrops or are only covered by sand near or under the lake. Near the shore therefore their water level approaches lake level and then rises as we go into the interior of the county. The head under cover will depend somewhat upon the relative nearness to the different parts of the outcrop, being most nearly dependent upon that part of the outcrop nearest. For example, the head of the Napoleon sandstone around Elkton will not be higher than somewhere between the water level on Sec. 9, Meade, where the sandstone is exposed, and the water level around Badaxe, i. e., between 660 and 740 feet above tide. Since the level of the surface near Elkton is only 650 feet or so above tide the chance of flowing wells thus indicated is good. But another class of considerations must also be taken into account, viz., the escape through wells or fissures at lower levels. This is a factor which we cannot neglect in the case of the Napoleon sandstone. Practically all the brine of the Saginaw valley is drawn from this formation, and around Sebewaing, at Oak Grove and numerous other places there are strong flowing wells. Now if these wells are, in the aggregate, but a drop in the bucket to the amount which may be rapidly taken in and percolated, then they have no appreciable effect on the head, but if not, then for a wider and wider circle about the point of outflow the head will be lowered toward that maintained at the point of outflow. For example, suppose two holes to be put down side by side where the water rises, at first ten feet above the ground in both. Then let the casing of one of them be untouched but the casing of the other of them be cut off level with the ground. The water will flow from the former and the level in the latter will be lowered. As the holes are farther apart the effect in lowering the level wall be less and less marked, the greater the gap and the less porous the beds between the two wells. We have a number of illustrations of this principle in the county. Chappell's deep well at Sebewaing burst its casing and leaked into the coal mine and consequently all similar wells drawing their sources from the same stratum, the Napoleon

sandstone 250-300 feet below surface, dropped two or three feet in their head or ceased to flow entirely. So for example at Elkton, when the casing of the deep railroad well was cut off below ground, so that the water was allowed to flow into a basin (whence it could find its way into the surface beds the water surface of which stood at a lower level) the wells around immediately lost their head. Fig. 12 therefore shows a common form of casing not to be recommended for this reason among others, that if the porous beds A have a good head,—more than that of the surface water,—the water will flow out from the lower beds A up and out into the surrounding surface materials C and thus lower the head of A. It is not at all necessary that such a well should be a possible flowing well. Just as soon as we strike a water stream so strong that it will fill up the old basin, in the bottom of which the new boring was put down, higher than the surface water would, it will tend to spread through the stoning of such basins into the surrounding surface materials, and tend to dissipate the head of the lower beds. An interesting illustration of this action is in the case of abandoned salt wells where the casing has been pulled. These are frequently flowing. The old salt wells at Port Austin and Port Crescent flow, those at Caseville are at least very near the surface and the Bayport well had a head, as I am informed, of 10 to 32 feet above ground. Now there are a number of the Port Austin wells which are salty, though shallow, whose saltness may readily be accounted for by supposing that the salty w7ater from the flowing wells, has had head enough to push its way out into the higher strata.* It might be well to case these old salt wells far enough down to prevent this action. The effect on quality of the arrangement illustrated in Fig. 12 and of insufficent casing we shall return to later. It is enough now to notice that a group of such wells large enough to be an appreciable factor in comparison with the amount of water which can freely circulate through a bed may seriously lower its head, perhaps checking its flow in some other district. I dwell on this point because this form of drilling and casing is extremely prevalent. Now although it is difficult to form even an approximate estimate as to how much water can be taken in, say by the Napoleon sandstone, it must be remembered that wherever overlaid by clay or till the flow of water which can be taken in to replace any drain upon it must be slow. Thus although the outcrop (under the surface materials of the Pleistocene) of the Napoleon sandstone is over 200 square miles, and a precipitation of 30 inches each year over that area would give (200 x 43, 560 x 2.5) 21,780,000 cu. ft., i. e. (÷ 365 x 24 x 60 = 525,600), about 40 cu. ft. per minute, when we consider how much runs off directly, is evaporated, or finds its way into the rivers by way of surface gravel beds, the outcrops where the sandstone is close to the surface being probably much less than ten square miles, if we estimate the amount subtracted, by the thirty or more flowing wells draining upon this formation and the much larger number of wells that draw their supply from it but do not flow, it becomes evident that the draft upon it must be a large fraction of the supply and hence the head will diminish almost uniformly from the highest levels to the points of escape. We must consider also that the Napoleon sandstone is subjected to drain by wells outside the county limits, and that water may escape up the line of fissures like that exposed in the Sebewaing coal mine. The exact drainage by the flowing wells we do not know, though from some observations on some of the flowing wells, and the time required to fill a pail of about 3 gallons (0.4 cu. ft.), I infer that many of them wall flow more than a quarter of a cubic foot per minute.

*It is true, however, that the Lower Marshall sandstones are sometimes salty in themselves as we can see by wells on Sec. 12, Dwight, and in Bloomfield township.

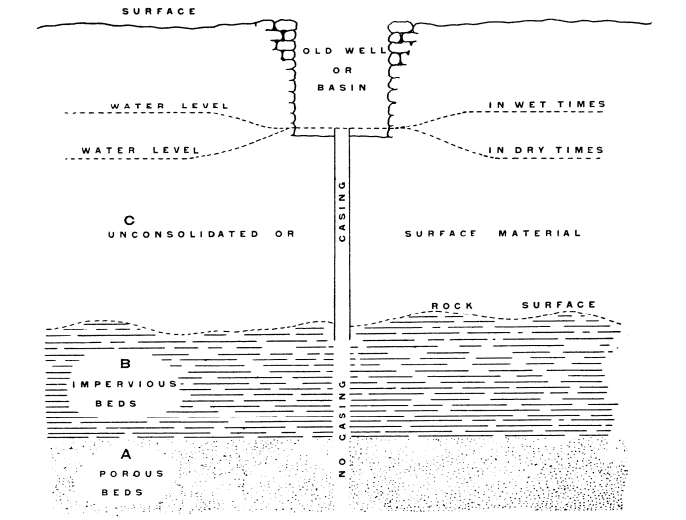

Figure 12. Illustrates improper boring and casing, involving danger of contamination from surface waters or of contamination of surface waters by a salty layer with strong head in A. There is also probability of reducing the head in the layer A, by flow of water into the surface layers. There is also danger of the bore hole closing, through clogging from the basin, or caving in of beds above A.

Chamberlin in the paper mentioned has suggested that a fluctuating head is a sign that the supply is being drawn on to the point of approaching the limit of supply (loc. cit. pp. 151-165). Judging by this test the supply from the Napoleon sandstone is already in that condition, for almost all the flowing wells report changes in the head from day to day depending on the weather, amounting to stoppage at times. I do not consider any definite law as proven as yet.*

Nor do I mean to say that the water supply from the Napoleon sandstone will fail entirely. Nature has her own methods of enforcing economy, and will simply lower the head, until the water running to waste by the flowing wells or escaping into the upper beds, is sufficiently cut off to restore the balance between demand and supply. But I do mean to say that a higher head could be obtained or retained by more ample and effective casing and greater economy in use.

However, in the immediate future we shall probably have an ampler supply, since the series of dry years culminating in 1895 will probably be succeeded by wetter ones.

The effect of the opening of the Saginaw coal mines should not be overlooked in this connection. As they must be pumped out, the water level for the strata in which they are located must be kept some 120 feet below the present surface or about 470 feet above tide. Now this would have no effect on the water level of other strata separated from them by impervious layers. But, as we noted, there were water channels all along the crack opened by the fault encountered by the mine, and ample indications that such channels were used. Beside this, a deep well into the Napoleon sandstone (7 of Fig. 10) was encountered in mining and the casing burst and it leaked into the mine. Furthermore there may have been other borings and wells with so little casing as to have served as channels of communication between, the lower beds and those in which the mining and pumping were done. There seems to be a notion prevalent, that the abundance of water which was so large a source of expense to the Saginaw Bay Coal Company was derived in some way from Lake Huron. It is my impression that the lake had nothing appreciable to do with it and that most of it came from below. In most of the wells within a radius of four or five miles the lowering of the water at the time of the opening of the coal mines was marked. It is true, however, that this opening took place during a period of decreasing rainfall and lowering lake level, so that more than one cause was working in the same direction in the same time. But I doubt not that the draining of those mines had a marked effect in lowering the head in all the beds down to and including the Marshall sandstone.

*Among the causes which might affect the flow thus periodically are: (1) A decrease in atmospheric pressure would allow the flow to be more free. (2) If there were points of discharge of the water under the lake, as is likely, then a rise in the lake level would raise the level in the wells, as raising the height of a dam backs the water up stream. (3) Variations of wet and dry seasons, affecting the water level at the outcrop, would slowly make themselves felt. A few of the more important observations on such fluctuations may be of interest, and will be found in connection with the wells on Secs. 8, 15, 18, and 27, Sebewaing, T. 15 N., R. 9 E.; Sec. 22, Fairhaven, T. 16 N., R. 9 E.; Sec. 9, Oliver, T. 16 N., R. 11 E.; and Sec. 13, Caseville, T. 17 N., R. 10 E. See also Sherzer's comments on the same phenomenon in Monroe county, Part I, p. 194.

The flowing wells and fluctuating head in the wells that draw their supplies from, the Bayport limestone and sandstones, and occur in the northern part of Fairhaven township, have already been noticed. On the extreme southern verge of the county in the southern part of Sebewaing and Brookfield townships we seem to be entering a similar district, which will be more fully understood when Tuscola county has been studied. But before we leave this subject we have still to say a few words upon the sandstone beds of the Lower Marshall. These as we have said are less persistent, and (with possibly one exception) fade out, not being bearers of water either in the Bayport or Caseville wells. In other words they are shore deposits replaced by finer deposits to the southwest. This is a case mentioned by Chamberlin as favorable to flows* and is also illustrated by the cross-section at the foot of Plate VII. Wells in the fine grained extensions of the Lower Marshall sandstone will not affect their head, but as the outcrops of these strata lie on the eastward slope from the highest land of the county, we can expect flowing wells from them only in case they are struck on the western side of this divide at an altitude lower than the water level over their outcrops, and yet not so far to the west as to find them already too impervious to give a free supply of water. In such case, as the water level of the intermediate county stands high, we may expect as Chamberlin has shown, a head almost equivalent to that at the outcrop. The experience of Mr. B. Kreutziger in Sec. 6, Colfax, T. 16 N., R. 12 E., who went through the Napoleon sandstone into the shales below and got no increase of head, is discouraging for such a possibility in general. Three wells, however, seem to have been fortunate enough to lie in this narrow belt and to be at a sufficiently low altitude, to wit: a well at Port Crescent, the .well on Sec. 19 T. 16 N., R. 13 E., near Badaxe, and Homer Filion's on Sec. 8, T. 18 N., R. 13 E. I should suppose that a few more flowing wells of this type might be obtained along the valley of Bird Creek, in the southeast corner of Colfax township, and perhaps in the lower part of Sheridan and in the Cass River valley and the valley of the upper Willow. At any rate the water should rise to near the surface at these places.

*Loc. cit., Figs. 11 and 17.

(c). *Quality*. The quality of the water is generally good, with exceptions that we take up later. Surface wells, especially those in the sand ridges, are liable to contamination, but while wells may be noted in the list whose percentage of chlorine, unusually high for the district, indicates that they are affected by barnyard waters or by sewage, and presence of chlorine (a constituent of common salt, which is sodic chloride) is often used by water chemists as an indication of the presence of sewage contamination; in this district it would be entirely wrong on that account alone to condemn a water, for some of the very best and purest wells of the county show quite a perceptible amount of salt, which is of course not injurious, and up to a certain point only renders the water more palatable. Indeed it is remarkable what an amount of salt the palate can become accustomed to, and not notice. A water free from salt will taste flat and insipid, after using a slightly saline water for awhile. It is hard to say what the limit of drinkable water is. We have found a water with over 4% of salt used, although under protest, and one-half of one per cent of salt is soon quite unnoticed. Cattle and to a less degree horses all enjoy a moderately salty water. A connection between diabetes and mineral water has been suspected, but not at all proven. There is an interesting field of research open here for the physician.

In the area of the Marshall sandstones the percentage of mineral constituents is generally low. This is so markedly the case for the Upper Marshall,—the Napoleon,—that we find it comparatively fresh, even when there is salt water above it. One suggested explanation of this as follows.*

*It is also quite possible that the water was very early freshened as it is an emergence sandstone.

The total amount of salt which Michigan has produced to 1896 is very nearly 75,000,000 barrels. Almost all the salt of Saginaw Bay, Midland and Gratiot counties was derived from this formation, though not quite all. These counties produced practically nine-tenths of the salt until 1879, since when they have had a less and less share. Though we have not the statistics to separate the production accurately, it seems safe to say that two-thirds of the whole production or 50,000,000 barrels of salt were derived from the Napoleon sandstone. At 280 pounds to the barrel, and allowing an 86° brine which would yield certainly not more than 22.10% solids, or allowing for the other mineral constituents and loss of salt in manufacture, supposing six times as much brine by weight to be used as salt was produced, and this, as the analyses given in Vol. Ill of these reports show, is too low an estimate of the volume of brine required, we would have 84,000,000,000 pounds of concentrated brine abstracted from the formation. If a cubic foot of the sandstone (See Table II, p. 90) holds 10% voids, it would contain about 100 ounces of pure water or about 116 ounces, or 7.25 pounds of brine. Thus nearly 11,600,000,000 cubic feet of sandstone would have to be drained to furnish this brine, or 42 square miles of a sandstone 10 feet thick. But in addition to the brine made into salt, there has been a great deal wasted and a great deal abstracted by the salty flowing wells, like the Oak Grove well, that reach the formation. Moreover all through the geological ages preceding the ice period while the Marshall existed as a basin with the water level over its outcrop higher than that over the center, there must have been a tendency for the water to work up by every crack and crevice (e. g. such a fault as we find in the Sebewaing coal mine) toward the center of the basin, to be replaced by fresh water working in at the margin. Thus the tendency will have been for the water to become fresher in the more porous layers near the margin of the basin.

This is an important fact, for we have only to compare Mr. Leipprandt's wells on Sec. 13, Caseville, or the Brewery well at Sebewaing with Mosner's near by, to see that in case there is too much mineral matter in the water it is probable that casing down to the top of the Napoleon will help matters (casing off tightly with rubber washers or a seed bag to prevent the heavy brine from working down). Wells traversing the overlying Michigan series have more mineral matter than is necessary or frequently than is healthy or palatable, i. e., many wells to the east of the line which I have marked as the outcrop of the gypsum beds, or in the lower part of the map the line of the top of the Napoleon sandstone. Of course some beds east of that line are too shallow to be affected by the formation, drawing their supply from the drift, or Bayport limestone and sandstone; others have so strong a current from the Napoleon sandstone as to weaken the water until it is comparatively drinkable, but speaking generally in the district thus marked off and colored on the map, wells in rock are likely to prove unsatisfactory, being highly charged with sulphates, and very likely salt also. Gypsiferous waters, technically called selenitic, our tests have not sharply distinguished from the allied group of more cathartic sulphated waters which also contain sodium and magnesium sulphate^ but it is my general impression, from the taste and reported effects that the northern area in Chandler contains more calcium sulphate in proportion than the southern area in Fairhaven and Winsor townships.

Mr. McCoubrie's well on Sec. 7, Chandler, is cased deeply and yet is salt, but as the casing is smaller than the hole, and as the water becomes fresher after pumping, I believe the casing leaks and lets the heavy brine work slowly down to the bottom of the well.

The Burton ale of England is said to owe its peculiar excellence to the gypseous waters from which it is made. Generally speaking brewers find artesian waters satisfactory, but seek as low a percentage of mineral as possible.

Almost all the waters of our list which are graded as more than low in mineral matter are bad boiler waters, in other words, all except the best sandstone waters. The sulphates of lime are especially bad. The best remedies are frequent blowing off, and, for calcium, and sulphate the use of salsoda, and using very, hot feed water. As regards iron and the carbonates of lime, etc., some help will be obtained by letting the water stand in a tank exposed to the air some time before using, just as in salt manufacture, for the iron and lime will then spontaneously separate out to a large extent. The following well at Grassmere is said to furnish an excellent boiler water. So should the waters of the Napoleon generally, when properly cased. Occasionally there is a well that foams somewhat badly for boiler use.

The next section is written by Prof. Davis and gives his account of the waters of the middle district, which are in general much less charged with mineral matter than those of the other districts.

§ 3. Wells and well waters of the middle townships of Huron county. (By C. A. Davis.)

The territory assigned to the writer for examination was a strip a township and a half wide on either side of the line between ranges XII and XIII east, i. e., the middle north and south road of the county. This area was subsequently changed somewhat by Dr. Lane who added to his own territory the east half of Chandler township and of the township south of it, because .of the ease with which they could be reached from his headquarters and by the railroad. After the completion of the survey of this territory parts of Grant and Brookfield townships were assigned to me with headquarters at Owendale.

The wells of these sections may be classed under the following heads:

(a) Dug wells.
(1) Springs,
(2) Boarded or planked,
(3) Tiled,
(4) Stoned.

(b) Drilled wells.
(1) In the drift,
(2) Through the drift to rock,
(3) In rock.

Springs were comparatively rare, and were found most commonly along stream banks, where the gravel deposited by the stream at some earlier time had been cut through to an underlying clay. Such springs where they were near the house were usually the source of supply for domestic purposes and a reservoir was made by sinking a headless barrel around the spring. The water of such of these springs as were examined was found to contain rather more calcium salts, chiefly carbonates, than deeper wells.

The most common form of curbing for wells in newly settled districts where the wells were comparatively shallow and dug through clay or gravel soil was a box of boards or planks. Such wells were often noticeably foul from the decay of the timber used and from material which had mechanically mixed with the water.

A few wells were noticed in which a large sized drainpipe or ordinary tile or cement was used as curbing. Such wells are free from the objections to which planked ones are liable, and are more permanent. By far the larger number of dug wells visited were stoned up, either with sandstone, drawn from a distance in some cases, or with erratic boulders from the drift. In either case the use of this form of curbing is open to very serious objection, since the spaces between the stones permit the entrance of surface water during storms, and also of that which runs from the surface through cracks and channels, which in clay soil are far from uncommon. During the long continued series of dry seasons which have prevailed for the past years many of the dug wells, partially or entirely failing, have been deepened by boring small holes by hand with augers of various sizes to underlying water-bearing strata. These holes were commonly left without tubing and the water supply was frequently not permanently improved unless the water-bearing stratum which was found, gave a strong up-current, which could keep the opening made by the auger clear. Only one case was noted in which a dug well was flowing over the top.

The water from such of this type of wells as were chemically tested varies characteristically with the soil, or rather with the form of drift deposits in which they were dug, or from which the water came. The water from "veins" in the clay or clay gravel, generally contained more dissolved mineral matter than that from, sand or gravel. The mineral matter was frequently largely calcium carbonate, although the sulphate was not wanting. The presence of iron was frequently shown by the reddish color of the '"tea-kettle scale" and in nearly every case the presence of chlorin was strongly indicated by the usual test. The water from sandy layers, as would be expected, was more free from the calcium salts, and in general contained less mineral matter.

The character of the soil also has much to do in determining the kind of wells which are most common in a given district, and in studying the wells of the region traversed this was well shown. In sections where the surface layers were porous and underlain at a depth of several feet by impervious strata, or where the drift materials were clay and sand and gravel intermingled in layers, dug wells as described above were almost exclusively used. Where the surface material was a compact clay without intermixed sand, or where the rock was near the surface, the wells were frequently drilled. If the clay deposit was very deep the drill would sometimes strike a water-bearing stratum before rock was reached, and along the southern border of Grant township the wells were frequently of this character. The water from such wells was practically the same as that from those dug in the clay. In many places, however, the drill would reach rocks before water would be found in any quantity, especially if the overlying clay was compact to the rocks.

An interesting region was found just west of Ubly, where there are many high clay ridges. On these the water was nearly all obtained from deep drilled wells which went a foot or two into the underlying sandstone ninety or a hundred feet below the surface, while the wells in the lower flat land on either side of the ridges were not twenty or thirty feet deep to the same sandstone, showing that the rock surface was in the main nearly uniformly flat underlying the regions. Where the surface material is rather thin and porous and the rock directly below, wells drilled a considerable distance into the rock are the only reliable source of supply. In such cases drilling is continued until a "vein" of water is struck, and, judging from reports, the rock is more or less intersected with small channels in which the water collects, as it is said that the drill drops, at the time water is found, as if a hole had been reached. The water from this class of wells was so characteristically pure and free from mineral matter (see Anal. Badaxe water p. 137) that it was possible to tell by the taste alone whether water came from the sandstone or from the clay above it. Calcium was usually present in traces in the form of the sulphate, and chlorin was either absent or present in small amounts. With the exception of two drilled wells on the middle line of Sec. 18, Huron township, and two dug wells on the N. E. ¼ of Sec. 12, Dwight township, and one in Paris township, near the quarter line on the north side of Sec. 20, the wells visited by me alone were remarkably uniform in the character of the mineral constituents. The two wells mentioned as exceptional were quite brackish, and contained in addition considerable calcium sulphate. In some neighborhoods the iron dissolved in the water was noticeable to the taste, and one well about 100 feet deep was found at Pinnebog P. O., and was quite strongly impregnated with hydrogen sulphid. One well a half mile west of Owendale P. O. was found which was strongly

gypsiferous. In the day's trip to Sand Beach to assist Dr. Gordon, I found the wells about there, in Bloomfield and Sigel townships very brackish or even unpleasantly salt, and to the west of the territory assigned to me the wells contained both salt and gypsum in large quantities.

To sum up the results of the examination, the well waters of the section are remarkably free from mineral matter, except along the northern tier of townships. The water from the sandstone is very pure and more so than from the drift above it. All the waters of the section contain chlorin and in some districts the amount is largely in excess of that normal to well waters of the country as a whole, and in other formations might be looked upon as an indication of bad drainage and contamination, but in this region, the fact that salt-bearing formations are so near, both horizontally and vertically, and that there are many old salt wells in the vicinity, affords a satisfactory explanation of the occurrence of chlorids in such quantities.

No flowing wells were found in the region, except one just east of Badaxe, until the valley of the Pinnebog was reached. South of Elkton, about Owendale, and south and west of that point, a considerable number of such wells were found, and also some that formerly had given good flows, but within a year or two had ceased flowing.

§ 4. Mineral waters.

So much for the waters as drinking water, but, like some other things, what will make a well man sick may often make a sick man well, so that some of the less potable waters may still be useful.

The water from the well of Mr. Raither on Sec. 13, south of Bayport, has been brought to the Bayport resort to be used as a cathartic and southeast of it are a number of wells still more powerful. Most of them that are used regularly are mild and one can quickly become used to them, but in hot weather when one is tempted to drink more, and especially if neighbors come to help in the thirsty work of harvesting, they give their characteristic effects. Some are really too strong to drink at all. Such cathartic wells are low in chlorides but strong in sulphates. The sulphates of magnesia and soda are probably the most efficient agents, but no complete analysis of the waters of these wells has as yet been made. Free sulphuric acid is sometimes to be detected.

Then there are the flows from abandoned salt wells. Port Crescent has quite a local reputation, and it seems to me that for tonic salt baths, such wells, which flow, as we have remarked, at Bayport, Port Crescent, and Port Austin, should be an attractive addition to the resources of a summer resort. The deep well at Harbor Beach, however, has been the most exploited in the county, and its analyses are given in Table III.

The way in which some of the wells rust tinware points to the presence of free acids, probably free sulphuric and carbonic acids, and many of them are slightly chalybeate or iron-bearing, judging from the red coating they throw down. However, the iron may be derived from the casing.

One or two cases have been reported where malarial cases have been greatly benefited by drinking the water from these deep wells. Whether there is any chemical ingredient in the water (one of the wells was Mosner's well in Sebewaing) that was helpful, or whether the change was really due to the leaving off drinking swamp water, the real trouble being bad water and not bad air, I shall not presume to decide.

The amount of iron necessary to make a chalybeate (or ferriferous) water of marked medicinal effect is very small; many of the wells seem to contain some iron, especially those otherwise strong in mineral matter.

Chemical components.	Helderberg brines.			Berea brines.		
	(1)	(2)	(3)	(4)	(5)	(6)
H_2O				776.761	767.197	789.764
$CaSO_4$	0.58	0.9936	0.90	0.129	2.539	2.623
$CaCl_2$	41.07	62.6636	56.89	31.274	3.000	5.373
			Fe. tr.			Fe_2O_3 .032
$MgCl_2$	22.44	5.3542	4.85	15.675	1.591	4.106
$MgBr_2$	0.84	24.8400	22.50			
KCl	3.07	37.7788	34.22			
NaCl	203.29	179.2391	162.64	176.161	225.673	189.134
H_2S		0.2271				
Loss	14.41	0.0004				
Total solids	285.7	311.6000	282.00	223.239	232 803	201.236
Sp. Gr.	1.187	1.180		88°	84°	

Table III. Analysis of Huron County waters.

Note.—These analyses are all reduced to parts per thousand, i. e., grams per kilogram or ounces per cubic foot, nearly, from various forms of statements as referred to. It has been assumed that the respective chemists in stating the amount in grains per imperial gallon, etc., have really taken 10 lbs. of the water a gallon, regardless of the specific weight of the brine. It is quite common to neglect the specific weight of mineral waters.

(1) Hetherington & Rasher, analysts; for U. S. Alkali Co., Sp. Wt. 1.187, from grains per imperial gallon divided by 70.

(2) S. P. Duffield, analyst, left unchanged from grammes per litre, but Sp. gr. = 1,180 at 60° F. Harbor Beach.

(3) R. C. Kedzie, analyst, from grains per imperial gallon, dividing by 70, with tr. of Fe., both these analyses from Vol. V, p. 82. These two are earlier than No. 1, but all three are of waters from the same well.

(4) From Vol. III, p. 183, and Vol. V, Part II, p. 75, from percentages, 88° salinometer; Ayers' well, Port Austin.

(5) S. P. Duffield, from percentages, 84° salinometer, Harbor Beach 702 ft. deep. Another report gives 98.7% of the solids NaCl.

(6) From percentages, 78.5° salinometer, Thomson Bros.; White Rock 566 feet deep, Vol. III, p. 184, and Report on Centennial Exhibit.

(7) A. B. Prescott from well about 2000 feet deep, but plugged off at 550 feet, see below; main flow from Napoleon. Sp. Wt. 1.0029. Old Bayport, T. 17 N., R. 10 E.

(8) A. B. Prescott, Oct. 13th, 1891, from well 328 feet deep at Bayport, main flow from Napoleon sandstone, but Michigan series not cased off, well flowing all the time; from grains per gallon by dividing by 700 ÷ 12.

(9) Bayport Station, 19 foot well, A. B. Prescott. Residue of half a litre tested for K, Li, and Br. Sp. Wt. = 1.0007. Faintly alkaline, saline solids, 0.5006 per thousand.

(10) Dr. R. C. Kedzie, well 15 feet deep pumped, Bayport, by dividing by 70 from grains per imperial gallon. Hardness 12° temporary, 6.5° permanent.

(11) Is a sanitary analysis of a shallow well at (Sand) Harbor Beach. See Water Supply Paper of the U. S. Geol. Survey, No. 31, p. 47. The above analyses I have all incorporated in that paper, where their statements in other forms will be found.

	7	8	9	10
$Ca H_2(CO_3)_2$	.451	.038	.344	.148 $Ca CO_3$
$Ca SO_4$	.360	.440	.019	.000 $Ca SO_4$
$Fe CO_3$		.044	.009	
$Mg H_2(CO_3)_2$		.100		.031 $Mg CO_3$
$Mg Cl_2$	.198		.016	
Silicic acid	.015	.144	.010	
Na Cl	2.379	.925	.022	.007 Na Cl
$Na H CO_3$		.201	.078	.014 Organic
Total	*3.403	1.892	.499	.200

* By summation.

No. 11 is by Prof. V. C. Vaughan at Ann Arbor.

Nos. 12 and 13 are partial sanitary analyses of the Badaxe water supply by F. S. Kedzie and are from wells 200 feet deep in the Upper and Lower Marshall sandstones. See § 6, under T. 16 N., R. 13 E. No. 12 is from the dead end of the pipe (the references in water supply paper No. 31 are erroneously interchanged, and the increase in organic matter over No. 13 is doubtless due to growth of algae, while the increase of inorganic matter may probably be iron dissolved by free CO_2 in the water from the pipe.

No.	11.	12.	13.
Number of bacteria in 72 hours	.812		
Albuminoid ammonia	.00008	.000072	.000048
Free ammonia	.00002	.0000024	light tr.
Permanganate reduced	.003		
Chlorine as NaCl	.002		
Organic residue	.020	.100	.090
Inorganic residue	.035	.235	.204
Total residue	.055	.355	.295
Hardness	5°.5	5°.9	5°.2

Of these analyses the most interesting geologically and practically are those of the brine near the bottom of the Harbor Beach well. That the water analysed by Dr. Kedzie is as strong in K and Br as shown there can be no doubt. Some of it is still preserved at the Agricultural College and used for exhibiting tests upon bromine. That the sample was artificially doctored there is no reason to believe, in view of the fact that the well was used and continued to be used only for salt manufacture, and so far as I know there was no attempt made to sell the property.

All parties seemed to be much surprised at the result of the analysis, which was repeated, as shown. The most plausible supposition is that the sample contained an extra large amount of the bitter water struck at 1860 feet, which was later diluted by lower brine of more normal composition at 1875 feet. It will be noticed that these brines are somewhere in the Helderberg dolomites, probably (possibly Hamilton i. e. Traverse) and not in the Berea which as elsewhere in the county was a strong pure brine, the analysis of which is No. 5. Nos. 4, 5 and 6 are from the Berea grit and show clearly the progressive increase in solids with depth. Nos. 12 and 13 show the pure water of the Marshall sandstone. No. 8 shows the same water mixed with the sulphated waters of the gypsiferous Michigan series above. No. 7 penetrates deeper into the lower Marshall and we see that the $CaSO_4$ is relatively reduced while the salt and carbonates increase,—just what might be expected. Nos. 9 and 10 are shallow" wells showing the water yielded by the Bay-* port limestones and sandstones,—a little hard and not as low in mineral matter as the Badaxe, but less mineralized than most of the water in the state. Probably the circulation of water in these beds is quite free, as I have indicated in discussing Fig. 9, and an analysis in sand would not be very different. Such analysis I take No. 11 from a Harbor Beach well to be, for I know that the deeper wells like that at the Dow House are salty.

§ 5. Chemical tests of well waters.

In a county as flat and with as few outcrops as Huron county, any thought of following the stratigraphy was out of the question, unless the wells helped us to do it. Information gathered concerning the beds passed through is valuable so far as it goes, but often the important facts have passed from the memory, and again memories are deceptive. I had the depth of the Port Crescent salt wells reported to me from memory as all the way betwen 900 and 1,500 feet deep. It was therefore very desirable to have as a check something that could be tested as a present fact, and it seemed to me possible from things I had heard about different wells, that something might be made by testing them. Practical tests in a small way were hopeful, and as the proof of the pudding is the eating, I resolved on a systematic testing of the wells. It was obviously necessary that the tests should be of the simplest and most rapid description, and they could be but qualitative.* "A pocket case containing a set of reagents for making the ordinary qualitative tests for the more common metals forming soluble salts was devised and taken into the field, equipped with test tubes, etc., but was abandoned after a few weeks' trial as too cumbersome, and from this time on a discarded bicycle-tool-bag, respectively compass case," containing a few physicians' casevials of reagents and a test tube constituted the laboratory. The brief experience had shown that the waters were practically free from substances easily recognizable, except the sulphates, chlorids, calcium and iron, and search for others was not practicable in the field. Under these circumstances the reagents selected were,—silver nitrate, barium chlorid, ammonium oxalate and tannic acid, the latter not perhaps the best for the purpose, but the only available

one at the time it was adopted. A small quantity of the water to be tested was used to rinse out the test tube thoroughly, then not more than one-half inch of the water was taken into the tube and a drop or two of the reagent required was allowed to run into it. If chlorin was the substance sought and after the addition of silver nitrate a mere opalescence appeared, the result was noted as indicating a 'trace' of chlorin. If the silver nitrate gave a milky appearance to the water, up to the point of curdiness it was noted as 'Cl low' or 'low plus;' if a curdy precipitate formed, it was said to be 'medium' or 'medium plus,' according to the promptness with which the curdiness appeared, and if the water had a brackish taste, it was noted as 'Cl strong,' and the curdy precipitate was very marked in such waters.

"After the test was made it was usually repeated, and the tube was very carefully cleaned, before another substance was looked for. In this way the wells were tested quantitatively in a rough way, as well as qualitatively.

"The other mineral constituents could not be graded so accurately as the chlorin, but the density of the precipitate and the rapidity with which it formed gave a fairly good indication of the relative amount of each substance present, and by the aid of these tests we were enabled to determine the mineral impurities of the wells visited, with sufficient accuracy for the purpose."*

I may remark that the chemicals above mentioned have the advantage that they can be carried around in a dry form, and dissolved in rainwater as needed. Citric acid may be used instead of HCl for the same reason.

*All in quotation marks is from Prof. C. A. Davis.

A few suggestions as to recognition of the substances by the general behavior of the waters, may be also interesting. Lime and to a less extent magnesia and iron make tea kettle scale; a scale of carbonates, will dissolve in hot vinegar quite rapidly with effervescence, but the sulphate of lime dissolves more slowly with no effervescence, and has a fibrous appearance when carefully examined, and is softer. An iron water makes a red scale and turns tea black or a weak yellow solution brown, practically the same reaction as that which we used with tannic acid. Cathartic effects are generally due to sulphate of magnesia or sulphate of soda.

As Prof. Davis remarks above, the testing was qualitative, but we give below a table which he prepared showing roughly the quantitative equivalents of his chlorine tests. As the difference between medium and strong is one of taste it is more uncertain, and I found that as I was in a region, and staying at hotels at Sebewaing and Bayport where there was more salt naturally in the water, than was usual in the district in which Davis worked, my division line between medium and strong was higher than his. In order to grade more accurately these wells with much mineral matter I had recourse to a physician's urinometer, which measures the specific gravities. This consists of an instrument like a salinometer,—a cylindrical vase in which floats a glass bulb with mercury in the lower end, and the upper end prolonged into a stem like a thermometer, which is usually divided into 60 divisions, with the 0 at the top, at the point at which it floats in pure water. The heavier the water is, i. e. the more salt it contains, the higher the bulb floats and the excess of weight of equal volumes measured with reference to the volume of pure water is measured on the urinometer scale and the reading gives about twice the salinometer reading and about eight times the percentage of salt. For example, if the urinometer reads 16 the salinometer will read 9 minus, the percentage of salt will be somewhat over 2%, the specific gravity will be 1.016 or a cubic foot of the water (thirty quarts) will weigh nearly 16 ounces more than a cubic foot of pure water would under similar conditions.*

*Approximately; the table on pp. 177-179 in Vol. III, of our reports gives more accurate figures, but that is itself not quite accurate, and the varying percentages of different salts prevent great accuracy, so that the rule above is probably practically as accurate as the table. The temperature ought also to be considered. Urinometers are usually graduated for a temperature of 60° F.

My tests around Sebewaing indicated that by taste I usually classed a well with a specific gravity of 1.002 as moderate, but anything above that as strong or "medium plus." Hence the range of "medium" in my case would be up to 2.6 parts per thousand of solids, and if as in analysis (8) the salt (NaCl) was about half the solids (and the wells were generally strong of sulphates as well as chlorides), my "medium" would correspond to Davis's "medium plus." The range of meaning in the other components is still less exact, but speaking generally, "SO_4 strong" would correspond to a saturated solution of gypsum, about 178 grains per imperial gallon or 2,170 to 2,540 parts per million.*

The following are Prof. Davis's notes to determine the value of his Cl tests during the summer:

100	milligrams	NaCl	to	litre	H_2O	=	no saline taste ... Cl low—"
200	"	"	"	"	"	=	" " " ... Cl low—
300	"	"	"	"	"	=	" " " ... Cl low—
400	"	"	"	"	"	=	very slight saline taste ... Cl low—
500	"	"	"	"	"	=	slight saline taste ... Cl low+
600	"	"	"	"	"	=	faintly brackish ... Cl low+
700	"	"	"	"	"	=	faintly brackish ... Cl low+
800	"	"	"	"	"	=	brackish ... Cl medium
900	"	"	"	"	"	=	well marked brackish ... Cl medium
1000	"	"	"	"	"	=	well marked brackish ... Cl medium
1100	"	"	"	"	"	=	well marked brackish ... Cl medium+
1200	"	"	"	"	"	=	well marked brackish ... Cl medium+
1300	"	"	"	"	"	=	well marked brackish ... Cl medium+
1400	"	"	"	"	"	=	slightly salt ... Cl strong
1500	"	"	"	"	"	=	slightly salt ... Cl strong
2000	"	"	"	"	"	=	well marked salt ... Cl strong+

"So our 'Cl low' or 'traces' probably indicate salt present as high as 2 parts to 10,000 of water, 'low' up to 5 parts to 10,000, 'low +' up to 8 parts to 10,000, 'medium' up to 1.1 parts to 1000, 'medium +' up to 1.3 parts to 1000 and strong above 1.3 parts to 1000; in every case, provided the chlorides of calcium and magnesium were not present (which seems likely from the faintly saline tests which are present in nearly all my solutions). The lowest amount of salt I could get to give a reaction was two milligrams to the litre, — 2 parts to 1,000,000, — from which I got a very slight opalescence, forming very slowly. In these experiments I used the same silver nitrate which I used all summer, and the results may have additional interest on that account.†"

The main result of these tests is to show that the Napoleon sandstone has less mineral matter, and

especially less of sulphates in proportion to chlorine than the overlying beds, and a parallel phenomenon has long ago been observed by Garrigues, in the brines of the Saginaw River (Vol. III, pp. 182-183). Below the Napoleon the salt reappears, but the sulphates are not so prominent, and the analyses of the deeper wells show a predominance of magnesium and calcium chlorides.‡

*Its solubility varies somewhat with temperature, being greatest at 95° F., and also with the other substances in solution.

†Extract from letter of C. A. Davis, Feb. 12th, 1897.

‡The varying percentage of sulphates on the one hand and of the chlorides of magnesia and lime on the other in association with these brines suggests some interesting questions. How can the gypsum which exists in the sea water be so completely got rid of as in analysis (4) or must we suppose that the sea was then deficient in a sulphate of lime? The latter supposition in view of the beds of gypsum that occur both above and below seems hardly likely, and one is tempted to conceive the sulphate of lime as having been chemically replaced. But the only place where the sulphur can be disposed of is in the sulphides. We find, in fact, brine-bearing sandstones, the top of the Napoleon sandstone, or the sandy layers exposed at the Point aux Barques lighthouse, heavily charged or entirely encrusted with sulphides. But this disposition of the sulphur implies a reducing or deoxidizing action, and it may be noted that the sulphides tend to form near and replacing fossils or in blue or black shales which owe their color to the organic matter contained, which may serve as a deoxidizing agent. The general reaction would then be that organic carbon in oxidizing would bring into solution the iron as bicarbonate, which would partially then interchange with the lime, forming sulphate of iron (Geol. Sur. Miss. III, 1892, p. 19), which would then in presence of more reducing carbon compounds, be reduced to the sulphide of iron. According to this scheme the sulphides would form near the reducing agents and the sulphates and bicarbonates farther therefrom. In the same way the carbonic acid slowly generated by decomposing organic matter, would crowd out the sulphuric acid from the sulphate of lime to a slight extent, which would in its turn claim a certain proportion of the sodium (Na) from the sodium chloride (NaCl), thus giving rise to the complicated associations that we find.

§ 6. Systematic catalogue of wells and borings.

Explanations and Abbreviations.

In so many records taken by different men at different times perfect uniformity in description is not observed. But in general the first thing given is the location of the wells within the section, according to the system which has been for some time adopted by the Survey, i. e., by the number of paces north and west of the southeast corner of the section, assuming ordinarily 2000 paces to the mile, and that wells are ordinarily about 50 steps from the road. Thus locations beginning 1950 N. are on the north side of the section. Occasionally wells are located from some other corner, or by feet, instead of paces, or described by the fraction of the section in which they occur, but it is explicitly stated in such cases. Next generally follows the depth, and the depth of bed rock, or the depth of casing, in feet and then the results of tests for salt (Cl) sulphuric acid H_2SO_4, sulphates (SO_4), and lime (Ca) and iron (Fe), as above described (§ 5), stating whether they are present in large quantity (strong or str.) in moderate quantity (med. or mod.), in slight quantity (low), or in traces (tr), or absent (0). Next comes the elevation above sea or tide level (A. T.) which sometimes precedes, sometimes follows the altitude in feet. The elevation above Lake Huron is about 581 feet less. When the water tasted markedly of mineral, the specific gravity test with the urinometer was often made (Sp. Gr. or Sp. Wt).

When the well flowed the temperature was commonly noted with a pocket thermometer. That read by Davis seemed to read about 2° higher than that by Lane. The latter has been compared with Green's thermometer No. 7536 and agrees within a degree. The general division of field work has been given above. In certain case of doubt the field observer is indicated by initial; (D) Davis, (G) Gordon, (L) Lane.

The records are arranged first by townships then by ranges, beginning at the S. E. and then by sections.

Sebewaing Township (T. 15 N., R. 9 E.).

Section 1.

1950 N., 1280 W., 80 feet deep, 65 to rock, with Cl low. SO_4 trace. J. Graves, owner. A. T. 631.

1950 N., 880 W., 122 feet deep, 68 to rock; Cl low, drilled by A. Jahnke for Ch. Marotski. Chas. Falle drilled 300 ft., near by in a vain attempt to obtain a flow.

620 N., 50 W., 160 feet deep; Cl low, SO_4 low. A. T. 629.

1000 N., 980 W., 11 feet deep. A. T. 630.

Section 2.

In southwest quarter. Drilled by J. Russell for Henry Gettel, A. T. 630.

DRILLER'S RECORD.

	Thickness.	Total.
Clay	62	62
Hardpan	6	68
Limerock	2	70
Slate	20	90
Sandrock	30	120
Limerock	8	128
Sand rock (Napoleon sandstone)	65	193

and in the same quarter, J. Russell drilled a well for Mrs. J. Gettel as follows:

	Thickness.	Total.
Old well	66	
Hardpan	4	70
Limerock	5	75
Slate	27	102
Dark sandrock	15	117
Sandrock	10	127
Limerock	4	31
Sandrock	2	133
Limerock	6	139
White (Napoleon) sandrock	15	154

980 N., 920 W., first well 100 ft. deep, SO_4 low, second surface well dry. A. T. 630.

1360 N., 820 W., 12 feet deep, dug. A. T. 628.

980 N., 1440 W., 190 feet deep, 80 to rock, the first 50 or 60 feet "slate" (shale), then 40 feet and more sandstone; Cl low. L. Ebert, owner. A. T. 622.

1640 N., 1950 W., 140 feet deep, 60 to rock, the casing driven 90 feet, i. e., 30 feet into soft rock; Cl med. SO_4 tr. A. T. 616.

Section 3.

780 N., 1950 W., deepened from 75 feet, which may be about the depth to bed rock, down to 135 feet, at present Cl med. SO_4 tr. *It was harder when shallower*. A. T. 616.

1240 N., 1950 W., 157 feet deep, about 70 to rock. Drilled by C. Hofmeister for C. Winter. The water never overflowed, though at first it came just to the top, and always remains nearly full. Cl low. SO_4 tr. There is another shallow 6 foot well.

1700 N., 50 W., Depth to rock 60 feet, total depth 160 feet. Cl med. SO_4 low. Carl Beck, owner. A. T. 628.

620 N., 50 W., depth 290 feet. A. T, 620.

50 N., 1100 W., Cl med. SO_4 low. See Russell's record following, probably of this well. A. T. 620.

Section 4.

1130 N., 1450 W., well 18 feet deep, water yellow and probably surface water. A. T. 610.

800 N., 50 W., well 210 feet deep, and around here it is 80 to 90 feet to rock; Cl. med. SO_4 trace. Geo. Gremel, owner. A. T. 610.

120 N., 50 W., 205 feet deep, 96 to rock, and then sand rock all the way down. Water begins at about 160 feet and at 205 feet we pass through the waterbearing rock. F. J. Gremel, owner. A. T. 612.

1890 N., 50 W., 20 feet deep, not drilled. A. T. 608.

Section 5.

50 N., 50 W., shallow well in surface sand, of which there are extensive ridges and dunes on the south line of the section. A. T. 612.

Section 7.

Southeast quarter. Test well by J. C. Russell for J. C. Liken on Kobeld's land. No. 1, May 9th, 1894. A. T. 590.

	Thickness.	Total.
Clay	52	
Hardpan	4	56
Loose sandrock	2	58
Sandrock	2	60
Light slate rock	6	66
Fire clay	2′ 7″	68′ 7″
Black slate	4′ 8″	73′ 3″
Fire clay	5′	78′ 3″
Slate and iron	1′ 4″	79′ 7″
Coal	1′ 2″	80′ 9″
Dark sandrock	1′ 8″	82′ 5″

Test well No. 8, on Kobeld's land near the railroad, as recorded below. A. T. 590½. Record as follows:

	Thickness.	Total.
Clay	43	
Sandstone	15	58
Shale and slate	6	64
Coal	6 in	64½
Hardpan	8	72½
Slate	17	89½
Coal	4	93½
Fire clay	3	96′ 6″

No. 9. Test well on Kobeld's land (Coreyell's series). Depth 99 feet. A. T. 590. Record as follows:

	Thickness.	Depth.
Clay	50	
Sandrock 2 ft. very hard	15	65
In black slate	4′ 6″	69′ 6″
Coal	6″	70
Hardpan	3′	73
Blue shale	5′	78
Coal	15′ 4″	93′ 4″
1 ft. in fire clay		99

S. E. ¼. No. 2 test well for J. C. Liken on Kobeld's land. Probably put down May 26th, 1894. Depth 85 feet 9 inches.

	Thickness.	Depth.
Clay	52	
Loose sandrock	1	53
Sandrock	7	60
Iron pyrites	1	61
Black slate rock	5	66
Fire clay rock	1	67
Slate rock	14′ 4″	81′ 4″
Coal	2	83′ 4″
Brown rock	2′ 5″	85′ 9″

S. E. ¼. No. 2 test well for Sebewaing Mining Company. Depth 91 feet 11 inches. About 590 A. T. Record as follows:

	Thickness.	Depth.
Clay	50′ 6″	
Hard-pan	5′ 6″	56
Loose sand rock	1	57
Hard pan	4′ 10″	61′ 10″
Soap or slate rock	13′ 3″	75′ 1″
Black slate rock	4′ 4″	79′ 5″
Coal	1′ 6″	80′ 11″
Fire clay	6′ 6″	87′ 5″
Fine sand	4′ 6″	91′ 11″

No. 1 test well for Sebewaing Mining Company. Depth 130 feet. About 590 A. T. Record as follows:

	Thickness.	Depth.
Clay	50	
Hardpan	7	57
Loose sandrock	2	59
Small vein of sand		
Hardpan	3	62
Black slate	13	75
Light slate	19	94
Black slate	24	118
Fine sandrock	12	130

Section 8.

S. W. ¼. Block 2, Lot 9, of Chappell's subdivision, 980 N., 1600 W. Cl med. +, SO_4 tr. Henry Muller. Original depth 273 ft. It was deepened in August, 1896. This well was cased to 192 feet, afterward to 194 feet, and the deep casing has improved the water. Flow was strong; 2 gallons in eight seconds. T. 52.5°; 10 foot head. Record as follows:

	Thickness.	Total.	Correlation.
Old well	57	.....	Pleistocene.
Loose sandrock	2	59	Coal Measures.
Light slate rock	24	83	
Black slate rock	5′7″	88′7″	
Coal	3	91′7″	
Dark sandrock	3	94′7″	
Water sandrock	10′5″	105	
Offset at	126½	.....	
Slate with hard streaks	102	207	Grand Rapids group.
Dark lime rock	16	223	
Slate with hard streak	12	235	
Soft slate rock	12	247	
Sandrock	67	314	

1360 N., 1316 W. About 50 feet southwest of corner of Young and Center streets, Lot 3, Block 2, of J. C. Liken & Co.'s plat. J. Bauer, owner. A. T. 596. Driller's record as follows: A. C. Lane was present at the drilling and the notes in brackets are his.

Clay (old well 20′)	48	.....	
Hardpan (clay with little stones, Sept. 2)	16	64	Pleistocene.
Light shale	10	74	
Black shale	7	81	Coal
Black slate	8	89	Measures.
(Sept. 3, down to 95′2′, coal between 81 and 88 ft? Lighter fire clay at bottom). A little coal.			
Black shale	12	101	
Sand rock	3	104	
Hard dry lime rock. Cl mod SO_4 mod.	9	113	Bayport, *i. e.*,
Sept. 5, Down to 118 ft., struck water in last 10 feet; the drillings full of brown angular fragments with some sulphide of iron and zinc, showing probably that they have passed through a siderite nodule.			Maxville.
Light lime rock (effervescing freely)	14	127	Limestone.
A drop of 7 in., SO_4 mod. Cl med. + Sp. gr. 1.002 +.			
Light and blue shale	50	177	
Sept. 9, sandy shale 7′ below the drop, then blue shale 12 to 144 this day.			
Sept. 10, 145-155 blue calcareous shale.			
Sept. 11, 155-170 blue calcareous shale sticky.			
Work interrupted 12-13th.			
Sandrock	5	182	Michigan series.
Lime rock	6	188	
Sandy shale	10	198	
Light shale	8	206	
Dark lime rock	19	225	Soule beds.
Light shale	24	249	
Lime rock	3	252	
Water sand rock	48	300	Napoleon sandstone.
Fine sand rock	10	310	Upper Marshall.

Finished Friday, Oct. 2d, 1896. Good flow.

S. E. ¼ of N. W., on dividing line between Campbell and Martini's place, about 100 feet from the street.

1130 N., 1430 W. Cl med. SO_4 med. Hard. Sp Wt. 1.004. Head fluctuates every day. In 1889, 10 foot head, Aug., 1896, 3 foot head, in Sept., 1896, 2 foot head. It failed entirely soon after. Martini and J. W. Campbell, owners. Depth 280 to 285 feet (330?). No flow until at the very bottom, then with one blow of the drill at least 10 feet head. A. T. 596.

675 N., 1265 W., Main street, opposite Fourth street. Flowing well T. 8° R. = 50° F. Depth 365 feet. Owned by Hæberlein's Brewery. This well is deeper than necessary for water, and they stopped going further for fear of getting salt. It is 5° less hard than Mosner's well and has less S. It is cased to 160 feet, then there is blue slate 20 feet, the rest is solid rock,—about 300 feet to sandstone. It is probable that the driller commenced getting into the red rock which other records show underlies the Napoleon, and is commonly taken to be a sign of salt. A. T. 607.

650 N., 1350 W. Block 11 W. C. Chappell's addition 400 ft. N. of 1-16 line and 50 feet west of center. Depth 275 feet. A. T. 600. Chappell's well.

This well is slightly salty, and used to flow, but the casing burst and the water leaked into the old mine. In Jan., 1898, the leak is said to have become so bad that the heads of all the other flowing- wells dropped. It seems to be largely responsible for the drop of the head in the Napoleon.

1100 N., 1537 W. N. W. corner Union. Mosner's hotel. Flowing well, supplies 6 pipes, 3 or 4 foot head. Cl. med. T. 54° F. Depth 298 feet. An analysis lost showed Fe_2O_3 Na Cl., S, Mg., etc. A. T. 593.

1160 N, 1420 W., S. E. of N. W. Depth 304 to 307 feet. Owner, C. F. Bach. Drilled in December by C. Hofmeister. Sp. gr., 1.003, Cl med. SO_4 low. A. T. 597.

Flowed at first, but has ceased. They keep pumping it night and day by a wind mill.

750 N., 1800 W. N. W. of S. W. Depth 293 feet. Sebewaing Coal Co. A. T. 593.

Forms a white scale in boiler. Salt and iron evident.

1010 N., 1400 W. Cl med. SO_4 low. Depth 160 to 170 ft. A. T. 596 feet. Behind Likens' store.

700 W, and about 650 N. A. T. 610. Bach's well.

Used to flow but stopped when the Martini-Campbell well started.

About 1200 N., 1950 W., at Stave Mill. Depth 115 feet. A. T. 593. Liken and Bach, owners

490 N., 1460 W. A. T. 600.

Original coal exploration.

490 N., 1375 W. Depth 86 feet. A. T. 600.

Original shaft 86 feet to bottom of coal passing- through boulders of sandstone.

On Chappell's land. Depth to rock 50 feet, total depth 112 ft. 3 in. A. T. 596. J. C. Liken's well No. 10. Record as follows:

	Thickness.	Depth.
Clay	50	
Sandstone	10	60
Hardpan and gravel	2	62
Sandstone	13	75
Light shale	7	82
Slate	23′ 7″	105′ 7″
Coal	4′ 5″	110
Fireclay	2′ 3″	112′ 7″

Section 9.

1350 N., 1400 W. Depth 70 feet (120). A. T. 607.

Used to flow but has not flowed since 1889. It was later deepened in testing for coal, but we have no record of it; only a few inches of coal at most, were found.

50 N., 1900 W. Cl tr. SO_4 med. Depth 160 to 180 feet. A. T. 607. Driller J. C. Russell, for Graves. Cf. Sec. 1.

Section 10.

50 N., 1680 W. Depth 164 feet. Cl tr. SO_4 trace. A. T. 620.

This well is in blue stone not sandstone, but of a pale ash blue color. Water at 64 feet and rose to within 9 feet of surface at first, at 164 feet depth rose to within 7 feet of the surface. Now (1806) it is lower.

50 N., 1200 W. Depth to rock 60 feet, total depth 247 feet. Cl low, SO_4 0; at 180 feet water rose to within about 1 foot of surface. A. T. 622.

Mainly blue rock at bottom, 50-60 feet in sand rock.

50 N., 600 W. Cl med. SO_4 trace, stains of Fe. Depth 490 feet. A. T. 624.

Chas. Voltz, owner; Chas. Hofmeister, driller.

At 180 feet water, which at first rose to within 2 or 3 feet of surface. At 220 feet water again; got red rock after passing through sandstone at bottom.

1950 N., 460 W. Cl low. Depth to rock 80 feet, total depth 182 feet. At 140 feet in sandstone as much water as it ever got.

1850 N., 760 W. A. T. 620.

Section 11.

1780 N., 240 W. Cl trace, SO_4 strong. Depth 145 feet. A. T. 630.

1950 N., 1280 W. Cl low, SO_4 strong. Depth to rock 50 feet, total depth 172 feet. Water at 57 feet and rises to 18 feet below surface. This well is cased to rock and has white sandstone at the bottom. This well has two slightly different records, the one above was furnished at the house, the one below from J. Russell.

J. Russell, driller. Joseph Gruen, owner. A. T. 630.

August 29, 1895.

	Thickness.	Depth.
Red clay	9	
Blue clay	48	57
Hardpan and boulders	2	59
Sand and gravel	1	60
Slate or soap rock	4	64

Deepened June 26th, 1896.

	Thickness.	Depth.
Hard dark rock	6	70
Slate rock	14	84
Hard dark rock	1	85
Slate rock	2	87
Hard dark sandrock	4	91
Black sandrock	5	96
Hard flint rock	2	98
Sandrock	18	116
Very hard rock	3	119
Sandrock (Napoleon)	51	170

50 N., 1240 W., Cl low, SO_4 strong. A. T. 630.

Depth 200 feet, about 80 feet of casing. E. Rievert, owner.

50 N., 820 W. Cl low. SO_4 med. Depth to rock about 70 feet, total depth 300. A. T. 630. D. H. Voltz, owner.

Sandstone at 70 feet, then a few feet of soap rock, then sandstone the rest of the way to 300 feet. (?)

50 N., 320 W., Cl low. SO_4 med. A. T. 630. Depth about 96 feet. This well is-cased for 58 feet. Cost (50c a foot for first 50 feet, $1 a foot thereafter) + $29 for casing = $100. Caleb Voltz, owner. C. Hofmeister, driller.

120 N., 50 W. Cl low, SO_4 strong. Depth to rock 182 feet.

1240 N., 1950 W. Depth 60 feet. A. T. 630.

Water is said to have been struck just on top of rock, but the well is filled up. W. Kuehn, owner.

N. E. of N. W. ? A. T. 630. C. Finkbeiner, owner. J. Russell, driller. Aug. 13, 1895.

	Thickness.	Depth.
Red clay	14	
Blue clay	43	57
Hard pan	8	65
Slate or soaprock	9	74
Very hard lime and sandrock	20	94
Sandrock	16	110
Very hard rock	2	112
Water sandrock	16	128

Section 12.

1950 N., 1760 W. Depth 128 feet. A. T. 630.

1500 N., 50 W. Cl low, SO_4 trace. A. T 630. Depth 90 feet.

680 N., 50 W. Depth 86 or 200 feet. A. T. 630.

Section 14.

1950 N., 1580 W. Cl trace, SO_4 strong. A. T. about 630. A. Voltz.

50 N., 1680 W. Cl trace, SO_4 med. A. T. about 632. Depth to rock 90, total depth 268 feet. At first in soaprock, then harder rock and sandstone.

50 N., 1360 W. Cl trace, SO_4 med. Depth to rock 80, total depth 296 feet. A. T. 632. This well is cased for 80 feet.

50 N., 700 W., Cl trace, SO_4 strong. Depth 150 feet. Bauer, owner. A. T. 632.

Section 15.

1850 N., 1950 W. Cl low SO_4 trace. Depth to rock 70 feet, 74 casing, total depth 216 feet. A. T. 620.

Riever and Studer's cider mill. C. Hofmeister, driller. From 69 to 80 feet this well passed through buff limestone, from 80 to 105 feet green calcareous shale. No coal was found, and it did not go down to sandstone.

When the water in this well is roily rain is expected in 24 hours.

1950 N., 200 W. Cl low, SO_4 0, A. T. 625. Depth to rock 84 feet, total depth 200 feet. John Adams, owner. No more water than a second well has at 107 feet. About 4 feet in sandrock.

400 N., 1950 W. Total depth 135 feet. Cl low, SO_4 med. A. T. 622.

Water level 24 feet below surface. This well is cased for 100 feet, gas pipe is used for 70 feet.

670 N., 1950 W. Sp. Wt. 1.003, Cl low, SO_4 med. Ruppert and Sanders, owners. Drilled by J. Russell.

This well was 150 feet deep, afterwards deepened to 200 feet.

Section 16.

1950 N., 520 W. Cl low. Total depth 260 feet.

400 N., 50 W. Cl low, SO_4 med. A. T. 625. Depth to rock 73 feet, total depth 126 feet. There is said to be about 2 in. of coal in this well.

650 N., 50 W. Sp. Wt. 1.004 Cl strong, SO_4 trace. A. T. 624. Depth to rock 72 feet, total depth 350 feet. This well goes through sandrock to red paint rock. Soft water, which stood at first 4 ft. 3 in. below the surface afterwards fell to 20 feet below the surface.

Section 17.

W½ of N. W. ¼, on land of Henry Liken, Jr., Sebewaing. No. 3 test well for Saginaw Bay Coal Company. A. T. 600. Total depth 82 feet 1 inch. Record as follows:

	Thickness.	Depth.
Sand	3	
Clay	52	55
Hardpan	4	59
Hard sandrock	5	64
Light slate	13	77
Black slate	2	79
Coal	2′ 10″	81′ 10″
Reddish slate	3″	82′ 1″

N. ½ of N. W. ¼, on Beck's land, Sebewaing. No. 2 test well for Saginaw Bay Coal Company. Total depth 84 feet. Record as follows: A. T. 600.

	Thickness.	Depth.
Clay	65	
Hardpan	7	72′
Black slate	8′ 8″	80′ 8
Sulphur and iron	8″	81′ 4″
Coal	2′	83′ 4″
Sandy fire clay	8″	84

S. E. ¼ of N. W. ¼ on Schilling's place. Records from J. C. Liken.

No. 1.

	Thickness.	Depth.
Clay	60	
Hardpan	7	67
Rotten shale	1½	68½
Slate	13	81½
Coal	4′ 5″	85′ 11″

No. 2.

	Thickness.	Depth.
Clay	62	
2 ft. gravel at 40 ft.		
68 ft. to sandstone.		
Sandstone	10	78
Shale	4	82
Slate	13	95
Coal	4′ 7″	99′ 7″

N. W. ¼. Sebewaing Mining Company. J. Russell, driller. Record as follows: (Note the greater depth to rock.)

	Thickness.	Depth.
Clay	59	
Hardpan	2	61
Sand and gravel	3	64
Hardpan	11	75
Large boulders	1½	76½
Slate and sand mixed	13½	90
Black slate	12′ 1″	102′ 1″
Coal	4′ 2″	106′ 3″
Rotten slate	1	107′ 3″

Section 18.

900 N., 600 W. Sp. Gr. 1.005, Cl strong, SO_4 med. Depth 300 feet. A. T. 590. Record below. Well at the Saginaw Bay mine, record below by J. Russell.

	Thickness.	Depth.	
Sand	8		
Clay and dry quicksand	12	20	Pleistocene
Blue clay	28	48	
Boulders	5	53	
Sandrock	38	91	
Cave in of slate	21	112	
Slate, soft	6	118	Coal measures.
Fireclay	6	124	
Sandrock	10	134	
Sand and slate mixed	70	204	
Dark limerock	19	223	Grand Rapids group.
Soap limerock	7	230	
Hard limerock	17	247	
Hard sand rock	4	251	
Fine sand rock	13	264	Marshall
Slate rock	1	265	

N. E. ¼. A. T. 590.

No. 1 test well for Saginaw Bay Coal Co.

	Thickness.	Depth.
Sand	4	
Clay	55	59
Hardpan	6	65
Light slate	6	71
Sandy fireclay	15	86
Hard black rock	2	88
Sandy fireclay	19′ 6″	107′ 6″
Hard black rock	5′ 6″	113
Water sandrock	1′ 6″	114′ 6″

1900 N., 1100 W. Cl strong, SO_4 med. Fe indications, Sp. Gr. 1.006. Depth 284 (384?) feet. This well has fine flow and stands on the edge of the old shore about 4 feet above lake.

1750 N., 100 W. Sp. Gr. 1.007, Cl strong, SO_4 med. T. 52° F. Depth to rock 52 feet, total depth 303 feet. 592 A. T.

This well had a strong flow 4 feet above ground, but the strength of flow varies with the weather. It was deepened 22 feet since first put down, which did not improve the flow.

	Thickness.	Depth.	
Clay	51		
Sand and gravel	1	52	
Loose sandrock	2	54	
Hard rock	2	56	
Dark sandrock	18	74	
Coal about	6 in.	74′ 6″	
Sandrock	1′ 6″	76	
Slate	6	82	
Coal	3′ 8″	85′ 8″	
Bottom slate	1′ 4″	87	
Sandrock	13	100	
Light slate or sandy fireclay	96	196	Michigan
Hard dark rock	24	220	
Slate	20	240	
Hard lime rock	8	248	
Sand rock	55	303	Napoleon sandstone

About 16 feet east a well was put down for coal and found none where this found 3 ft. 8 in., see the following record:

	Thickness.	Depth
Clay	50	50
Hardpan	5	55
Sandrock	30	85
Coal	1	86
Clay	2	88
Sandrock	30	118
Shale	8	126′ 6″

1750 N., 94 W. On the Lutz farm N. part of 18. J. C. Token's farm. A. T. 590.

No. 5.

	Thickness.	Depth.
Clay	45	
Sandrock	21	66
Sticky blue shale	6	72
Slate	10	82
Coal	4′ 4″	86′ 4″
Fireclay	1′ 6″	87′ 10

No. 6 on same farm.

	Thickness.	Depth.
Clay	45	
Sandrock	5	50
Sand and gravel	20	70
Shale	3′ 6″	73′ 6″
Coal	2	75′ 6″
Hardpan	2	78′ 6″
Sandstone	21	100

No. 7 same farm.

	Thickness.	Depth.
Clay	43	
Sandstone	9	52
Shale and slate	10	63
Coal	1	63
Hardpan	8	71
Slate	8	79
Coal	3′ 2″	82′ 2″
Fireclay	1	83′ 2″
Sandstone	2′ 4″	85′ 6″

1300 N., 1000 W. No. 5 test well for Saginaw Bay Coal Co., on their own land. July, 1894. J. Russell, driller.

	Thickness.	Depth.
Sand	3	
Clay	39	42
Hardpan	3	45
Sand rock	26′ 4″	71′ 4″
Coal about	5″	71′ 9″
Sand rock	8	79′ 9″
Slate	6″	80′ 3″
Sand rock	7′ 1″	87′ 4″
Coal	4	91′ 4″
Light shale	3″	91′ 7″

N. E. ¼ of S. E. ¼. No. 4 test well for Saginaw Bay Coal Co., on land of B. Engelhard, Sebewaing.

	Thickness.	Depth.
Sand	4	
Clay	58	62
Hardpan and gravel	10	72
Sand and gravel	18	90
Slate	3	93
Coal	2′ 7″	95′ 7″
Bottom slate	5″	96

1050 N., 1000 W. No. 10. Depth to rock 45 feet, total depth 79 feet 7 inches. A. T. 586 (4.5 above datum). Record:

	Thickness.	Depth.
Clay	43	
Sand and gravel	2	45
Sandstone	15	60
Limestone	6″	60′ 6″
Sandstone	7′	67′ 6″
Slate	1	68′ 6″
Sandstone	6′ 6″	75
Slate	1	76
Coal	3′ 7″	79′ 7″

1060 N., 600 W. No. 9. Depth to rock 76 feet, total depth 90 feet 6 inches. A. T. 588 (6.3). Record:

	Thickness.	Depth.
Clay	45	
Sand and gravel	5	50
Hardpan	26	76
Slate	11	87
Coal	3′ 6″	90′ 6″

940 N., 0 W. No. 13. Depth to rock 64 feet, total depth 86 feet 5 inches. A. T. 598 (16.7). Record:

	Thickness.	Depth.
Clay	63	
Sand and gravel	1	64
Sandstone	17′ 4″	81′ 4″
Slate	1	82′ 4″
Coal	4′ 1″	86′ 6″

500 N., 750 W. No. 14. Total depth 163. A. T. 585 (12.6).

90 N., 1040 W. No. 12. Depth to rock 58 feet, total depth 118 feet. A. T. 592 (9.7). Record:

	Thickness.	Depth.
Clay	58	
Sandstone	42	100
Slate	14′ 3″	114′ 3″
Coal	3′ 9″	118

Section 20.

900 N., 1250 W. A. T. 620. Chas. Winter, owner.

	Thickness.	Depth.
Clay	74	
Sand and gravel	45	119
Fine sand rock	30	149
Lime and dark sand rock	67	216

Section 21.

900 N., 50 W., Cl med. +, SO_4 med. A. T. 620. Depth 180 feet+.

1460 N., 50 W., Cl low, SO_4 med. A. T. 620. Total depth 230.

980 N., 50 W., Cl low, SO_4 med. A. T. 620. Depth to rock 100 ft. Total depth 193 feet. This well has 4 in. casing for 60 feet, and 3 in. casing for 100 feet.

800 N., 1950 W. Cl strong, SO_4 strong. Sp. Wt. 1.003. A. T. 620. 80 feet to rock, total depth 367 feet.

This well is cased to rock. The water becomes more brackish after pumping. (Cathartic on harvesters unused to it.)

1950 N., 160 W. SO_4 low, Cl med. +, Sp. Wt. 1.002. Depth to rock 86 feet, total depth 270 feet.

At first the water in this well rose to within 18 feet of surface. The first rock is sandstone, 20 feet, then some coal, then soaprock, and then the sandstone whence the water came.

50 N., 420 W. Cl low, SO_4 med. A. T. 620. Depth to rock 72 feet, total depth 285 feet.

The water in this well rose to within 22 in. of the surface. This well has about 70 feet of white sandstone, Napoleon, at the bottom.

50 N., 1640 W. Cl 0, SO_4 med. A. T. 620 feet. Depth 100 feet+.

This well flowed at first, now the water stands 20 feet below the surface.

Section 22.

50 N., 300 W. Cl 0, SO_4 low. A. T. 630. Depth 168 feet. John Sting, owner.

300 N., 1100 W. A. T. 626. Depth to rock 66, total depth 105 feet.

This well had 66 feet of surface, of which the bottom, 35 feet, was "putty" clay, then 6 feet of hardpan, I foot as hard as emery, (?) about 6 in. limestone, with a spring between

limestone and sandstone, then 32 feet sandstone and soaprock.

300 N., 1200 W. Cl trace, SO_4 med. A. T. 626. Depth to rock 70 feet, total depth 124. This well ends in 3 feet hard rock, then 3 ½ feet sandstone.

1240 N., 1800 W. Cl low, SO_4 low. A. T. 620. Depth to rock 60 feet, total depth about 200 feet. Shell rock hard as flint over the last 20 feet of sandstone, very little soap rock.

1460 N., 1950 W. Cl low, SO_4 med. A. T. 620. Total depth about 400 feet. A. Bach, owner.

Section 23.

3950 N., 1360 W. Cl trace, SO_4 med. A. T. 635. Total depth about 200 feet.

560 N., 1950 W. Cl 0, SO_4 med. A. T. about 635.

Section 26.

1300 N., 1950 W. Cl trace, SO_4 med. A. T. 632. Total depth 100. This well used to flow. All around this neighborhood it is 100 to 115 feet to water.

Section 27.

1950 N., 200 W. Cl 0, SO_4 med. A. T. 630. Depth to rock 60 feet, total depth 205 feet. This well is cased for 60 feet.

1950 N., 900 W., Cl trace, SO_4 med. +, A. T. 629. Depth to rock 74 feet, total depth 168 feet.

1400 N., 1950 W. Cl low, SO_4 low. A. T. 625. Total depth 140 feet. When the wind is from the west the water is said to be cloudy.

50 N., 540 W. A. T. 630. Total depth 95 feet. This well is not flowing.

Section 28.

1950 N., 700 W. Cl low, SO_4 med. Depth of casing 95 feet, total depth 227. A. T. 620.

1950 N., 100 W. Cl 0, SO_4 med.

200 N., 1950 W. Cl trace, SO_4 trace. Depth to rock 50 feet, (?) total depth 79. This well is in white sandstone and is cased for 50 feet.

740 N., 1950 W. Cl low, SO_4 low.

1740 N., 1950 W. Cl low, SO_4 med. Total depth 294 feet.

1120 N., 50 W. Old mill which had a drilled well.

Section 29.

1950 N., 260 W. SO_4 strong, Cl med. +, Sp. Wt. 1.003. Depth to rock 140 feet,(?) total depth 228 feet. A. T. about 620 feet. Water was struck at 200 feet. This well used to flow and is cased for 140 feet,—is evidently in the channel.

1800 N., 1950 W. Depth to rock 150 feet, total depth 260. Owner, F. Becker.

720 N., 1950 W. Sp. Wt. 1.008. Cl strong, SO_4 strong. A. T. 620. Depth to rock 140 feet, total depth 300 feet. Geo. Hofmeister. The water rose more than 10 feet above ground until the coal mines began to work. Good water was found at 180 to 200 feet, then became salty.

500 N., 1460 W. Cl low, SO_4 low. A. T. 620. Depth to rock 128 feet, total depth 266 feet. A. Armbruster, owner. This well was cased for 128 feet. Some coal was found in it but mostly hard rock or sandstone.

420 N., 50 W. Cl low, SO_4 low. A. T. 620. This well was cased for 67 feet and is 80 feet deep.

740 N., 50 W. Cl tr., SO_4 trace. A. T. 620. This well is 136 feet deep and a trace of coal was found in the sandstone.

1500 N., 50 W. Cl low +, SO_4 med. A. T. 620. Depth to rock 70 feet, total depth 105 feet. This well "showed coal."

Section 30.

750 N., 150 W. A. T. 620. Owner, H. Irion; Chas. J. Hofmeister, Jr., driller. This well cost 50c a foot (5% off for cash), and 35c for casing.

The water is quite hard and can be lowered, by pumping, to 23 ft. below surface. It rose at first to 14 feet below surface, and is used for house and cattle.

RECORD FROM SAMPLES OF DRILLINGS.

	Feet.
Struck quicksand at	23
Blue clay	32 to 50
Quicksand and gravel	50 to 150
Rock at	150
Mainly sand (this is doubtless sand and the next is dolomite)	160 to 164
Impure sand, angular, dolomitic	164 to 166
Arenaceous dolomite, pyritiferous with speck of feldspar	166 to 180
Clean gray quartz, sandstone	188 to 191

350 N.. 1000 W. Sp. Wt. 1.003, Cl med. +, SO_4 strong. Depth to rock 95 feet, total depth 202 feet. This well used to flow.

Section 31.

300 N., 1950 W. No. 1, Brackish, SO_4 strong, Sp. Wt. 1.007. Depth about 200 feet. No. 2, said to have been not salty originally. It is now stopped up. Depth about 150 feet.

Section 32.

640 N., 1950 W. Cl tr., SO_4 low. A. T. 620. Depth 150 feet. This well is cased for 120 feet.

1460 W., 1950 W. Cl low, SO_4 low. A. T. 620. Depth 165 to 175 feet, cased for 140 feet. The rock is said to be mainly hard stuff, probably limestone.

1400 N., 50 W. A. T. 620. Depth 125 feet.

1600 N., 50 W. A. T. 620. Depth to rock 64 feet, total depth 135 feet. This is a flowing well. T. 51½° F.

140 W., 50 N. Depth to rock 73 feet, total depth 118 feet. Strong flow five feet above ground.

Section 33.

1800 N., 880 W. Cl tr. SO_4 low. A. T. about 625. Depth to rock 73+ feet, total depth 105 feet. This well was at first drilled to 81 to 85 feet and afterwards deepened 20 feet. It was 8 feet in sandstone at first. Flowing well, T. 50½°.

1950 N., 1320 W. Cl low, SO_4 trace. Depth 105 feet. The temperature of flow is 52° F.

1780 N., 50 W. Depth 72 feet. A. T. 627 feet. This well is drilled and used to flow.

50 N., 200 W. Depth 72 feet. Water rose to within three feet of surface.

50 N., 720 W. Depth 64 feet. Water rose 4 feet above surface.

600 N., 1950 W. Depth 96 feet, cased 61 feet. Water tastes free from mineral.

800 N., 1950 W. Depth 126 feet.

Section 34.

50 N., 1160 W. Cl 0, SO_4. Fred Sting, owner. A. T. 629. This well was sunk 59 to 60 feet in quicksand, and the water rose 2 feet above ground. T. 54° F.

760 N., 50 W. Cl low, SO_4 med. Depth to rock 88 feet, total depth 205 feet. A. T. 632.

1120 N., 50 W. Cl low,— SO_4 med.+ Depth 280 feet (?).

1720 N., 50 W. Cl trace, SO_4 trace. Depth to rock about 64 feet, total depth 188.

1900 N., 50 W. Cl trace, SO_4 trace. This well is 132 feet deep, cased to 58 feet. Water rose to 10 feet below surface. A. T. 632 feet.

50 N., 260 W. Cl trace, SO_4 low. A. T. 631. This well is more than 100 feet deep.

1700 N., 1950 W. A. T. 627. Depth of well 75 feet. This well used to flow.

The wells of this section are divided into two groups, one (a) drawing water from the subcarboniferous limestone at from 58 to 100 feet, the other (b) from the Napoleon or Upper Marshall sandstone from 150 to 200 feet down. The latter pass through dolomitic shales of the Michigan Salt Group and these not being cased off give a somewhat gypsiferous water.

Section 35.

400 N., 1950 W. Depth to rock 80 feet, total depth 202 feet. A. T. 632 C J Hofmeister, driller, for Christ Deeg, owner.

900 N., 1950 W. A. T. 632. Depth to rock 62 feet, total depth 192 feet Jacob Sting, owner. Cased two feet in rock and one foot above ground.

RECORD FROM SAMPLES.

Pleistocene	0 to 18	Hardpan.
	18 to 60	Blue clay.
	60 to 62	Gravel.
Upper Grand Rapids	62 to 66	Yellow dolomite.
	66 to 72	Greenish grey shale.
	72 to 80	Grey micaceous sandstone.
	80 to 85	
	85 to 90	
Michigan series or Lower Grand Rapids	96 to 100	Dolomitic. Shales somewhat pyritiferous and arenaceous, dull grey.
	100 to 105	
	112 to 120	
	120 to 125	Impure grey sandstone with some pyrite and calcareous matter.
	126 to 128	
	129 to 130	
	130 to 132	
	132 to 136	
	136 to 140	White sandstone, clearest at 150-160 (glass sand).
Napoleon sandstone	140 to 145	
	150 to 160	
	160 to 167	
	191 to 192	Somewhat impure calcareous sandstone.

Brookfield township (T. 15 N., R 10 E. L.).

Section 1.

50 N., 540 W. Cl low, SO_4 med. A. T. 649. Total depth 62 feet.

Section 2.

1950 N., 660 W. A. T. 648. Total depth 185 feet.

Section 3.

1950 N., 1320 W. SO_4 low, Cl low. A. T. 645. Depth to rock 135 feet, total depth 235 feet. Fritz Matz, owner; driller, W. Smith. Mainly blue clay (sample taken) chips came from the boring at 130 feet.

Section 5.

1050 N., 1900 W. Cl low, SO_4 trace. A. T. 632. Frank Smith, owner. Depth 138 feet.

940 N., 1950 W. Cl low, SO_4 mod. Depth 122 feet. L. Wisner, owner; J. P. Russell driller. Sept. 13, '95.

	Thickness.	Depth.	
Red clay	13	.....	Pleistocene.
Blue clay	52	65	
Hardpan and boulders	8	73	
Sand and gravel	2	75	
Shell slate	2	77	Grand Rapids group.
Hard slate	12	89	
Soap rock	3	92	
Hard slate rock	6	98	
Dark sandrock	2	106	
Soap rock	2	108	
Hard dark sandrock	2	110	
Soft white rock (gypsum?)	5	115	
Very hard sand rock	2'6"	117'6"	
Water sand rock	12'6"	130	

Section 6.

1000 N. W., along diagonal road, i. e., 707 N., 707 W. Trace SO_4, Ca low Cl med., strong Fe taste. Depth to rock 64, total depth 165 feet.

Depth 127 feet. George Kundinger's well, Kilmanagh, P. O. drilled by J. Russell. July 10th, 1896.

DRILLER'S RECORD.

	Thickness.	Total.
Clay	55	55
Hardpan	3	58
Loose dark rock	4	62
Hard clay rock	4	62
Hard dark rock	5	67
Hard dark rock	6	73
Dark lime rock	25	98
Sandy fire clay	4	102
Hard sand rock	4	106
Soft sand rock	21	127

1000 N., 1120 W. SO_4 medium, Ca medium, Cl strong trace. A. T. 632. Total depth 65 feet, a few feet in rock.

50 N., 1280 W. Cl low, SO_4 med. Depth to rock 65 feet, total depth 65 feet. Few feet in rock.

950 N., 1220 W. Cl trace, SO_4 strong. Total depth 65 to 70 feet.

Section 7.

1950 N., 1950 W. Cl trace, SO_4 med. A. T. 630. Total depth 76 feet.

1825 N., 1950 W. Total depth 100 feet.

N. W. of N. W. Total depth 140 feet. Cl low, SO_4 trace. Much less hard than the dug well, water came at 95 feet. 69 feet of casing, well extends about 20 feet in grey sandstone. Owner, A. Dreher.

680 N., 1700 W. Cl low, SO_4 trace. At about 80 feet first water was struck, it was cloudy and rose to five feet below surface and was very abundant. Owner, Carl Jahnke.

350 N., 1950 W. Cl trace, SO_4 med. Water at 80 feet. Total depth 99 feet. This well does not reach sand rock, but is in blue soap rock.

Section 8.

1000 N., 900 W., 1480 W. on diagonal road, trace SO_4, trace Ca, at Cole's saw mill. Cl low, Fe present. A. T. 640. This well has about 83 to 85 feet casing and is 160 to 165 feet deep.

Section 10.

SO_4 strong, Ca med., Cl low. A. T. 650. Owner, J. D. Durand. Depth to rock 41 feet, total 51. This well had a slight flow.

Section 11.

SO_4, light trace D. Ca trace; Cl low. A. T. 651. This well is at Owen's farm house and is 180 feet deep.

Section 13.

220 N., 50 W. Cl 0, SO_4 0 D. A. T. 676. Depth about 30 feet to rock, total 102½. The well passed through flintrock first and then mainly sandrock. There was about two feet of rock before striking water.

210 N., 40 E. A. T. 676. Depth about 64 feet. This well went about 64 feet in surface material before it came to sandrock. The wells are near by and belong to the same owner.

Section 14.

About 1900 N., 1400 W. Ca low, Cl low, SO, tr. A. T. 650. Depth 170 feet. Temperature 48°. This is a flowing well at saw mill, Owendale, but the pump is not working. Same data also apply to another well at saw mill.

2000 N., 1060 W. SO_4 trace, Ca low, Cl medium. A. T. 650. Well at hotel.

660 N., 950 W. Depth 45 feet. This well once flowed, and had 4 foot head.

280 N., 1050 W. Depth to rock 56 feet, total depth 70 feet. Owner, Mrs. Carver. This well is in hard and soft blue rock, and water rose close to the surface.

800 N., 950 W. A. T. 655. Depth to rock 38 feet, total depth 53 feet, McArthur's well.

700 N., 1050 W. A. T. 655. Depth to rock 40 feet, total depth 43 feet. Owner, S. Good. This well is in soft rock, chips were struck at about 15 ft. in boring well. The water is good for washing.

T. Davis' well has total depth of 107 ft. Water was struck at 70 feet.

Section 15.

200 N., 1050 W. Depth to rock 54 feet. Owner, J. Ross. This well flows, and has a five foot head.

50 N., 520 W. Depth 33 feet. A. T. 644. This well used to flow and had 1½ foot head at first but stood just at the surface in the fall of 1897. The water is hard. Owner, F. Carson.

N. W. part Shufeldt's. Flowing well.

800 N., 900 W. Total depth 60 feet. Flow with one foot head. T. Welch. Struck in gravel.

Section 21.

J. Finkel's well 60 feet deep, struck in gravel the water.

Section 22.

1950 N., 260 W. A. McKenzie's well. Dug 10 and bored 40 more feet, flows. Ca medium.

Section 23.

1250 N., 1900 W. Total depth 60 feet. Taylor's well, flows, in drilling were black lumps like coal.

1160 N., 1000 W. Depth to rock 47 feet, total depth 51 feet. Sandstone water. This is a drilled well. A. T. 613.

Section 24.

0 N., 120 W., Sandstone water. This is a drilled well.

Section 26.

720 N., 720 W. This well was hand drilled and used to flow.

1180 N., 1000 W. Depth to rock 50 feet, total depth 65 feet. A. T. 670. This well is in sandstone, the pipe was cut three feet below level to get flow.

680 N., 1000 W. A. T. 675. Trace SO_4, tr + Ca and Cl. Depth to rock 58 feet, total 62 feet.

This well is on the west side of the road. It used to flow but stopped in 1894.

Section 27.

900 N., 1000 W. A. T. 650. Total depth about 60 feet. This is sandstone water. T. 51° F., the pipe is exposed to the sun for 4 feet.

Section 33.

50 N., 50 W. A. T. 656. Baird and Prestage's sawmill. There are three wells on this farm and they all flow. (1.) Depth to rock 40 feet, total depth 90 feet. (2.) Depth to rock 40 feet, total depth 44 feet. (3.) Depth to rock 40 feet total depth 48 feet.

Section 34.

50 N., 400 W. A. T. 655. Depth to rock about 30 feet, total depth about 60 feet. This well used to flow.

50 N., 1780 W. Depth to rock 40 feet, total depth 60 feet. This well used to flow with a six foot head but was checked.

2000 N., 1000 W. A. T. 658. This is sandstone water and has traces of Ca, Cl and SO_4. T. 50° F.

Section 35.

260 N., 1000 W. A. T. 692. This well was drilled in sandstone, the depth is unknown. The water has traces of Ca, Cl and SO_4.

Section 36.

1000 N., 860 W. A. T. 710. This well is in sandstone water. This is a drilled well on top of gravel beach.

1950 N., 1300 W. A. T. 693. This well was drilled near the front of a dissected terrace of gravel and sand and had only a little oily water.

Grant Township (T. 15 N., R. 11 E.).

Section 1.

1200 N., 2000 W. Total depth 13 feet. This is a surface well and there is plenty of water in the hollow. A. T. 782 feet.

S. W. of S. E. Total depth about 45 feet.

10 N., 50 W. Cl low, Ca low, SO_4 0. Depth to rock 85½ feet, total depth 86% feet. A. T. 697. There is ½ foot of bluish rock at the bottom. The water rose to five feet from surface.

Section 6.

50 N., 50 W. Total depth 46 feet. A. T. 660 feet. This well was bored.

50 N., 1280 W. Total depth 11 feet. A. T. 660.

Near N. E. corner. A. T. 650.

Lead is said to have been found at 65 feet, but I doubt it. Cf. Henning's explorations there later. This shows the rumor on which he probably went. Chas. Henning's explorations were on E. ½ of N. E. ¼, first in slate.

1400 N., 1950 W. These are surface wells.

80 N., 1950 W. A. T. 650. Total depth 20 feet. This is a surface well.

Section 7.

220 N., 1950 W. A. T. 660. Depth to rock 35 feet, total depth 36½ feet. This well is in sandstone. The water contains traces of SO_4, Ca and Cl. George Zimiker, owner.

A. T. 608. Jay M. Burgess, owner. Depth to rock 42 to 52 feet, total depth about 70 feet. Water was struck in this well at about 45 to 50 feet and flowed eight gallons an hour, but has since decreased and nearly stops flowing during northerly or northeasterly winds.

Shodwell and others say this well has not reached rock.

Section 8.

50 N., 1300 W. Depth to rock 60 feet, total depth 70 feet. A. T. 710. This well is in white sandstone. J. King, owner.

Section 11.

50 N., 860 W. Depth to rock 59 to 60 feet, total depth 120 feet. A. T. 730.

Aaron Endersby, owner. The water in this well stands about 15 feet below ground. The well is cased 43 feet 3 inches through quicksand, then 16 feet 2 inches more casing and below this is a bluish whetstone.

Around the N. W. corner of this section wells are about 8 to 11 feet deep.

Section 13.

N. E. ¼. Total depth 35 feet. A. T. 762. This well is probably not to rock. D. McPhail, owner.

Section 16.

300 N., 50 W. SO_4 low, Ca low, Cl none. Depth to rock 60 feet (40 or 100 feet ?) total, 210 feet. A. T. 647. The water rose to 4 feet below surface, and is sometimes muddy.

The following record is from memory by J. H. Hare:

60 feet surface.

At 60 feet, fine flow of water, but in quicksand.

40 feet, sandstone.

40 feet, limestone hard and disturbed. The balance is grey grindstone with last ten feet in a soft sandstone holding a fine second vein of water.

Section 17.

1160 N., 50 W. 57 feet to rock, total depth 73 feet. Mrs. P. Walsh, owner. (Put down in Oct., 1897.) Record as follows:

Clay	15
Quicksand	20
Till, "red clay, gravelly clay and hard-pan"	22
White sand, soft rock	4
White flint	1½
"Blue liquid paint rock," i. e, soft clay shale	1½
Hardrock	9

In some respects this agrees with a section into the Bayport limestone.

Section 18.

320 N., 1950 W. Cl 0, SO_4 0. Depth to rock 62 feet, total depth 126 feet. A. T. 670. This well is mostly through sandrock. There is said to be 3½ feet of "zinc" (?). Miles King of Elmwood, driller.

1950 N., 680 W. Cl 0, SO_4 0. A. T. 670. This well was newly drilled in 1896, apparently all through sandstone.

Section 22.

0 N., 1380 W. Ca. med., Cl low, D. A. T. 722. Total depth 50 feet. This is a clay water and comes up to the surface, through hardpan 3 or 4 feet deep.

Section 35.

2000 N., 940 W. Total depth 60 feet. This is a drilled well, some distance into rock. Wells in this vicinity are bored in several cases to about 35 feet depth in clay and gravel, but not to rock.

Sheridan Township (T. 15 N., R. 12 E.).

In a large part of this township wells are not in «rock as there are numerous water-bearing gravels.

Section 1.

1740 N., 50 W. Depth 12 feet. Shallow like all around here. A. T. 762.

Section 3.

300 N., 1950 W. Depth 16 feet, plenty of water. A. T. 762.

Section 6.

550 N., 1800 W. Depth 20 feet through gravel, etc. Abundant water. A. T. 764. Another well was dug 12 feet through gravel and bored 35 feet.

Section 8.

1500 N., 1800 W. A. T. 700. Wells around here are surface wells at 12 to 20 feet deep.

Section 9.

1380 N., 50 W. Depth 24 feet through gravelly clay. A. T. 762.

Section 10.

580 N., 1850 W. Depth 27 feet on sandy ridge 200 feet broad. A. T. 770.

Section 13.

1720 N., 50 W. Depth 200 feet. A. T. 778.

120 N., 50 W. Depth to rock 30 feet. This well was dug 15 feet and drilled 8 feet. It flowed too much and they stopped it up. A. T. 780.

1720 N., 0 W. Depth to rock 24 feet, total depth 54 feet. Ca low, Cl low, SO_4 trace. Rock, blue sandstone. Sandstone varies from surface to 25 feet below surface in this neighborhood. A. T. 770.

Section 24.

540 N., 50 W. Depth 43 feet, 18 feet dug, the rest drilled. A. T. 796.

Section 25.

S. W. ¼. A. T. 780. Depth to rock 102 feet, (?) total depth 102 feet.

Section 35.

0 N., 780 W. Depth to rock less than 73 feet, total depth 73 feet. Ca trace, Cl slight trace. A. T. 791. This well is some distance in rock.

Section 36.

1600 N., 50 W. Total depth 52 feet. Bored but not to rock.

500 N., 150 W. SO_4 none, Ca trace, Cl slight trace. Depth to rock 60 feet, total depth 93 feet. A. T. 761. This well is 24 rods west of road, the rock is very hard for 3 or 4 feet, then very soft for the rest of the way. B. Morrison, owner.

800 W. 0. N., A. T. 843 feet. Depth to rock 90 feet, total depth 144 feet. This well is mostly through sandstone but there is some "soapstone" (shale) at the bottom.

Bingham Township (T. 15 N., R. 13 E.).

"Toward Ubly it is hilly and the wells are 100 feet deep on the hills."

Section 2.

1900 W., 300 N. Depth to rock 86 feet, total depth 91 feet. A. T. 844.

The water rises to 30 feet below the surface and this corresponds to the difference of level between this and Harrison's well on Sec. 3, T. 15, R. 13.

E. half of S. E. quarter. Depth to rock 130 or 135 feet, total depth 140 to 141 feet. A. T. 879.

The water rises 81 feet and is pumped 60 feet with force pump. T. Rapson, driller; Richard Harrison, owner. Record as follows:

Hardpan	20	
Blue clay	60	80
Mainly quicksand	50	130
Coarse sandstone	10	140

1420 N., 50 W.

50 N., 50 W. A. T. 824. Depth about 25 feet.

Section 8.

School house well 85 to 108 feet deep. A. T. 780. Most wells around here are 115 feet deep.

Section 9.

0 N., 800 W. Depth to rock 90 feet, total depth 95 ft. A. T. 831. This is a drilled well.

Section 10.

On the S. E. quarter of the N. E. quarter is a driven well.

1950 N., 880 W. A. T. 862 feet. Depth to rock 106, total depth 112.

The water rises to 65 feet from top. If the water has the same head as at Harrison's 3-15-13, this well has about equal elevation, and this appears to be the case.

Section 16.

2000 N. A. T. 859. Depth to rock 100 feet, total depth 124 feet. John Wilson, owner.

Section 17.

0 N., 1900 W. A. T. 802. Depth to rock probably 73 feet, total 80 feet. This well was drilled.

Section 18.

1120 N., 1900 W. 782 A. T. Not 18 feet deep. Richard Nugent, near a marked rise in the road.

560 N., 2000 W. A. T. 774. Depth to rock 25 feet, total depth 35 feet. Samuel Donaldson, owner. The water rose to within two or three feet of the top.

Section 19.

2000 N., 1260 W. A. T. 770. Depth 28 feet to rock through gravel.

1360 N., 1950 W. A. T. 772. Depth 25 feet to rock.

Section 20.

0 N., 520 W. A. T. 864. Depth to rock 110 feet, total depth 115 feet. Owner, J. Hagen.

0 N., 1240 W. A. T. 864. Depth to rock about 100 feet, total depth 150 feet. James Richardson, owner.

Section 21.

2000 N., 1520 W. A. T. 820. Total depth 115. This well is 20 rods south of road in rock of unknown depth.

Section 23.

0 N., 1340 W. A. T. 800. SO_4 none, Cl none, Ca very low, Fe perceptible to taste. Depth to rock about 20 feet, total depth 70 feet. Owner, Geo. Baskin.

Section 29.

2000 N., 940 W. A. T. 863. Depth to rock 100 feet, total depth 150 feet. John Wurm, owner. This well is through clay to rock.

1000 N., 2000 W. A. T. 560. Depth to rock 90 feet, total depth 130 feet. Thomas Richardson, owner. This well is a quarter of a mile south of the north and south road.

600 N., 1900 W. Depth to rock 120 feet, total depth 140 feet. A. T. about 860. R. Richardson, owner.

Section 30.

1050 N., 50 W. Depth to rock 100 feet, total depth 130 feet. Robert Donaldson, owner.

Section 31.

560 N., 1700 W. Depth to rock about 102 feet, total depth 111 feet. This well is 50 rods east of road. A. T. 865.

1860 N., 1950 W. Not to rock though 50 feet deep. A. T. 830.
300 N., 1950 W. Total depth 100 feet, probably just to the bed rock.

Paris Township (T. 15 N., R. 14 E. D.).

Section 1.

400 E., 50 N. of S. W. corner. A. T. 768. Total depth 12 feet. This well is through sandstone and conglomerate and not noticeably salty.

Sections 7 and 8.

1000 N., near quarter post between the sections. A. T. 792. Depth to rock 50 feet, total depth 60 feet. This well is drilled through sandstone.

Section 11.

740 W., 100 N. S. E. corner. A. T. 770. John Sinda, owner. Depth to rock 40 feet, total depth 70 feet. The water is bad and is said to be black. A well used to flow in this neighborhood.

Section 12.

680 S., 100 E. N. W. corner. A. T. 770. Depth to rock 30 feet. Thomas Loch, owner. This well is bored through 78 feet of sandstone and the water is not noticeably salty.

Section 13.

100 N., 50 W. A. T. 766. Depth to rock 60 feet, total depth 68 feet. The water is salty.

Section 16.

720 W., 140 S., N. E. corner. A. T. 800. Depth to rock 65 feet, total 95 feet. This well was in 1896 being drilled through sandstone and shale, and they have not found water yet. John Oborski. owner.

1½ mile E. of S. E. corner of section 7. No rock or water found. Depth 172 feet (the same well?).

Section 20.

1020 W., 2000 N. SO_4 low, Ca low. Cl strong (brackish). Depth to rock 103 feet, total depth 168 feet. Owner, Arch. Curry.

Section 23.

1990 N., 1990 W. Cl. med., H_2S present also. A. T. 784. Depth to rock 80 feet, total depth 150 feet. The water has a nasty sweet taste (from decomposing pyrite?).

Section 24.

1990 N., 1300 W. A. T. 790. This is a mineral well.

Section 26.

At hotel N. W. corner. Depth to rock 90 feet, total depth 93 feet. A. T. 712. Owner, Zuiger.

Section 29.

1380 W., 2000 N. Depth to rock 100 feet, total depth 117 feet. A. T. 840. Chas. McMillan, owner. This well furnishes a good supply of sandstone water.

Section 32.

0 N., 1240 W. Total depth 20 feet, just to rock?. A. T. 795.

Section 34.

S. W. quarter. Depth to rock 110 feet, total depth 114 feet. A. T. 880. Owner, W. Wilson. This well is through sandstone.

Section 36.

The general range of rock wells here is from 40 to 70 feet.

Sherman Township (T. 15 N., R. 15 E.).

Section 7.

"Good water" occurs in gravel wells twenty feet deep on gravel ridges of the Forest Beach. A. T. 756.

Section 12.

420 N., 140 E. Total depth 70 feet, depth to rock 54 feet. A. T. 680. 16 feet through shale. There is not much water in this well and it is salty. Martin Hoeldke, owner.

Section 30.

S. E. quarter. Total depth 47 feet, depth to rock 40 feet. This well is through sandstone and the water rose to surface. Hipps, owner.

N. E. quarter. Total depth 162 feet, depth to rock 114 feet. A. T. 790. Witwer's Cheese Factory. This well is through shale.

Section 31.

N. E. quarter. Depth to rock 55 feet, total depth 114 feet. A. T. 790. The water in this well is very little salty.

Section 32.

N. W. ¼, N. W. ¼. Depth to rock 60 feet, total depth 64 feet. A. T. 780. Owner, Hanselman. This well is through shale and the water is salty.

White Rock Township (T. 15 N., R. 16 E).

Section 6.

900 N., 50 W. A. T. 610. Total depth 24 feet. This is a dug well.

Section 29.

1100 W., 800 N. A. T. 590. Total depth 566 feet. Owners Thomson and Bro. This well is abandoned. See brine analysis in Chap. VI, § 4.

600 N., 110 W. A. T. about 590 feet. Owner, W. Thomson and Bro. Total depth 1311. See above.

The exact records of the above two wells cannot be disentangled, for the works are abandoned and the references to them do not serve to distinguish them. As Dr. Rominger saw samples down to 700 feet the record may be relied upon down that far.* In his report the depth of one well is variously given as 555, 566, and 565 feet and the other deeper one of which he saw the samples he reports as 700 feet in depth. It was probably deepened later, for a note of Wright gives a record to 1311 feet, whence we may derive the following column:

From 1 to 495 (Rom. about 450) blue shales with pyritiferous sandy streaks.

From 495 to 555 (Rominger about 100 feet of porous gray sandrock) strong and pure brine, as analyzed, 80% at 45° F. (or according to Garrigues in Rom. Ill, 184, 78.5°) brown sandrock, the Berea sandrock.

From 555 to 700 (Rominger reports only blue shales. According to Wright.

From 555 to 1311 are alternating strata of blue shale and limestone, shale predominating 20 to 1. From 600 to 610 feet down a three foot stratum of gaseous black shale was found, which is in the right place for the Cleveland shale. (See Chap.

II, § 8). The drill must have gone into the Traverse (Hamilton) group, but probably not through it or the change would have been noticed. Besides according to the record of the Harbor Beach well it is not due. The chances are that this well stopped at the same belt of "extremely hard rock," found at 1,400 ft. at Harbor Beach, and at 153 feet in an Alpena well, which may be the Encrinal limestone.

*III, pp. 76-77, 184, 201.

Fairhaven Township (T. 16 N., R. 9 E.).

Section 1.

1340 N., 50 W. Total depth, just to rock, 7 feet. A. T. 622.

1000 N., 50 W. Total depth 30 feet. SO_4 and Cl low. A. T. 622.

It is 12 feet to rock in this well and water was struck at 13 feet which rises just to the surface. On top of the water was a hard scale (limestone) then a 6 in. cavity and grindstone below.

620 N., 50 W. Total depth 33 feet, depth to rock 11 feet. A. T. 622.

The first 11 feet of this well was dug, the rest was drilled. The well flows every spring.

50 N., 140 W. A. T. 612. This well is 50 or 60 feet deep and into rock.

Section 10.

50 N., 50 W. Total depth 150 feet. A. T. 590. Owner, J. D. Weeks. This is a flowing well and is salty.

Near mouth of Shebeon. Total depth 130 feet, cased for 31 feet, according to W. Hartmann, driller. This well was drilled mostly through soft grey rock, with an occasional four or five inch seam of hard stuff, e. g., at 128½ feet, but the driller already felt the springiness of the water underneath and urged him to go on. When struck water rose to the surface in ½ a minute.

Section 11.

30 N., 1200 W. Depth 40 to 45 feet. This well used to flow at first, according to Bullock the following was passed through:

	Thickness.	Total.
Clay and gravel	31	31
Rock	3	34
Blue clay	19	53
Limestone	3	56

Limestone, 12 feet; Blue rock, pyritiferous zone struck at 17 feet here, at 35 feet on Sec. 14.

Section 12.

1900 N., 1400 W. Cl low, SO_4 low, Depth to rock 63 feet, total depth 64 feet. A. T. 622. This well was sunk 48 feet 4 inches before reaching rock, then 10 inches rock (boulder) 14 feet quicksand, 1 foot limerock.

1050 N., 50 W. Depth to rock 30 or 36 feet, total depth 36 to 40 feet. A. T. 669. H. Dewing, owner. Pump used.

50 N., 50 W. A. T. 617. Depth to rock 11 feet, total depth 33 feet. Analyst, D. Fall of Albion. 0.008 Cl per thousand.

Section 13.

50 N., 900 W. Depth to rock 42 feet, total depth 50 feet. A. T. 618. Flowing with 2½ feet head.

50 N., 800 W. Depth to rock 43 feet, total depth 56 feet. A. T. 618. Flowing well with 2 feet head. SO_4 med. Sp. Wt. 1.002.

500 N., 50 W. Depth to rock 40 feet. Total variously reported as 150, 160, or 186 feet. A. T. 622. H. Rather, owner; well at barn.

SO_4 very strong, Cl str., Ca str. Sp. Wt. 1.004. Mr. Webber sent for this water to Bay Port for a cathartic. Dr. J. W. Campbell reports it to have a powerful cathartic effect on cattle. Analysis by Prof. Delos Fall of Albion. 0.323 parts Cl per thousand.

(2) At house—

Depth to rock 40 feet, total depth 50 feet. SO_4 not so strong as in well No. 1, Sp. Wt. 1.002. Water rises to 1½ feet from surface.

860 N., 720 W. 47 feet casing and 47 feet deep. A. T. 616. Temp, of flow 51½°, Cl 0.

620 N., 700 W. A. T. 616. Well at barn, Temperature of flow 50°, about 3 feet head. Total depth 45 feet.

1160 N., 50 W. This is 35 feet deep and drilled. A. T. 621; Cl low, SO_4 low. Water about 1 foot from top.

1700 N., $SO_4$0. Total depth 30 feet. A. T. 620 feet. Temperature of flow 49° F. About 6 in. above ground.

Section 14.

W. half of N. E. quarter on Tom Snell's 80. D. Bullock, driller. This well was down 7 feet at 9 A. M. Thursday, June 11, and down 18 feet on Friday.

1980 N., 912 W. Depth 45 feet. It is said that lead was struck in this well. Calcareous fossiliferous sandstone is the surface rock; a darker limestone comes next underneath, then under that from 30 to 45 feet is blue shale with more or less pyrite, and the galena (?) The chances are that if struck this was a mere nodule in the shale.

Section 15.

280 N., 360 W. Depth 33 feet to rock, 107 total. A. T. 597. Collison's well. Land now owned by J. G. Tarry. D. Bullock, driller, July 15, 1896. Rock was struck at 31 feet, then blue shale with cubes of pyrite at about 51 to 52 feet 7 to 8 ft. bed of gypsum. At 65 ft. a bed of pyrite. July 21 report with samples.

0 to 32 feet hard white clay, cased 37 feet.

35 to 40, gray rock (argillaceous limestone free eff.).

40 to 45, gray rock with pyrite and galena at 45 gypsum in large flakes. (?)

45 to 60, said to be gypsum. Bullock says only 7 ft. of gypsum.

60 to 65, pyritiferous shale with galena.

69 to 73, shale.

73 to 85, very pyritiferous.

85 to 107 fine grained dark sandrock. At 89 feet the water rose to within 6 feet of surface. It flows from the bottom, Sp. Wt. 1.005, SO_4 strong.

100 N., 1260 W. Depth to rock 25 to 30 feet, total depth 50 feet. Water rises to six feet of surface. At 35 to 40 feet there is said to be lead.

Section 21.

50 N., 320 W. A. T. about 597. This well is 18 feet deep. In surface deposits. George Schack is said to have found a piece of galena in digging this well.

Section 22.

1980 N., 600 W. Depth to rock 33 feet, total depth 60 feet. A. T. 597. Sp. gr. 1.005, SO_4 strong. This well is in shale and soapstone and has a pyrite galena vein between 40 and 50 feet.(?)

1800 N., 800 W. Depth 63 feet. A. T. 597. The water in this well rises to 6 feet from surface, but does not stand pumping.

(S. W. of S. W.) 100 N., 1900 W. Temperature of flow 51½°. A. T. 597. D. Bullock's record as follows:

0-52, surface.

52-58, soap rock, etc.

75, mineral, pyrite and galena.

110-130, brown sandrock, then white sandrock following.

They say at the house they have but 52 feet casing. They stop in white gypsum rock and show samples of gypsum. SO_4 tr., Cl low

50 N., 1560 W. A. T. 597. This is a surface well.

450 N., 1450 W. Depth 50 to 70 feet. A. T. 597. Well at schoolhouse. "Flow about 1½ feet above the surface, in the winter and spring gradually growing less. A north wind increased the flow and an east wind diminished it." Geo. Kleaber.

Section 23.

N. E. of S. E. 50 W. This well was sunk to rock.

1950 N., 50 W. Total depth 12 feet. A. T. 608.

50 N., 400 W. Cl low, SO_4 str. Total depth 135 feet. A. T. 612. Water rises to 8 feet from surface. Mrs. Estman, owner.

100 N., 100 W. Depth to rock 50 feet, total depth 140 feet. A. T. 615. Jacob Brown, owner. This well is said to have four feet of black coal, cf. Weiser's well on Sec. 26.

Section 24.

1950 N., 900 W. A. T. 620. Total depth 55 feet. The water rose to within 20 inches of the ground.

1950 N., 800 W. Depth to rock 40 feet, total 49. A. T. 620. Water rises to the surface.

1950 N., 1740 W. A. T. 618. Depth to rock 7 to 8 feet, total depth 48 feet.

480 N., 50 W. A. T. 624. This is a shallow surface well.

820 N., 50 W. A. T. 623. This is a shallow surface well, not drilled.

1280 N., 50 W. Total depth 18 feet. A. T. 618. This well was dug in summer of 1895.

1620 N., 50 W. Total depth 7 feet. A. T. 618. There is said to be a spring on the east side of the place.

In W. ½ of N. W. ¼ of 24.

50 N., 1900 W. Depth 8 feet.

Section 25.

N. E. of N. W. 1900 N., Cl low, SO_4 strong. Total depth 78 feet. A. T. 622. Anton Adams, owner.

1600 N., 1950 W. SO_4 strong. A. T. 620. Anton Adams, owner. This well is drilled.

1260 N., 1950 W. Cl trace, SO_4 strong. Total depth 85 feet. A. T. 622.

50 N., 1840 W. Cl low, SO_4 low. Depth to rock 166. A. T. 626. Owner, J. Finkbeiner. This well was drilled 12 years ago in hard rock.

340 N., 50 W. Cl 0, SO_4 strong. Depth to rock about 80 feet, total depth 175 feet. A. T. 624. Owner, Buschlein. Rock was found at 40 or 50 feet, but it shaled off.

680 N., 50 W. Cl low, SO_4 strong. Depth about 180 feet.

Section 26.

400 N., 1950 W. Depth to rock 60 feet. A. T. 610. Owner, Wm. Henry.

1950 N., 400 W. Cl low, SO_4 strong. Casing 48 feet, 100 deep. A. T. 612. Carl Weiser, owner. Blue slate (with four feet of black) at 50 feet.

1900 N., 100 W. Depth to rock 50 feet, total depth 148 feet. A. T. 620. Owner, L. Engler.

1860 N., 50 W. Total depth 10 feet. A. T. 620. This is a surface well.

900 N., 50 W. Cl low, SO_4 strong. Total depth about 92 feet. A. T. 622. George Davis, hand drilled.

540 N., 50 W. Cl low, SO_4 strong. A. T. 626. Depth to rock 66 feet, total depth 102.

50 N., 660 W. Total depth 8 feet. A. T. 620 feet. Six feet of clay and two feet of water bearing sand.

(2) Total depth 18 feet.

Section 27.

1950 N., 760 W. A. T. 610. This is a surface well.

Section 28.

1950 N., 520 W. Depth to rock 60 feet, total depth 100 feet. A. T 530. Temperature of flow 51½° F. E. Rose, owner. W. Smith, driller. There is over 40 feet of casing to a big boulder, then small casing to rock at 60 feet. The mixed drillings show pyritiferous shale and limestone.

Section 33.

1701 N., 100 W. Cl med. Depth to rock 46 feet, total depth 175 feet. A. T. 600. Owner, Mrs. Schuch. Chas Hofmeister, driller. Record from samples:

	From	To
Brown dolomite	48	52
Blue shale	62	68
Sandstone	148	175

640 N., 940 W. Total depth 14 feet. A. T. 609.

1400 N., 1800 W. Cl med., SO_4 low. Depth to rock 51 feet, total depth 205 feet. A. T. 610. Owner, J. Haffner; driller, Bullock.

	From	To
Blue shale looks like a good clay	53	85
Dolomite and shale	85	100
Blue shale	100	117
Impure pyritiferous limestone	117	124
Pyritiferous limestone	125	132
White sandstone with pyrite, Napoleon sandstone	133	205

Section 35.

50 N 1900 W. A. T. 630. Cl low, SO_4 trace. Depth to rock about 80 feet, total depth 116 feet. Sample at 75 feet was pyritiferous shale. Driller's record:

	Thickness.	Total.
Clay surface	60	
Loose lime rock	5	65
Soap rock (i. e., calcareous shale with pyrite)	23	88
Very hard dark rock	4	92
Sandrock	24	116

1640 N., 1950 W. SO_4 low, Cl low. Casing 64 feet. Total depth about 150 feet. A. T. 612. Owner, August Rehbein. Record by J. Russell:

	Thickness.	Total.
Clay	49	
Hardpan	5	54
Dark lime rock	6	60
Slate rock	2	62
Lime rock	2	64
Soap rock	16	80
Hard lime rock	2	82
Slate rock	7	89
Hard sand rock	3	92
Fine sand rock	26	118
Dark lime rock	4	122
White sand rock (Napoleon)	21	143

Section 36.

1440 N., 50 W. A. T. 630. SO_4 low, Cl low. Depth to rock 60 feet, total depth 154 feet. S. Stahl, owner, of Bay Port.

50 N., 1760 W. Cl low, SO_4 strong. Depth to rock 50 to 55 feet, 80 to 90 feet of casing, total depth 136 feet. A. T. 630. This well passed through various kinds of rock, mainly soap rock.

50 N., 700 W. Depth to rock 70 feet, total depth 200 feet. A. T. 630. This water is, not salty and rose to 18 feet below surface.

Winsor Township (T. 16 N., R. 10 E.).

Section 1.

1950 N., 1320 W. Depth to rock 30 feet. A. T. 633. Water rose to about 6 feet from the ground.

1950 N., 1040 W. A. T. 635. (1) This well was dug for 12 feet and is not cased. The water rises to the top. SO_4 low.

(2) Depth to rock 60 feet. This well used to flow, but is now stopped up.

1950 N., 400 W. Depth 40 feet, through gravel. A. T. 637. Water rose to within 6 feet of the top.

60 N., 50 W. SO_4 low, Cl med. Depth to rock 40 feet, total depth 40 ft. This is a dug well.

360 N., 1950 W. SO_4 low. Cl low. Total depth about 47 feet. A. T. 635.

860 N., 1950 W. SO_4 low. Total depth 32 feet. A. T. 634. This well was dug 8 feet, then drilled in gravelly clay and about 6 in. in black slate. This well is not flowing now.

1060 N., 1950 W. Depth to rock 30 feet. A. T. 633. This well flowed fast 3 or 4 years ago, it now stands about one foot from ground. When this well was dug, the one above, just south, stopped flowing.

1200 N., 1960 W. A. T. 633. Depth to rock 30 feet, total depth 30 feet. The water in this well stands two feet from the surface and the well passes through sand, clay, gravel and at the bottom fine sandy bluestone.

S. E. quarter of N. W. quarter. A. T. 639. This well used to flow a ½ in. stream, but has now gone down to 3 feet from the surface. SO_4 low, Cl low. Total depth 41 feet. The water comes from a soapstone. (A windmill was put in 3 or 4 years ago and I suspect is partly to blame for the other wells not flowing.)

Section 2.

(Pigeon.) Wells from 29 to 40 feet deep used to flow. The surface water and water generally is hard.

160 N., 1287 W. Depth to rock 43 feet, total depth 90 feet. A. T. 630. H. Moeller, owner; W. Smith, driller.

The first rock was coarse, impure pyritiferous sandstone, then bluish arenaceous shale at 48 feet, then a mixture of fine sand, black shale, pyrite, etc.

50 N., 1075 W. Total depth 163 feet. A. T. 632. This well is at the Kleinschmidt house next to P. O.

Depth to rock 49 feet 3 inches, total depth 50 feet 6 inches. This well is 15 inches in rock at the store.

450 N., 1900 W. Depth 39 to 40 feet. A. T. 632. The water rises only 6 inches. The surface water is hard.

360 N., 50 W. Total depth 36 feet. A. T. 635. The water flowed at first, but is now 5 feet from the surface.

700 N., 50 W. Total depth 30 to 33 feet. A. T. 634. The water is about at level of ground.

1200 N., 50 W. Total depth 29 feet. Berne, 2d house from N. E. corner. A. T. 633. SO_4 and Cl low, like other wells on this road. This well used to flow and now rises to five feet from the surface.

1980 N., 880 W. Cl low, SO_4 low. Total depth 36 feet. A. T. 627. This well is at Leipprandt's store.

1950 N., 1820 W. Cl low, SO_4 medium. Total depth 31 feet. A. T. 626. This well was dug for 16 feet and drilled 16 feet.

There is no casing in this well, the stream was so strong that it lifted the one-inch casing out.

Section 3.

1320 N., 1925 W. Depth to rock 40 feet, total depth 80 feet. A. T. 626. F. D. MacCauley, owner; drilled by Hofmeister. Water was struck at 30 feet and rose to 8 or 9 feet below surface.

520 N., 1200 W. Driller, F. Mueller. A. T. 629. This well is but 9 feet deep and they found gypsum. In a dug well at 32 feet was “a big layer of gypsum," very good according to samples, but probably in the drift. On the other side of the stream he says that a well struck the same layer, say 2 feet thick, and that an adjacent drilled well cut some 4 or 5 feet of it.

20 N., 760 W. Total depth 23 feet. A. T. 629. This well was dug 22 feet and bored to rock which is not very hard. There is 14 feet of water in the well.

50 N., 1180 W. Total depth 60 feet. This is said to have been a well all in hardpan, with no casing.

1950 N., 460 W. Total depth 17 feet. A. T. 612. This well was dug 14 feet and drilled 3 feet.

1950 N., 810 W. SO_4? Depth to rock 35 feet, total depth 40 feet. A. T. 626.

1950 N., 1320 W. A. T. 626. This is a shallow well.

Section 4.

1970 N., 1280 W. Total depth 18 feet. A. T. 626. This well was dry in July, 1895.

1980 N., 720 W. Depth 10 feet. A. T. 626. At house, in gravel and hardpan, quite often dry.

(2) Depth 14 feet. At barn, barely dry in hot summers. Next houses east, three wells and all were dry in summer of 1895. Total depths 14, 18 and 20 feet.

1320 N., 25 W. Total depth 35 feet. A. T. 626. This well was dug for 20 feet and hand drilled the rest of the way. Water was struck about 7 feet below surface.

750 N., 50 W. Total depth 60 feet. A. T. 626. The water in this well nearly rose to top.

700 N., 50 W. Total depth 35 feet. This well was dug 20 feet, and drilled 15 feet. It was never dry from 1892 to 1896 and was afterward drilled to 40 feet and filled up. There is gravel at the bottom.

300 N., 50 W. Depth just to rock 44 feet. A. T. 626. This well goes to rock which is limestone like the quarries.

S. E. quarter of S. W. quarter. H. Eimers' well strikes rock near surface.

1980 N., 1000 W. Total depth 53 to 54 feet. Cl low, SO_4 strong. A. T. 626. At 58 feet there is blue rock with seams of plaster.

Section 5.

1900 N., 1350 W. Depth 49 feet. A. T. 624 (42.5). This well passes through 13 feet of limestone similar to that of quarry, then 24 feet sandstone, then 4 feet soft, fine sandstone, then 7 feet (last few feet a mixture) slate and sandstone mixed.

400 N., 1950 W. Depth to rock 16 feet, total depth about 22 feet. A. T. 622.

840 N., 1950 W. This well is about 7 to 11 feet deep. A. T. about 622.

1050 N., 800 E. A. T. 630 (48.2). Surface of quarry is 51 to 52 feet above lake. This is a test bore hole at the quarry. In atlas of Huron county is a view of Bay Port quarry 40 feet down. See Fig. 8.

	Thickness.
Limestone	16
Grindstone or coarse sandstone	20
Fine sandstone, red brown or brindle	13-15
Shale, which I assign to the Michigan series	50

From 25⅓ to 29 feet the sandstone dipped decidedly according to diagram, 6:11, being cross bedded, the rest being practically horizontal stratification.

Sample marked "(1) 41 feet" is fine grained sandstone with some mica, light brown; "50 feet slate" is a shale; "Sample taken in 1884 at 9 feet, 8 in., from the bottom of this hole No. 1" is a fine grained light grey shale with laminae across core, at one end a lump of Fe S_2 weathered to sulphates. Also at the bottom of hole 100 feet from surface, a very soft grey slightly calcareous shale with a streak 1-10 inch of sand cemented with pyrite. At total depth 28 feet 3 inches the core saved was 18 feet 4 inches, a portion of loss from earthy deposits between layers.

(2)	Thickness.	Total.
Limestone	13	
Sandstone	24	37
Soft fine sandstone	4	41
Slate and sandstone mixed	7	48

The variation in the record of these two borings and the quarry section shows how variable the beds of the sandstone, etc., are.

720 N., 1950 W. Total depth 29 feet. A. T. 617. This well flowed for the first few years.

100 N., 1950 W. Depth to rock 28 feet, total depth 32 feet. A. T. 617. This well passes through rock, then through clay and gravel. (Cavern clay, or some of the shale beds of quarry record.)

50 N., 1720 W. Cl trace, SO_4 strong. A. T. 619. This well usually flows until about July 4th and then stands at surface.

50 N., 1300 W. Total depth 27½ feet. A. T. 620. This well used to flow.

260 N., 50 W. Depth to rock 16 feet, total depth 22 feet. A. T. 622.

840 N., 50 W. Depth to rock 7 to 11 feet, total depth 12 feet. This well passes through 5 feet of limestone and flint, sandstone below; 50 rods on it is 6 inches to rock.

Section 7.

950 N., 740 W. Total depth about 28 to 30 feet. A. T. 617. This is a drilled well.

950 N., 1280 W. Depth to rock 26 (?) feet, total depth 33 feet. A. T. 619. This well is in quicksand and did not flow, water rose about 6 feet from ground. Nine feet of this well is said to be in rock, the rest is in gravelly sand.

1050 N., 1900 W. Total depth 27 to 37 feet. A. T. 618. This well flowed 2 feet above ground. Cl and SO_4 not more than trace. Temperature 49½°.

700 N., 1950 W. Total depth 29 feet. A. T. 619. Temperature of flow 49° F. SO_4 trace.

50 N., 1320 W. Total depth 33 feet. A. T. 622. E. Harder, driller.

50 N., 640 W. Depth to rock 32 feet, total depth 36 feet. A. T. 624. A. Graves, owner. Water was struck at about 31 feet.

50 N., 300 W. A. T. 625. This is a shallow well at the school house.

N. W. of S. W. Total depth 24 or 28 feet. Adam Mueller, driller. These wells are of muck and clay loam. Clay 3½-4 feet, then hardpan gravel, etc.

50 N., 1950 W. Total depth 24 or 40 feet. Cl trace, SO_4 0. Temperature 50° F. This well has a strong flow at school house.

1850 N., 1950 W. This is about like flow opposite in Sec. 6.

1950 N., 720 W. Depth to rock 27 feet, total depth 29 feet. A. T. 612. T. Radloff, owner. In the spring water was at surface now it is more than 7 feet from the top.

840 N., 50 W. Total depth 25 feet. J. B. Harder, owner.

1460 N., 50 W. Total depth 40 feet. Less than 40 to rock.

1700 N., 50 W. Depth to rock 30 feet, total depth 100 feet. A. Grant, owner. The well was sunk this deep in order to get a flow, in vain.

Section 8.

A. T. about 624.

S. W. ¼. Depth to rock 21 to 26 feet; total depth 22 to 26 feet. The wells around here are to rock (F. G. Harder's place, 3½ miles E. and 1 mile south of Pigeon).

N. E. Depth to rock 2 to 8 feet.

1950 N., 1020 W. Depth to rock 25 feet, total depth 39 feet, Cl 0, SO_4 low. This well gets roily at times.

1950 N., 60 W. Depth to rock 38 feet 8 inches, total depth 110½ feet. There is a little water in this well at 40 odd feet, but not enough even now. It is very strongly cathartic, Cl 0, SO_4 strong. D. Grant, owner.

500 N., 1950 W. This well is 7 or 8 feet deep in quicksand.

450 N., 1120 W. Cl 0, SO_4 trace. Total depth to rock 33½ feet.

510 N., 1120 W. Total depth 15½ feet.

1460 N., 1950 W. Total depth just to rock 40 feet.

1700 N., 1750 W. Cl 0, SO_4 med. Total depth 52 feet. This well is in rock and the water is cold and good.

Section 9.

W. ½ of S. E. ¼. Two miles south of north part of Sec. 4. A. T. 630. Total depth 80 feet. W. Challis, owner. This well is in rock.

1680 N., 50 W. Total depth 180 feet. A. T. 628. C. J. Hofmeister, driller. This is a flowing well with over 1 foot head. Temperature of flow 48°. The water is salty.

1220 N., 50 W. Depth to rock about 30 feet, total depth 190 feet. A. T. 628. H. Maier, owner; C. J. Hofmeister, driller. This well is through soapstone, limestone and sandstone. The water was struck in sandstone and rises to within 7 feet of the surface. The temperature of water is 47° F.

380 to 420 N., 50 W. Depth to rock 2 feet, total depth 180 feet. Cl low, SO_4 0. A. T. 630. Only 2 feet to limestone which is close to the surface and like that of the quarries on Sec. 5, T. 16, R. 10; the rock drops 18 feet suddenly to north and to south slopes off gradually.

1950 N., 1540 W. Depth to rock 8 to 10 feet, then the rock limestone is 18 feet thick. A. T. 627.

50 N., 660 W. Cl low, SO_4 trace. Depth to rock 18 feet, total depth 76 feet. A. T. 630.

500 N., 600 W. Depth to rock 3 feet, A. T. 629.

Section 10.

1680 N., 1950 W. Total depth 198 feet. A. T. 628. This well is mostly through soapstone.

620 N., 1950 W. Depth to rock 24 feet, total depth 240 to 242 feet. A. T. 630. Henry Eimers, owner. D. Bullock, driller. This is about the same as at 1220 N., 50 W. Sec. 9-16-10, 24 feet to rock, 4 feet limestone, then white stuff.

50 N., 1740 W. Total depth 30 feet. A. T. 630. Temperature of flow 48° F. Perhaps this well does not strike rock. A. Aublam, owner.

1980 N., 1220 W. Total depth 22 feet. A. T. 629. This is good water.

1160 N., 50 W. Total depth 163 feet. A. T. 632. Owner, J. Reither. The water in this well is hard, the wells near by are shallow and not so hard.

1980 N., 1640 W. Total depth 22 feet. A. T. 628.

Section 11.

Pigeon village. See also Sec. 2-16-10. Depth to rock about 40 feet, total depth 150 feet. A. T. about 623. Maclean, owner.

1850 N., 950 W. Depth to rock 50 feet, total depth 223 feet. This well is at the Elevator. It passes largely through slate and soap rock, some sulphur rock, black and pyritic seams.

1900 N., 1100 W. Depth to rock 40 feet, total depth 109 feet. This well is at the Arlington house and the water rises to 5 feet below surface. Winter, proprietor. Bullock, driller.

About 1 rod away is a well 50 feet deep. This water is good and it is plenty. Fisher, blacksmith. There is a well 140 feet deep at the planing mill, and 149 feet deep at the cheese factory. Other wells are 45 to 50 feet to rock.

840 N., 1900 W. Depth to rock 63 feet, total depth 163 feet. Louis Schultz, owner. There is sandstone from 130 to 163 feet in this well.

120 N., 1900 W. Total depth 140 feet. A. T. 631. Henry Schultz, owner. The depth to rock in this neighborhood is generally 40 feet. This well is 48 feet to rock, then 1 foot blue rock, then mainly soaprock and calcareous shale down to 98 feet, from 98 to 102 water-bearing rock.

1900 N., 1337 W. Total depth 285 feet. A. T. 633. This well is at the steam stave mill, Liken and Bro. Bullock, driller. This well got into red stuff and salt, Bullock says the red rock was 200 feet down. At 160 feet they found fresh water. The general section for Pigeon is therefore as follows.

0-50, surface.

50-90, blue clay, brick clay near surface.

90-120, sandstone, Napoleon or Upper Marshall.

120-126 (perhaps sandstone), Napoleon or Upper Marshall.

160-200, sandstone, fresh water, Napoleon or Upper Marshall.

200-285, red rock at first, with salt water, the Lower Marshall, the same as at 350 feet at Bay Port, and at 196-208 in Elkton. The Schultz well in the W. part of the section shows a dip of about 40 feet while toward Bay Port the dip must be about (350 — 200), + (30 — 50) = 170 ÷ 5.2 (miles) = 33 feet per mile.

1780 N., 50 W. Depth to rock 40, total depth 150 feet. A. T. 637. SO_4 med., Cl low. This well is cased.

1700 N., 50 W. Depth to rock 40 feet, total depth 40 feet.(?)

1440 N., 50 W. A. T. 637.

600 N., 50 W. Depth to rock 39 feet, total depth 65 feet. A. T. 639. At first the water rose 4 feet above ground and flowed, and at 50 feet the water was very hard. SO_4 mod., Cl trace. A second well in same locality is 27 feet deep.

50 N ? W. A. T. 637. Water was struck at about 70 feet. (?)

Section 12.

800 N., 1813 W. (1) Total depth 46 feet. A. T. 640. The water rises to 6 or 7 feet from surface. On top of the water-bearing stratum is a greasy or slippery blue clay which tends to close up the wells. (2) Depth 49-80 feet; closed up.

50 N., 740 W. SO_4 low, Cl low. Depth 150 feet. A. T. 644.

1950 N., 860 W. SO_4 low, Cl low. Depth about 90 feet. A. T. 641.

Section 13.

1080 N., 1950 W. SO_4 mod., Cl low. Depth about-160 feet. A. T. 640.

1900 N., 1900 W. Depth of casing to rock 47 feet, total depth 50 feet. A. T. 640.

1950 N., 1420 W. Total depth 15 feet. There are some 12 and 15 feet dug wells.

Section 14.

1930 N., 1980 W. Depth a little over 15 feet. A. T. 630. This well goes dry in summer.

1420 N., 1980 W. Depth 12 feet. A. T. 635. This well is not dry.

840 N., 980 W. Depth to rock about 75 feet, total depth 110 feet. A. T. 638. Temperature of flow 47° F. This well was drilled in 1895.

240 N., 1940 W. Depth 20 feet. A. T. 637. J. String, owner. This well was dry in summer, and another was drilled. Depth to rock 80 feet, total depth 200 feet in sandstone.

1080 N., 80 W. A. T. 642. Wells around here are said to be 175 to 200 feet deep when drilled, 14 to 16 feet when dry.

Section 15.

1300 N., 1775 W. Total depth 120 feet. A. T. 632. There was limestone with Lithostrotion at surface. The limestone was at least 3 feet thick. J. Zinzer, owner.

1950 N., 250 W. Depth to rock 50 feet, total depth 100. A. T. 632. This well was drilled by Reithel and Hofmeister in 1894.

1420 N., 20 W. This well is only 12 feet deep. A. T. 632.

980 N., 20. Depth 32 feet, 12 feet dug and 20 feet bored. This well always has water.

50 N., 1240 W. Total depth 42 feet.

S. half of N. W. quarter. On H. Bergmann's farm rock occurs at or near surface.

Section 16.

1950 N., 1680 W. A. T. 628. This well is 32 to 36 feet deep according to different reports.

Section 17.

1950 N., 620 W. Cl 0. Total depth 24 feet. A. T. 627. Barr, owner.

1950 N., 1420 W. About 26 feet to rock. Total depth 26 feet. A. T. 627.

Section 18.

760 N., 1900 W. Depth to rock 40 feet, total depth 110. A. T. 622. Owner, Chas. Rather. Cl low, SO_4 low. The water rises just to the top.

1600 N., 1950 W. SO_4 0. Total depth 30 feet. A. T. 620. This well flowed about 6 inches above ground. A sample has been sent to Lansing or to D. Fall, by Snell.

1900 N., 1000 W. A. T. 624. This well is like the others around here, i. e., about 30 feet deep.

1950 N., 940 W. Total depth 33 feet. A. T. 624. This well is drilled. The water rises to two feet below ground.

50 N., 1360 W. Depth to rock 46 to 48 feet, total depth 120 feet. A. T. 626.

Section 19.

50 N., 1440 W. Total depth 10 feet. A. T. 626. Blue sandy clay just opposite in the ditch. (Perhaps some of the wells entered under Sec. 24-16-9 belong in this section.

Section 20.

0 N., 260 W. Cl low, SO_4 strong. Total depth 235 feet. A. T. 634. The water tastes puckery.

50 N., 1000 W. Total depth 35 feet. A. T. 632. 25 feet of this well is dug and 10 feet bored in gravel.

1950 N., 740 W. Cl trace. SO_4 strong. The water has a slight inky taste. Total depth 65 feet. A. T. 628. Eimer, owner. There is no house near by.

Section 21.

1720 N., 20 W. Total depth 56 feet. A. T. 635.

600 N., 20 W. Total depth 20 feet. A. T. 637.

50 N., 700 W. SO_4 low. Depth to rock 28 feet, total depth 30 feet. A. T. 637. T. Titz, owner.

T950 N., 1740 W. Total depth 22 feet. A. T. 634. (1) 5 in. well. (2) Largely in bluish boulder clay.

50 N., 1950 W. Total depth 9 feet. This is a surface well.

Section 22.

In general it is said to be from 22 to 38 feet to rock.

1950 N., 840 W. Total depth 33 feet, 14 feet through clay and 19 feet through gravel. A. T. 637. Chas. Knott, owner. The water is moderately hard.

1950 N., 1240 W. Depth 28 feet. A. T. 637.

1950 N., 1740 W. Total depth, just to rock, 48 feet. A. T. 637. Water was struck on top of the limestone. Down to it was all clay. One-fourth of a mile south and one-half mile east it is said to be only 4 feet to limestone.

1360 N., 1900 W. Depth to rock 27 feet, total depth 40 feet. A. T. 637. A. Lindeberger, owner. This well was dug 20 feet and drilled 20 feet, and the water is roily in stormy weather.

1020 N., 1900 W. Total depth 27 feet. A. T. 637.

600 N., 1900 W. Total depth 27 feet. A. T. 637.

660 N., 100 W. Depth to rock 16. total depth 45 feet. A. T. 637. On the 40 acres of August Blunde, only 4 to 5 or 8 feet to rock.

Section 23.

1740 N., 1950 W. Total depth 210 to 220 feet. A. T. 640. W. Wagner, owner. The water is too bitter for cooking (i. e. SO_4 strong), Cl trace. Tastes of S and Mg.

1240 N., 1950 W. Total depth 30 feet. A. T. 641. This well is never dry.

1900 N., 50 W. SO_4 strong, Cl trace. Depth to rock 70 feet, total depth 125 feet. A. T. 645. S. Poster, owner.

1000 N., 50 W. SO_4 low. Depth to rock 150 feet, total depth 223 feet. A. T. 643. This well is cased for 150 feet. The first rock is soaprock, it is mainly blue rock and not so very hard, then 35 to 40 feet of sandrock, i. e., about 185-223. As the SO_4 is low it is probable that it begins below the gypsiferous layers of the Michigan series which lie more than 35 feet above the Napoleon sandstone.

Center of the N. W. ¼ of the S. E. ¼. Depth to rock 96 feet, total depth 145 feet. A. T. 645. P. J. Reithel, owner.

S. E. ¼ of N. W. ¼. 1050 N., 1100 W. A. T. 645. Cl trace, SO_4 strong, cathartic, alum taste. This water "hardens butter."

Depth to rock 90 to 99 feet. Total 99 feet. This well is through soft rock. B. Franklin, owner.

500 N., 1950 W. Cl trace, SO_4 strong. Total depth 137 feet. A. T. 644.

Section 24.

1950 N., 1250 W. Depth, not to rock 70 to 80 feet. A. T. 645.

Section 25.

50 N., 340 W. Depth to rock 14 feet. A. T. 648.

1950 N., 1950 W. Total depth 100 feet. A. T. 648. This is a new well, Aug. 28, 1896, and has 100 feet 3 inches casing, but is not to rock yet. There is plenty of water in this well.

Section 26.

1925 S., 75 W. Depth to rock 75 feet, total depth 141 feet. A. T. 647. J. Decher, owner. Fred J. Reithel, driller. This well passed through soaprock, then lime-rock and hard slate, blue argillaceous limestone and dolomite (cement rock). This well was deepened to 144 feet on Aug. 28th. Cl trace, SO_4 strong.

Section 27.

1820 N., 1950 W. Total depth, not to rock, 38 feet. A. T. 637. This well was dug 12 feet and then drilled to gravel. There is another well on the other side of the road. Depth to rock 31 feet, total depth 61 feet. A. Hartman, owner.

1000 N., 1900 W. Total depth 60 feet.(?) A. T. 637.

100 N., 1260 W. Depth to rock 68 feet, total depth 100. A. T. 630. Soaprock, sandstone at 100 feet. John Lucht, owner.

100 N., 840 W. A. T. 641. This well was down 138 feet to rock on the forenoon of June 3d, 1896, through clay, sand and gravel. Engelhardt Stueck, owner. Chas Hofmeister, driller.

Cf. Brown's well on § 23 in Fairhaven, T. 16 N., R. 10 E.

680 N., 1950 W. 148 feet to rock, 160 feet deep. A. T. 637. Louis Kain, owner. This well used to flow.

Section 28.

50 N., 950 W. A. T. 636. SO_4 strong.

840 N., 50 W. Cl low, SO_4 strong. Total depth 220 feet. A. T. 636. This well passed through much soaprock.

480 N., 30 W. SO_4 strong. School district No. 1. Winsor. Sept. 30, 1895. A. T. 636. Record of J. Russell as follows:

	Thickness.	Depth.	
Red clay	12	12	Post-glacial.
Blue clay	39	51	Post-glacial.
Hardpan and boulders	3	54	Post-glacial.
Sand and gravel	1	55	Glacial.
Hardpan and boulders	19	74	Glacial.
Light slate rock	7	81	Glacial.
Black slate rock	2	83	Michigan series.
Light slate rock	3'6"	86'6"	Michigan series.

Cf. Brown's well on § 23 in Fairhaven, T. 16 N., R. 10 E.

1950 N., 1950 W. Total depth 41 feet. A. T. 634. This well goes through soap-stone (probably solid clay).

50 N., 1900 W. Cl low, SO_4 strong. Depth about 60 feet. A. T. 636.

50 N., 660 W. SO_4 low. Total depth 85 feet. A. T. 636. This well passed through a few feet of gravel, then it was hand drilled for 27 feet through hardpan, i. e., till; then sand 9 feet thick was found at 45 feet, then 18 feet of soapstone, 2¾ feet of hard rock.

1950 N., 1240 W. SO_4 med. Depth 45 feet or more. A. T. 635.

Section 29.

50 N., 700 W. SO_4 strong. Depth to rock 69 feet. A. T. 636. Wm. Weinlander, owner. Chas. Hofmeister, driller. Record of samples sent to survey:

126 to 128, sandstone fine grained arenaceous.

128 to 150, yellow and brown limestone and sandstone.

150 to 216, clear white sand (a few green grains of spinel?) apparently good enough for glass making.

50 N., 1820 W. Total depth about 183 feet. A. T. 632. The water is very hard, Cl trace, SO_4 strong. W. Kappen, owner.

50 N., 1100 W. Total depth 125 feet, about 59 feet casing. A. T. 636.

50 N., 940 W. Cl trace, SO_4 strong. Depth to rock about 69 feet, total depth 148 feet. A. T. 636. Miller, owner. C. Hofmeister, driller. At 82 feet dolomitic limestone; 107-148 sandstone slightly calcareous.

50 N., 260 W. Total depth 188 feet or more. A. T. 637.

1660 N., 50 W. Depth to rock about 70 feet. A. T. 635.

1950 N., 1000 W. A. T. 632. Cl trace, SO_4 strong. This water is cathartic and probably comes from decomposed pyrite. Depth to water 60 feet, total depth 225 feet. Jacob Hoist, owner. This well is through soaprock and at 160 feet ("stuff like gold, called sulphur") pyrite.

Section 30.

(Depth to rock said to be in general about 60 feet.)

140 N., 1950 W. Total depth 200 feet or more. A. T. 630. This well is mainly shale and soaprock. C. Buschlein, owner.

50 N., 700 W. Cl 0, SO_4 med. + total depth 40 feet, but not to rock. A. T. 632.

Cl trace, SO_4 strong. Depth to rock 60 feet, total depth 180 feet. A. T. 632. M. Regenscheit, owner; C. Hofmeister and Crafts, drillers.

1000 N., 50 W. Cl trace, SO_4 strong. Depth to rock 64 feet, total depth 220 feet. A. T. 631. From 200-215 in sandstone. The tools were stuck fast, and some pyrite was encountered. George Kramer, owner; Smith, driller.

Section 31. (Kilmanagh.)

50 N., 540 W. Total depth about 60 feet. A. T. 630. This is like the well just south.

50 N., 990 W. A. T. 630.

50 N., 1300 W. Cl low. About 100 feet deep. This well is cased to rock for 80 feet. There was hard rock at the top of bed rock. C. Heckert, owner.

A. T. 630. Geo. Kindig, owner. Record as follows:

	Thickness.	Total.
Clay	55	
Hardpan with boulders	3	58
Loose dark rock (hard slate)	4	62
Hard rock, water	5	67
Soapstone	6	73
Light colored hard rock with 8-16 in. soft seams	25	88
Sandy fine clay, slate	4	102
White hard sand rock with some pyrite	4	106
Soft white sand rock	21	127

SO_4 trace.

1460 N., 1950 W. Total depth about 185 feet. A. T. 630.

1950 N., 700 W. Cl trace, SO_4 med. Depth to rock about 64 feet, total depth 200 feet. A. T. 630. This is mainly through soaprock, water was struck in sandrock.

1200 N., 50 W. Cl low, SO_4 med. Total depth about 170 feet. A. T. 636. Gottleib Layhen, owner.

50 N., 50 W. Depth to rock 60 feet, total depth 85 feet. A. T. 638.

A. T. 630. Frank Thompson, owner. Cl low, SO_4 med.

	Thickness.	Total.
Clay	60	
Slate or soap	10	70
Hard rock	25	95
Hard sandrock	12	107
Water sandrock	12	119

Section 32.

50 N., 660 W. This well was drilled. A. T. 676.

50 N., 1760 W. SO_4 low, Cl low. Depth to rock 80 feet, total depth 155 feet. A. T. 637. C. Finkbeiner, owner. The first rock encountered was slate, the last 25 feet was sandrock in which was water. Water also occurred at the surface of the rock

1950 N., 1820 W. Depth to rock 64 feet, total depth 172 feet. A. T. 636.

1950 N., 1100 W. Cl low, SO_4 med. Depth to rock 59 feet, total depth 116 feet. A. T. about 636. S. Ellenbaum, owner. The water has fallen from five feet below ground to 14 feet below.

1950 N., 940 W. Depth to rock 35 feet,(?) total depth 178 feet. A. T. about 636.

1950 N., about 300 W. Cl strong, SO_4 strong. Total depth 186 feet or more. J. D. Finkbeiner, owner.

Section 33.

1360 N., 20 W. Total depth 14 feet. A. T. 637. This well is shallow in gravel and gravelly clay.

750 N., 50 W. Total depth 135 feet. A. T. 637. Wm. Hinton, owner.

50 TN., 1700 W. SO_4 trace, Cl med. Depth to rock 80 feet, total depth 170 feet. A. T. 637. Jacob Kain, owner.

1950 N., 1800 W. Cl tr., SO_4 strong. Total depth 226 feet. A. T. 635. This water is cathartic.

1950 N., 1300 W. A. T. 635. Cl trace, SO_4 strong. Total depth about 214 feet. This well has 70 or 80 feet of casing.

Section 34.

1900 N., 1260 W. Depth to rock 104 feet (or 96), total depth 175 feet. Henry Einwochter, owner.

820 N., 1950 W. A. T. 637. Depth to rock 120 feet, total depth 165 feet. Cf. § 3-15-9.

Section 35. (Linkville, =Winsor, =Kilkenney). A. T. 648.

100 N., 950 W. Depth to rock 73 feet, total depth 101 feet.

	Feet.
Blue clay	71
Red clay	71-73
Grey rock	73-101

100 N., 950 W. Strong of SO_4. Depth to rock 75 feet, total depth 105. This well is in soapstone and hard black rock. C. Link, owner.

150 N. Total depth 225 feet. This well is at the stave mill, and has about 40 feet of red rock at the bottom.

50 N., 950 W. SO_4 trace, Cl low. This well is at the saw mill and has 120 feet casing. There was a bad flow from 105 to 110 feet, but it is cased off. "Grindstone" occurs from 135-140 feet and 150 to 200 feet.

1050 W. Total depth 173 feet. SO_4 low, Cl low. The water rises to about 10-12 feet from the ground.

Probably 1 and 2 are the same well, but different reports, also 3 and 4. The general section would then be probably (compare Grand Rapids Pl. XXI, Vol. V, Geol. Sur. Mich., at 147, 191 to 248, and 248 to 265 feet).

	Feet.
Drift	70-75
Grey calcareous shale	75-101
Hard black rock, perhaps limestone, and gypsum, brackish water	101-120
Shale	120-140
Sandstone	140-185
Red sandstones and shales	185-225

880 N., 50 W. Total depth 16 feet. A. T. 645.

50 N., 1950 W. Dug in boulder clay.

Oliver Township (T. 16 N., R. 11 E).

50 N., 1520 W. Total depth 10 feet. A. T. 667.

Section 2.

50 N., 700 W. SO_4 strong, Cl low. Temperature of flow 51° F. Total depth about 150 feet. A. T. 657.

50 N., 1100 W. Depth to rock 26 feet, total depth 142 feet. A. T. 663. This is a flowing- well in very hard rock.

Section 3.

1900 N., 300 W. Depth to rock 25 feet, total 146. A. T. 644. Salt at 48 feet. This well used to flow 2 feet above ground, the water is salty and at 143 feet was not good. This well should be cased deeply. Compare Adams' well in Caseville; i. e., about 90-100 feet above the sandstone is a salt streak.

1780 N., 1900 W. Depth to rock 26 feet, total depth 239 feet. A. T. 647. At 180 feet the water was not good. It now rises to within 6 feet of the ground.

220 N., 1540 W. Cl trace, SO_4 low. Total depth 130 feet. This well is cased for 30 feet. A. T. 645. This well is at the brick yard.

Section 4.

1950 N., 1480 W. Total depth dug, and not to the rock, about 12 feet. A. T. 657.

Section 5.

50 N., 960 W. Total depth about 20 feet. A. T. 657.

700 N., 1950 W. SO_4 low, Cl low. Total depth 109 feet. A. T 647. D. Bullock, driller, for Dwight and Heywood.

1420 N., 1950 W. SO_4 low, Cl low. Depth to rock 95 feet, total depth 156 feet. A. T. 647. D. Bullock, driller. The question is, is this casing really only to rock or did they case deeper to keep off bad water? The rock was blue "like slate pencils," i. e., blue shale in the Michigan series.

1950 N., 1280 W. SO_4 med. Cl low, like the one in Sec. 32-17-11. Depth to rock 60 feet, total depth 150 feet or more. A. T. 647. This well is in blue shale and sand-rock.

1950 N., 1210 W. SO_4 med., Cl low. Depth to rock 40 feet, total depth 168 feet. A. T. 647. Fliege, owner.

Section 6.

360 N., 50 W. SO_4 trace, Cl low. This well is 50 to 60 feet to rock and 125 feet deep. A. T. 647. This well was put down by D. Bullock for J. E. Lynch.

160 N., 1950 W. Total depth 29 feet. A. T. 646. This well was dug for 11 feet, then hand drilled. The water rose to within 12 feet of the surface.

800 N., 1950 W. Total depth 40 feet. A. T. 642. This well was dug and drilled, and has not very much water. SO_4 low, Cl med.

1950 N., 1460 W. Total depth 40 feet, hand drilled. A. T. 640. Good supply of water.

1950 N., 980 W. Total depth 140 feet or more. A. T. 642. This well is a few feet deeper than next well east, which is steam drilled.

W. half of N. E. quarter. Total depth 140 feet, depth of casing 52 feet. A. T. 642. J. Ackerman, owner.

Section 7.

60 N., 1950 W. SO_4 trace, Cl trace. Depth to rock 48 feet, cased for 2 feet or more, total depth 68 feet. A. T. 646. D. Bullock, driller; A. Neely, owner.

Section 8.

The surface wells around here vary from 50 to 65 feet deep.

560 N., 50 W. A. T. 652. Not to rock.

600 N., 50 W. Depth to rock 50 feet, total depth 82 feet. A. T. 652.

1450 N., 50 W. SO_4 trace, Cl low. Depth to rock 58 feet, total depth 166 feet. A. T. 652. Hoffman, owner.

100 N., 1950 W. Total depth 14 feet. A. T. 648. This well is in hard, tough, drab, very compact hardpan or boulder clay. This well was not finished.

1600 N., 1950 W. A. T. 650. This well was not drilled.

Section 9. (Elkton)

135 N., 37 W. Total depth 215 feet. John Grill, owner. SO_4 trace, Cl low.

There were flows of water at 66 feet, but at 110 feet came the regular flow. The rock consists of slate rock, black rock "coal" (not so), white rock, and passing through the sandstone the well goes into 10 feet of red rock. This well is cased to rock and piped to 110 feet. When the wind came from the S. E. it flowed a 1-inch stream, when from N. or W. it did not flow. This well used to flow until they cut the packing of the R. R. well 4 feet below ground.

125 N., 37 W. Cl. med. Total depth 23 feet. Compare sec. 10.

1900 W 600 N. SO_4 trace, Cl low. Depth to rock 55 feet, total depth 80 feet. This well starts in sandy soil. H. Becker, owner; 50 to 65 feet is the usual depth of surface wells around here.

Section 10. (Elkton)

There are two or three wells for engines 2½ miles east of Pigeon. Andrew Newly, 18 to 28 feet of white rock (gypsum)?

"There are 14 or 15 wells right in Elkton and they are robbing each other and wells that used to flow do so no more."

150 N., 1800 W. Depth to rock 25 feet, total depth 228 feet. A. T. 650. S. T. and H. R. R. station. Cf. John Grill's well on Sec. 9. Summary:

	Feet.
Surface	0-25
Mainly sand rock with occasional seams of slate and limestone	25-99
Sand rock (hard down to 170 feet)	99-196
In soft red rock, slate	196-208

Water would flow at 207 feet, five feet or over above ground. Drilled by Cyrus G. Wells, of Badaxe, under a contract dated October 10, 1890. Daily report:

Oct. 23, 1890. Reached 25 feet below surface and struck rock.

Oct. 24, 1890. From 25 to 35 feet sand rock; occasionally an inch or two of slate.

Oct. 25, 1890. From 33 to 40 feet, hard sand rock.

Oct. 27, 1890. From 40 to 58 feet, hard sand rock, intermediate layer of about 6 inches of limestone.

Oct. 28, 1890. From 58 to 75 feet, hard sand rock.

Oct. 31, 1890. From 75 to 99 feet, hard rock and slate.

Nov. 4, 1890. From 99 to 102 feet, very hard sand rock.

Nov. 6, 1890. From 102 to 120 feet, hard sandrock.

Nov. 7, 1890. From 120 to 129 feet hard sand rock.

Nov. 8, 1890. From 129 to 130 feet, hard sand rock.

Nov. 10, 1890. No progress, hard sand rock.

Nov. 13, 1890. From 130 to 140 feet, hard sand rock.

Nov. 14, 1890. From 140 to 145 feet, hard sand rock.

Nov. —, 1890. From 145 to 150, hard sand rock.

Nov. 20, 1890. From 150 to 158 feet, hard sand rock.

Nov. 22, 1890. From 158 to 170 feet, hard sand rock,

Nov. 25, 1890. From 170 to 178, soft sand rock.

Nov. 26, 1890. From 180 to 196, soft sand rock.

Nov. 28, 1890. From 196 to 202, soft red rock.

Dec 2, 1890. Down 207 feet, red soft rock; broke down, not drilling at present.

Dec 6, 1890. Well will flow, if fixed with piping and packing, five feet or over, above ground.

Dec. 6, 1890. Down 208 feet in red slate; the pipe has been put in and tried and water flowed five feet above surface.

1200 N., 950 W. Total depth 130 feet. A. T. 642. SO_4 med., Cl low. This well does not flow.

Section 11.

1950 N. Total depth 170 feet.

1950 N., 50 W. Depth to rock 26 feet, total depth 130 (128 to 138) feet. A. T. 664. Water at first rose to 3 feet from surface, and was struck at 100 feet.

1000 N., 50 W. SO_4 med., Cl trace, taste of H_2S. Depth to rock 100, total depth about 130 to 170. Wells of D. Rolph and neighbors. This well did flow.

Section 12.

1950 N., 540 W. Depth to rock 25 feet, total depth 220 feet. A. T. 670. This well is mainly through slate and soapstone. The

first water was at 90 feet. This well flowed for sometime and the water is now within 4 feet of the ground.

Section 13. Grassmere.

1040 N., 50 W. Cl 0, SO_4 0. Depth to rock 40 feet, total depth 175 feet. A. T. 694. This water was tested by Prof. W. B. Prescott as follows: Hardness, 0.171 per thousand. Cl = 0.0025 per thousand; contains Ca, Mg, Na, Cl, SO_4, Cl and Co_2 in minute quantities and trace of Fe. This well goes 48 feet to a bluish grey sandstone, shelly, i. e., flags. At 158 feet is a coarse grey sandrock.

Concerning the behavior of this well we insert the following from the Bad Axe Republican of Aug. 10, 1900. Compare what we have said on p. 4 about varying flows. The sweating of the pipe in times of storm is due to the extra humidity of the air which is congealed by the cold pipe.

Practically all of the water used for drinking purposes at the little hamlet of Grassmere comes from a well on the Grassmere stock farm. The well stands just inside a field on the road near the station and is patronized by everyone in the vicinity as the water is very pure, clear and cold. An iron pipe has been driven into the earth to a depth of 170 feet and the water from it is carried to a large trough in the adjoining barnyard where the cattle on the farm are watered. Where the pipe comes out of the ground a barrel has been sunk in the earth and the water flows direct from the well into this barrel. Manager Sam Goodwill says this well has several peculiarities that are odd, to say the least. When the wind is in the southwest the flow of water is abundant, taut let it veer around to the opposite point of the compass and the supply is diminished at least one-half. The well is also a faithful barometer. When a storm is in the air the water in the barrel is greatly disturbed. It boils violently and the sediment at the bottom rises and roils the water so that it has to be taken direct from the pipe for drinking purposes. At the same time the pipe, otherwise dry, becomes covered with moisture and great beads of perspiration drop from its rough, iron surface. This is due doubtless to the coldness of the pipe condensing the moisture already gathering in the warm air surrounding it. On Saturday all the conditions were present, and that night this vicinity was visited by a copious and welcome rain storm.

Section 15.

860 N., 1950 W. A. T. 650. This is a flowing well and is about the same as 800 N., 50 W., 16-16-11.

Section 16.

200 N., 50 W. A. T. 650. This is a shallow well.

800 N., 50 W. This is a flowing well. Depth to rock 35 to 40 feet (25), total depth 140 feet.

1950 N., 980 to 1620 W. SO_4 low. Total depth 12 to 16 feet. A. T. 647. There is no rock well near here.

Section 18.

1950 N., 220 W. Depth to rock 82 feet, total depth 304 feet. A. T. 650. Meredith, owner. At 180 or 190 there was plenty of water but they went lower hoping for a flow and got bad water, which was shut off. From 200 to 304 is red rock.

Section 21.

S. E. quarter of S. E. quarter. Depth to rock about 30 feet, total depth 85 feet. A. T. 670. Temperature of flow 47½° F.; water not as hard as that o f the 16 foot well at the same place.

800 N., 50 W. Flow not strong. Total depth 91 feet.

1260 N., 50 W. Depth to rock 27 feet, total depth 104 feet. A. T. 662.

1740 N., 50 W. Temperature of flow 47½° F. Total depth 104 feet. A. T. 660.

Section 22.

800 N., 50 W. Total depth 20-30. A. T. 665.

Section 27.

½ mile E. and ½ mile N. of 1280 N., 50 W. in Section 28. Total depth 110 ft. A. T. 672.

1920 N., 1950 W. Depth to rock 30 to 35 feet, total depth 110 feet. A. T. 672. This well is like the one 1280 N., 50 W., in Sec. 28-16-11.

0 N., 440 W. Ca trace, Cl none, SO_4 none. Total depth 149 (140 to 145) feet. A. T. 684. John Wooster, owner. This is a flowing well.

Section 28.

50 N., 320 W. A. T. 670. Paul Praseham, owner. This is not a flowing well.

50 N., 780 W. A. T. 670. This well is probably to rock, 32 feet deep.

1280 N., 50 W. T. 47½° F. Depth to rock 30 to 35 feet, total depth 106 feet. A. T. 670. This well is through sandrock and some slate, and did not have a strong flow.

750 N., 50 W. Total depth 140 to 145 feet. A. T. about 670. This is a flowing well.

1920 N., 50 W. Depth to rock about 30 to 35 feet, total depth 110 feet. A. T. about 670. This well is like 1280 N., 50 W.

Section 29.

50 N., 800 W. A. T. 667. This is a fifteen-foot dug well.

50 N., 400 W. A. T. 667. Total depth 16 feet. This is a dug well. The country is sandy all along here and to the west.

Section 30.

112 N., 1560 W. Depth to rock 54 feet, total depth 178 feet. A. T. 652. Head of flow 6 feet. J. Cassinke, owner. The first rock was sandstone at 54 feet, lots of slate in the rock, blue sandstone, then 7 or 8 feet of clear white sandstone, water bearing rock. According to Bullock, of same well, soaprock, lime and slate made up the well which went from 130-178 into sandrock.

Section 31.

1950 N., 460 W. Total depth 13 feet. A. T. 660. 4 feet of gravelly sand, the rest is clay. There was about 6 feet of water in this well all summer.

Section 33.

1950 N., 780 W. Depth to rock 30 feet, total depth 127 feet. A. T. 662. SO_4 trace, Ca trace, Cl 0. Fe present. Fred Elbe, owner. At 35 feet went through gypsum bed 1 foot thick.

Water was struck at 127 feet, it flowed a water pail a minute and rusts iron. Temperature 47½° F., Lane, 48° F., Davis.

Section 36.

S. E. corner. Ca low, Cl trace, $H_2 SO_4$ low. Total depth 13 feet. A. T. 730. This water is strongly impregnated with $H_2 S$. When wind is E. water is said to turn black.

Colfax Township (T. 16 N., R. 12 E. L.).

Section 1.

50 N., 1900 W. Total depth 20 feet. A. T. 734. This well is not deep enough.

Section 6.

200 N., 260 W. Depth to rock 30 or 35 feet, total depth 242 feet. A. T. 690.

The water was good and rose to surface. B. Kreutziger, owner. There was loose rock to 35 feet to which it was cased. At 85 feet the water rose to the top. The well was continued through soap rock in the vain endeavor to get more head, though the supply was increased.

N. W. quarter of N. W. quarter. Total depth to rock 40 feet.

100 N., 1260 W. A. T. 670. J. Klemmer, owner. Cl 0, SO_4 med. The water rose originally to 3 feet of surface, now it rises to 7 feet of surface. Water was struck at 50 or 70 feet, then 21 feet hard rock, then 4 feet of plaster.

A general section for this part of the country is 20 feet to rock, 21 feet to flinty limestone, gypsum and calcareous shales to top of Marshall sandstone at 70 feet, and at 240 feet were shales of the Lower Marshall.

Section 7.

N. W. quarter of N. W. quarter. Depth to rock 20 feet, total depth 150 feet. A. T. 677. This well flowed at first.

Section 9.

A. T. 708. Total depth 26 feet. J. Hutchinson, owner. The water in this well is not good.

Section 13.

1300 N., 50 W. Total depth 15 to 16 feet. A. T. 752.

1950 N., 860 W. Total depth 12 to 16 feet. A. T. 744. This is the general depth of wells around here.

Section 18.

200 N., 50 W. Cl 0, SO_4 0. Depth of casing to rock 40 feet, total depth 85 feet. A. T. 709. The water rises to 3 feet from top.

A. T. 693. Grassmere. See Sec. 13, Oliver. Around Grassmere wells are said to be about 90 feet deep.

Section 20.

340 N., 50 W. Depth to rock 60 or 70 feet, total depth about 200 feet. A. T. 745. Fred Wettzel, owner. This is a sandstone water. D.

S. W. ¼ of S. E. ¼. Depth to rock 50 feet, total depth 75 feet. A. T. 745. Robt. I. Hazard, owner. This well used to flow.

Section 23.

1000 N., 640 W. Total depth 8 to 9 feet. A. T. 762.

1050 N., 1060 W. Total depth 10 to 12 feet. A. T. 762.

1250 N., 1200 W. Depth to rock 50 feet, total depth 85 feet to 102 feet. A. T. 762. This well is at the county poor house, in soaprock (?).

1200 N., 1250 W. Total depth 91 feet. A. T. 762. This well is at the road.

220 N., 1950 W. A. T. 757. The water rose 8 feet from top.

Section 24. (Badaxe.)

T. Rapson says that it is mostly sandstone around here, now and then soapstone, but as we go north toward Grindstone City there is very little rock (i. e. sandstone) until the soapstone, then 100 to 200 feet of soapstone with seams of sandsone, i. e., Lower Marshall. Other deep wells generally to rock are put down in Badaxe at the jail, Connaton House, Bank of F. W. Hubbard & Co., Post and Seely, Skinner, School house and R. R. station, etc.

Lot 17, John Street, 1400 N., 700 W. Depth to rock 40 feet, total depth 90 feet. A. T. 770. S. Burgess, owner.

1050 N., 1050 W. Total depth 80 feet, in rock. A. L. Wright, owner.

1450 N., 1800 W. Depth 10 to 12 feet. This well is at the cemetery and went through 4 feet gravel, 4 to 12 feet sand, and the rest clay.

A. T. 770. Depth to rock 56 feet, total depth 110 feet. Well at the new cemetery, drilled in 1896. This well was through sandstone, with no change all the way. This compared with the flowing well on Sec. 19-16-13, Verona, shows that there is a very heavy sandstone at the top of that.

Section 26.

1780 N., 1950 W. A ten-foot well in hard clay, not stoned up. A. T. 752.

Section 27.

1780 N., 50 W. Seven feet hard blue clay, 6 inches gravel, 4 feet blue clay, then more gravel. A. T. 752.

Section 29.

1950 N., 260 W. Depth to rock 60 feet, total depth 66 or 75 feet. A. T. 745. The first 60 feet were mostly clay, but there were 12-15 feet of quicksand on the rock, and 5 to 6 feet sandrock at the bottom. The water rose to within 4 feet of the surface, it was clayey but otherwise good.

50 N., 300 W. Total depth, not to rock, 18 feet. A. T. 762.

Section 30.

440 N., 200 W. Depth to rock 60 feet, total depth 66 feet, or depth to rock 70 feet, total depth 75½ feet. A. T. 730. Robert Brown, owner; T. Rapson, driller.

	Thickness.	Total.
Clay	45	45
Quicksand on top of rock	12 to 15	60
Sandrock	5 to 6	66

The water rose to within 15 feet of the surface. There was good water in this well which rose to 16 feet of surface.

Section 32.

1950 N., 140 W. Total depth 12 feet. A. T. 765.

Section 33.

E. half of S. E. quarter. Total depth 17 feet. A. T. 757.

Section 34.

1950 N., 260 W. Total depth 12 feet. A. T. 770. This well is in clay but the road is sandy.

920 N., 50 W. In Sec. 35 (?). Depth 18 feet. A. T. 762. Ten feet to water through a bluish gravelly clay with much white chert.

480 N., 50 W. Depth 13 feet. A. T. 764. This well is through the clay which seems to "drop out" at the bottom, with a quicksand and gravel beneath yielding plenty of water.

50 N., 1565 W. Total depth 20 feet or more. A. T. 764. This well struck water at 20 feet.

50 N., 1950 W. Total depth 18 feet. A. T. 760. This well is through gravel into coarse gravel. The water is very hard and "furrs the kettle right up."

Section 35.

1450 N., 950 W. Total depth 6 feet. A. T. 752.

1050 N., 1950 W. A. T. 760.

Verona Township (T. 16 N., R. 13 E. L.).

Section 6.

1037 N., 1476 W. Probable depth 63 feet. A. T. 750. There was plenty of water in this well for 30 head of cattle, and it rose nearly to the top.

Section 7.

50 N., 1950 W. Total depth 10 to 12 feet. A. T. 770.

1180 N., 1950 W. Total depth 10 to 12 feet. A. T. 750.

Section 11.

1000 N., 1000 W. Depth to rock 50 feet, total depth 60 feet. A. T. 756.

Section 18.

1950 N., ? W. Total depth, just to rock, 40 feet. A. T. 770. Mott, owner.

1000 N., 1950 W. Depth to rock 40 feet, total depth about 85 feet. A. T. 712. H. Wilcox, owner.

Section 19.

890 N., 1700 W. June 2d, 1896. See record from J. Coreyell, see also analysis of Badaxe water below. These wells rose to 11 feet below ground, now they have to raise it about 15 feet.

About 300 feet south and 800 feet E. of W. ¼ post of Sec. 24, on Hanselman street. Depth to rock 40 to 45 feet, total depth 200 feet. A. T. 760. Waterworks of Badaxe. Very pure from mineral matter. T. 49° F.

The town is supplied by these three artesian wells, about two hundred feet deep, from which the water is pumped to the stand pipe, 200 feet high. The record turned in by Coreyell below may be from one of these wells by mistake as it does not match that of the 400 foot well which it was supposed to be. I copied the original record of the latter. The main flow is at about 200 feet. During the summer there was some complaint of the taste of the water, and I was shown a piece of wood which was said to have come up from the well. But in spite of my tests showing that the trouble was not with the water as it came from the well, it seemed wise to send off to the Agricultural College and have the water tested. Two samples were sent. No. 1 was from the dead end of a water main, i. e., beyond any water connection to a house. No. 2 was from a pump direct. The following was Prof. P. S. Kedzie's report:

"The two samples of water sent some time ago have been very carefully examined with the following result:

	(In grains per imperial gallon.)		
	No. 1.	No. 2.	Lansing city.
Total solid matter in a gallon	23.45	20.65	19.00
Organic	7.00	6.30	4.00
Inorganic	16.45	14.30	15.00
Hardness, degrees of	5.9	5.2	13.00
Free ammonia	0.0024	Slightest trace.	0.08
Albuminoid, degrees of	0.072	0.048	0.10

(Lansing City water given for comparison.) We consider this water very good, and I think that your water may be safely placed in the same class if not better. We are, however, always troubled with bad water at the dead ends of the mains, and find it necessary to have the pipes frequently, flushed. The cause for the bad smell and taste given to the water by standing at the dead ends of the pipes is thought to be the organic matter acting on the sulphate of lime contained in the water, causing the liberation of H_2S in the water which gives the water a strong and decidedly unpleasant smell when the faucet is first opened in the morning. We are never free from that trouble here, and probably never will be, so long as the water contains the lime compound and the amount of organic matter which seems to be natural to most of our Michigan waters. The only remedy is frequent flushing."

The Badaxe water does not contain anything like as much Ca SO_4 as the Lansing certainly, and from my inspection I am inclined to attribute the difficulty more to the rapid growth of vegetable matter in the stagnant ends or stand pipe in a water with much carbonic acid. But the well water is extremely pure. It will be well to exclude light from the stand pipe.

Sand Beach Ave., White Elm. At the Morrow House there is a shallow well.

Heisterman and Sand Beach Ave. Post and Seeley's bank.

Sand Beach Ave. and Hanselman's deep well at Hubbard's bank.

Block 11, Irwin and Hanselman Street. Skinner, owner.

Block 8. There is a deep well at the school house.

A. T. 758. Total depth 40 feet. This well is at the R. R. Station. This well is through solid clay. "Clay is not as thick on hills as in lowlands."

E. part of town. Locke's well is just 49 feet to rock.

970 N., 12 W. Total depth 400 feet. A. T. 757. John Sullivan, driller. This well flows a strong stream 3 feet above ground at the rate of 1 quart per second. Temperature 47° F. Lane or 49° F. Davis. The two thermometers were about 2° apart, SO_4 0, Cl 0, Ca slight traces.

Fifteen feet was unaccounted for in depth to rock, probably 5 feet of muck; also 5 feet unaccounted for in the total. Size of hole 5⅝ inches. This I copied from original record which was hunted up for me. Depth to rock 45 feet.

	Thickness.	Total.	
Muck and shell marls? not in record	5	.....	
Clay	20	.....	Pleistocene.
Gravel	5	.....	
(Glacial) hardpan	5	*45 or 50	
Sand rock	30	80	
White shale	5	85	
Sand rock	30	115	Upper Marshall, Napoleon.
Lime rock	8	123	
Sand rock	30	153	
Lime rock	10	163	
White shale	27	190	

Here is said to have been the main flow at about 200 feet or 175-200 feet (i. e., by record 190-215), according to report through W. L. Webber from J. Coreyell at 270 feet was sandstone with a strong stream of water rising above surface (probably read 207 for 270 feet).

	Thickness.	Total.	
Sand rock	25	215	Port Austin sandstone?
Lime rock	5	220	
White shale	10	230	
Sand and lime	20	250	Point aux Barques sandstone?
Blue shale	25	275	
White shale	20	295	
Red sand	5	300	
Black lime	7	307	
Sand rock	5	312	Grindstone quarry beds?
Black lime	5	317	
Gravel and sand rock (conglomerate)	3	320	*Bottom of Lower Marshall.*
Blue shale	15	335	
Lime rock	5	340	Coldwater shales.
Sandy shale	10	350	
Lime rock	10	360	
White shale	40	400	

John Coreyell's record through W. L. Webber, dated May 11, 1894. This is evidently not a record of the same well as above, although it was supposed to be; it may be one of the city waterworks wells.

	Thickness.	Total.
Gravel	12	12
Hardpan	20	32
Blue clay	7	39
Gravel	3	42
Hardpan	2	44
Sandrock	20	64
Blue shale	36	100
Sandy shale, blue	21	121
Sticky shale	22	143
Sandy shale	2	145
Grey sandrock	45	190
Blue shale	7	197

Cf. letter of W. L. Webber, Nov, 3d, 1896.

1037 N., 1963 W. Total depth 18 feet. A. T. 770. At the Irwin House. This well never goes dry. Hanselman street. A. T. 760. This is a shallow well at the county jail.

*Totals obtained by subtraction from 400 feet leaving discrepancy indicated by 45 = 50.

Section 20.

950 N., 460 W. A. T. 768. This well is on a gravelly rise.

1050 N., 50 W. Total depth 16 feet. A. T. 782. This well went dry in the summer of 1895.

Section 21.

1050 N., 1120 W. Total depth 16 feet. A. T. 765. This well is on a muck, sand and gravel knoll. All the wells around here are shallow.

950 N., 500 W. A. T. 772. This well contains 5 to 6 feet of water.

Section 22.

950 N., 1280 W. Thomas Rapson, driller.

1050 N., 700 W. Total depth 20 to 22 feet. A. T. 807. This was a dug well.

Section 25.

1760 N., 0 W. Depth to rock 78 feet, total depth 84. A. T. 812. Sandstone water.

Section 29.

1650 N., 140 W. Total depth 16 feet. A. T. 782. D. McCrea, owner.

Section 31.

A. T. 757. There are shallow wells around here. Water was within 4 feet of surface on June 10, 1896.

Section 34.

1900 N., 500 W. Total depth 10 feet. A. T. 780. Two or three wells (one of them used to be a spring), all went dry in the summer of 1895.

1060 N., 50 W. 27 feet deep. A. T. 834. This well never went dry. This well is on top of a hill; near by are undrained hollows on the hill, and water standing in them.

Section 35.

460 N., 1850 W. Total depth, perhaps, just to rock, 47 feet. A. T. 798.

Sigel Township (T. 16 N., R. 14 E. L.).

In this township there are large surface deposits of sand or gravel in connection with the Forest Beaches so that deep wells have not been found necessary yet, but except at the extreme east side possibly it will be possible to get water in the sandstones which occur in the first hundred feet of the underlying rock. There will be no flows and the. deeper water will be somewhat salty. In this township it will not be improved by going deeper as in Chandler.

Sand Beach Township (T. 16 N., R. 15 E.).

Section 5.

100 paces W., 20 N.

20 N., 100 W. SO_4 low. Ca low, Cl strong. Depth to rock 73, total depth. 82 feet. A. T. 700.+ J. Gerstenschlager's well. 5 feet shale and 4 feet solid.

Section 18.

40 rods N., 40 rods W. SO_4 low, Ca low, Cl strong, as at Cowpers. Depth to rock 48 feet, total depth 100 feet. A. T. about 750. This well passed through shale 6 feet, slate 2 feet, limestone 2 feet, shale and sandstone 42 feet. R. A. Brown, owner.

250 N., 250 W, of N. W. corner of 19, half way from Brown's to Cowpers. Ca low, Cl med., SO_4 low. Depth, just to rock, 22 feet.

Section 19.

N. W. corner. Ca low, Cl med., SO_4 low. Depth to rock 6 feet, total depth 12 feet. A. T. 750. Cowper's well, with 6 feet of "grindstone" rock.

Section 25.

640 paces W. of Engert's, Ca low, SO_4 low, Cl strong. Depth to rock 83 feet, total depth 85 feet. A. T. about 650. Jacob Layer, owner. There was a layer two feet thick of sandy shale.

140 W., 80 S. of N. E. corner. Ca low, SO_4 low, Cl strong. Depth to rock 54 feet, total depth 57 feet. A. T. about 640. George W. Engert. This well passed through sandy shale.

Section 12. L. Harbor Beach.

The village is supplied by water works taking water by lake from a 1200 foot conduit near north end of breakwater, described in Huron Times, Friday, Sept. 17, 1897, cost

$16,000. Walker system of water supply. Rock is soon reached and is within a few feet of the surface for 2 or 3 miles north and south.

Two deep wells have been put down, fully reported in previous volumes, and discussed in the description of the geological column, and the analyses of waters given above.

(1) Depth 702, 715, 800 to 900. See Geol. Survey of Mich., Vol. III, p. 184; V, p. 80. Sandstone from 650-715.

(2) Geol. Surv. of Mich., V, p. 81. Abstract of record:

Coldwater shales	1-500 feet.
Berea black shale	500-603
Berea grit	603-664
Bedford and Erie shales	664-850
Huron black shale	850-1120
Traverse, i. e., Hamilton shales and limestones	1120-1725
Encrinal limestone?, 15 feet of hard rock at	1400
Helderberg limestone	1725-1920

T. 16 N., R. 16 E. Sand Beach.

Section 30.

600 paces N., 700 W. SO_4 trace, Ca low, Cl high. Depth to rock 24 feet, total depth 65 feet. A. T. 622.+ S. Lincoln, owner. Situated 3.94 miles from Sand Beach on lake shore road.

1950 N., 1400 W., 600 paces E. of the N. W. corner. T. 16 N., R. 16 E. Total depth 18 feet. A. T. 602. Robert Brennan, owner.

660 S., 400 W. of the N. W. corner. Sec. 30, T. 16 N.. R. 16 E. Depth to rock 16 feet, total depth 22 feet. A. T. 622.+ SO_4 low, Ca low, Cl medium. Ingall, owner. This well is through sand and clay to rock, then in 2 feet sandy shale. The water is not so hard but that it can be used in washing. There is 7 feet of water in the well. This well is situated 3.55 miles south from Harbor Beach on Lake Shore road.

200 paces E. of the N. W. corner. Depth to rock 30 feet, total depth 50 feet. A. T. 682, SO_4 low, Ca low, Cl high Davis. Chas. Keane, owner. This well is through sandy shale.

1890 N., 1800 W. A well 300 feet from road.

Fairhaven Township (T. 17 N., R. 9 E.).

Section 36. Bayport.

420 feet W. of center line, 946 feet N. of center line.

1358 N., 1159 W. Cl med., SO_4 med. Sp. Wt. 1.0017. Total depth 328. A. T. 590 + Located below the bluff and between the hotel and the bay. Water was found in a coarse grey sandrock, and rises above the surface and forms a flowing well. The temperature of the flow is 47°, "'uniform winter and summer." Analyzed by Prof. A. B. Prescott. See p. 136.

1400 N., 1500 W. Total depth 338 feet. This is similar to the one above.

Near the W. line of E. ½ of S. W. ¼. A. T. 602. Webber's No. 3 well. This well passed through 4¼ feet of "firestone," so called because used for hearths; 3% feet limestone; 15 feet sandstone, sample grey white, fine grained at 12 feet 9 inches; 4 feet sand and limestone, light "cement bed" shale and sandstone; 23½ feet shale with occasional mixture of sandstone.

Laurence Smith's well. Total depth 30 feet. These wells are through rock, 2½ feet surface, 10 feet limestone. 4 feet sandstone.

Stoll's well. Depth to rock 18 feet, total depth 40 feet. Rock powder like milk at 40 feet. Cf. records above. This must be in the shale formation and is probably a gypsum streak.

1075 N., 520 W. 200 feet N. of center line. A. T. 612. From 264 to 350 was water bearing sandrock; from 350 to 453 "red stuff, stopped in it." Cf. Sovereign's well on Sec. 30. Lake Tp. There is another report of the same well as follows:

Depth to rock about 30 to 50 feet, total 500 to 600 feet. The well passes through soapstone, sandstone, limestone and gypsum and shows some fool's gold (pyrite). At 250 feet they struck good water which rose to within 2 feet of top of casing. The first rock is sandstone.

1550 N., 650 W. Total depth 80 feet. A. T. 627. This well begins in sandstone at the house.

Depth to rock 20 feet, total depth 100 feet. A. T. 592 feet. This well is at the engine house.

Depth to rock 30 feet. A. T. 602. This is at the barn.

Pyrite was found near Bayport at 44½ and at 94½ feet.

All the above wells were on L. P. Mason's place.

665 feet N. of center line and 660 feet W. of center line. 1250 N., 1250 W. Depth to rock 3 feet, total depth 15 feet. A. T. 600. This well is said to be in sandstone, but from outcrops near by probably also passes into limestone. The analysis is No. 10, by Prof. R. C. Kedzie, given on p. 136. It is the Bayport springs as advertized, under the Arbor.

640 N., 50 W. Total depth 6 or 7 feet. A. T. 620. This well is in rock and can be dipped dry.

260 N., 50 W. A. T. 625. This well is to rock, but it is shallow.

1250 N., about 1350 W. At Bayport R. R. station. About 19 feet deep. This well has been analyzed by Prof. Prescott, analysis No. 9 on p. 136; it is somewhat more strongly mineralized than the Bayport springs and being a little deeper probably penetrates the limestone more.

900 N., 250 W. Depth to rock 0, total depth 47 feet. A. T. 593 (11.16). This is W. L. Webber's No. 4 well.

10½ feet of fire stone (as in hole No. 3, and the stone in the railroad cut, used by early settlers instead of fire brick for lining their arches, whence the name), 15 feet sandstone, 8½ feet superior coarse sandstone, 1½ feet shale, 7 feet whetstone (fine) for honestone, 4½ feet shale. This hole begins very close under the outcrop of Lithostrotion beds near by. Sp 19170-19173.

Caseville Township (T. 17 N., R. 10 E. L.).

Section 1.

1260 N., 1950 W. This well is about 17 feet deep and is not cased, but has plenty of water. SO_4 probably strong. Cf. Sec. 2.

50 N., 540 W. Total depth 16½ feet. A. T. 600. The water is not salty, but gives a white kettle scale. Cl low, SO_4 trace.

50 N., 1580 W. A. T. 610. Owner, J. A. Holmes.

800 N., 1950 W. Depth to rock 20 feet, total depth 178 feet. A. T. 607. J. Adams, owner; Mozier and Erb and later D. Bullock, drillers. At 93 feet they struck salty water and at 96 feet gas indications. Bullock cased to 112 feet and at 178 feet found fresh water. This is the house well.

The one at the barn is dug 24-26 feet, then tubed. The first water is probably at 20 feet or 25 feet. Cf. Libby's well across the way.

Section 2.

800 N., 50 W. SO_4 probably strong. Total depth (just to rock?) 21 or 23 feet A. T. 609. Libby, owner. This well is "to plaster rock."

1800 N., 50 W. SO_4 strong. Total depth 14 feet. A. T. 608. J. Gardner, owner. This well is to rock.

Section 10.

50 N., 280 W. There is no SO_4 in the water. Total depth 32 feet, dug 8 feet and drilled 22 feet. A. T. 617.

740 N., 50 W. SO_4 strong. Depth to rock 22 feet, total depth 26½ feet. A. T. 617.

Section 11.

50 N., 500 W. A. T. 617. This is a "mineral" water, that is SO_4 strong. Total depth about 30 feet. 14 or 15 feet was dug and 10 feet drilled.

Section 12.

Around here it is 26 to 30 feet to rock. At 10 feet the water shows SO_4 0 and at 23 feet SO_4 trace.

50 N., 1400 W. Total depth of well 9 feet. A. T. 612.

200 N., 1300 W. Total depth 16 feet. A. T. 612. This is not a drilled well.

50 N., 240 W. SO_4 strong and Cl strong. Total depth 27 feet. A. T. 619. This well was bored with an auger, and the water came up with a rush when it struck rock. There was 16 feet of water in the well.

Section 13. (Hayes.)

1460 N., 1950 W. A. T. 612. C. F. Leipprandt, owner. Depth to rock 30 feet, total depth 55 feet. This water is not salt to taste but contains SO_4 strong.

1500 N., 1900 W. Depth to rock 28 feet, total depth 100 feet. A. T. 610. The water is very salt to taste and is also strong of SO_4. The owner makes his own family salt and frees it from iron by setting it in the sun for 24 hours.

1580 N., 1900 W. SO_4 0, not salty tasting. A. T. 610. This is a flowing well. Total depth 278 feet. At about 228 feet very white sandstone. It is cased for 260 feet. Three days of north wind will make the head rise a foot, and three days of south wind will make the head fall a foot. This is a more than usually accurate observation, as Mr. Leipprandt is an observer of the State Weather Service.

50 N., 540 W. SO_4 strong, Cl med.+ Total depth, just to rock, 25 feet. A. T. 620. W. Steinmann, owner. Sp. Wt. 1.005. The water in this well stands at five feet from the surface.

1950 N., 1300 W. This well is not drilled. A. T. 615.

1950 N., 560 W. Total depth about 30 feet. A. T. 617. This is a dug well.

1950 N., 240 W. A. T. 619. This well is slightly mineral and is 16 feet deep.

Section 14.

600 N., 1950 E. The water is hard, SO_4 strong. Total depth 20 feet. A. T. 619. This well is at barn and was dug.

There is a well at the house which is only 12 feet deep and the water is not so hard.

600 N., 1700 E. Total depth 52 feet. This well was dug for 19 feet and passed into two feet of blue clay.

1840 N., 1100 W. SO_4 strong. Total depth 26 feet. A. T 617. Geo. Anderson, owner. This well was dug for 16 feet and drilled for 10 feet.

100 N., 400 W. Cl med. Total depth 35 feet. A. T. 617. This well was drilled for some 16 feet. Chas. Stewart, owner.

150 N., 400 W. SO_4, low, Cl low. Total depth 40 feet. This well was hand drilled.

940 N., 50 W. This water is good. Total depth 12 feet. A. T. 617. M. C. Gregory, owner.

Section 15.

1950 N., 420 W. A. T. 617. This water is not very good. Depth of wells 6 and 11 feet.

Section 16.

S ½ of N. W. ¼ of S. E. ¼. This is a salt spring found by F. Lawrence.

50 N., 780 W. Cl strong, SO_4 strong. Total depth 18 feet. A. T. 600. They found gypsum in digging this well, Sp. 19159.

Section 21.

50 N., 780 W. A. T. 612. This is a shallow well and the water is about 6 feet below surface. Another well near by has SO_4 0. Total depth about 27 feet.

There is a well 7 feet deep at the house and one 11 feet deep at the barn which contains only two feet of water. It is said to be 37 feet from ground to bed rock hereabouts.

880 N., 50 W. SO_4 strong. Total depth 40 feet. A. T. 619. This well was dug 12 feet and drilled to 40 feet.

Section 22.

1240 N., 1950 W. Total depth 9 feet. A. T. 620. T. D. Smith, owner.

1760 N., 1950 W. Total depth about 40 feet. A. T. 620. This well was dug 20 feet and drilled the rest of the way.

1050 N., 1300 W. Depth to rock 30 feet, total depth 242 feet. A. T. 619. This well has about 50 feet of casing. There was good surface water at 28 feet, but the water now is salty. Hon. J. J. Murdock, owner. At the bottom of this well there is about 40 feet of white sandstone; it also passes through limestone and soap-stone, but gray and white sandstone are supposed to make up half the depth. The water would be better if tightly cased 200 feet.

1050 N., 1820 W. Total depth 6 feet. A. T. 610. This is a dug well.

1840 N., 1420 W. Total depth 3 feet. A. T. 610. This is a spring on the side of the well marked stream valley.

1950 N., 50 W. A. T. 619. This well is 10 to 20 feet, and is a dug well.

400 N., 50 W. A. T. 617. SO_4 trace. (1) 73 feet deep. There was six or seven inches of hard rock struck in this well, which was drilled with hand drill. It must be right in a channel. (2) Total depth 50 feet.

Section 23.

N. E. quarter of N. W. quarter. 1700 N., 1050 W. SO_4 strong, Cl strong. Sp. Wt. 1.009. Total depth, just to rock(?), 50 feet. A. T. 617. J. Newman, owner. This well was put down in July, 1896.

1750 N., at the barn there is a well 40 feet deep. The water contains SO_4 med., Cl med.

400 N., 1950 W. Total depth 18 feet. 11 feet of this was drilled. A. T. 617.

S. E. quarter of S. E. quarter, 50 N., 200 W. A. T. 617. The water is salt, Cl med., SO_4 med.

1400 N., 50 W. SO_4 strong, Cl low. Total depth 50 feet. A. T. 617. D. Schubach, owner.

Section 24.

400 N., 50 W. SO_4 trace. Total depth 12 feet. A. T. 623. This well contains fresh water. Schram, owner.

Section 25.

1950 N., 960 W. SO_4 strong, Cl strong. Total depth about 42 feet. A. T. 622. This well was dug for 10 feet and 42 feet drilled by hand. A strip of country ½ mile N. and S., and more than a mile east and west has yielded bad, i. e., salty and sulphated water.

1950 N., 1360 W. Total depth 40 feet. A. T. about 620. (1) Cf. This is salt (said to be the most so in this area). (2) Depth 14 feet, said to be fresh.

1580 N., 1950 W. A. T. 618. This water is salty. Total depth 49 feet.

800 N., 1950 W. SO_4 strong, Cl low. Total depth 42 feet.

Section 26.

840 N., 1950 W. SO_4 strong. Total depth 14 feet. A. T. 617. J. Barr, owner. There were large blocks of gypsum found in the drift.

400 N., 1850 W. Total depth 40 feet. A. T. 620. Old drilled well now closed up.

(2) This well was dug 18 to 20 feet and is now down to 25 feet and is to be drilled farther. In the drift a loose piece of pyritiferous rock with spirifers was encountered (some of the Soule limestone) hand drilled.

800 N., 50 W. SO_4 strong, Cl low. Total depth 51 feet. A. T. 620.

Section 27.

A. T. 621. Harry Barr. owner. Gypsum was found at 25 to 30 feet.

Section 28.

280 N., 1950 W. SO_4 strong. A. T. 622. This is a dug well.

950 N., 1860 W. SO_4 strong. A. T. 617.

750 N., 1200 W, SO_4 strong. Total depth 50 feet. A. T. 620. J. P. Smith owner. This well was dug for 10 feet, and drilled for 40 feet.

950 N., 120 W. SO_4 0. A. T. 620. This is a shallow well at house.

1100 N., 1050 W. A. T. 619. 8 feet deep at house.

1100 N., 1150 W. Total depth less than 40 feet. A. T. 619. This well is in quicksand and is both dug and drilled.

950 N., 1300 W. Total depth 8 feet. A. T. 620.

1050 N., 1200 W. SO_4 trace. A. T. 622. This is a dug well 18 feet deep.

1050 N., 1300 W. Total depth 37 feet. A. T. 620. This well passed through a boulder 3 feet thick with quicksand beneath.

Section 29.

50 N., 400 W. Total depth 17 to 18 feet. A. T. 620.

980 N., 50 W. Total depth 40 feet, 20 feet dug and 20 feet drilled. A. T. 612. This well had a great flow. The water was very hard and not good for cooking. SO_4 strong.

950 N., 1350 W. SO_4 low. Total depth 20 feet, not to rock, in blue clay. A. T. 607.

Section 30. (Old Bayport.)

Depth to rock 7 feet, total 2,000. A. T. 590.

See analysis on p. 136; about 550 feet below surface it is stopped off, and the head is +15 feet or 20 feet; at 600-700 the head is even greater, +25 to 30 feet, but the water is charged with salt.

Total depth 2000. This is the Old Bayport well and is over 2000 feet deep. It was cleaned by J. Coreyell. W. L. Webber. Dec. 3, '97, reports that in 1873-74 the well was put down for salt. It failed soon after and W. L. Webber bought the property. John Coreyell redrilled it and got him to recase. At 500-800 feet there was a flow so strong as to equal 32 feet head. At present the head is almost 10 feet. When stopped off at 750 feet according to one account, it was still salty, when stopped off at 500 to 550 though it was strongly mineral it was not salt. This is, therefore, probably near the line between Upper and Lower Marshall. J. Coreyell reports the record to be about the same as at Caseville, but with more limestone, as follows: (From memory.)

	Feet.
To top of rock	7
Limestone	3-4
Very hard limestone, then sandstone	12-15
Very large flow of water	250-260
Beginning of 135 feet of sandstone (Napoleon L.)	270-280

At 600 perhaps a streak of plaster (probably not, he is thinking of the Saginaw valley. L.).

At 900. Only 10 feet of salt rock which pinched out as compared with Caseville. (Conglomerate I of Point aux Barques lighthouse? L.)

At 1900. Stopped in shale with no sufficient flow of brine.

Section 31.

950 N., 1440 W. Total depth 15 feet. A. T. 622. This well is through solid clay. S. M. Fuller.

950 N., 1000 W. This is a similar well, John Severn.

260 N., 20 W. Total depth 61 feet. A. T. 630. There are 5 feet of sandstone at the bottom of this well, limestone at top, water 20 feet from top of ground. There are five other wells on this place. Cf. records of Sec. 5, T. 16 N., R. 10 E.

Section 32.

50 N., 900 W. A. T. 637. This well has good water.

20 N., 300 W. This well is about 10 feet deep. There is 4 feet of sand in the well, the rest is clay and the water is poor.

50 N., 1600 W. Depth 15 feet. A. T. 630. This well is through clay? and contains water all the year.

50 N., 1360 W. Total depth 10 feet. A. T. 630. This well runs dry.

1950 N., 400 W. Depth to rock 48 feet, total 62 feet. A. T. 626. Plenty of water, but SO_4 strong. This well is owned and drilled by Byron Lutson. The water is said to come up white and creamy.

1050 N., 1420 W. A. T. 626. This well is not drilled.

1050 N., 800 W. SO_4 trace. This well is not to rock at 40 feet depth. A. T. 625. It was dug 20 feet and had 12 feet of water in it.

1050 N., 800 W. SO_4 strong. Depth to rock 40 feet, total depth 50 feet. A. T. 625.

Section 33.

1050 N., 1440 W. SO_4 0. A. T. 622.

950 N., 1440 W. Total depth 7 feet. A. T. 622.

50 N., 1700 W. A. T. 645. This was a new well July 24, 1895. At 41 feet it stopped in quicksand.

Section 34.

50 N., 320 W. Total depth to rock 35 feet. A. T. 622. SO_4 med. Much white kettle scale. This well used to flow. The water comes in the rock. This well was hand drilled.

Section 35. (Berne).

2 miles north of Moeller of 2-16-10, i. e., N. W. of 35. A. T. 622.

"There is plenty of water and it rises to the top of the well. This well was dug 8 feet, and drilled 20 feet, into a cement rock like soapstone blue and soft, the blue soapstone was on top of the water-bearing rock."

1300 N., 1950 W. Total depth 10 feet. A. T. 620. This is not a drilled well.

50 N., 800 W. Total depth about 50 feet. A. T. 627.

50 N., 800 W. This well is about 35 feet deep. A. T. 627. There is plenty of water just above rock, at 28 to 30 feet in Berne village near south quarter post.

A. T. 627. Depth 29 feet and cased. H. Dominis, owner. Well at mill 75 to 80 feet deep.

1200 N., 50 W. SO_4 med., Cl trace. Total depth, just to rock, 39 feet. A. T. 627. This well is hand drilled.

860 N., 50 W. Depth to rock 30 feet, total depth 34 feet. A. T. 627. The water rises to about 7 feet below surface.

Section 36.

1380 N., 50 W. Total depth, just to rock, 43 feet. See Sec. 36-17-10. A. T. 632.

50 N., 900 W. Total depth, just to rock, 35 feet. A. T. 636. The water rises to within two feet of the ground.

50 N., 1000 W. A. T. 632. This is a similar well, at the house, which used to flow.

1800 N., 1950 W. Cl low. SO_4 0. Depth to rock 70 feet, total depth 78 feet. A. T. 622. (1) Is a shallow well at the house. (2) At 25 feet struck a rock but did not strike, rock "for good" until 70 feet.

Chandler Township (T. 17 N., R. 11 E. L.).

Gould's well is said by Hartman to have found gypsum from 70 to 72 feet, and left off in it. Cf. Sec. 16 Chandler.

Section 2.

0 N., 80 W. Total depth, just to rock, 25 feet. A. T. 627.

0 N., 1320 W. SO_4 none, Ca low, Cl low. A. T. 629. This well is 25 feet deep, probably.

Section 3.

3000 N., 1640 W. A. T. 627. SO_4 low, Ca low, Cl traces. D. Wm. Riddle, owner. Total depth 64 to 68 feet. Abundant supply of water.

1900 N., 600 W. SO_4 trace, Ca and Cl low. Fe present. D. Depth to rock 29 feet, total depth 275 feet. A. T. 627. J. Lonsberry. owner. Wm. Church, driller. This well was drilled in 1895 and water rises to about 10 feet of surface. This well passes through sandstone rocks, not very different all the way down.

1900 N. Depth to rock 20 feet, total depth 22½ feet. This well is in the same vicinity.

Section 4.

50 N., 1280 W. A. T. 632.

50 N., 1060 W. A. T. 640. SO_4 0, Cl trace.

50 N., 200 W. A T. 640. This is a shallow surface well on an 8 foot ridge.

1950 N. 1640 W. Depth to rock 40 feet, total depth 185 feet. A. T. 620. Sandstone was struck at about 80 feet. Cl 0, SO_4 low. The water rises to within 2 feet of the surface, at 130 feet it stood 6 feet above the surface.

1950 N., 820 W. Total depth 46 to 56 feet.

Section 5.

50 N., 1440 W. A. T. 627. This is a well that they dip water out of.

50 N., 260 W. (1) Cl low, SO_4 0. A. T. 627. Total depth 23 feet. (2) Cl med., SO_4 low. Depth to rock 23 feet, total depth 60 feet. This well was dug 23 feet and then hand drilled. (3) SO_4 low, Cl low. This well fell into the one above. It was down to sandstone and the water rose four feet from the surface.

1000 N., 50 W. Depth to rock about 20 feet, total depth about 90 feet. A. T. 620. This well is at the school house.

200 N., 1700 W. A. T. 620. Cl strong, SO_4 brackish, and so is a spring nearly on the section line. This well is about 25 feet deep. T. B. Woodworth, owner.

Section 6.

1950 N., 820 W. SO_4 0. Total depth 23 feet. A. T. 612.

1950 N., 220 W. This well is not drilled and is only 12 feet deep. A. T. 612.

400 N., 0 W. A. T. 615. This is a salt spring.

50 N., 600 W. Cl 0, SO_4 trace. A. T. 615. Total depth 18 feet. This is a persistent spring and has plenty of water.

50 N., 1840 W. A. T. 615.

Section 7.

1950 N., 1380 W. Total depth 303 feet. A. T. 617. Cl strong, SO_4 strong. This well has 250 feet of 1½ inch casing, which is leaky and lets the salt down on the sandstone, but the water is fresher after pumping. James McCoubrie, owner. Drilled by O. & W. Church.

At 303 feet there was grindstone, and white stuff at about 200 feet. Salt water was struck at top of rock, and there was also a smell of kerosene, at 280 feet there was 25 feet of white sandstone.

1950 N., 1000 W. A. T. 620. This is a dug well 8 feet deep and contains plenty of water.

1950 N., 1700 W. A. T. 617.

Section 8.

800 N., 1950 W. Cl low, SO_4 strong. Total depth 30 feet. A. T. 622. E. Gericke, owner.

1950 N., 1740 W. SO_4 low. This well is 18 feet deep. A. T. 627.

1950 N., 1200 W. Cl low, SO_4 strong. Total depth 25 feet. A. T. 622.

1950 N., 500 W. Total depth 24 feet. A. T. 627.

1900 N., 425 W. SO_4 strong, Cl low. This well has a strong flow and its temperature is 49½° F. Total depth 18 feet. A. T. 625.

740 N., 50 W. A. T. 640. This is a dug well.

Section 9.

1950 N., 1800 W. Cl low, SO_4 trace. A. T. 630.

1950 N., 1400 W. Total depth 24 feet. A. T. 635.

1500 N., 50 W. A. T. 642. This well is 32 feet deep and is dry sometimes because it has only surface soakage.

50 N., 122 W. Cl trace +, SO_4 mod. This is a surface well at the house. There is also a well at the barn.

Section 10.

N. E. Cor. of N. E. quarter of Sec. 10. Depth to rock 37 feet, total depth 40 feet, A, T. 657. John Quinn, owner; A. W. Rapson, driller. This well was dug to rock through hard blue clay. The rock is soapstone.

1900 N., 1400 W. (about). Depth to rock 37 feet, total depth 37 feet. A. T. 650, Ca low, Cl none, SO_4 low, Fe present in considerable amounts. D.

1500 N., 1950 W. Cl low, SO_4 strong. A. T. 644.

Section 11.

760 N., 100 W. Total depth 30 feet. A. T. 645. This well is in clay.

Section 14.

2000 N., 420 W. Depth to rock 40 feet, total depth 97 feet. A. T. 613. A. Malphus owner. There is sandstone or soapstone then water. SO_4 0, Ca and Cl low, Fe present. D. There is a dug well at the same place in clay, 18 feet deep. SO_4 none, Ca and Cl less than in deep well. No Fe. D.

50 N., 1400 W. Total depth 12 feet. A. T. 620. There is said to be a spring in the bottom of this well.

Section 16.

W ½. Depth to rock 12 feet, total depth 217 feet. A. T. 640. At 80 feet a dark water was cased off. It is possible that this well should be in T. 17 N., R. 12 E.

700 to 1200 N., 1900 W. SO_4 strong. Total depth 33 feet to rock. A. T. 640. This is like Maxwell's well on Sec. 17.

1950 N., 800 W. Cl low, SO_4 strong. Depth to rock 35 feet, total depth 74 feet. A. T. 615. (1) This well was drilled by Hartman and Hill of Bayport. (2) This is a dug well.

Section 17.

50 N., 920 W. SO_4 strong, Cl med. Total depth 26 feet. A. T. 636. Alex Maxwell Water burst in at the bottom of this well.

? N., 100 W. A. T. 640. Frank McArdle, owner. This is the same in quality as Maxwell's well.

Section 18.

50 N., 640 W. A. T. 627. This is a surface well.

1950 N., 1620 W. SO_4 strong, Cl strong. Depth to rock 28 feet, total depth 28 feet. A. T. 620.

Section 19.

1950 N., 640 W. A. T. 627. Total depth about 16 feet. This is a surface well.

50 N., S. ½ of S. E. ¼ of Sec. 19. Total depth 40 feet. A. T. 627. This well is hand drilled and the water is bad, i. e., strongly sulphated. Fisher, owner.

Section 20.

200 N., 50 W. SO_4 0. This well is dug and is 14 feet deep. A. T. 642.

1950 N., 920 W. SO_4 strong, Cl med., "like the well in Sec. 17." About 26 feet to rock, total depth about 26 feet. A. T. 636. J. Drummond, owner.

1990 N., 1920 W. Depth to rock about 20 feet, total depth about 20 feet. A. T. 626. Thos. Maxwell, owner. This well is similar to A. Maxwell's on Sec. 17.

Section 21.

1000 N., 1950 W. Total depth about 50 feet to rock. This is a dug well, but was once drilled. It has no water now.

1950 N., 780 W. Total depth 24 feet. A. T. 640. This is a dug well. There are no drilled wells nearby.

Section 23.

240 N., 1060 W. Total depth 214 or 217 feet. A. T. 640. Mrs. Harvey, owner. Mozier, driller.

Section 24.

1440 N., 1050 W. SO_4 trace, Cl low. Depth to rock 12 feet, total depth 100 feet. A. T. 632. At 12 feet a thin bedded, blue-brown, slightly bituminous fetid fossiliferous limestone or cement rock, as seen in creek, was struck; below this was soap-stone rock (arenaceous, blue, ripple-marked, micaceous shale) and about 14 feet of sandstone at the bottom, 86 to 100 feet, i. e., the Napoleon or Upper Marshall.

1300 N., 1050 W. Cl 0, SO_4 low. Depth to rock about 20 feet, total depth 225 to 250 feet. A. T. 640.

950 W. SO_4 med.+ Cl low. Depth to rock 20 feet, total depth 80 feet. A. T. 620. This is Mr. Cody's old well which was only 14 feet deep at first. It passed through a few feet of (limestone) cement rock, then soapstone, and goes only about 2 feet in sandstone.

340 N., 950 W. A. T. 642. (1) Total depth about 200 feet. This well has 20 to 22 feet of casing. It passed through, first, plaster rock, then mainly all white sandstone. This well was at first drilled to 133 feet and it flowed freely at this depth, but when I. Heaton's well "broke loose" two years ago, on Sec. 26, this well went dry. (2) A dug well nearby showed plaster (gypsum).

50 N., 1060 W. SO_4 med.+ Cl trace. Total depth 100 feet. A. T. 642. This well has 15 to 22 feet of casing.

50 N., 1070 W. Total depth 22 feet. A. T. 642. The water in this well is much harder.

Section 25.

E. half of S. W. quarter. Depth to rock 20 feet, total depth 25 feet. A. T. 662. S. Shaw, owner.

400 N., 1050 W. Total depth 26 feet. A. T. about 662. This well was dug and blasted through plaster.

400 N., 950 W. Total depth 177 feet. A. T. 662. This is good water. It will make a suds, but the water is hard.

700 N., 1050 W. Total depth 40 feet. A. T. 660.

750 N., 950 W. Depth to rock 20 feet, total depth 140 feet. A. T. 660. This well used to flow but now the water comes close to the top. When it flowed the water was softer. This is significant probably; the flow came from the Napoleon, the Upper Marshall sandstone, and dissolved more or less gypsum on the way.

1950 N., 560 W. A. T. 650. This is probably a drilled well, the water rose to the surface.

900 N., 1950 W. Cl low. Total depth, just to rock. ? 60 feet. A. T. 652. F. Goulds owner. The cost of this well was $60.00. Mosher and Erb, drillers.

1½ miles south of Soule. Gershom Wilson Smith, owner. This well is said to have passed through gypsum on top of cement.

Section 26.

1720 N., 940 W. I. Heaton, owner. The water broke out from this deep drilled well around the casing and made a spring in the river bank and stopped adjacent flowing well.

1950 N., 1400 W. Total depth 18 feet. A. T. 640. This is a dug well. It is also a spring in the side of the river valley.

1950 N., 1950 W. Total depth 30 feet. A. T. 642. This well was nearly dry in summer of 1895.

600 N., 1950 W. Total depth 153 feet, dug 20 feet. A. T. 652.

50 N., 920 W. A. T. 567. SO_4 strong, Cl med. Total depth 90 feet. 85 feet dug or cased. At first the water was salty, then cased off, but it is still strongly mineral.

Section 28.

640 N., 1950 W. Depth to rock 60 feet, total depth 157 feet. A. T. 647. The water is cathartic, strongly mineral and turns tea black, i. e., Fe strong, SO_4 strong, Cl med. +, present, Sp. Wt. 1.002. This well passes through blue and black rock and at 120 feet strikes mineral water.

Section 30.

Probably S. ? E. quarter of S. W. quarter. A. T. 632. Total depth 120 feet.

1040 N., 1950 W. A. T. 627. SO_4 strong, Cl strong. The water is poor. Sp. Wt. 1.010. Total depth 22 feet. Newberry, owner.

1950 N., 1500 W. (1) A. T. 627. Cl strong, SO_4 strong. Depth to rock 40 feet, total depth 223 feet. Here are three wells belonging to W. MePherson of Berne. Drilled by Agnew of Fairgrove. At 100 feet was strong salt brine in bluish soapstone, at 200 feet black sandrock, water not so salty. At 210-223 pure white sandrock. It is now packed down at 130 feet, but is still salt (probably not packed well or low enough), Sp. Gr. 1.032. (2) Total depth 10 feet. (3) A. T. 625. Depth to rock 28 + feet, total depth 140 feet. The water was salty and was stopped up. This well was cased 28 feet, but not to rock. The well was muddy and went to 140 feet. (4) The water in this well is brackish, Sp. Gr. 1.003, total depth 22 feet.

Section 31.

1280 N., 1950 W. SO_4 strong, Cl low. Depth to rock 45 feet, total depth 45 feet. A. T. 632. W. Eichler, owner. The water came out of "soapstone."

1380 N., 1950 W. Total depth just to rock 43 feet. A. T. 632.
1380 N., 1900 W. SO_4 strong, Cl trace. Total depth 150 feet. A. T. 632. H. Bean, owner.

1860 N., 1950 W. Depth to rock 51 feet, total depth 56 feet. A. T. 630. SO_4 strong, and at more than 60 feet depth there would be salt water. This well is through soaprock.

50 N., 240 W. SO_4 strong, Cl low. Sp. Wt 1.006. Depth to rock 54 feet, total depth 165 feet. A. T. 640.

Section 32.

50 N., 1780 W. SO_4 med., Cl low +. Depth to rock 63 feet, total depth 129 feet. A. T. 679. The other wells nearby are said to be deeper, i. e., about 10 feet in sandrock.

50 N., 1280 W. SO_4 med., Cl low. Total depth 140 to 145 feet.

50 N., 100 W. A. T. 645. This is a dug well, total depth about 30 feet.

Section 33.

100 N., 1950 W. A. T. 649.

50 N., 1480 W. A. T. 651. SO_4 0. (1) Total depth 7 feet. This was dug through gravel. (2) Total depth 14 feet. Gravelly.

50 N., 740 W. Total depth 12 feet. A. T. 650. This well is not to rock.

1950 N., 500 W. Total depth 33 feet. A. T. 650. This well is in sand and gravel.

1950 N., 1400 W. SO_4 trace, Cl low. Total depth 80 feet. A .T. 650. Down to 45 feet hard gravelly soil, 15 feet quicksand. 20 feet gravel. This well is piped to 80 feet.

50 N., 700 W., SO_4 0, Cl low. Total depth 15½ feet. This well is on a stony clay (till) rise.

Section 34.

Norton, owner. The water was very salt at first, then they drilled deeper.

1730 N., 90 W. Depth to rock 46 feet, total depth 250 feet. A. T. 642. This well passed mostly through slate, but went 18 feet

(232-250) in sandrock. Olmstead, owner. The water is good and flowed freely.

Section 35.

10 N., 50 W. Depth to rock 20 feet, total depth 190 feet. A. T. 652.

Section 36.

1950 N., 1000 W. Depth to rock 20 feet, total depth 40 feet. It is 20 feet to rock with gypsum in the blue clay at 15 feet and in layers and great chunks just above the rock.

	Feet.
Cement rock	4
Gypsum	8
Hard rock	4
Gypsum	4

This well stopped in slate. There is generally a sandstone at 80 feet. The water was very hard and gypseous.

Meade Township (T. 17 N., R. 12 E. D.).

Section 2.

0 N., 720 W. Depth to rock 40 feet, total depth 40 feet. A. T. 693. This well is down to sandstone and belongs to Arnold. The well at the old saw mill on main road struck rock at 12 feet.

Section 3.

2000 N., 820 W. Depth to rock 30 feet, total depth 30 feet. A. T. 658. This well is not quite to rock.

2000 N., 1900 W. Depth to rock 20 feet, total depth 28 feet. A. T. 647. H_2, SO_4 none, Ca medium, Cl trace.

Section 4.

2000 N., 1220 W. Total depth 22 feet. A. T. 631. This well is to gravel.

Section 5.

1000 N., 2000 W. SO_4 none, Ca and Cl low. Depth to rock 8 to 18 feet total depth 65 feet. A. T. 644. M. Dibb, owner.

SO_4 none, Ca and Cl trace. Depth to rock 6, total depth 20 feet. At the house of same owner, rock seems like a thick bedded compact sandstone. On the other side of the road rock at 6 feet, 14 or 15 feet drilling gives good water. The rock is very close to the surface three miles south of this place.

Section 6.

680 N., 0 W. SO_4 none, Ca and Cl traces. Depth to rock 4 feet, total depth 40 feet. A. T. 632. M. E. Parsonage, owner. Rock found in post holes in front of house at four feet from surface.

Section 7.

980 N., 0 W. Depth to rock 20 feet, total depth 23 feet. A. T. 651. The other wells in the neighborhood find about the same depth to rock.

Section 8.

920 N., 19-50 W. Depth to rock 20 feet. A. T. 649.

Section 12.

2000 N., 1280 W. Total depth 22 feet. A. T. 704. This is a dug well.

Section 14.

S. W. corner. Depth to rock about 40 feet, total depth 60 feet. A. T. 700. Mark Colts, owner.

Section 15. (Napoleon sandstone near the surface.)

1950 N., 1950 W. Depth to rock 5 feet, total depth 6 feet. A. T. 685. This is a dug-well and rock is only 2 feet below the surface near by.

1950 N., 1900 W. Depth to rock 4½ feet, total depth 21 feet. A. T. 665. The sandstone is thin bedded and greenish. Rock is also 4½ feet from the surface in the cellar of the house.

Section 17.

1040 N., 2000 W. Total depth 16½ feet. A. T. 642. They struck no rock in this well.

560 N., 2000 W. Total depth 20 feet. A. T. 642. There was no rock in this well.

2000 N., 140 W. Depth to rock 4 feet, total depth 12 feet. A. T. 667. This well passed through one foot of rock, then 12 feet of "clay." There was plenty of water in this well.

2000 N., 440 W. SO_4 none, Ca and Cl trace. Depth to rock 7 feet, total depth 10 feet. A. T. 650. The water in this well was abundant.

0 N., 1840 W. SO_4 trace, Ca low, Cl trace. Depth to rock 10 feet, total depth 24 feet. A. T. 658. 18 feet of this well was drilled by hand. This is a surface water.

In a prospecting hole in Sec. 19, 2000 N., 1300 W., rock is only 5 or 6 feet from surface, and is dark, compact, soft grained, with conchoidal fracture and weathers to a light color.

0 N., 1100 W. SO_4 none, Ca low, Cl slight trace, Fe present. Depth to rock 1½ feet, total depth 132 feet. A. T. 667. Henry Clark, owner. Mosher and Erb, drillers. This well passes through 5 feet of shell rock, 19½ feet of "cement" (argillaceous limestone), and then soapstone.

50 N., 1900 W. SO_4 none, Cl low. Depth to rock 12 feet, total depth 58 feet. A. T. 650. This well is cased 14 feet and 9 in. There was 20 feet of "cement rock" in this well and sandstone was struck at 52 feet.

Section 19.

There is an outcrop of "cement rock" Michigan series limestone, on Pinnebog river.

20 rods S. of corner. Depth to rock 13 feet, total depth 200 feet. A. T. 660. James Thompson, owner. Erb and Mosher, drillers. This well passed first, through sandstone, then cement rock 18 feet, then soapstone, then hardrock. The water was never pumped out of the pipe and it smells of decaying organic matter.

Section 20.

W. half of N. E. quarter. A. T. 670. W. H. Stephenson's well has grindstone within 3 feet of the surface.

Section 21.

S. E. quarter. Depth to rock 29 feet, total depth 34 feet. A. T. 703. Lackey, owner. This well was dug 25 feet and then drilled 4 feet to rock and then 4 or 5 feet in rock, when the drill dropped and water rose to within five feet of the surface.

0 N., 1140 W. A. T. 712. Depth 14 to 18 feet. E. Stephenson, owner.

2000 N., 1920 W. Total depth, just to rock, 16 feet. A. T. 680.

Section 22.

0 N., 1800 W. Depth to rock 28 feet, total depth 38 feet. A. T. 717.

1975 N., 25 W. SO_4 none. Cl none, Ca very low. Depth to rock 40 feet, total depth 47 feet. A. T. 720. This well is at Filion P. O., 50 feet south of the corner.

860 N., 25 W. A. T. 727. Total depth 40 feet.

Section 27.

0 N., 1160 W. Ca trace, Cl slight trace, SO_4 none. Depth to rock 24 feet, total depth 81 feet. A. T. 710. J. Church, owner. This well passed through sandstone and then shale.

2000 N., 460 W. SO_4 0, Ca traces, Cl low, tastes of Fe. Depth to rock 48 feet, total depth 56 feet. A. T. 717. L. A. Mosey, owner. The water comes to within 9 feet of the top of pipe which does not quite reach rock.

Section 29.

2000 N., 800 W. A. T. 692. SO_4 none, Ca trace, Fe present. Depth to rock 30 to 40 feet, total depth 171 feet. Philip Schad, owner; Erb and Soule, drillers.

Section 32.

2000 N., 640 W. Depth to rock 24 feet, total depth 87 feet. A. T. 692. Max Ritter, owner.

Section 33.

2000 N., 1220 W. Depth to rock 20 feet, total depth 58 feet. A. T. 699.

Lincoln Township (T. 17 N., R. 13 E.).

Section 5

0 N., 1400 W. Total depth 18 feet. This well is in clay. It is a dug well, there are no drilled wells in this vicinity.

Section 6.

Kinde. A. T. 702.

Mr. Hall, a banker at Bayport. has three wells, 11. 18 and 20 feet deep, respectively, all through blue clay into gravel and they each have plenty of water.

Section 18.

S. E. quarter of S. W. Quarter. Desire Filion has a drilled well.

1400 N., 1950 W. Total depth 20 feet. A. T. 717. This well was dug 3 feet and bored 7 feet, in clay and quicksand. Jas. Penna, owner.

1900 N., 1950 W. A. T. 717. T. Rapson was to bore this well.

Section 19.

1780 N., 2000 W. Depth to rock 37 feet, total depth about 38 feet. A. T. 722.

Section 20.

2000 N., 1580 W. SO_4 none, Ca trace, Cl slight trace. Depth to rock 50 feet, total depth 55 feet. A. T. 717. H. S. Tilt, owner. Water is abundant in this well.

Section 22.

A little W. of the north quarter post. Total depth 21½ feet. A. T. 712. This well was through black loam, very hard red clay, blue clay, sand. It was dug just to sand. After digging the well was left dry, but next morning it had 16 feet of water in it. The water could not run a boiler a week. It had to be blown off for it was red, soapy and foaming. The water rose to 1 foot below the surface.

Section 30.

100 N., 50 W. This is a shallow well, dug 9 feet. A. T. 746.

75 N., 1700 W. Total depth 12 feet. A. T. 745. "This well is like a spring."

Section 31.

112 N., 1950 W. Depth to rock 40 feet or more, total depth 60 feet or more. A. T. 746. The water rises to 7 feet below the surface.

Section 32.

220 N., 1950 W. Total depth 13 feet. This, the old well, had 20 inches of water. The new well was 66 feet deep, and the water rose to 17½ feet below the surface. It was a mineral water, but not as hard as the surface water.

Bloomfield Township (T. 17 N., R. 14 E.).

Section 5.

1680 N., 2000 W. Total depth 30 feet. A. T. 690.? This well is in blue clay.

Section 6.

2000 N., 1580 W. Total depths 11 and 16 feet, in clay. A. T. 697.

Section 14.

20 N., 100 W. Depth to rock 30 feet, total depth 65 feet. A. T. 715. W. R. Stafford, owner. The water in this well is salty.

Section 17.

1250 N., 750 W. (about). Total depth 22 feet. A. T. 709. There are two wells here in clay. Wells in the region to the north are shallow in the clay, but there is as yet plenty of water.

Section 18.

0 N., 1120 W. A. T. 694. Total depth 22 feet. This is a dug well, no rock.

Section 20.

S. W. quarter of Sec. 20. Depth to. rock 40 feet, total depth 150 feet. J. W. Kelly, owner. The water in this well is salty and comes to within 1½ feet of the surface. The well passes through 40 feet clay. 20 feet sandstone with water 20 feet soapstone, 70 feet unknown, blue, hard, "kind of slate," between soaprock and hard rock.

Section 22.

200 E., 400 S. of N. W. Depth to rock 40 feet, total depth 135 feet. W. Wright, owner. A. T. about 732. Water was salty at 80-90 feet. There is no water in this well now. The well passed through sandstone (shale?) and soapstone. Another report says 50-60 feet to rock, total depth 145 feet.

Rubicon Township (T. 17 N., R. 15 E.)

Section 4. Port Hope.

A. T. 610. There is a salty shallow well at the hotel. There were also deep wells for the manufacture of salt.

See Geol. Sur. of Mich., Vol. V, Pt. II, p. 76, an abstract of the record is as follows:

1-16 feet drift.
Coldwater shales:
16-22 feet green micaceous sandstone, outcrops along shore.
22-532 feet blue arenaceous shales with occasional seams of sand rock.
532-533 feet hard rock, pyrite or siderite.
533-687 feet dark-blue shale.
687-716 feet arenaceous shales.
Berea Grit:
716-787 or 800-865 feet coarse whitish sandstone impregnated with strong salt brine.

Section 15.

700 N., 800 W. Total depth 13 to 14 feet in blue clay. A. T. 622.

Section 27.

S. W. quarter of N. E. quarter. Depth to rock 70 feet, total depth 103 feet. A. T. about 610. John Schmucker, owner. SO_4 trace, Ca and Cl low. This well is through blue sandrock. There is not much water and it is apparently from the clay.

3¼ miles W. of this there is reported a salt well. The well was not stoned and was abandoned. There is also a surface well near that of John Schmucker about 12 feet deep.

Section 35.

20 paces E. of shore road, 1850 N., 950 W. Surface well 12 feet deep. A. T. 622. John Hopson, owner.

Section 36.

20 paces E. of shore road, 950 N., 1950 W. SO_4 trace, Ca low, Cl med. Depth to rock 20 feet, total depth 23 feet. A. T. about 612. This well went through one foot of thin sandstone and the drill dropped beneath it. Wm. F. Burley, owner.

Caseville Township (T. 18 N., R. 10 E.).

Section 25.

S. W. of N. E., or Sec. 26, lot 4, perhaps more likely. A. T. 607. It is reported that they went through 40 feet of plaster on Mintline's place.

Near center, Cl 0. A. T. 607. Mr. Corless, owner. This is a dug well.

Section 26.

1950 N., 700 W. A. T. 612. Lot 4. D. Mintline, owner. It is reported that they went through 40 feet of plaster.

Section 35.

(2030 feet) 840 paces N. (2740 feet) 1950 paces W. There are various reports as to the total depth, viz.: 2200, 2300, 2270. (1) The first well of the grist mill was deeper than the rest, and gave a 96% brine and some gas. In this well at 18 feet they .struck boulders with sandstone and had about 100 feet of it. The well was put down by Hiram Adams, and was one of F. Crawford's wells, Geol. Sur. of Mich., III, p. 94, 184, 201, V, p. 53. It was 2200-2300 feet down to third salt rock. They had to wash the pans when they used the brine from the various levels below 1800 to 2300 feet every 24 hours and later every 12 hours. Whereas before they only needed to wash every 48 hours to get rid of bittern. This shows the relative impurity of this lowest brine. From 1700 to 1800 was hard sandrock (the Berea Grit), another at 1900, then some clay and a streak of very hard rock with brine again at 2200 feet. This is probably from some horizon below the Genesee or Huron black shale. Compare from 2560 to 2740 in the deep Bay City well, in which the Berea Grit is at 2100 to 2260.

(2) 2300 feet N., 3880 feet W. A. T. 585. Curran Flach and Conley. Total depth 1800 feet. At 8 feet rock.

At 18 feet sandrock, first casing to 20 feet.

23 feet sandrock.

10 feet blue clay and hardpan.

10-12 feet "hard rocks like flint with boulders," probably cherty limestone.

About “100 feet slate or shale."

About 50 feet gray sandstone.

At (165 feet) about 190 to 200 feet, a seam of coal.?

At about 300 feet black clay as per sample.

At about 400 feet a fine powder, like copper filings, mixed with clay. Casing hard to pull.

750 feet salt rock.

The well is cased to 800 feet (not far enough), shutting off this brine. From 800 feet down was mostly dark grey slate. At 1800 second salt rock. When the casing was pulled the water flowed out at first and even now is only 4 feet from the top.

(3) 1780 N., 3700 W. About 590 feet. F. Crawford, owner. Cf. Rominger III, p. 94, 184, 201. Total depth 1735, 1760, or 1750.

1-900 feet. "Principally through blue shale, sometimes through red shales with no important seam of harder rock in the whole interval." (This is not so.)

At 900 feet. Large body whitish rock with strong brine; "near bottom another supply." C. E. Wright says from 850 to 950 was sandstone, and from 1650 to 1770 sandstone.

J. Coreyell reports 2 to 3 feet bed rock, limestone shell and slate.

At 115-120, first sandstone.

From 125 to 150 sandstone with streaks of shale.

At 900-950 first salt rock, 80°.

At 1750 feet second salt rock, i. e.

From 1680 to 1765 sandstone.

(4) About 1600 N., in Sec. 26. Total depth 1760. Pigeon River Furnace Company.

950 N., 1000 W. SO_4 strong. Depth to rock 40 feet, total depth 140 feet. A. T. 602. Well at Adams' store. There was a little limestone, then shale most of the way, then bottom in sandrock. The well at his house in Sec. 1-17-10 is about the same. Campau dug gypsum on his place, also something like gypsum was dredged from the river in blocks.

South part of Caseville. Total depth 48 feet. A. T. 607. C. Crawford, owner. There are "several kinds of rock" in the short distance of 48 feet, viz., "limerock, shale, sandrock, gypsum."

1800 N., 80 W. Total depth 14 feet. A. T. 612. This well is in quicksand.

Lake Township (T. 18 N., R. 11 E.).

S. E. quarter, 50 W. Total depth 12 feet. A. T. 610. This well is not to rock.

Section 18.

Lot 1, close to lake about 300 N., 100 W. Depth to rock 9 feet, total depth 100 feet or more. A. T. 690. G. M. Stewart, owner. D. Bullock, driller. 0 to 100 sandstone, then black slate, soapstone and red stuff, according to driller, or another report says all sandstone. Mr. Flach thinks that 4 or 5 inches of coal were struck, i. e., black slate, but Mr. Dufty says it was all sandstone and no coal.

Section 23.

50 N., 50 W. Total depth 10 to 12 feet. A. T. 624. (2) Depth to rock 15 feet; total depth 30 feet. This well was dug 15 feet and then drilled 15 feet, but they got no water.

S. W. quarter of S. E. quarter. Total depth to rock 4 or 4½ feet. A. T. 612. There is plenty of water in this well.

50 N., 1300 W. Total depth 9½ feet. A. T. 607. W. King, owner.

Section 24.

1780 N., 50 W. SO_4 trace, Ca low, Cl low. Depth to rock 20 feet, total depth 20 feet. A. T. 612. T. Welsh, owner.

Section 25.

1950 N., 1350 W. SO_4 low, Ca low, Cl low, signs of Fe. Total depth 18 feet in rock. A. T. 623.

Over 1000 N., 1950 W. Total depth 40 feet. A. T. 622.

Section 26.

0 N., 260 W. SO_4 none, Ca and Cl trace. Depth to rock 40 feet, total depth 68 feet. A. T. 638. Alex. Champine, owner. J. McLaren and C. Jones, Bay City, drillers.

1320 N., 2000 W. H_2 SO_4 trace, Cl trace, Ca low. Depth to rock 27 feet, total depth 37 feet. A. T. 635. This well is first through shell rock (shale), then a harder one.

1950 N., 1360 W. Total depth probably 14 feet. A. T. 610.

420 N. 0 W. Total depth 36 feet. A. T. 632. This well was drilled part way.

1750 N., 1000 W. A. T. 612, Cl trace, SO_4 med. Ed. Sovereign, owner; D. Bullock, driller.

RECORD.

	Thickness.	Total.
Surface	7 feet	7
Black slate, perfectly dry, with coal at 42 feet, and at 60 feet and 12 (?) feet of "sulphur" pyrite, in the middle	80	87
Sandrock light grey	67 ±	154
Iron ore (compare this with the paint rock so often spoken of. Cf. Mauch Chunk shales or Catskill shale, and the Lower Marshall sandstones	100	254

1162 W., 1450 N. Cl trace, SO_4 strong. Total depth 100 feet. A. T. 612. Mrs. McKay, owner.

1100 N., 1400 W. The water is very hard. Total depth 13 to 18 feet. A. T. 607. "River sand" occurs at the surface.

Section 32.

50 N., 660 W. Wm. Dufty, owner. A. T. 622. (1) Depth to rock 40 feet, total depth 202 feet. The water rose at first to 3 feet, now to 20 feet below surface. Cl trace, SO_4 trace. At 40 feet rock, at about 80 feet sandrock, coarse at first, then whiter and finer to the end. (2) Depth to rock 40 feet, total depth 75 feet. Cl low, SO_4 strong. This is in dark slate, never in sandstone there was a sinkhole near by thirty years ago, filled up with stumps and rubbish, but a second drop took place about 1883. like a well 6 feet across and 20 feet deep. A line of similar holes seem to extend E. S. E. It used to be a salt lick. These sinks are probably over a limestone, possibly gypsum.

Section 34.

80 N., 1820 W. Total depth 28 feet. A. T. 632. R. Gotts' three wells.

Section 35.

1925 N., 820 W. Depth to rock 23 feet, total depth 35 feet. A. T. 629. This well is 150 feet south of road.

2000 N., 1320 W. Depth to rock 26 feet, total depth 29 feet. A. T. 635. This well is opposite the last.

Section 36.

150 N., 1300 W. SO_4 none, Ca low, Cl low. Depth to rock 23 feet, total depth 53 feet. A. T. 637. There is also a dug well 27 feet deep.

Hume Township (T. 18 N., R. 12 E. D.).

1950 N., 500 W. Ca low, Cl low, SO_4 trace. Temperature 46° F. This is not a flowing well. This is probably one of Learned's drilled wells.

Section 10.

1605 N., 450 W. Brackish SO_4 med., Ca med., Cl strong, Fe present. This is an old salt well flowing slightly near Port Crescent. Williams, Eakins and Soule, owners. Hi Adams of Waukesha, Wis., driller.

About 1500 N., 1000 W. Total depth 1250 feet. This is a flowing well. The water is brackish, SO_4 strong, Cl strong, Ca strong, Fe present. Miss Haskell's well "from pipe N. E. of well;" 600 feet to mineral water now flowing; 1250 feet to bottom of salt well.

900 N., 10 W. Depth to rock 18 feet, total depth 20 feet. A. T. 612. Tom Clancy, owner. He has another well which is flowing. Total depth 23 or 29 feet. It was dug 18 feet, drilled 11 feet to a flow, through hard clay. There is 110 rock in this well, but I think it likely that the water is just above bed rock. Total depth 30 feet.

Carter, owner. This is a flowing well.

Section 11.

Most of the wells here are dug down to bed rock, and then holes drilled farther.

E. half of S. W. quarter. Depth to rock 12 feet, total depth 30 feet. A. T. 612. The water rises to about 8 feet from the top in dry times. John Clancy, owner. This well was dug 12 feet to rock and went 18 feet through grindstone.

950 N., 740 W. There are two surface wells here. Both went dry in 1895 and water had to be drawn from the lake.

1050 N., 840 W. Depth to rock about 22 feet, total depth 43 feet. A. T. 616. Sinclair, owner. 22 feet basin, 21 feet drilled, or another says 20 and 20.

1050 N., 1360 W. Depth to rock 12 feet, total depth 37 feet. A. T. 612. The water supply is constant but not large. This well has a twelve-foot basin to rock, probably shale.

Section 12.

1050 N., 1340 W. SO_4 0, Ca low, Cl trace. Depth to rock 5 feet, total depth 100 or 118 feet. A. T. 624. Ed Ahearn, owner.

950 N., 1260 W. SO_4 0, Ca low, Cl trace. Depth to rock 7 feet, total depth 80 feet. A. T. 628. Henry Conley, owner.

	Thickness.	Total.
Clay	7	7
Then 44 feet rock, no casing	44	51
Then 1 foot blue clay, *i. e.*, shale, but compare section at Hardwood Point	1	52
Rest gravel, etc (*i. e.*, conglomerate)	28	80

950 N., 1760 W. SO_4 0, Ca trace, Cl low. Depth to rock 6 feet, total depth 54 feet. A. T. 627. 14 feet basin. Rock is a soap rock, i. e., shale, hard at first but dissolves away. At 50 feet, sandrock with water, then a black sticky shale. All along this ridge it is but 6 feet to rock while down at the corner it is 18 feet to rock, which is a soapstone and bits of gypsum are reported in it.

1050 N., 1760 W. Depth to rock about 6 feet, total depth 54 feet. A. T. 627. This is similar to wells just south.

950 N., 1900 W. Ca traces, SO_4 low, Cl low. Depth to rock 18 feet. A. T. 617. The bits of rock about well site are blue micaceous flags or sandy shale.

1000 N., 1800 W. Depth to rock 6 feet, total depth 54 feet. A. T. 627. This well is through soapstone 50 feet to sandrock below which was a black soft rock.

1050 N., 50 W. Depth to rock 25 feet, total depth 398 feet. A. T. 639. Mr. Carpenter says that in going down they had to blast through 3 feet of grindstone, then underneath struck dirt and below this there was a crevice in the rock at 30 feet where they left off. Church Bros, report first a hard flint rock for a few feet, a sort of crust then a few feet of grindstone. At 200 feet about 15 feet of sandstone with no crust over it. Under this sandstone the shale was quite black for about 20 feet. The pumping water shows traces of oil. A coarse sandstone at 365 to 375 feet. Cl med.. Ca strong, SO_4 strong, Mg Cl_2 probable, white kettle scale, Sp. Wt. 1.006. The well was 340 feet deep Saturday night, June 7th, and 350 feet deep at noon, June 9th, apparently in a blue shale. Chas. Wright, owner. This well was deepened by Church Brothers. Reactions:

355. Citric acid gives no effervescence, H Cl trace; for SO_4 strong reaction.

365. Citric acid gives a trace, H Cl strong effervescence, for SO_4 only a trace of reaction.

375. In hot citric acid a strong, in cold citric acid moderate affervescence; trace of sulphate.

385. In citric acid traces of effervescence, in H Cl not strong, no sulphates.

389. In hot dil. H Cl traces of effervescence, sulphates present(?).

Section 13.

S. E. quarter of N. E. quarter. A. T. 648.

1360 N., 50 W. SO_4 med., Ca med., Cl med. Depth to rock 32 feet. Total depth 115. D. Ahearn, owner. This well was dug 32 feet in blue clay, probably 40 to 60 feet to rock which is soap rock. Another account says 118 feet in soaprock and sandstone.

30 N., 50 W. SO_4 med., Ca trace, Cl strong, Mg trace. Total depth 137 feet. A. T. 657. T. Walker, owner. The soil is a sandy loam.

50 N., 1210 W. Total depth not yet to bed rock 36 feet.

Section 14.

1500 N., 1050 W. A. T. 612. Depth to rock 7 feet, total depth 92 feet. Robert McAllister, owner. The water was June 26, 1896, 18 feet from top, but is generally about 15 feet from top, and is not enough for stock.

Depth to rock 50 feet, total depth 66 feet. A. T. 622. Ward's well.

Depth to rock 14 feet, total depth 55 feet. Wm. Starbeck, owner.

There are three or four feet of slate and at 14 feet brown rock, and 23 feet of solid rock.

A. T. 622. Total depth 25 to 36 feet. Ed. Gritzner, owner.

Depth to rock 7 feet, total depth 100 feet. Edward Haring, owner.

All the above wells are near by.

Section 15.

250 N., 1000 W. SO_4 trace, Ca low, Cl traces. Depth to rock 33 feet, total depth 47 feet. A. T. 612. This well was dug 23 feet and bored 10 feet, and the rest drilled. Wm. Kennedy, owner.

750 N., 950 W. Depth to rock 7 feet, total depth 83 feet. A. T. 608. This is on the farm next north and east of the last. Shell rock at 7 feet, four feet thick, and then 12 feet through to hard rocks.

About 1000 N., 1000 W. Cl and SO_4 traces, Ca low. Depth to rock 26 feet, total depth 56 feet. A. T. 609. This well was dug 26 feet and drilled 30 feet. Water is scarce on the east side of the road.

Section 19.

50 N., 900 W. Total depth not to rock 37 feet. A. T. 632. This well was dug.

Section 20.

S. W. quarter about 1500 W. Total depth, just to rock, 16 feet. A. T. 602.

740 N., 1000 W. Depth 15 to 20 feet to rock, total depth 42 feet. A. T. 607. Wm. Sawyer, owner. This well is dry in summer. In summer water is taken from spring hole 3 feet deep in shell marl, 100 yards back (W.) of the house in valley of Pinnebog river. SO_4 none, Ca low, Cl trace (in spring water).

1000 N., 1280 W. Total depth 18 feet. A. T. 608. This well is dug in clay.

50 N., 940 W. Depth, not to rock, 40½ feet. A. T. 620. This well is close to margin of valley.

Section 23.

1950 N., 400 W. Depth to rock 50 feet, total depth 66 feet. A. T. 640. SO_4 low, Ca low, Cl low, Mg trace. Ward owner. Rapson Bros., drillers.

1950 N., 1050 W. A. T. 635. SO_4 low, Ca low, Ca med., Mg tr. J. R. Learned, owner.

1620 N., 950 W. Total depth 14 feet. A. T. 632. SO_4 trace, Ca med., Cl low, white kettle scale. Water is 6 feet below the ground.

900 N., 1000 W. Total depth 30 feet. A. T. 646. SO_4 trace, Ca low, Cl med. L. Scharizer, owner. This well is dug in blue clay.

900 N., 1000 W. A. T. 616. SO_4 trace, Ca low, Cl med. Depth to rock 40 feet, total depth 53 feet. This well passed through 3½ feet of sandstone, then gravel rock, and at very last, clear hard rock.

900 N., 2000 W. SO_4 low, Ca low, Cl low. (1) J. Campbell, owner. This is a dug well. (2) SO_4 low, lower than No. 1, Ca low, about equal to No. 1, Ca low, more than in No. 1. This well is about 30 feet deep and probably just to rock.

Section 26.

0 N., 880 W. Total depth 14 feet. A. T. 662. There are other wells in the neighborhood of about the same depth. There is a layer of quicksand about 12 to 14 feet down, below clay.

Section 27.

1950 N., 340 W. Total depth 16 feet. A. T. 632. No. 1 at house.

1950 N., 300 W. SO_4 low, Ca low, Cl low. Depth to rock 8 feet total depth 22 feet. A. T. 632. This well was dug- 18 feet, then drilled 3 or 4 feet in stone. No. 2 is at the barn.

Section 28.

There are dug wells around here 15 to 30 feet deep which do not reach rock.

1900 N., 1240 W. SO_4 trace, Ca low. A. T. 622. This is a flowing well. T. 54° F. June 26, 1896. There are two springs in the place. Total depth 40 feet. This well was hand bored for 40 feet, the auger dropped a little when water was struck.

40 rods N. of the corner, i. e., 250 N., 1980 W. Total depth 50 feet. A. T. 627. This well was dug to sandstone and deepened in 1895. The water was abundant, and the sandstone was of a dark-blue color like grindstone. This answers to the Port Crescent samples.

1000 N., 2000 W. Depth to rock 50 feet, total depth 90 feet. A. T. 639. This well is at the school house. There are other deep wells in the vicinity of the school house

740 N., 50 W. A. T. 639. H_2, SO_4 none. Ca and Cl low. This well is about the same depth as at school house (about 90 feet to rock).

Section 31.

1950 N., 1200 W. H_2, SO_4 trace, Ca low, Cl low. Depth to rock 30 feet, total depth 96 feet. A. T. 639. James Whelihan, owner. The rock is probably a sandstone 1950 N., 1840 W. Depth to rock 30 to 40 feet, A. T. 627. Wm. Wheliham, owner.

Section 32. [Pinnebog.]

0 N., 720 W. Total depth about 46 feet. A. T. 627. It is not known whether this well is in rock or not.

0 N., 1280 W. Total depth 32 feet. A. T. 617. This well is not to rock.

0 N., 2000 W. A. T. 614. Smells and tastes of H_2 S, SO_4 trace, Ca low, Cl traces, total depth 110 feet. James Casey, owner. McLaren, Unionville, driller. The well is said to have flowed at the top of the ground with a strong stream when first dug, H_2 S odor and taste not present until 1896

Depth to rock 50 feet, total depth 87 feet. Dr. Sellers, owner. A. T. 617 SO_4 trace Ca low, Cl trace, Fe present, slight H_2 S taste. The rock at top is slate (shale), the rest is sandstone. The water rises to within 6 feet of surface. At one-fourth mile to south rock is 6 feet from surface. O. Erb of Soule, driller.

Section 35.

50 N., 1000 W. Total depth about 52 to 53 feet. A. T. 679. The water is not clear, milky, SO_4 absent, Ca low, Cl trace. Jerome Farwell, owner. This well is said to have struck rock at 9 feet. The water is not clear and is not used. The more it is pumped the more fine sand seems to come up so that the water is almost milky. The sand which settles first is very fine and micaceous. The drillers (McLean and Reed of Bay City) said bottom of pipe was 6 feet in rock, which is doubtful Something is wrong with the casing.

There is a well 14 feet in clay 8 feet south of last. SO_4 absent, Ca low. Cl trace.

250 N., 1050 W. Total depth 30 feet. H_2, SO_4 absent, Ca low, Cl trace. The water is milky. The well is "40 rods north of road on W. side." It is said by the drillers to be in rock.

1500 N., 2000 W. SO_4 trace, Ca low, Cl trace. Depth to rock 35 feet, total depth 120 feet. A. T. 661. The water contains much sand of fine grey color. A neighbor said rock was 35 feet from the surface. Thomas Lockman's well.

Section 36.

50 N., 780 W. A. T. 674. The water is abundant. Total depth 14½ feet. The well is dug in clay. Also several others in the same neighborhood with about the same depth and with abundant water.

Dwight Township (T. 18 N., R. 13 E. D.).

Section 1.

1560 N., 0 W. SO_4 traces, Ca and Cl low. Total depth 22 feet. A. T. 637. This well is at the barn and has 14 feet of water.

S. half of S. E. quarter. A. T. 646. (1) Depth to rock 4 feet, total depth 30 feet. This well went dry in the summer of 1895. W. Noble, owner. It was drilled 16 feet in a blue lime rock; in 6 hours it was 26 feet deep. (2) This is a well at the house, it used to flow, but does not flow now. It is 15 feet deep.

50 N., 1160 W. Depth to rock 22 feet, total depth 34 feet. A. T. 652. J. Walsh, owner. Half way back on this farm it is but 5 feet to rock; 11 to 13 feet of grindstone, rock.

Section 2.

S. end of E half of N. W. quarter. Total depth 16 feet. Coal is said to occur in this well.

50 N. 1820 W. A. T. about 745. This well is probably 13 to 14 feet deep. Jas. Higgins says that "coal" in a blue-black shale and blue clay occur.

50 N., 1260 W. Water in this well is plenty, SO_4 trace, Ca low, Cl low. L. Total depth 14 to 15 feet. Another well is 18 feet deep.

50 N., 1200 W. Total depth, not to rock, 20 feet at barn.

1840 N., 0 W. Ca trace, Cl trace. SO_4 none. Total depth 90 feet. A. T. 636. This is said to have struck coal "probably through sandstone to a black rock." M. Gary of Badaxe driller. There was sandstone near the surface, then blue clay 16 or 20 feet, after that blue rock. There is 65 feet of water in the well, and the supply is good.

1420 N., 0 W. Depth 16 feet. A. T. 635. There is no rock, the well is in sand. (2) SO_4 none, Ca trace, Cl none Depth to rock 4 feet. Total depth 10 feet. This well is at the barn in the same locality on property of H. O. Smith, Saginaw.

Section 3.

1900 N., 1420 W. Total depth, not to rock. 7 feet.

50 N., 1740 W. Total depth 10 feet, to rock.

50 N., 1320 W. Total depth not more than 10 feet.

50 N., 800 W. Total depth not more than 77 feet. This well is probably to sandstone. The S. W ¼ of this section is full of boulders and hard heads. From the south quarter post a ridge strikes N. E. on which the sandstone is near or at the surface. It is 4 to 6 feet to rock as shown by the ditches.

1950 N., 700 W. SO_4 trace, Ca low, Cl med. Mr. Sommerville, owner.

Section 5.

50 N., 1100 W. SO_4 and Ca trace, Fe trace, Cl low. Water rose to within 6 feet of the surface. Depth to rock 40 feet, total depth 121 feet. A. T. 628. This well passed through sandstone, then soapstone, then sandstone again. Good water was struck at 45 feet.

Section 6.

E. half of S. E. quarter. Total depth 30 feet, perhaps nearly to bed rock. A. T. 629. This well is through hard blue clay. When the water broke in it came to within 4 feet of the top of the well. C. Culhane, owner. SO_4 low, Ca low, Cl med. Total depth about 60 feet. P. Smeder, driller.

750 N., 1500 W. SO_4 trace, Ca low, Cl trace. Total depth 66 feet. Wm. Davis, driller. This well is now owned by Bleicher.

400 N., 1700 W. SO_4 low, Ca med., Cl low. Depth to rock 9 feet, total depth 10 feet. This well is 8 or 10 inches in rock, a greenish micaceous sandstone.

Section 8.

100 N., 1500 W. SO_4 trace, Ca low, Cl med., Fe trace. Depth to rock 40 feet, total depth 88 feet (other accounts say 100 to 103 feet). A. T. 639. This well passed through soaprock at first, then grindstone and sandstone. Homer Filion, owner; A. Rapson, driller. This is a flowing well. The water rose 2 feet above the surface, which is 10 or 15 feet above the stream valley, but below country level. It has now about one foot head.

1950 N., 1440 W. Depth to rock 42 feet, total depth 66 feet. A. T. 650. SO_4 none, Ca tr., Fe tr., Cl low; rises now to 10 feet below ground. W. McGargle, owner; N. Mosher, driller. There was lots of water at 28 feet before they came to rock.

1950 N., 1200 W. SO_4 trace, Ca low, Fe none, Cl less low than at McGargle's well. Total depth 27 feet. A. T. 652. This well is in a very blue clay, under which is water. There is also a dug well 20 feet, perhaps, to rock.

1660 N., 100 W. Total depth 18 feet. A. T. 630.

50 N., 400 W. Total depth 19 feet. A. T. 660.

Section 9.

50 N., 260 W. Total depth 16 feet. A. T. 662.

50 N., 660 W. and 860 W. A. T. 662.

50 N., 146 W. A. T. 662. The water stands at 4 feet below the surface. Total depth of well 14 feet.

Section 11.

1950 N., 1100 W. Total depth 19 feet. A. T. 645.

1950 N., 820 W. A. T. 650.

1950 N., 780 W. A. T. 650. SO_4 low, Ca med., Cl low.

1950 N., 380 W. A. T. 652. There are three wells on this place 18, 22 and 27 feet deep respectively.

50 N., 200 W. A. T. 672. There are outcrops of sandstone at barn and in the woods.

Section 12.

1950 N., 1360 W. Total depth to rock 18 feet. A. T. 652 feet.

1200 N., 1200 W. Total depth 5, 6 or 7 feet to rock.

50 N., 900 W. A. T. 662. SO_4 none, Ca trace—, Cl low. This well is in blue boulder clay, and not to rock.

50 N., 1420 W. Total depth 8 feet. A. T. 665. The water does not come in fast. This well is through very blue stuff. N. of the house in the hollow it is 22 feet to bed rock.

50 N., 1900 W. Total depth 14 feet. A. T. 672. This well is at the barn.

1700 N., 1900 W. Depth to rock 9 feet, total depth 23 feet. A. T. 646. The water is brackish when pumped. The first well is 30 rods west of road, and passes through some conglomerate; the lower part is very hard. Surface water good. SO_4, Cl and Ca all medium when dipped from top. All strong when pumped. (2) Depth to rock 20 feet total depth 30 feet. SO_4 and Ca are medium, Cl low. There is not much water in this well in the dry part of summer. It is 5 feet higher than No. 1, and 15 rods east of No. 1. (3) Depth to rock 20 feet, total depth 36 feet. This is at the house. It was drilled 16 feet in rock and it is thought "soapstone" was struck. No water. (4) Across the road is a well 30 to 35 feet deep. (5) Depth to rock 10 feet, total depth 23 feet. The water is brackish. This is in the same vicinity, dug a number of years ago.

Section 13.

1950 N., 1180 W. SO_4 none, Ca trace, Cl low. Depth to rock 7 feet. A. T. 662.

1900 N., 1180 W. Depth to rock 6 feet.

1900 N., 1700 W. Depth to rock 3 feet, total depth 6 feet. A. T. 662. This well passes through not more than 3 feet of shelly grindstone.

1625 N., 1700 W. Total depth 5 feet. A. T. 680. S. E. of the school house is sandstone at the surface.

520 N., 640 W. SO_4 none, Ca trace, Cl trace. Total depth 101½ feet. A. T. 697. Geo Robinson, owner. There are outcrops of a massive sandstone like that of Port Austin close to the top of the well. At 20 feet there was "vein" of water, and at about 75 feet more water.

100 N., 200 W. Total depth 12 feet. A. T. 692.

Section 14.

1950 N., 200 W. Depth to rock 5 feet. A. T. 680. The water is not plenty in this well, which is at the barn.

1500 N., 200 W. Total depth to rock 9 feet. A. T. 680. This well is at the house near the road. 40 rods south it is only 2 feet to rock, so that they could not drive post holes.

1950 N., 740 W. Total depth, perhaps to rock, 28 feet. A. T. 680.

50 N., 520 W. Total depth, not to rock. 14 feet. A. T. 687. Spalding, owner.

400 N., 50 W. Total depth 20 feet. A. T. 690.

Section 15.

600 N., 100 W. Depth to rock 18 to 20 feet, A. T. 687. At 18 to 20 feet there is a coarse sandrock and the water rises to 4 feet from ground. At 35 feet there was a very hard, very white rock; at 36 feet a sand stream in a seam of the rock.

600 N., 150 W. Depth, to rock 22 feet, total depth 25 to 40 feet. A. T. 687. This well was dug 22 feet and drilled 3 feet, and is without much water.

600 N., 50 W. Depth 5½ or 11 feet to water. A. T. 687.

1950 N., 640 W. A. T. 662. This well is through blue sandy clay.

50 N., 1440 W. Total depth about 12 feet. A. T. 698.

Section 16.

1950 N., 780 W. Depth to rock 12 feet, total depth 14 feet. A. T. 662. This well passes through 2 feet of sandrock.

Section 17.

1975 N., 400 W. SO_4 trace, Ca med., Cl med., no iron. Total depth 17 feet. A. T. 658. There was 1-2 feet of water in a well twenty feet deep, not to rock, near by.

1950 N., 1260 W. Total depth 16 feet. A. T. 654. There is 3 to 4 feet of water in this well.

950 N., 1260 W. Depth to rock 6 to 8 feet.

1140 N., 1950 W. A. T. 650. (1) Depth, just to rock, 32 feet. Whitechurch, driller. (2) Total depth 28 feet.

50 N., 220 W. Total depth 29 feet. A. T. 657.

Section 18.

50 N., 960 W. Total depth 25 feet. (1040 if R. R. is center line.) A. T. 650.

Section 20.

980 N., 220 W. Depth to rock 54 feet, total depth 181 feet. A. T. 652. At about 85 feet the main stream of water came. J. Bleicher, owner. Rapson drilled deeper after Kelly had drilled it to 55 feet with no water. They wanted a flow and therefore had to go deeper than otherwise for water. The rock passed through is bluish. SO_4 trace, Ca low, Cl med. No Fe.

1240 N., 1950 W. A. T. 652. SO_4 trace, Ca low, Cl low. Depth to rock 24 feet, total depth 48 feet. M. Fremont, owner. This well is at the house. Another well at the barn goes 30 feet without striking rock.

Section 21.

1980 N., 1780 W. SO_4 trace Ca trace, Cl low. This water is unsuitable for washing. Depth to rock 30 or 40 feet. Total depth about 60 feet. A. T. 660. Wooster,

50, N., 840 W. Depth to rock 18 feet, total depth 21 feet. A. T. 672.

Section 22.

1950 N., 1440 W. Depth, not to rock, 16 feet. A. T. 697.

Section 23.

1950 N., 1360 W. Total depth 9 feet. A. T. 688. This well is on the edge of a five-foot gully.

1950 N., 50 W. Total depth 14 feet. A. T. 690. This water is hard.

50 N., 50 W. Depth to rock 10 feet, total depth 10 feet. A. T. 689. This well is to sand rock, and could get no further. There are numerous large blocks of fossiliferous sandstone around here, especially on Sec. 26, which seem to be the outcrops or almost so. In post-holing, and also back on the north end of the lot the rock is shown to be surely in place.

Section 24.

1950 N., 810 W. SO_4 none, Ca trace, Cl trace. Depth to rock 7 feet total depth 9½ feet. A. T. 690. This well is in soft rock, like sand.

300 N., 100 W. A. T. 677. SO_4 0. Ca trace, Cl trace. Total depth 90 feet. Mr. W. J. Wilson, owner. Tom Rapson, driller. The soil was sandy. At first this well was only 50 feet deep, but the water was not good, and the well was then put down to 90 or 96 feet.

260 N., 50 W. A. T. 672. Total depth 16 feet. This well is through boulder clay.

Section 26.

250 N., 1560 W. SO_4 trace, Ca and Cl low. Total depth 24 feet. A. T. 699. Wm. Robinson, owner. This well is in quicksand 40 rods north of road.

A. T. 689. The sandstone is near the surface at the northeast corner of this section.

Section 27.

0 N., 1640 W. SO_4 tr., Ca low, Cl low. Total depth 38 feet. A. T. 692. This well was dug 16 feet and bored with a two-inch auger to 38 feet. It is not in rock.

Section 28.

1950 N., 50 W. A. T. 646. (1) Total depth 40 to 46 feet. SO_4 trace, Ca low, Cl low. (2) Total depth 24 feet.

1950 N., 1500 W. Depth to rock 12 feet, total depth 15 feet. A. T. 667. This well is through sandy gravel soil; a 15 feet gully occurs just south.

1900 N., 1950 W. Total depth 18 feet. A. T. 662.

Section 30.

820 N., 2000 W. SO_4 low, Ca trace, Cl trace. Total depth 20 feet. A. T. 679. Joseph Thompson, owner. This well is in clay.

1480 N., 2000 W. Total depth 14 feet in clay. A. T. 682.

1040 N., 2000 W. Total depth 12 feet.

Section 31.

1950 N., 780 W. This water is not very hard. Total depth 14 feet. A. T. 682. Frederick Engels, owner. This well is in clay.

Section 32.

2000 N., 1600 W. Total depth 22 feet. A. T. 720. There are four wells here in clay to "gravel."

Section 33.

2000 N., 1860 W. SO_4 trace, Ca and Cl low. Total depth 18 feet. A. T. 698. Jacob Knaski, owner. This is the old saw mill well. There was quicksand at 18 feet, and the well is very full.

Section 34.

2000 N., 1340 W. SO_4 traces, Ca low, Cl low. Total depth 38 feet. A. T. 685. This well is dug 16 feet, and was bored with a two-inch auger to 38 feet. There was no rock.

0 N., 360 W. Total depth 30 feet. A. T. 710. This well is through gravel and clay to bottom of clay where the water broke through.

Section 35.

220 N., 0 W. Total depth 16 feet. A. T. 706. This well is in clay.

640 N., 2000 W. Total depth 22½ feet. A. T. 708. This well is through coarse gravel to clay.

Total depth 22 feet. This well is of the same character as the last and is in the same locality.

Section 36.

2000 N., 1960 W. A. T. 1663. There are two shallow wells here, one 8 feet and the other 12 feet deep in clay. There are no drilled wells in this neighborhood.

Huron Township (T. 18 N., R. 14 E. D. and L.).

According to T. Rapson there is a strip of country about 2 miles wide from Grindstone City to Sand Beach where the water is salty, the section being about as follows:

4 to 5 feet surface, then blue clay.

40 feet rock, a soapstone with a few feet (8-10) of sandstone.

At 100 feet we get salt water.

The wells around here should be 65 to 75 feet deep, if much deeper the water is too salt. In other words, soon after striking the Coldwater shales we get salt water.

Back of Huron City the depth to rock is 25 to 30 feet, total depth 70 feet. The surface wells are 12 to 14 feet deep. The deeper drilled wells are 60 to 70 feet deep. At 65 to 75 feet a sandstone is met, with blue clay above it and soaprock like the bottom of Willow Creek (i. e., shales) below.

Section 2.

150 N., 1400 W. SO_4 tr., Ca low —, Cl low. Depth to rock 3 feet, total depth 10 feet. A. T. 669. Wm. Bruce, owner. It is 3 feet to "shell" rock.

450 N., 320 W. SO_4 trace, Ca low, Cl low. The water is pretty hard. The depth to rock 12 feet, total depth 12 feet. A. T. 659. A. Morrison, owner. This well is at his house. He has a well at the barn 16 feet deep, just to rock, and in 1895 he was short of water,

500 N., 500 W. Total depth, just to rock, 4 feet. A. T. 650. This well is 30 rods back of barn.

Section 4.

1660 N., 640 W. SO_4 low, Ca low, Cl strong, Mg trace. Depth to rock 12 to 13 feet, total depth 18 feet. A. T. 611.

1660 N., 500 W. Total depth 14 feet. A. T. 611.

1600 N., 425 W. SO_4 low, Ca med., Cl med. + Total depth 40 feet. A. T. 636. This well was at Hubbard's barn, now owned by W. L. Phelps.

Section 5.

0 N., 760 W. SO_4 low, Ca low. Depth to rock 25 feet. A. T. 630. In this well there was shell rock 1 foot 10 inches thick and then grindstone. There was a seam containing water between the two.

900 N., 950 W. Total depth 23 feet. A. T. 632. This well was dug- by Forbes.

760 N., 1050 W. A. T. 632. (1) Total depth, not to rock, 24 feet. Geo. Wressel, owner, at house. (2) Depth to rock 37 to 39 feet, total depth 63 feet. This well is in sandstone at the barn.

440 N., 1050 W. (1) Depth to rock 11 feet, total depth 15 feet 4 inches. A. T. 637. This well is in rock, a sandstone with a good grit. (2) Depth to rock 5½ feet, total depth 8 feet. A. T. 633. This well is back in the orchard and is lower by four feet.

220 N., 950 W. Depth to rock 5 feet, total depth 8 feet. This well is five feet to rock and goes through 3 feet of grindstone.

Section 6.

1560 N., 2000 W. A. T. 632. SO_4 trace, Ca low, Cl low. There are two wells here, one at the house, and one at the barn. They are 22 feet to rock, total depth 22 feet, and contain 14 feet of water.

260 N., 1000 W. Total depth 35½ feet. A. T. 637. This well was dug 23½ feet and drilled 12 feet. They did not find water. (2) Total depth 11 feet. A. T. 639. (3) Total depth, just to rock, 37 feet. A. T. 639. This well was dug 22 feet and drilled 15 feet, and was probably through grindstone. There was no water at rock.

50 N., 1640 W. A. T. 640. Total depth to rock(?) 22 feet.

Section 7.

1950 N., 400 W. Total depth 28 feet. A. T. 632. Thos. Colander, owner. This well is at the house, and is only to chunks of sandstone.

1900 N., 400 W. Total depth 21 feet. This well is at the barn. There is sandstone in stream 16 feet lower, not far off and blue slate is said to lie over it.

Depth to rock 25 feet or more, total depth 35 feet. A. T. 650. SO_4 tr., Ca low, Cl low, Fe 0. There is plenty of water in this well. McBrine, owner.

1300 N., 1500 W. Depth to rock 40 feet, total depth 60 feet. A. T. 642. From 10 to 40 feet there is blue clay. Chas. Schubel, owner.

About 2000 N., 2000 W. It is 26 feet to rock.

Section 8.

1920 N., 1000 W. Total depth, probably not to rock, 18 feet. A. T. 640.

1920 N., 1000 W. Total depth 13½ feet. A. T. 640.

1120 N., 900 W. Total depth 16 feet. A. T. 657. This well was dry in summer of 1895.

50 N., 1140 W. Total depth probably 14 feet. A. T. 650.

50 N., 1660 W. Total depth 22 to 25 feet. A. T. 657. This well used to be only 18 feet deep, and now goes probably to rock.

50 N., 740 W. SO_4 low, Ca low, Cl trace. Total depth 25 feet. A. T. 640. This well passes through blue grindstone with 1 foot 10 inches of shale at the bottom, with a seam of water between them.

Section 9.

0 N., 1160 W. Depth to rock 4 feet, total depth 5 feet. A. T. 621. This well is in stream valley.

0 N., 1780 W. Total depth, just to rock, 18 feet. A. T. 643.

Section 10.

900 N., 50 W. Ca tr., SO_4 0, Cl 0. Depth to rock 10 feet, total depth 15 feet. A. T. 663. This well was incomplete, and passed through soft slabby sandstone that could be handled with pick and shovel.

1240 N., 50 W. Total depth 9 or 10 feet, not to rock. A. T. 642.

1640 N., 50 W. Total depth 8 feet. A. T. 642.

Section 11.

1700 N., 1100 W. The water is harder than in the well north. (1) Total depth 16 feet at the house. SO_4?, Ca med., Cl low. (2) Depth to rock 4 feet, total depth 87 feet at the barn.

4 feet surface before rock.

12 feet dug in sandstone (Lower Marshall sandstone?).

87 feet drilled, but not enough water came to drill with (Coldwater shale).

There was no gravel in this well.

1700 N., 950 W. Depth to rock 4 to 6 feet, total depth 22 feet. SO_4 none, Ca tr., Cl tr., soft water. This well is right on front of the terrace close to a steep descent.

465 N., 50 W. This well is in rock, total depth 6 feet.

300 N., 1950 W. Depth to rock 8 feet, total depth 18 feet.

Section 12.

460 N., 1950 W. Total depth 13 feet. A. T. 632. This is a drilled well for 12 feet. The water comes slowly (probably in the shale).

Section 13.

750 N., 1950 W. Depth to rock 15 to 16 feet. A. T. 652. The last ten feet of this well was dynamited through fine grained sandstone (grindstone with streaks of blue shale), not very fossiliferous.

50 N., 700 W. Depth to rock 6 feet, total depth 18 feet. A. T. 652. A. Brinning, owner.

1900 N., 1200 W. A. T. 627. (1) This well is said to be in rock only 8 feet, total depth 32 feet, but the bluff nearby shows arenaceous shale close to the surface. (2) Total depth 22 feet. (3) Total depth 14 feet. The wells around here are never dry, but do not yield much water.

Section 14.

50 N., 200 W. Depth to rock 10½ feet, total depth 12 feet. A. T. 645.

100 N., 360 W. Total depth 4 feet. A. T. 645. This is merely a hole, and has poor water.

Section 15.

1900 N., 1600 W. SO_4 0, Ca tr., Cl low. Depth to rock 4 feet, total depth 16 feet. A. T. 676.

1900 N., 1120 W. Depth to rock 8 feet, total depth 15 feet. A. T. 683. This well has plenty of water. This well is in grindstone rock. Rock has been found in post holes between the two wells just mentioned.

Section 16.

2000 N., about 475 W. Depth to rock 16 feet.

180 N., 1050 W. Depth to rock 3.5 feet, total depth 15½ feet. A. T. 645. This well passes through 5 feet of rock and 7 feet of clay, then grindstone and water.

Depth to rock 7 feet. This is north of the last mentioned well and found water.

1500 N., 600 W. Depth to rock 2½ feet, total depth 12½ feet. A. T. 640. This well passed through 10 feet of sandstone, then grindstone, and is at the school house.

1900 N., 440 W. Depth to rock 16 feet. A. T. 649.

Section 18.

1900 N., 1100 W. Depth to rock 25 to 26 feet, total depth 30 to 36 feet. This well is in rock. Water around here is generally found at 8 to 10 feet in gravel.

980 N., 1000 W. SO_4 strong, Cl strong, Ca med. Depth to rock 52 feet, total depth 87 feet. A. T. 666. Evan Wade, owner. This well has been also reported to be 40 feet to rock and 60 to 80 feet deep. It goes through 15 feet of grindstone, then through soap rock or clay into sandstone again. In the bottom of the creek there is blue clay.

1600 N., 950 W. Depth to rock 52 or 53 feet, total depth 52 or 53 feet. A. T. 627. M. McDonald owner. This well was dug 20 feet, and bored 32 feet.

SO_4 low, Ca med., Cl med. Total depth 7 feet. A. T. 627. This is a dug well at the barn.

1280 N., 1950 W. Total depth, not to rock, 19½ feet. This well is in clay.

Section 19.

1950 N., 1140 W. Depth to rock 22 to 23 feet. A. T. 653. This well is in clay to quicksand.

Section 21.

300 N., 950 W. Total depth 13 feet. A. T. 670. This well is in clay.

2000 N., 950 W. Depth to rock 10 feet, total depth 11½ feet. A. T. 642. There is 2 feet of grindstone in this well, then 1 foot of blue clay.

Depth to rock 11 feet, total depth 14 feet. A. T. about 642.

2000 N., 1900 W. Depth to rock 10 feet, total depth 14 feet. A. T. 652. This well is in sandstone. The rock is said to be 9 to 11 feet from the surface and makes a layer of sandstone 2 feet thick, then comes 10 feet of blue clay, then sandrock again. The clay probably represents shale.

Section 24.

1800 N., 1800 W. Depth to rock 10 feet, total depth 12 feet. A. T. 650. Tischendorf, owner.

1900 N., 1160 W. Depth to rock 6 feet, total depth 22 feet. A. T. 650. This well was drilled and blasted. A. F. Banker, owner.

1900 N. Total depth 14 feet. A. T. 650.

Section 28.

50 N., 820 W. A. T. 687. SO_4 tr., Ca tr., Cl low. Depth to rock 13 feet, total depth 16 feet. This well is at the house east of road, and passes into grindstone rock. There is a well 13 feet deep, just to rock, east of this one.

Section 29.

1750 N., 1700 W. 40 rods E. and 40 rods S. of N. E. corner of Sec. 29. H_2 SO_4 trace, Ca trace, Cl low. Depth to rock 38 feet, total depth 52 feet. A. T. 692. Thomas King, owner; T. Rapson, driller. The rock in this well is probably grindstone for 12 feet, then soapstone.

1000 N., 1000 W. Depth to rock 28 feet, total depth 28 feet. A. T. 644. Mr. Gaine, owner. This well is at the edge of the stream ½ mile N. and W. of S. E. cor. of Sec. 30 (?).

Section 30.

50 N., 1720 W. Depth 16 feet. A. T. 691. This well is in gravel and clay.

50 N., 50 W. Total depth 26 feet. A. T. 684.

Section 31.

1950 N., 160 W. Total depth 10 feet. A. T. 684. In clay. There is 4 feet of water in this well.

Section 33.

1900 N., 700 W. Total depth, just to rock, 13 feet. A. T. 685. This well is to grindstone.

About 1500 N., about 1000 W. Depth to rock 13 or 14 feet.

Section 34.

2000 N., 500 W. Depth 10 to 20 feet. A. T. 691. This is the average depth for wells around here to grindstone rock.

0 N., 480 W. Depth to rock 7 feet. A. T. 704.

Gore Township (T. 18 N., R. 15 E. L.).

In a strip of country about 2 miles wide, water is salty at about 100 feet, for example, Weiss's well.

Section 18.

0 N., 1900 W., A. T. 627. (1) W. H. Cole, owner, at house. Total depth 26 feet. (2) Water in a blue stony gravelly clay (till), cold but not abundant.

Section 30.

Cl med. Depth to rock 28 feet. A. T. 681. This well was bored but the tools stuck. Chas. Gettz, owner.

Section 32.

100 N., 1600 W. Depth to rock 30 feet, total depth 154 feet. A. T. 659. Cl strong, salty taste. F. Weiss, owner. At about 35 feet soapstone, a little water, no more was found in going deeper.

Section 33.

900 N., 1300 W. Wm. Schlaach, owner. A. T. 600. This well is said to vary with the wind, rising when the wind is off the lake. The well is close to the lake.

Port Austin Township (T. 19 N., R. 12 E.).

Section 25.

E. ½ of S. E. ¼. Total depth about 1200 feet. A. T. 592. This is the well reported by Reminder and Garrigues had drillings of it. See Vol. V, Pt. II, p. 75-76. Summary of record: 1-336 feet sandstones and conglomerates of the Lower Marshall, fresh water; 336-1120, blue shale; 1120-1160, red shale (Berea shale) at bottom; 1160-1225, sandstone, brine (the Berea Grit).

Section 36.

Depth to rock about 16 feet, total depth 40 feet. A. T. 616. SO_2 trace, Ca med., Cl low, red matter. This well went through 10 feet of sand, then red clay to rock.

Depth to rock 6 feet, total depth 80 feet. A. T. 610. 50 steps farther on, SO_4 trace, Ca low, Cl trace. Some parts of this well are blue stone, and from 78-80 is hard blue rock.

1000 N., 50 W. Depth to rock 2 feet, total depth 40 feet. A. T. 632. SO_4 0, Ca trace, Cl trace. Water comes in at about 5 feet. J. R. Learned, owner. There is a well near by about 7 feet deep.

T. 19 N., R. 13 E.

Section 23.

The section exposed June 24, 1896, showed 9 inches arenaceous shale, 3 inches conglomerate, 12 feet grindstone. There was a well according to Supt. Wallace.

800 N., 1000 W. A. T. 592, which shows 0-25 feet, grindstone, then soaprock, etc., at 80 feet brine in 3 feet of sandstone, at 95 feet soap rock. It is probably the same well as the following; also said to be at Eagle Bay: 0-24, sandstone; 24 to 54 soaprock, 54 to 78 feet sandstone, and the rest shale. The sandstone has conglomerate streaks, bits of coal and fish teeth. A well, 100 yards away is said to have shown coal, cf. Geol. Surv. of Mich., III, p. 71. Winchell also reports a pocket of coal as having been uncovered in grindstone quarrying. At the grindstone quarries, "there are 30 feet of soapstone, 24 feet of sandstone, and the rest is shale." 100 yards away there was another well with core.

340 N., 950 W. Depth to rock 5 feet, total depth 10 feet. A. T. 596. This is on top of a slight rise and goes into fine grained rock.

Section 25. Grindstone City.

1600 N., 600 W. A. T. 592. (1) This is at the present meat market, close to the station. See Vol. V. p. 62. The Berea sandstone, is said-to occur at 1010 to 1080 feet depth.

(2) In the present grindstone mill about 200 feet east, about as deep.

1600 N., 525 W. A. T. 592. In September, 1897. Church Brothers and Company put down, close to this well in the Cleveland Stone Company's quarry, a well for water. In the first ten feet some water was met in some salty shales which was cased off. Cf. E. Wade's well on Sec. 18, T. 18 N., R. 14 E. Then they went (360 + 75) 435 feet without getting water, i. e., in the Coldwater shales all the way.

1250 N., 200 W. Total depth 19 feet. A. T. 602. It is five feet to loose rock in this well, and 8 feet through grindstone to water, and then 7 feet of soaprock.

50 N., 1460 W. A. T. 612. At school house. This water is yellow. Pumping two pails exhausts the well. SO_4 0, Ca tr., Cl low. Drilled well.

1950 N., 120 W. 7 feet to rock. A. T. 599. The record at the quarry near by is as follows: 1 foot dirt, 1 foot loose stuff, 10 feet quarry, 30 feet from bottom of quarry to soaprock. There is no water in this well.

Section 26.

50 N., 1820 W. A. T. 636. SO_4 low (like R. Lundy on Sec. 34, T. 19 N., R. 13 E.), Cl med., Ca low, Mg trace. This is a drilled well.

50 N., 1280 W. Depth to rock 5 feet, total depth 112 feet. A. T. 632. SO_4 tr., Ca (lowest of the wells anywhere near) tr., Cl tr., Mg. tr. Wm. Nash, owner. This well passed through 5 feet of surface. 10 to 12 feet of sandstone, 20 feet of grindstone, 5 to 6 feet of soaprock, then grindstone and then soaprock. mainly, with hard veins and black stuff at bottom. There is black oil on the water. (The hard veins are probably nodules of carbonates or pyrite.)

50 N., 740 W. Depth to rock 4 feet, total depth 10 feet. A. T. 640. This well passes through 4 feet of drift, 6 feet of sandstone, then blue shale. In some places it is but 18 inches to rock on this farm.

1060 N., 160 W. SO_4 low, Ca low, Cl low. Total depth 20 feet. A. T. 603. Wm. Jackson, owner.

1950 N., 1900 W. Depth to rock 18.5 feet. Total depth 19 feet. A. T. 632. The water rose at first to 8 feet from top, now it is 14 feet from the surface, Ca low, SO_4 low, Cl med.

Section 27.

50 N., 1900 W. Total depth 10 feet. A. T. 622. There are four wells around here and they were dry in the summer of 1895. SO_4 low, Ca med., Cl strong, Mg low. Mrs. Kramer owner. Some people like the salt taste of this well better.

50 N., 1760 W. SO_4 very low, Cl med., Mg tr., Ca med. (all less than in the ten-foot-wells. Total depth 17 feet. A. T. 622. This well was drilled by Tom Rapson.

50 N., 800 W. SO_4 trace +, Ca low, Cl med., Mg tr. Brownish white scale of carbonates on the kettle, pretty hard. Depth to rock 12 feet, total depth 90 feet. A. T. 610. Ed. Meagher, owner. This well passed through 12 feet of surface, 40 feet of sandstone with 2 to 3 feet of gravel bed (conglomerate) at bottom, 41 feet of soapstone. There was no gain in water supply in this last.

1080 N., 1900 W. SO_4 tr., Ca low, Cl low. Depth to rock 16 feet. A. T. 612.

1950 N., 1320 W. Total depth 8 feet. A. T. 612. This well is 2 feet in rock.

1950 N., 180 W. Cl low, SO_4 low, Ca low. Total depth 14 feet. A. T. 642. J. Hall, owner. This well is at the house and goes only into loose broken rock.

1950 N. 280 W. Cl low, SO_4 low, Ca low. Ca and SO_4 less than at house. Depth to rock 8 feet, total depth 10 feet. A. T. 642. This well is at the barn.

Section 28.

A. T. 610. Depth to rock 18 feet, total depth 75 feet.

Section 29.

(1050 feet) 400 N., 1990 W., A. T. 596. Railroad well. This is hard water. The record is by J. Pearspn, Dec., 1895. Total depth 102 feet, soil, sand 5 feet, 95 feet rock, clay and water under.

(3040 feet N., 80 feet E.) 1150 paces N., 1940 paces W. A. T. 587. Total depth 1200 feet. SO_4 strong, Cl med., more Ca than lake water, Fe not enough to give yellow precipitate. Carrington's salt works has an abandoned flowing well.

(2) 1000 N., 225 W. Depth 1198 feet. A. T. 590. Ayres' well is similar, "second salt well in Michigan." Cf. Record given by Wright, Geol. Surv. Mich., V, p. 76.

1-275 feet sandy shale.

275-1100 feet blue and red shales.

1100-1200 feet porous sandstone.

The analysis of the brine is given in a previous section.

Section 30. Port Austin.

The wells around Port Austin are 60 to 100 feet deep and the rock is close to the surface. Some of the wells are flowing.

A. T. about 600. 13½ feet to rock, total depth 14 feet. Carpenter, owner. This well is 3 feet in gravel and 6 inches in rock. There are several wells about 14 feet deep, all similar, owner by Addison, Williams, Cartwright, and Latham.

450 N., 1200 W. A. T. 610. Depth to rock 16 feet, total depth 60 feet. (At the Methodist church the rock surface leaves the sand and begins to get clay on top.) It is about 16 feet to rock.

A. T. 802. Depth to rock 4 feet, total depth 75 feet. Ayres, owner. The record is from memory, white sandrock, slate rock with a darker black scum to water. Quite a streak to soaprock, grindstone, coarse gravel and sandrock.

400 N., 1000 W. SO_4 low, Ca low, Cl strong. Total depth 104 feet. A. T. 607. J. Buttars, owner. The water was cut off at 75 feet.

800 N., 450 W. Depth to rock 15½ feet, total depth 112 feet. A. T. 595. The water rose to 5 feet below the surface and there was plenty of it. Cl low, Ca low, SO_4 low, Mg, CO_2 present. The water left a red tea kettle scale. 96½ feet of the rock was blue stone, etc. Mr. Lundy, owner, on Spring street.

650 feet N., 900 feet W. 245 paces N., 337 W. Cl low, SO_4 low, Ca low. Depth to rock 12 feet, total depth 60 feet. A. T. 599. J. R. Learned, owner.

225 N., 150 W. Cl strong, SO_4 med., Cl med. Total depth 165 feet. A. T. 596. This well is at the barn and used to flow more than at the house.

300 N., 75 W. Depth to rock 10 feet, total depth 10 feet. A. T. 592. This well is at the creamery. There is a well 17 feet deep at the planing mill.

750 N., 710 W. Lot 20 of original plat. Total depth 90 feet. A. T. 590.

A water from Port Austin has Sp. Wt. 1.004. Cf. Learned's well. In a well ½ mile from shore, the water is said to be roily when the lake is stormy.

Section 31.

920 N., 500 W. A. T. 610. Total depth 17 feet. There is no bed rock in this well, but there is 10 feet of water.

160 N., about 500 W. A. T. 610. Total depth 24 feet. This well is through clay to sand and has 12 feet of water.

Section 32.

810 N., 50 W. Total depth, not to bed rock, 16 feet. A. T. 612.

1950 N., 1240 W. A. T. 612. Blue sand and clay were thrown out of this well.

Section 33.

1950 N., 300 W. Total depth 100 or 110 feet. SO_4 low, Ca low, Cl med., Mg low. The water is too salt. The well is at J. Ryan's house.

1950 N., 1840 W. Mg?, Ca low, Cl med., SO_4 low, Mg SO_4 rather marked. Depth to rock 17 feet, total depth 22 feet. A. T. 609. S. J. Murdens, owner.

1950 N., 1260 W. Depth to rock 12 feet, total depth 12 feet. A. T. 602. SO_4 low, Cl med., but less than at Murden's, not half as much Mg SO_4, but more Ca. This well was dug to rock. This is a flat ground moraine country.

1950 N., 860 W. Total depth, just to rock, 16 feet. A. T. 610. The well is sometimes dry. SO_4 low, Ca low, Cl med. +, Mg low.

Section 34.

E. half of N. W. quarter, 1950 N., 700 W. There is plenty of water in this well. SO_4 low, but more than in last well on Sec. 27-19-13. Depth to rock 21 or 18 feet, total depth 40 or 42 feet.

100 N., 100 W. Total depth 16 feet, not to rock. A. T. 627.

50 N., 1260 W. Total depth 22 feet. This well once went dry.

50 N., 1960 W. SO_4 low, Ca low, Cl med. Total depth 18 feet (just to rock?).

640 N., 107 W. Total depth 22 feet. V. Kula, owner (nearly to rock?).

1950 N., 700 W. A. T. 620. SO_4 low. Depth to rock near 21 feet, total depth 42 feet. R. Lundy, owner.

50 N., 740 W. A. T. 622. This is a shallow well.

50 N., 860 W. This is another shallow well.

50 N., 1260 W. A. T. 622. Total depth 22 feet. This well once went dry.

50 N., 1960 W. SO_4 low, Ca low, Cl med. Depth to rock 18 feet, total depth 18 feet. A. T. 617. This well is through clay.

Section 35.

1950 N., 1640 W. Depth to rock 8 feet (? a boulder), total depth 10 feet. A. T. 625. Wm. Underwood, owner. The well is about 6 feet above stream, which does not expose rock, SO_4 low, Ca low, Cl med., Mg low.

1950 N., 740 W. Ca tr, SO_4 tr. Total depth 18 to 20 feet. A. T. 640. This well is mostly through shale.

100 N., 1900 W. Total depth 18 feet. A. T. 627.

Section 36.

1950 N., 680 W. SO_4 tr, Ca low, Cl low. Depth to rock 16 feet, total depth 23 feet. A. T. 622. W. J. Harrington. owner. Drilled by W. Smith.

50 N., 1340 W. A. T. 629. Depth to rock 20 feet, total depth 23 feet.

Huron Township (T. 19 N., R. 14 E.).

Section 31.

1900 N., 900 W. SO_4 tr., Ca low, Cl med. The water rises to about 17 feet. Depth to rock, just 16 feet., total depth 100 feet. A. T. 616. Record as follows: 2 feet of soil, 14 feet of hardpan, 12 feet grindstone and the rest soap rock with seams of grit. F. Kinch, owner. There are also two other wells just to the rock 14 and 16 feet deep.

920 N., 50 W. Total depth, not to rock, 17 feet. A. T. 603. This well contains 10 feet of water.

160 N., 50 W. Total depth 24 feet. A. T. 618. This well is down in clay to sand and contains 12 feet of water.

1160 N., 50 W. Depth to rock 35 feet, total depth 40 feet. A. T. 607. 5 feet of this well is drilled in rock.

Section 31.

840 N., 1950 W. Total depth 13 feet. A. T. 624. This well is in clay.

Section 32.

500 N., 100 W. A. T. 607. This is a shallow well in gravel, practically a spring.

100 N., 500 W. A. T. 612. Total depth 40 feet.

A. T. 606. The New River salt well, vol. V, pp. 72-5.

1-15 feet grindstone.

15-45 feet blue shale.

At 90 feet salt brine, probably from the Point aux Barques lighthouse conglomerate.

45-800 feet alternate shale and sandrock.

800-900 feet rotten, bad smelling soft rock, including the Berea shale.

900-1000 feet porous coarse grained white sand rock, brine 85°. This is the Berea Grit

1000-1029 feet blue shale. Bedford shales.

S. W. quarter of S. W. quarter. SO_4 low, Ca low, Cl med. Depth to rock 22 feet, total depth 39 feet. A. T. 604. Moses Thompson, owner. Through 17 feet of blue arenaceous shale. (2) Depth to rock 19 feet, total depth 21 feet. A. T. 607. This well is 2 feet in rock, 4 or 5 feet of sand came, then clay, hardpan and gravel. Dixon is said to have a well over 100 feet deep.