SECOND ANNUAL REPORT OF THE STATE GEOLOGIST, OF THE STATE OF MICHIGAN.

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REPORT, &c.

OFFICE OF STATE GEOLOGIST,
Detroit, Feb. 4, 1839.

To the Hon. Senate and House of Representatives of Michigan.

In conformity with the requisitions of your honorable body, I herewith transmit such information, touching the progress and general results of the works placed under my charge, as would appear to be called for in an annual report; reserving the great mass of matter which has been accumulated, with the view to an elucidation of the condition and resources of our state, for a *final report*.

Immediately upon the reception of an act "relative to the geological survey," approved March 22, 1888, I proceeded, in conformity with the instructions contained in said act, to organize a geological board and to divide the complete work in such a manner as to constitute a geological and mineralogical, a zoological, a botanical, and a topographical department.

At as early a day as circumstances would permit, the heads of each of these departments took the field, and continued their arduous duties until the inclemency of the season compelled a suspension of labor; since which time they have been busily engaged in arranging the great amount of information which has been obtained in such a manner that it may eventually be made available.

My individual labor has been chiefly devoted to an examination of the coast of those portions of our state bordering on lakes Huron and Michigan, together with so much of the interior of the peninsula as circumstances would permit. I have also devoted a portion of the past season to a general examination of some of the southern and central counties of the state, preparatory to the more minute examination which has been commenced and which it is proposed to renew with the first opening of spring.

The geographical information respecting the northern portion of this peninsula is so imperfectly understood that, were it at this time desirable, it would be impossible to lay before you the minute results of the examinations in that portion of the state, in such a manner as to be intelligible, unless accompanied with complete new maps, which could not be expected to be forwarded in a report, that at most, can only be looked upon as setting forth, in a general manner, the progress of the work placed under my charge.

NORTHERN PART OF THE PENINSULA.

Topography and General Character.

The country under consideration, lying west of Saginaw bay, and extending north from townships 10 and 11 north, to the straits of Mackinac, has been so imperfectly known to the citizens of our state that no estimate of its value could be made. No circumstances have occurred to aid in developing its resources, and from the forbidding character of most of the coast, it has very naturally been considered as a flat country, worthless except for the immense tracts of pine timber which were supposed to exist in it; both of which suppositions are, to a great extent, without foundation. It is true, however, that the northern portions of the peninsula are characterized by a larger proportion of irreclaimable marsh than is to be found in the southern counties, yet notwithstanding this, many portions are not inferior to the other parts of the state.

Several streams of considerable size occur on the northern part of the peninsula; among the most important of which are the Maskego, White, Pere Marquette, Manistee and Platte on the west; Cheboigan on the north, and Thunder Bay, Au Sable, Pere and Tittabawassa rivers on the east.

The Maskego river, which is the largest of the streams enumerated, has its principal source in a group of large inland lakes situated west of the meridian, in about ranges 3 and 4 west, and towns 22 and 23 north. These lakes are almost completely surrounded by nearly impenetrable swamps, covering a large portion of the area of from 7 to 8 townships, the chief portions of which may safely be said to be utterly irreclaimable. From one of the principal lakes of the group mentioned, the Maskego river runs southwesterly in a line partially parallel with the coast of lake Michigan, receiving numerous tributaries, until it finally discharges its waters into the last mentioned lake, in town 10 north, range 17 west. The stream through its whole course is extremely crooked and its total length, including its windings, may be estimated at about two hundred miles. The waters descend with an extremely rapid, though for the most part uniform current, and their depth is very regular. The stream is capable of being easily made navigable for steamboats nearly, if not quite, to the lake which forms its source. Large portions of the lands situated upon this stream are well adapted to the purposes of agriculture, and although the great majority are timbered lands, there

is nevertheless a sufficient amount of prairie to greatly facilitate the settlement of the surrounding country.

The Maskego, like almost all the streams on the western side of Lake Michigan, first discharges its waters into a small lake that is separated only by a very slight distance from the main lake. The Maskego river may be said to furnish one of the best natural "stream" harbors which is found upon Lake Michigan.

The Tittabawassa on the east, which is one of the branches of the Saginaw river, has its source not very far distant from that of the Maskego, and the upper portion of its course is nearly parallel to the latter stream, the Maskego being upon the west side of the summit, while the Tittabawassa is upon the eastern side. The latter stream, gradually curving to the east, discharges its waters through the Saginaw river into Saginaw bay of Lake Huron.

The Tittabawassa is navigable for boats of light draught for a distance of from 40 to 50 miles, above which it is obstructed by numerous rapids that will furnish, if properly applied, an abundance of hydraulic power. The surrounding country is considerably elevated, and the banks of the stream sometimes rise quite abruptly to a height of from 20 to 40 or even 50 feet. Portions of the lands in the vicinity of the river are of good quality and well adapted to agriculture; but other portions occur where the soil is of a light sandy character and will require much labor to render it productive. Some valuable tracts of white pine exist in the vicinity of the Tittabawassa, but in consequence of the ravages of fire, which has been communicated from Indian camps, pine in quantities is rarely seen upon the immediate banks of the river.

The Au Sable and Thunder Bay rivers are both capable of being made excellent harbors for lake shipping, and they are streams of considerable magnitude. The former may be rendered navigable, but to what distance I am not able to say. The navigation of the latter stream is obstructed near its mouth by a series rapids, the bed of the stream being composed of limestone *in place*.

The water of most of the other streams enumerated, like those already mentioned, flows with a brisk current and sometimes with great rapidity. The beds of the streams are chiefly composed of a yellow sand, and the depth is remarkably uniform. An abundance of hydraulic power will be furnished, but the sandy character of the soil, more particularly upon the eastern slope, will sometimes render it difficult to secure from accident the dams which may be erected.

The country north of the southern boundary of Arenac county and east of the meridian, so far as examined, is on the whole but ill adapted to the purposes of agriculture, being chiefly composed of sandy ridges with intervening swales, and rising so gradually towards the central portions of the state as to leave the country extremely flat. There are, however, many valuable tracts of w hi to pine, which will serve to render this portion of the state of some importance. Yellow pine, well adapted for light spars, also abounds.

A large portion of the immediate shores of the lake is composed of marsh.

An exception to the flatness of the country exists in an elevated district commencing in high hills a little south of Thunder Bay river and stretching in a southwesterly direction towards the head of Lake Michigan. This range, at its commencement, is usually known as the highlands of the Au Sable. These hills follow the line of bearing of the rock formation, and no doubt extend diagonally completely across the state, forming a portion of the summit of the more northern part of the peninsula.

The greater portion of the country, after passing the summit west of the meridian, is of a character totally different from that just described. From the site of old Mackinac, at the very extremity of the peninsula, south to the Manistee river, a direct distance of about 140 miles, the immediate shores of the lake are almost invariably considerably elevated, sometimes rising abruptly to a height of from 300 to 400 feet. The country, (more particularly the northern portions,) as we proceeded into the interior, continues to rise, until it attains an altitude probably quite equal, if not superior, to any other portion of the peninsula. This is more particularly the case in the vicinity of, and southeast from Little and Grand Traverse bays. Here the surface is considerably broken by elevated ridges of limerock, which are, without doubt, a continuation, of the line of bearing of the great limestone formation of Wisconsin.

In proceeding south from Grand Traverse bay, the interior of the country would appear to become less elevated, or gradually to fall away to the southeast, while the elevation of the coast is increased: a circumstance which will serve to account for the general direction of the two principal streams, the Maskego and Tittabawassa rivers. The elevated shores of Lake Michigan, which when viewed from a distance have the appearance of sand, are found in reality to be composed, except in the recent sand dunes, of alternating layers of a highly marly clay and sand.

The hilly limestone region to which allusion has been made, is mostly heavily timbered with beech and maple, and although portions of it are rather broken, it is as a whole admirably adapted to the purposes of agriculture.

After leaving the limestone district, in passing south the country becomes more variable, the soil sometimes assuming a sandy character. The face of the country is also generally more level, although some districts are considerably rough.

This northern portion of the peninsula is usually regarded, by the inhabitants of our state as possessing too rigorous a climate to admit of agriculture, but this is an error which deserves to be corrected. The Ottawa Indians residing on Little Traverse bay and who have somewhat extensive cultivated fields in the elevated limestone district of the interior, more particularly in the

vicinity of one of the southwestern forks of the Cheboygan river, inform me that their crops of corn have not failed within their recollection to yield largely, and certainly I never saw finer corn than in some of their fields.

The soil of these lands is strictly a "*warm*" one, and exposed as it is to the vivifying influences of the southern winds during the summer, it cannot fail to be productive. In this respect the country on the western slope is precisely the opposite of that on the northerly and easterly slopes, for this latter district is constantly subject to the chilling influence of the northerly winds from Lake Superior, an influence which even the most cursory observer could hardly fail to notice. This difference of circumstances, even were the character of the soil similar upon the opposite sides of the peninsula, could not fail materially to affect the value of the lands for the purposes of agriculture, adding to the value of those of one district while it would detract from those of the other.

Rocks.

The examinations of the past year, in the northern and unsettled portions of the peninsula, have been wholly of a general character, and were made with a view of determining, as far as possible; the precise points to which the minute examinations can, hereafter, be directed with the greatest profit. These examinations cannot be completed in such a manner as to enable us to delineate the geology of that country upon our maps, until the United States' *linear* surveys be completed. These latter surveys, which during the past year have been extended as far north us town twenty-six, have nearly reached a portion of the peninsula, which, in a geological point of view. Is possessed of the highest interest. Several parties of surveyors are now nearly in readiness to commence the work north of the town mentioned, and we confidently hope, that during the ensuing year the chief part of the subdivisions which remain to be done, may be completed.

It is not my intention, at this time, to enter into a minute description of the order of superposition of the rocks, over the large area of country under consideration, nor would it be possible, were it desirable, to present the subject to you in such a shape as to render it intelligible without the aid of diagrams. The accompanying descriptions will, therefore, be almost exclusively confined to those points at which the out-crop of rock occurs under such circumstances that it may be made available for practical purposes, together with such suggestions as the circumstances may appear to warrant.

The rocks of this northern portion of the peninsula may be regarded as referable to the great carboniferous group of the state, a position to which their fossil contents is amply sufficient to substantiate their claim. In this respect they coincide with the rocks heretofore described as occupying the southern counties; nevertheless, it must be borne in mind, as there stated, that these rocks occupy a very different position in the series.

The rocks of the district under consideration consist of a succession of limestones, with intervening shales, sandstones and clays; and as we approach the very extremity of the peninsula, the limestone is shattered, in a manner similar to that exhibited by the sandstone in the southern counties of the state.

The line of bearing of the members constituting this group of rocks, not only in the northern but likewise in the southern portion of the peninsula, is regularly northeasterly and south westerly, a direction which it is believed the rocks upon the opposite side of Lake Michigan will also, at least to a certain extent, be found to pursue. The general characters of the separate portions of the group arc preserved, in a remarkably distinct manner, at great distances, and the mineral contents are but little varied.

My examinations would lead me to infer that the coal of the central portions of our state, and that upon the Illinois river, is embraced in a rock which belongs to the same portion of the great basin; a conclusion which, if borne out, will aid much in determining some important points, respecting the relation which the neighboring rocks bear to each other.

I am also led to conclude that that portion of the rock series which, in Illinois and Wisconsin, embraces the ores of lead, is identical with a portion of the rock formation which occurs in the northern part of our own state; a circumstance, which might fairly have been inferred from the general line of bearing of the rock. Whether this extension of the rock also contains that mineral, in sufficient quantities to be of any practical value, remains yet to be determined.

A slight glance at the map of our state will sufficiently explain the relation which Saginaw bay, of Lake Huron, holds to the *line of bearing* already mentioned. This great arm of that lake, stretches in a southwesterly direction, making a deep indentation in the peninsula, and occupying a denuded space in the sandstone, just at that point where the latter comes in contact with the limestone of the north. Thus while the southerly portions of the bay are characterized by the appearance of abrupt, but low cliffs of sandstone, which rock may be traced in a southwesterly direction completely across the peninsula, the opposite, or northerly shore, is not less marked by the occurrence of limerock, which stretches in a like manner, southwesterly to Lake Michigan. This limestone forms several of the headlands and small islands of Saginaw bay and Lake Huron, and also occasionally appears in the beds of the streams, giving rise to rapids near their places of embouchure.

In proceeding northerly from the mouth of Saginaw river, limestone is first noticed, forming the very extremity of Point au Grais. Quarries have been opened here, and a rough building stone obtained. It is of compact structure, tolerably adapted to resist the action of the elements,

and being situated, as it is, in such a manner that the stone may be readily quarried and transported, it is a point from which the country in the vicinity of Saginaw river may be more economically supplied, with this character of stone, than from any other. By judicious selection, portions of it may be made use of for the manufacture of lime, but the great mass is of too siliceous a character to admit of use for that purpose.

Limestone still more siliceous in its composition, occurs on the Charity islands, where it may be quarried to a limited extent, and will answer a good purpose for rough walls. The rock of these islands, for the reason already stated, will scarcely admit of being applied to use for the manufacture of lime. That at Great Charity island contains large quantities of imbedded chert.

Between Charity islands and the southerly cape of Thunder Bay limestone appears at short intervals, but at such low levels (usually forming the bed of the lake,) as to be of no practical value. At this latter point the rock occurs in on abrupt cliff, which rises directly from the water, to a height of from ten to twenty feet, and is continued for the distance of half a mile.

The limerock alternates with layers of a fissile clay slate, the latter of which composes about two-thirds of the whole outcrop-ping rock forming the face of the cliff. The limestone may be easily quarried, and portions of it would answer tolerably well for architectural purposes, but as a whole, in consequence of the irregular shapes into which the rock is liable to separate, it is of inferior quality.

At a distance of something less than two miles, southeast from the cliff just mentioned, a dark colored and highly bituminous shale occurs, forming a small island. This island which, during the past season, in consequence of the high water, has been nearly submerged, is usually denominated Sulphur island.

This bituminous shale, which is seen to extend a considerable distance around, forming the bed of the lake, dips below the limestone just described, and may be regarded as of no great thickness. Small specks and nodules of iron pyrites are imbedded in it, and so completely is the whole mass saturated with bitumen, that when thrown upon “the fire” it blazes freely. From this circumstance it has been mistaken for coal, and considerable quantities of it were actually shipped to Detroit, under this delusive supposition.

Limestone is again seen in the bed of Thunder Bay river, at a distance of about one mile from its mouth. Over the *out-cropping* edge of the rock the waters descend in a series of very brisk rapids; and the stream is capable of furnishing a greater amount of hydraulic power, at this point, than has been noticed at any single place on the peninsula. Were it not that the sandy nature of the banks would render much care necessary in order to make the works secure, it might be very cheaply applied; and occurring, as it does, near the mouth of a large stream, which will furnish a safe harbor for lake vessels, the great value of this immense power, for application to mechanical purposes, cannot fail to be eventually appreciated.

Limestone was not observed at any point upon Thunder Bay river, sufficiently elevated, to admit of its being quarried.

Lime rock also occurs at the northerly cape of Thunder Bay, the Thunder Bay islands and Middle island, as also at several intermediate places upon the coast; but it chiefly occurs either below the water of the lake, or so little elevated above it as scarcely to be capable of being turned to any considerable practical account.

Outer Thunder Bay island is composed of limestone, covered, in part, by a very thin deposits chiefly of vegetable matter. An inferior coarse building stone may be obtained, in considerable quantities, upon this island, but it is extremely irregular in shape and not of the most durable character.

The southerly portion of outer Thunder Bay island is composed of a shelly or sub-slaty, silicious limestone, considerably charged with bitumen, and almost wholly composed of a congeries of fossils, the animal matter of which has undoubtedly given rise to the bituminous character of the rock. It possesses much interest in a scientific point of view, but is of no value for any practical purposes.

Much of the surface of Middle island is composed of loose masses of a limestone, which is admirably adapted to the manufacture of lime. Occurring, as these masses do, of a convenient size, the labor of quarrying is saved, while the manufactured lime may be safely and conveniently shipped. The manufacture of lime, for the counties bordering on the lower rivers, may be safely and economically carried on at this point. Several kilns have already been burned upon the island.

Between Middle island and Forty Mile point, limerock appears at intervals, forming the bed of the lake. The rock was not noticed, at any place, to rise above the surface of the water, and although it is of a compact and regular structure, and well adapted for practical use, its submerged situation wall effectually prevent its application to any useful purpose.

Limerock again occurs at the straits of Mackinac and in the vicinity. It appears upon the island of Mackinac together with Bois Blanc, Round and St. Martin’s islands, as also upon the northern peninsula, north from Mackinac.

The island of Mackinac, which has a circumference of about nine miles, rises in rocky cliffs, upon its easterly and southeasterly portions, very abruptly, to a height varying from 120 to 150 feet.

The site of the present Fort Mackinac is elevated 150 feet above the water of the lake. Beyond the first elevation, upon which the fort is situated, there is a somewhat level plateau, which, however, rises gradually, until by a final and quite abrupt ascent the island attains its greatest elevation, being 219 feet. This final

elevation, which is somewhat conical, has a flat area of limited extent on its very summit, upon which, during the late war, Fort George, afterwards called Fort Holmes, was erected. This beautifully situated spot furnishes one of the finest views of the surrounding coast and islands that could be conceived.

The island of Mackinac is based upon limestone, with a very superficial covering of soil. This soil, in consequence of the large amount of calcareous matter which enters into its composition, possesses a fertility that a superficial examiner would scarcely ascribe to it.

The limestone chiefly consists of an irregular assemblage of angular fragments, united by a tufaceous cement. These fragments usually appear, at first sight, to possess a compact structure; but a more minute examination shows them to contain numerous minute cellules, sufficiently large to admit water, which, by the action of frost, subjects the rock to rapid disintegration. Portions of the rock may, nevertheless, be selected partially free from this difficulty, and which are possessed of sufficient compactness to render them of value as a coarse building stone.

Hornstone, striped jasper, imperfect hog-tooth spar, calcareous spar and fluor spar occur imbedded in the rock, although the latter is of very rare occurrence.

Limestone, of a similar character, constitutes the chief portion of Round island; but here the rock is more compact, and will prove less subject to disintegration than that before mentioned. It will answer a good purpose as a coarse building stone.

A range of somewhat elevated hills, of limerock, occurs upon the main land, northwesterly from Mackinac, commencing a short distance inland. One of these hills, known as the “Sitting Rabbit,” presents an abrupt cliff, destitute of vegetation upon its southerly side. This rock is, without doubt, indentical, in geological position, with that upon the islands fast mentioned.

The low group known as the St. Martin’s islands, are also composed of a similar limestone.

The shattered and deranged condition of the rock upon the island of Mackinaw, and its vicinity, gives the whole mass a peculiarly complicated structure, and has led to what is conceived to be an error respecting it. Thus the rock has been described as a conglomerate, destitute of stratification, a conclusion which would appear to have been drawn without a proper consideration of the facts connected with the subject. That the fragmentary masses, composing the main portions of the rock, have not been transported, is conclusively shown by the fact that the most delicate angles are preserved, a circumstance which could not have taken place had they been subjected to the action of water, before being cemented. A careful examination has shown that portions of the rock still remain, in which the relative position of the original lines of stratification are preserved for an extent of several rods; and on Round island the line of stratification was traced for a distance of nearly half a mile.

The rock in question, no doubt occupies very nearly its original *relative* situation, and its present condition may be ascribed to an uplift of the strata, subsequent to the complete induration of the rock; a cause which is amply sufficient to account for the present appearances. The fragments thus separated have been imperfectly cemented by the gradual infiltration of calcareous matter, thus re-uniting the complete mass.

It is well known that portions of the sandstone, in the southern counties of the state, are shattered in a similar manner; but in this instance the fragments have not been re-united.

The *old red sandstone*, over a large area, in the vicinity of the Porcupine mountains, of Lake Superior, has been similarly disturbed, and the protruded trap rocks, which occur in the immediate vicinity, afford a sufficient explanation of the causes which have been most active in producing it; facts which should not be lost sight of in explaining the causes of the present condition of the rocks in the vicinity of Mackinac.

From the island of Mackinac to Little Traverse bay, rock does not appear upon the immediate shore of the lake, though hills based upon limestone, stretch at a distance, through the interior. These hills approach very near the head of the bay mentioned, where they attain an elevation of several hundred feet; and as a whole they probably constitute the most elevated and regular chain of hills on the peninsula.

On the easterly side, and near the head of Little Traverse bay the lime rock *crops out.* It continues for a distance of nearly a mile, forming an abrupt cliff elevated from 10 to 20 feet.

This rock varies from a dark blue and compact limestone to that of a greyish color and sub-crystalline structure. The rock may be easily quarried, and portions of it will answer a tolerable purpose as a building stone. But much of it is of an inferior quality; for the dark blue limestone is subject to break into irregular fragments, while much of the grey rock is either too flaggy, or contains so large a proportion of argilliceous matter in its composition as to render it unfit for use.

At a distance of from two to three miles westerly from the place of *out-crop* just mentioned, the rock again appears, in a continuous cliff, elevated from 15 to 20 feet.

The inclination of the rock is here northwesterly. It continues for a distance of about three-fourths of a mile when it dips beneath the water of the lake. This series of rocks no doubt overlies that last described.

The separate strata of this cliff, at its highest point, are represented, in a descending series, as follows: the rock being overlayed by about one foot of soil:

1. Siliceous limestone almost partaking of the character of sandstone—9 feet.

2. A confused mass of broken fossils, chiefly encrinites and cyathophyllae, imbedded in clay—2 inches.

3. Vesiculated chert, colored with iron—4 to 8 inches.

4. Flaggy limestone, mostly separable into layers varying from one-fourth of an inch to one inch in thickness; the laminea usually forming a small segment of a large circle—8 feet.

5. Bluish clay (having the odor and appearance of silt,) divided by septae into irregular masses. It contains imbedded semi-crystalline grains of iron pyrites, which has the appearance of coarse golden yellow colored sand. About four feet of this stratum appears above the surface of the lake and it was estimated to extend 4 feet below, making its total thickness 8 feet.

This clay is underlayed by limestone.

The rock appearing in the cliff is, as a whole, of an inferior quality for economical purposes, yet portions may be selected which would answer a very tolerable purpose as a building stone.

Limestone was noticed, at intervals, forming the bed of the lake, as far south as the northerly cape of Grand Traverse bay. At this latter place it was last seen to rise above the surface of the water, attaining an altitude of from 4 to 8 feet.

This rock contains large quantities of imbeded hornstone arranged in irregular layers, varying from 2 to 12 inches in thickness. The siliceous matter having been deposited in thin successive layers gives the whole mass of hornstone a beautifully zoned appearance.

Portions of the limestone rock will furnish a tolerably good material for use as a coarse building stone, but as a whole it is of inferior quality.

About lour miles southeasterly from the lime rock last described, and just within Grand Traverse bay, a dark colored bituminous slate, containing nodules of iron pyrites crops out, and continues at intervals for a distance of a mile. It closely resembles that before described as occurring at Sulphur island, near Thunder Bay, except that it is not so highly charged with bituminous matter. The rock is of no practical importance.

South from Grand Traverse bay to the southerly boundary of the state, rock was not seen, in *place*, upon the immediate shores of the lake, but it occurs at many points a little in the interior, one of which may be noticed as being immediately connected with the rock strata under consideration.

This limerock comes to the surface in a hilly region, lying between Pere Monquette and White rivers, (town 15 north,) at a distance of from 10 to 12 miles from the shore of Lake Michigan. The surrounding country, embracing between one and two townships, is composed of broken, conical hills, rising abruptly to a height varying from one to two hundred feet. From the bases and sides of these hills numerous beautiful springs of water are discharged.

The rock is mostly covered with soil, and its character is not well determined, but situated as it is, at a distance from the coast, and not near any navigable stream, it is at the present time of no practical value.

In connection with the subject under consideration, I would call your attention to the immense quantities of rolled pebbles of limestone which occur on the shores of Lake Huron, more particularly between Thunder Bay and Forty Mile point. The shores are lined at short intervals, with these small masses, consisting of the harder portions of the rock, which have resisted the action of the elements. These masses possessing, as they do, great uniformity of size, are admirably adapted for use in the construction of roads.

The coast is not unfrequently lined, many feet in thickness with these fragments, and so situated that vessels may be readily laden with them. Occurring in the form they do, the expense of pounding will be saved, and no preparation will be required to fit them for immediate use in macadamizing roads.

It is well known that great numbers of vessels annually pass down the lake “in ballast,” and it is deserving of serious consideration whether sufficient inducement could not be given, for the transportation of this material, for use upon the roads in the vicinity of Detroit river.

The finer gravels have already been considerably used for gravelling walks, but I am not aware that any use has, as yet, been made of the larger stones which occur in such abundance upon the upper lake coast.

Tertiary Clays.

A large proportion of the rocks of the peninsula are overlaid by a series of beds of clay, sand and gravel, that sometimes attain a thickness of several hundred feet. These beds compose a group of deposites, the lower portions of which, so far as I am able to determine, are destitute of fossil remains. Some of the members of the group, would appear to be of a local character, occuping but a limited extent; while others are spread over a large area of country. Of these deposites, perhaps no one occupies a greater extent than the lower clay, which is nearly universal upon the border portions of the peninsula.

The members of this group are most largely developed upon those parts of the peninsula bordering on the coast, and they gradually become thinner as we proceed inland, until they finally wholly disappear; their place being supplied either by rock *in place* or by diluvial deposites.

The great thickness of the exposed portions of these *tertiary* beds, upon the northwestern part of the peninsula, afford ample opportunities for examining this interesting series of deposites. But since the consideration of the subject, as a whole, will be left to

the future, a few allusions only will be made to some of the clays embraced in the series.

The lower clay, which is usually of a blue or bluish gray color, is almost universally more or less filled with imbedded pebbles, chiefly of *primary* rocks, which sometimes, though rarely, attain to several hundred pounds weight. These water-worn masses usually completely ruin the clay for all practical purposes, but in a few instances the clay has been found sufficiently free from them to admit of use, for the manufacture of bricks. The thickness of this clay is known only at a few points; and as the deposits was made unconformably upon an unequal surface, its thickness must be subject to very great variation. In the vicinity of Detriot it has been sunk completely through and found to have a thickness of 118 feet.

This lower deposite of clay, in the southeastern part of the state, is usually overlayed by a stratum, varying from 1 to 5 feet in thickness, of an exceedingly fine marly clay. This clay, when sufficiently free from lime, is well adapted to the manufacture of bricks and earthern ware.

On the northwestern side, bordering on Lake Michigan, the upper clays are much more largely developed than upon the more southeasterly portions of the peninsula. These deposites of clay alternate with beds of sand and gravel, the whole sometimes attaining a thickness of from 100 to 400 feet. The separate beds vary considerably in character; the upper usually containing a much larger proportion of lime than the lower ones, yet they usually agree in possessing an extreme fineness of texture. Many portions of these clays, appearing in the abrupt shores of Lake Michigan, are well adapted to the manufacture of bricks and earthern ware, but they usually contain so large a proportion of lime as to render them unfit for use for those purposes. Some portions of these clays, in which lime enters largely as an ingredient, rather deserve the name of marls, and they are admirably adapted for use upon the sandy lands of the northern part of the peninsula.

Shell Marl

Several beds of shell marl were noticed upon the northwesterly side of the peninsula; and upon the eventual settlement of the country they will prove of great value to the agriculturist, as well as for the manufacture of lime. In consequence of the unsurveyed condition of the country, it is impossible, at this time, to designate the localities.

White river of Lake Michigan takes its name from the occurrence of a bed of shell marl, of a very white color, directly at its mouth. The marl composing this bed would appear to have been deposited in an old channel of the river, which had been shut up by the action of the winds and waves upon the sand at its mouth, and afterwards to have been buried many feet in depth by drifting sands. In process of time the river returned to its former place of embouchure, thus laying bare the marl in question. It will prove a valuable material for the manufacture of lime, as well as for application to the light sandy lands in the immediate vicinity. The bed is not extensive.

Gypsum.

Gypsum occurs associated with the northern limestone, but for the most part under circumstances that will effectually prevent its being obtained in any considerable quantities.

Gypsum of a beautiful white color occurs in the bed of the lake a little north from Point au Grais river, but to what extent it is impossible to determine, for it is covered by several feet of water, which will effectually prevent the working of the bed.

On the St. Martin's group of islands, near Mackinac, gypsum also occurs, chiefly in loose pieces, scattered over the islands. A bed of gypsum is said to be associated with the limerock in the immediate vicinity of these islands, and in such a situation that during the low stages of water, it appears above the surface; but at the time of my examination it was covered by several feet of water. I am informed that some years ago several ship loads of gypsum, collected in loose masses upon the St. Martin's islands, were transported to the lower lakes. Nearly all which appeared upon the surface has been removed, and the low level of the islands will effectually prevent any considerable explorations for more.

Gypsum also occurs on the *northern peninsula*, between Green Bay and Mackinac, but to what extent has not yet been determined. Small quantities have also been collected and shipped from this part of the coast.

Change of Elevation in the Waters of the Great Lakes.

Intimately connected with the geological changes which are taking place, from the deposite of detrital matter at the mouths of streams, and in the deeper portions of the lakes, together with the degradation of the lake and river coasts, are the changes in the relative level of the waters of the lakes; a subject to which the attention of our citizens has been more particularly called within the past two years.

The great interest which this subject possesses in connection with our lake harbors, as well as with those agricultural interests situated upon the flat lands bordering the lakes and rivers, may be a sufficient apology for the introduction, in this report, of the accompanying facts and reflections upon the subject. An accurate and satisfactory determination of the total rise and fall of the waters of the lakes, is a subject, the importance of which, in connection with some of our works of internal improvement and harbors, can, at this time, scarcely be appreciated.

Much confusion is conceived to have arisen, in the minds of a portion of our citizens, in consequence of a confounding of the regular *annual* rise and fall to which the waters of the lakes are subject, with that apparently

irregular elevation and subsidence, which only appears to be completed in a series of years; changes that are conceived to depend upon causes so widely different that while the one can be calculated with almost the same certainty as the return of the seasons, the other can no by means be calculated with any degree of certainty.

It is well known to those who have been accustomed to notice the relative height of the water of the lakes, that during the winter season, while the flow of water from the small streams is either partially or wholly checked by ice, and while the springs fail to discharge their accustomed quantity, the water of the lakes is invariably low.

As the spring season advances, the snow that had fallen during the winter is changed to water, the springs receive their accustomed supply, and the small streams are again opened, their banks being full in proportion to the amount of snow which may have fallen during the winter, added to the rapidity with which it has been melted.

The water of the lakes, in consequence of this suddenly increased quantity received from the immense number of tributaries, commences rising with the first opening of spring, and usually attains its greatest elevation, (at least in the upper lakes,) some time in the month of June or July. As the seasons advance, or during the summer and a large portion of the autumnal months, evaporation is increased, and the amount of water discharged by the streams lessened, in consequence of which the water of the lakes falls very gradually until winter again sets in, when a still greater depression takes place from the renewed operation of the causes already mentioned.

The *extreme variation* in the height of water from winter to summer is subject to considerable change, according as the winters may vary from cold and dry to warm and wet; but during the past eight years, it may be estimated at two feet.

This annual rise and fall of the water of the lakes, dependent as it manifestly is, upon causes which are somewhat uniform in their operation, must not be confounded with that elevation and depression to which the waters are subject, independent of causes connected with the seasons of the year. These latter changes which take place more gradually, sometimes undergoing but little variation for a series of years, are least liable to be noticed, unless they be very considerable; but with respect to consequences they are of vastly more importance, since they are subject to a larger and more permanent range.

That the waters of the lakes, from the earliest settlement of the country, have been subject to considerable variation in relative height, is well known. At one time the belief was very general that these changes take place at regular intervals, rising for a space of seven years, and subsiding for a similar length of time; a belief which would appear to be in consonance with that of the Indians upon the peninsula, and with whom it no doubt originated. It is not wonderful that a subject, the causes of which are so little comprehended by our natives, should be invested with an air of mystery, or that an error once propagated (in consequence of the long series of years required to bring about any considerable change,) could scarcely be eradicated.

While the idea of the septennial rise and fall must be regarded as founded in error, it is nevertheless true that from the earliest records, the height of the lakes has been subject to a considerable variation, usually rising very gradually and irregularly for a series of years, and after this falling in a like manner.

Our old inhabitants agree in stating that the waters were high from 1800 to 1802 ; in proof of which it is stated that the roads which had before been in use upon the banks of the Detroit river, were so completely inundated as to be rendered impassable. A similar circumstance is related to have occurred in the vicinity of Chicago, a broad sandy beach forming the immediate shore of the lake near that place having been wholly overflowed.

I have been unable to obtain authentic information respecting the changes which took place between the years just mentioned and 1814, but from the latter year to the present time, we have a more connected series of facts relating to the subject.

“It is now a matter of record, that in 1814 and 1815 the Detroit and St. Clair rivers were unusually high ; that the foundations of the houses, and much land that had long been under dry cultivation, were submerged. These buildings had been erected many years before, and of course under the belief that they were aloof from all but extraordinary and temporary inundations. No observations appear to have been made upon the progress of the elevation, whether it were gradual or abrupt, or whether there were any preceding seasons of a character to produce it.”

“In 1820, or about that time, the rivers had resumed their usual level. Several wharves were built at Detroit, between that year and 1828, at a height, as was supposed, sufficiently above the general level for all purposes of convenience and safety. At the latter date the rivers had again attained the elevation of 1815, and remained so until 1830, with only such occasional depressions as might be caused by strong winds, being nearly upon a level with the wharves.”*

From 1830, when my attention was first drawn to this subject, to the present year, I have been enabled to make a somewhat connected series of observations, under circumstances peculiarly favorably, having during that time followed the complete line of coast, from the foot of Lake Huron to the head of Lake Superior by canoe, and having traversed portions of the coast several times, thus being enabled to renew observations at points where they had been previously made. During the time of these examinations, I have been enabled to fix, with a considerable degree of certainty, upon the height at which the waters of the lakes stood in 1819 and ‘20, when they were at their lowest level; a step which

was conceived to be one of the first, necessary in determining the complete range between high and low water.

For the last two years my attention has been more particularly called to the coast of lakes Huron and Michigan, and I feel confident in asserting that the water of these lakes has, during the last year, (1838,) attained a greater elevation than has before occurred in a very great number of years; a fact which is conclusively shown by the renewed degradation of banks covered with debris, that had long remained undisturbed, as well as by the great number of forest trees, sometimes covering many acres of ground, that have been destroyed in consequence of inundation.

*The above extracts are from the pen of Col. Henry Whiting, U. S. Army, and their value is much enhanced from the fact that they embrace only such portions of the subject as were the result of his personal observation.

Many of these forest trees may be estimated to have attained an age of from one to two centuries.

In order to arrive as nearly as possible at correct conclusions as to the variation in the height of the water of the lakes from 1820 to 1838, I have carefully compared my own observations with those contained in an invaluable register, kept in this city by Col. Henry Whiting, U. S. Army, as also with the valuable data contained in the report of the State Topographer, hereto appended. It should be noted that the height of the water in the Detroit river is much more subject to fluctuation from slight causes, such as the effects of the winds and ice, than that in the open lakes; causes for the operation of which, it is sometimes difficult, if not impossible, to make the proper allowance. In fact, slight causes are productive of such changes as to render it absolutely impossible to arrive at accurate conclusions, except by simultaneous observations, made at points widely separated.

Assuming June 1819 and 20 as zero, or the point of low water, the following table will not vary very far from an accurate statement of the relative height for several of the subsequent years.

	Ft. In.
June 1819 and 20,	0.00
" 1828, rise,	2.10
" 1830, same level,	2.10
" 1836, rise,	10—3.08
" 1837, "	5—4.01
" 1838, "	7—4.08 Total.

In examining this table of relative heights, it should be borne in mind that this estimate does not include the regular yearly variation to which the waters of the lakes are subject. The estimates, it will be seen, are made from June of each year, or that month in which the waters are invariably high; but it is conceived the result would not be varied were the calculations made from any other month in the year, provided the same month were selected for the observations of the succeeding years. Were the difference in height computed from February, 1820 to June, 1838, the total amount would be found to be increased to about six feet eight inches, a method of estimating winch would lead to conclusions wholly unwarranted; nevertheless the assumption of these defective premises may serve to account for the exaggerated statements which have so often been made, of the increased height of these waters.

This rise of water has by no means been confined to the great lakes, for the waters of the small lakes through the whole interior portions of the state have, unless their waters are discharged through broad and shallow outlets, been increased in a like mariner. Small streams the width of which, at their points of intersecting the section lines, were recorded by the United States' surveyors, in those surveys made from 1820 to 26, have been found, in many instances, during the past year, to have nearly double the width assigned them; and mills have actually been erected upon streams which, according to the field notes taken in the years mentioned, must at that time have been nearly dry. It is also well known that within the last few years, (preceding 1838,) portions of the elevated country which were previously dry, have been inundated with water; springs have burst out where they had been previously unknown, and that marshes, which before contained but little water, have been transformed into small ponds or lakes.

These changes have not been peculiar to Michigan, for they have been noticed, more or less, over the whole western part of the United States, and perhaps it may not be too much to add over most of the northern part of the continent; and they are changes which, from the immense extent effected, must depend upon causes which have operated in a very general manner.

It is well known that the water of all streams, during the occurrence of a wet and cold season, when the fall of rain is increased and evaporation diminished, is augmented, and that the augmentation or diminution will be in proportion as these causes are in more or less active operation. Our great chain of inland lakes, so far as these causes may be supposed to operate, may be regarded as a stream of great width, and must necessarily be liable to be affected by similar causes; although when the great extent occupied by these bodies of water is taken into consideration, it can be readily understood why these causes when once brought into operation would produce their results more slowly, as well as why the results once produced would be of a more permanent character.

That the changes in the relative height of the waters of the lakes may be dependent upon the operation of a similar series of general causes, operating for a succession of years, I have many reasons for inferring. The succession of cold and wet seasons immediately preceding 1838, have been proverbial over the whole western country; and the unfavorable influence which these wet seasons have produced, more particularly upon those farming interests situated on low and flat lands, has been severely felt by that portion of our

agricultural community. While these facts may be apparent to all, it is nevertheless desirable to refer to the subject in a more definite manner; a task which is rendered somewhat difficult, for the reason that, until the last few years, continuous tables, indicating the amount of rain which has fallen, have only been kept at a very limited number of places in the U. States.

The total amount of rain which fell at Philadelphia (as shown by a register, chiefly kept at the Pennsylvania Hospital) from 1810 to 1814 inclusive, or during the five years immediately preceding the high water of 1814 and '15, was 185.68 inches; and the amount which fell at the same place from 1815 to 1819, the five years immediately preceding the low water of 1819 and ?20, was 151.14 inches; showing an excsss of 34.53 inches, or a fraction over 2 feet and 10½ inch is for the years immediately preceding the stage of high water.

The amount of rain which fell at Philadelphia, as deduced from the same table, from 1810 to 1826 inclusive,* was 364.43 inches, and from 1827 to 1837 inclusive,† 451.05 inches, being an increase, in the last eleven years, of 86.62 inches, or a fraction over 7 feet 2½ inches.

The amount of rain which fell at Marietta, Ohio, (as deduced from the tables of Dr. Hildreth,) from 1819 to 1823 inclusive,‡ was 202.83 inches, and from 1828 to 1832 inclusive,‖ was 228.17,

*Eleven years, embracing the complete time from which the waters had perceptibly commenced falling, until they had again nearly attained the same alitude.

†Eleven years, during most of which time the waters have been steadily increasing in height.

‡Five years, embracing the time of low water,

‖Five years, during most of which time the water was increasing in height.

showing an increase during the last five years estimated, of 25.34 inches or a fraction over 2 feet 1⅓ inches.

That there has been a corresponding increase in the amount of rain that has fallen within the area of the great lake basin, I am not able to show by actual data, but the known increased size of the numerous tributaries, together with the other facts mentioned, will go far to substantiate the opinion that the fall of rain over that area has been greatly increased during that time.

According to the estimate of the State Topographer, it appears that the basin of the great northwestern lakes has a superficial area, nearly four times larger than that of the lakes themselves. Now if we may be allowed to assume that the increase of the amount of rain which has fallen into this basin, during the last eleven, of the fourteen years estimated, be equal to the increase at Philadelphia, during that time, it would follow that, had all sources of discharge been cut off, this cause alone would have been sufficient to elevate the waters of the lakes about 29 feet;* an elevation more than six times greater than that which is estimated to have taken place.

When we take into consideration, in connexion with the causes already enumerated, the feet that during the wet years, evaporation must have been less than during the dry ones, it may fairly be presumed that sufficient *apparent* causes have existed, to produce all the results which have been noticed; and we may add, should a succession of dry and warm seasons follow, we may look with certainty for a return of the water of the lakes to its former low leve.

SOUTHERN PART OF THE PENINSULA.

A small portion of the season was devoted to general examinations, chiefly in the counties of Calhoun, Branch, Hillsdale and Jackson, but as it is proposed to commence the minute examination of these counties with the first opening of spring, it will not be desirable to lay the mass of facts collected! before you at this time.

The *county of Calhoun*, which in an agricultural point of view

*It is not, of course, supposed, that had the sources of discharge been cut off, this would have been the *actual* result, for the estimate is made without any reference to the increased evaporation and other causes, which would have been brought into action in consequence of the extended area.

cannot be looked upon as second to any county to our slate, if abundantly supplied with many of those materials which, if properly appreciated, may be made to add much to the eventual prosperity and wealth of the people. But while the agriculturist reaps a rich reward for his labor, in abundant crops, he should not fail to bear in mind, that the soil which is now yielding so abundantly, will, unless the most watchful care be used, sooner or later be rendered comparatively sterile. With a lavish distribution of all that will be required to retain the original fertility of the soils of this county, it is to be hoped that those most deeply interested will not neglect to turn the materials around them to the best account.

The whole northern part, *at least*, of *Calhoun* county, is based upon the sandstone series of the great carboniferous group of rocks. The outcropping edge of this rock furnishes an abundance of a material well adapted to the purposes of building. Quarries have been opened, at short intervals, through nearly the whole of that portion of the county traversed by the Kalamazoo river, as well as upon several of the tributaries of that stream, and with a little care in selection, it is admirably adapted to the purposes to which that rock is usually applied.

Shell marl occurs at numerous points in the county, occasionally in beds of considerable extent, and it may be profitably applied to use, either as a manure or for the manufacture of lime, an article, of which, under under other circumstances, the county would be nearly destitute.

Fibrous peat also occurs in considerable quantities, and when properly prepared, in the compost heap, will prove of great value to the farmer in enriching his lands.

The articles of marl and peat, occurring as they do, at very short intervals through most of the county, will eventually be of a value, in sustaining the agricultural interests, that at the present time can scarcely be appreciated. It is true that most of the gravelly soils, which predominate through Calhoun county, contain at this time, sufficient calcareous matter to favor the growth of the small grains, more particularly wheat and rye, which are well known to require a comparatively large proportion of that ingredient in the soil, to insure productive crops; but the time will come when this will cease to be the case, and when the marl beds must be called upon to supply the deficiency.

The county of Calhoun, together with the adjoining portions of Jackson and Hillsdale, abounds in large springs, which having their sources deep in the sandstone, are little liable to be affected by the droughts of summer. The waters of these springs are, for the most part "hard," in consequence of the contained salts of lime, but they are usually of great transparency and coldness. Several springs were noticed, the waters of which were so highly charged with carbonate of lime, as to have given rise to somewhat extensive beds of tufaceous marl.

No rock, in place, was noticed in the southwestern part of Calhoun, but a little south, and just within the line of Branch county, a deposite occurs, which may probably be referred to one portion of the carboniferous group, though this connection has not absolutely been shown to exist.

The deposite consists of a tough semi-indurated and stratified clay, having at first sight much the appearance of a very fine sandrock. It contains imbedded clay iron stone, composed as usual, of thin concentric layers of the carbonate and hydrate of iron, surrounding nodular masses of septarea.

The iron ore in question is of the same character as that from which much of the iron of our neighboring state, Ohio, is manufactured, and should future examinations show the deposite to contain the ore in sufficient quantity to admit of working, it cannot fail to prove of immense importance to the surrounding country. Occurring as the ore in Branch county docs, upon the borders of a township, nearly the whole of which is heavily timbered, very great facilities exist for procuring the materials necessary for its reduction.

The "kidney ore" is usually reduced with great facility, and in the large way, in the furnaces of Ohio, yields from 30 to 37 per cent of cast iron.

Portions of the clay embraced in the deposite under consideration, if care be used to select such only as is free from iron, will prove of great value for the manufacture of stone ware, fire bricks, &c. The presence of lime, it is well known, renders clay unfit for the manufacture of the articles mentioned; for the reason that the clay, by this admixture, is rendered fusible at a comparatively low temperature. The great mass of the clay alluded to, contains only a minute proportion of lime; and being so situated that it may be obtained with facility, it may be very advantageously applied to the purposes mentioned.

The deposite under consideration was first noticed on the Cold-water river, a short distance above the junction of that stream with the St. Joseph, where it appears in the bed of the stream, and also forms the banks, attaining an elevation of from 10 to 12 feet. The outcropping edge was traced for a distance of from one to two miles, and it was also found, but slightly covered with soil, extending over an area of from 800 to 1000 acres. It is not supposed, however, that the complete extent of its near approach to the surface has been examined, for there can be little doubt that the range will be found to be quite extensive.

Allusion has already been made to the numerous springs which occur in Calhoun county; but in no portion of the state has such an abundance of large springs been noticed as in the southwestern parts of Jackson county. Springs were here observed, frequently at very short intervals, discharging almost incredible quantities of water, and in some instances giving rise to streams of considerable size, at once. The waters of the larger of these springs are invariably found to proceed from the sand rock. They are little liable to be affected by drought, and, as I am informed, never freeze. The waters of those springs examined had, during the month of October, a temperature ranging from 47° to 49° Fah.

The counties of Branch, Hillsdale and Jackson, like that of Calhoun, abound in beds of shell and tufaceous marl, which is usually well fitted for the manufacture of lime, or for use for agricultural purposes. Ligneous peat also frequently occurs, and it may, with proper preparation, be rendered of much value as a manure.

Coal.

We have been enabled, during the past year, considerably to extend the small amount of information before transmitted to you, respecting the coal beds of our state; and although, from the limited extent of the minute examinations in the coal district, I am still unable to place the subject before you in such a manner as could be wished; its great importance would, nevertheless, seem to call for an allusion, at least, to such additional information as has been obtained.

By reference to the report of C. C. Douglass, Assistant Geologist, hereto appended, on the subject of the minute surveys of Ingham and Eaton counties, it will be seen that the main bed of coal, which traverses the central counties of the state, has been traced northerly to within a few miles of the south line of Shiawassee county; and that the bed has been found of sufficient thickness to to admit of being profitably worked.

Much labor will be required in order to determine the northeasterly limit of the coal range; but so many facts respecting the line of its *outcrop*, have been collected, that the labor will be considerably lessened during the

continuance of the examinations. The unbroken character of the country, together with the readiness with which the rock embracing the coal, disintegrates, thus covering the outcropping edges with debris, throw obstacles in the way of a connected series of examinations, which are severely felt; but thus far, we have been enabled to combat these difficulties with greater success than could have been anticipated.

The line of coal has also been traced southwesterly into Jackson county, where the bed is of sufficient thickness to admit of being worked, and the coal is of a quality well fitted for all the purposes to which that substance is usually applied.

Two miles, in a southeasterly direction, from the village of Barry, (Jackson county,) some explorations have been made, and an amount, estimated at about 1500 bushels of coal, raised. This coal has been applied to use in the blacksmiths' shops of the vicinity, and is mostly of good quality, although it is occasionally somewhat injured by the presence of iron pyrites. For the reason that the outcrop of this bed is nearly on a level with the water of Sandstone creek, the persons engaged in the work were unable to sink completely through the coal; it was, however, penetrated at one point, to a depth of about three feet. The immediate banks of the stream rise, by a gentle acclivity, to a height of from ten to fifteen feet, and by renewing the examinations upon that side of the stream opposite to the dip of the strata, they may be conducted free from the difficulties before mentioned. This bed of coal is associated with a series of shales and sandstones, in a manner similar to that of the other beds in the stale. The coal is highly bituminous, a character in common with all that has been seen in the state, and it may safely be said that none other need be looked for on the peninsula.

From facts now before me, I am led to hope, that coal will be found in the elevated hills of the northern part of the peninsula, easterly from Little Traverse bay; a circumstance which, should it prove to be the case, will add much to the value of that portion of the state.

SALT SPRINGS AND STATE SALT LANDS.

The subject of salt springs, which was laid before you, somewhat at length, in the first annual report from this department, has been partially re-examined during the past year, and the observations considerably extended. These renewed examinations have served to add confidence to the hope then expressed, that a portion of these springs will eventually prove of value to the state. Many springs, before unknown have been observed, and would be more particularly noticed had not the facts, involving the main question, been before submitted.

The progress which had been made in the improvements directed to be commenced "at one or more of the state salt springs," has been duly submitted to you in a separate report. Since the reception of your instructions to continue the improvements, which had previously been partially suspended, the work has been renewed with a vigor commensurate with its importance. Should the examinations in progress lead to favorable results, as we trust they will, this important addition to the products of the state, cannot fail to add to its prosperity; while, should we fail in our anticipations, the income which may be derived from the lands, will create a sinking fund, that may soon be made to reimburse to the state, the amount which may be expended for that purpose.

Of the salt springs granted to our state by the general governernment, five yet remain to be located; which, with their contiguous lands, will amount to thirty sections. The location of these lands has been thus far delayed, in consequence of the unfinished condition of the United States' surveys, they not having been sufficiently completed to allow those selections to be made which were most desirable. Nor have we, as yet, been enabled to obtain from the general land office " plats" of the sections of country, in which it is proposed to complete those locations. Since, according to the terms of the grant, the returns of these lands are required to be made during the current year, it becomes a matter of no small moment to complete the selections at the earliest day possible; in view of which, so soon as the necessary information can be obtained from the general land office, steps will be taken to complete the locations.

ZOOLOGICAL AND BOTANICAL DEPARTMENTS.

These departments of the geological survey, which, during the year 1837, were united under the direct charge of Dr. Abm. Sager, have, in conformity to the provisions of the revised act, been separated into two distinct departments, that of zoology having been left in charge of Dr. Sager, while that of botany was placed under charge of Dr. John Wright.

The success which has attended the labors of the heads of these departments, is of the most flattering kind, and affords ample proof that the high character which those gentlemen have sustained as men of science and industry, has not been misplaced, and that we may anticipate from their labors the most interesting and useful results.

The subjects falling within the scope of these departments, being of a more abstruse character, do not so readily admit of being; treated in a disjointed manner, as the other subjects of the geological survey; for which reason the heads of these departments., in most of the states where these surveys are in progress, have not been called upon for annual reports, it being intended to embody the whole at once, in a final and connected report. As our own state is somewhat differently circumstanced, having been less explored, it was deemed advisable to throw together such catalogues as would furnish those persons who have devoted attention to the subjects in our state, a skeleton of the progress that has been made, hoping thereby to elicit such

additional information as may be at hand. The reports of the zoologist and botanist, numbered 1 and 2, are hereto appended.

The fact that there is, in reality, but one science in nature, and that all the subdivisions of that science are to a great extent, arbitrary, is frequently lost sight of in our utilitarian age; a circumstance to which, no doubt, may in part be ascribed the general disposition to scan results closely, while the steps necessary to bring about those results are scarcely considered. We are thus too often disposed to consider as of little value or importance, those very subjects, the laborious investigation of which are daily adding to our comfort and enjoyment.

The man who should richly endow an institution would be looked upon as a benefactor; while the man of science who should engage in a patient investigation of the habits of the Hessian fly, and thereby be able to suggest some successful expedient for avoiding the ravages committed upon our wheat fields, would, no doubt, be looked upon as one engaged in a work of no value to his fellow men; yet, if we look at results, the latter would be much more eminently entitled to the name of benefactor.

One of the fathers of natural history, after carefully studying the habits of a small worm that had proved destructive to the timber in the navy yards of his country, suggested a simple yet perfect remedy, thereby saving annually more than a million of dollars to his government; yet, during these investigations, he was stigmatized as one engaged in a work which was wholly unworthy his attention, and which could not possibly prove of any practical value.

The subjects of geology may be regarded as so intimately connected with the other departments of natural history, as to be absolutely inseparable. "All the branches of natural history, and most of the other sciences, cluster around geology, and lend to it and each other a mutual support. No man can make great advances in all the branches of geology; the proper course to be pursued, is for each individual to become acquainted with the outlines of the subject, and then devote his attention to some particular branch of enquiry. It is by such a division of labor, that geology has advanced so rapidly within a few years. The geologist must have the results of such labors before he can draw definite conclusions on some points of geology."*

When the work in the departments under consideration shall have been completed, it is proposed to embody in a final report, in a condensed yet intelligible manner, all that has been elicited during the progress of the examinations, as well as what is now embodied in abstract works upon those subjects. While an attempt will made to render this of value to the man of science, the subjects of practical utility will, nevertheless, be kept constantly in view.

The medical properties and various uses to which the indigenous plants of our state may be applied, are at this time scarcely known, and less appreciated, by our citizens; and while we are looking abroad for many articles necessary to our health and comfort, the very same articles, or those which will answer the purpose equally well, are growing in abundance around us.

COLLECTIONS FOR THE STATE UNIVERSITY.

That portion of the duties assigned the geological board, involving the collection of specimens of natural history for the university, has received as large a share of attention as a faithful performance of the other duties assigned would permit. The present time, no doubt, offers a more favorable opportunity to supply the parent university and its branches with specimens of natural history, than any that will again soon occur. In view of the limited facilities which are afforded for the study of these subjects in the colleges of our country, as also of the character which the addition of such facilities would give to our slate institution, the board of regents have manifested a deep anxiety to furnish every facility in their power to aid in making these collections as perfect as possible.

The collections already made in the several departments of mineralogy, geology, zoology, and botany are in such condition that they may be readily transferred to the university, at Ann Arbor, whenever the proper arrangements shall have been made by the regents for that purpose.

*Governor Marcy's report to the legislature of the state of New York, on the subject of the geological survey of that state.

The board of regents have already furnished ample rooms, in this city, as a temporary place of deposite for the collections now being made.

TOPOGRAPHICAL DEPARTMENT, MAPS, &C.

This department of the geological survey, which was duly organized under the provisions of the act of 1838, has been placed under the immediate charge of S. W. Higgins, Esq. whose report, No. 3, is hereto appended.

The arduous duties connected with this department have been performed with a degree of energy and devotion which deserve the highest encomiums; and we trust it may result in furnishing for our state an amount of accurately delineated geographical and topographical information, which will not be exceeded by any state in our union.

The present time is an exceedingly favorable one for carrying forward this portion of the work ; for at this time, while the state engineers are engaged upon our works of internal improvement, and while the United States' surveyors are engaged in subdividing the northern part of the peninsula, we are enabled, with a comparatively small amount of labor and expense, to collect a vast amount of the most accurate geographical and

topographical information, which unless recorded at once would soon be lost.

The necessity for the construction of accurate geographical maps, for the delineation of the geology and topography of the state, can be easily understood; and without the former, the projection of the latter would be a dead letter. The inaccuracy of our present maps, together with their reduced scale, is well known; and the necessity for the construction of those of a larger and more perfect character, has been deeply felt by every person whose attention has been called minutely to the subject. In order to avoid the embarrassment which this defective character of geographical information is daily producing, it is very desirable that the remedy should be provided, with as little delay as may be compatible with the magnitude of the work.

Maps of the separate counties of the state, have been commenced, upon a scale of two miles to the inch;* a size which will

*This scale is a fraction larger than that adopted by the surveyor general of the state of New York, for the maps of that state, which were constructed tinder his direction.

enable us to place upon them most of that information which will be required for the use of town and county officers ; such as the length of fractional section lines, variations in the surveys, width of streams at the crossings of the section lines, principal roads, &c. &c. Upon these maps, when completed, will also be introduced the complete geology and topography of the country.

In order that the materials upon which to base these maps may always be at band, the complete original United States surveys, so far as returns have been made to the land offices of the state, have been copied: and steps have been taken to procure from the general land office those new surveys in progress, immediately upon the transmission of the returns by the deputy surveyors. These "plats," however, only designate the small streams and marshes at the crossings of the section lines, leaving the whole interior of the sections to be filled up. In order to accomplish the immense work of filling up the deficiencies in the township maps, each of the assistants engaged in the survey, is instructed to take into the field perfect copies of the original surveys of the district in which he may be engaged, and to return the same with the streams carried out, across the interior of the sections, together with an accurate delineation of the marshes, small lakes, ranges of hills, the area of different kinds of soils, timbered lands, openings, prairies, the courses of the township roads, &c. &c, as also with the geology, and so much of the topography, as the work may warrant.

The difficulties connected with the construction of accurate maps, of the older counties of the state, are much increased in consequence of the inaccuracy of the original United States' surveys. In fact, so great is the discrepancy, in many instances, as to lead to the inference that some of the subdivisions were made, or plat-led, without going upon the ground. And where the lines, in many parts of these counties, were "run," the variation between the actual and proposed course is so great, as to render it nearly impossible to make the "work close." Many streams, of considerable magnitude, are wholly omitted upon these "plats"; lakes and swamps are placed where none exist; and small lakes, in a few instances, have been found to be upon sections widely separated from those upon which they are represented, facts which are known to have given rise to mistakes of a most serious character. Instances can be cited where lands have been purchased at the land office, by reference to the "plats" on file, and those lands afterwards found to be completely covered by the waters of a lake; others, where in consequence of erroneous marks at the corners of sections, lands have been "entered" several miles distant from those intended; circumstances which have given rise to much individual distress.

In connection with this subject, I would respectfully call your attention to the importance of dividing the northern portion of the peninsula into counties, and assigning to each a definite limit, with as little delay as the progress of United States' surveys will permit. The most natural divisions may as readily be determined from information which will be elicited during the continuance of the work in progress, as at any future time. By adopting this course before private interest comes to clash upon the subject, much legislation may be avoided; at the same time that it will throw those portions of our state into such a form that they may be more satisfactorily projected upon the maps now in progress. No possible objection, it is conceived, can be urged against this course, while it may fairly be supposed it will result in great good.

REPORTS OF GEOLOGICAL ASSISTANTS.

The reports of Messrs. C. C. Douglass and Bela Hubbard, assistants in the geological department proper, of the survey, numbered 4 and 5, are hereto appended. The great mass of geographical and topographical information which they have been industriously engaged in collecting, could not be laid before you, except in connection with complete maps of the counties in which they have been engaged. The duties which were assigned these assistants, notwithstanding the numerous difficulties by which they have been surrounded, have been accomplished in a manner highly creditable; and we have now on file nearly all the matter requisite for the complete elucidation of the condition and resources, as well as for the construction of maps of the counties, in the survey of which they have been engaged.

The consideration of that portion of the work which relates more particularly to agriculture, it has been deemed advisable, thus far, to defer, for the very good reason that sufficient time has not yet elapsed for the complete analysis of the soils, a labor which must be performed before minute practical conclusions can be drawn. The extent of certain characters of soils, in the

counties examined, together with their adaptation to the purposes of agriculture, and the remedies necessary to supply any defects in their composition, are subjects, to the consideration of which much time has already been, and will hereafter be devoted.

Upon the first opening of spring, it is proposed to renew the minute surveys in the southern counties of the state, and to complete the work, in each of those counties, as rapidly as circumstances will permit.

The difficulties by which we were surrounded in perfecting the survey, under the original act, have been removed by the present plan of organization, and moving on as a whole, the assistance and support given each other, by the separate departments, is such, that a much larger amount of labor is accomplished than, under other circumstances, could possibly be done, while the work is, at the same time, rendered uniform and complete.

In conclusion, I would respectfully tender through you my grateful acknowledgements as well for the uniform kindness with which I have been received, as for the valuable information and assistance which has been rendered to the work in progress, by the citizens of our state.

DOUGLASS HOUGHTON,
State Geologist.

DOCUMENTS.

(No. 1.)
REPORT
Of Doct ABM. SAGER, Zoologist of Geological Survey

Detroit, January 12, 1839.

TO DOUGLASS HOUGHTON, STATE GEOLOGIST.

SIR—In conformity to the provisions of an act approved March 22, 1838, providing for a geological survey of the state, the undersigned respectfully submits the following report of the progress made in the zoological department.

Previous to submitting the result of the investigation in this department during the past year, permit me, for the satisfaction of those whose liberality and zeal for the interest of our state authorized the survey, to present a condensed view of the objects and anticipated results of the investigation in this department.

To investigate as far as practicable the mode of existence, the relative position, office and influence in the sentient organic world of every animal native to our state, from the insect of ephemeral existence, the worm that wends its way darkling through a brief and simple life, to the quadruped of most varied and complicated structure and functions, more especially their relation to and influence, either direct and obvious, or indirect, upon the interest and happiness of man; operating by the developement of our intellectual and moral natures, and ministering to our physical necessities,—to ascertain if possible the means of rendering them directly subservient to our interests and avert the evils arising from an excessive developement of the species,—to collect, preserve and systematically arrange, in order to display affinities of structure, specimens of every species, and materials illustrative of their habits and instincts, the whole with a view to excite and disseminate a taste for the interesting and important study of zoology:— These appear to have been the objects contemplated by the legislature that framed and enacted the bill authorizing the investigation.

It must be obvious to every reflecting mind, that no well directed or availing efforts can be made, either to improve the advantages or avert the evils growing out of our connection with the animal world, without an intimate acquaintance with their structure, capabilities and habits. Destitute of this knowledge, we but strike in the dark, and are more likely to impair than promote our interests.

It will be seen at a glance that the subject is of vast extent; and surely if the study of the phenomena of the inorganic world, with a view to determine its general laws, of which to avail ourselves to advance our interest, is worthy of encouragement as of last importance, not less so are those manifold and varied manifestations of the Infinite that constitute the phenomena of the organic world, and the proper study of the Botanist and Zoologist. Nor should we anticipate less important results when those studies have been prosecuted to the educing those general principles that rule the organic creation, than we already derive from an acquaintance with those by which the inorganic world is directed and governed. As intellectual pursuits, in moral interest and sublimity, they do not concede the palm of superiority to any other subjects whatever. Surely the mind that can view from the pinnacle of the temple of science, at a glance, the whole organic world outspread beneath him, can comprehend its vast and intricate machinery, and behold it moving by a few simple, uniform and unvarying principles, is favored with a prospect not less sublime than that to whose intellectual vision the whole inorganic world is revealed.

As early in the season as the necessary arrangements and preparations would permit, we commenced our labor, the results of which will, in part, be found in the subjoined catalogue. Of many of the species contained in the catalogue, the requisite number of species have been preserved; of some other species, a much larger number than was required have been collected, with a view to foreign exchanges, and in consequence of the rarity of others not a sufficient number have been secured. Besides the species enumerated in the catalogue, a very considerable number belonging to the inferior classes have been obtained, but do not yet admit of arrangement in a catalogue. Although a considerable

amount of materials have been collected towards forming a history of the subjects of our investigation, yet much remains to be accomplished before the subject can be said to approach completeness.

ABM. SAGER, *State Zoologist*

CATALOGUE.

CLASS MAMMALIA.

Order Quadrumana
- Fam. Vespertilionidae. Gray. Bats
  - Sub-fam. Vespertilioninae. Gray.
    - Vespertilio arcuatus. Say.

Order Ferae. Linn.
- Fam. Felidae
  - Lupus occidentalis. Rich. Wolf
  - Vulpes fulvus. L. Red fox
- Fam. Mustelidae. Sw.
  - Sub-fam. Ursinae. Sw.
    - Procyon lotor. L. Raccoon
  - Sub-fam. Mustelinae. Sw.
    - Putorius lutreola. Cuv. Mink
- Fam. Sorecidae. S.
  - Sorex parvus. Say. Shrew
  - Scalops canadensis. Cuv. Canada mole
  - Condylura macroura. Harl. Star nosed mole

Order Glires. Linn.
- Div. 1st. Claviculata
  - Fiber zibeticus. L. Musk rat
  - Arvicola ———
  - Meriones canadensis. Ill. Jumping mouse
  - Spermophilus Hoodii. F. Cuv.
  - Sciurus vulpinus ? Gm. Fox squirrel
    - carolinensis. L. Gray squirrel
  - Sciurus hudsonius. L. Chickaree
    - niger. L. Black squirrel
  - Tamia striata. Kl. Ground squirrel
- Div. Inclaviculata
  - Lepus americanus. Gm. American hare

CLASS AVES.

Order Raptores
- Fam. Falconidae
  - Sub-fam. Aquilinae. Eagles
    - Pandion americanus. Sw. Fish eagle
    - Aquila leucocephalus. Bald eagle
  - Sub-fam. Buteoninae. Buzzards
    - Buteo Sancti Johannis. Gm. Black hawk
      - lagopus. ? Roughed legged hawk
      - lineatus, Aud. Red breasted hawk
    - Circus cyaneus. L. Marsh hawk
  - Sub-fam. Falconinae. Falcons
    - Falco peregrinus. Gm. Wandering falcon
      - sparverius. L. Amer. sparrow hawk
      - columbarius. L. Pigeon hawk
  - Sub-fam. Accipitrinae. Hawks
  - Accipiter pennsylvanicus. Sw.
    - Cooperi. Nutt. Cooper's hawk
  - Astur borealis. Sw. Red tailed hawk
- Fam. Strigidae Owls
  - Scotophilus acadica. Sw. Little owl
  - Otus. brachyotus. Sw. Short eared owl
    - vulgaris. Sw. Long eared owl
  - Asio virginiana. Sw. Great horned owl
  - Ulula nebulosa. Cuv. Barred owl
  - Nyctea candida. Sw. Snowy owl
  - Surnia funerea. Dum. Hawk owl

Order Insessores—Perchers
- Tribe Dentirostres
  - Fam. Laniadae
    - Sub-fam. Lanianae
      - Lanius septentrionalis. Gm. Shrike
    - Sub-fam. Tyranninae
      - Tyrannus intrepidus. Sw. Great crested king bird
        - crinita. Sw. King bird
        - inornata. Nutt
      - Tyrannula fusca. Sw. Phebe
      - Tyrannula virens. Sw. Wood pewee
        - acadica. Sw. Little pewee
        - Traillii. Sw. Trail's pewee
  - Fam. Merulidae
    - Sub-fam. Merulinae
      - Orpheus polyglottis. Sw. Mocking bird
        - rufus. Brown thrush
        - felivox. Sw. Cat bird
        - migratorius. Sw. American robin
        - mustelinus Sw. Wood thrush.
        - aurocapillus. Golden crowned thrush
        - aquaticus. Water thrush
  - Fam. Sylviadae
    - Sub-fam. Saxicolinae
      - Sialia Wilsonii. Sw. Blue bird.
    - Sub-fam. Sylvianae
      - Culicivora coerulea. Sw.
    - Sub-fam. Parianae
      - Setophaga ruticilla. Sw. Amer. redstart
        - canadensis. Sw. Canada flycatcher
        - cucullata. Sw. Hooded flycatcher
      - Dumecola (?) Wilsonii. Sw. Wilson's flycatcher
      - Sylvicola americana. Sw. Blue yellowbacked do
        - discolor. Sw. Prairie warbler
        - coronata. Sw. Yellow crowned warbler
        - castanea. Sw. Baybreasted warbler
        - icterocephala. Sw. Chesnutsided warbler
        - Blackburnaee. Sw. Blackburnian warbler
        - virens. Sw. Summer yellowbird
        - Canadensis. Blackthroated blue warbler
      - Vermivora pinus. Sw. Pine warbler
        - chrysoptera. Sw. Goldenwinged warbler
        - rubricapilla. Sw. Nashville warbler
      - Mniotilta varia Veill. Black and white creeper
      - Parus palustris. L. Black capt tit
      - Trichas personatus. Sw. Maryland yellowthroat
  - Fam. Ampelidae
    - Sub-fam. Vireoninae
      - Vireo olivaceus. Wils. Redeyed greenlet

Vireo flavifrons. Veill. Yellowthroated greenlet
noveboracensis. Bon. White eyed greenlet
Sub-fam. Bombycillinae
Bombycilla carolinensis. Briss. Cedar bird
Sub-fam. Garrulinae
Cyanurus cristatus. Sw. Blue jay
Fam. Sturnidae
Sub-fam. Scaphidurinae
Quiscalis versicolor. Veill. Crow Black bird
Scolecophagus ferrugineus. Sw. Rustle grakle
Sub-fam. Icterinae
Icterus Baltimore. Daud. Golden oriole
spurius. Bon. Orchard oriole
Sub-fam. Aglainae
Dolichonyx orizivora Sw. Rice bunting
Agelaius phoeniceus. Bill. Swamp black bird
Molothrus pecoris. Sw. Cowpen
Sturnella collaris. Bill. Meadow lark
Fam. Fringillidae
Sub-fam. Coccothraustinae
Coccoborus ludovicianus. Sw. Redbreasted grosbeak
Carduelis americana. Sw. Yellow bird
Sub-fam. Tanagrinae
Phoenisoma rubra. Sw. Summer red bird
Pipillo erythropthalmus. Veill. Towee bunting
Sub-fam. Fringillinae
Fringilla graminea. Wils. Ground sparrow
juncorum. Lath. Field sparrow
Zonotrichia savannarum. Sw. Savanna finch
leucophrys. Sw. White crowned sparrow
pennsylvanica. Sw. White throated do.
melodia. Sw. Song sparrow
Ammodramus palustris. Sw. Swamp sparrow
Chondestes strigata. Sw. Lark finch
Emberiza canadensis. Sw. Tree sparrow
americana. Wils. Black throated bunting
cyanea. Sw. Indigo bird
Plectrophanes nivalis. Selb.

Sub-fam. Alaudinae
Alauda cornuta Wils. Lark
Sub-fam. Motacillinae
Anthus aquaticus. Bech.
Tribe 3d, Scansores
Fam. Picidae
Picus villosus. L. Hairy woodpecker
pubescens. L. Downy woodpecker
Dendrocopus varius. Sw. Yellow bellied woodpecker
Dryotomus pileatus. Sw. Log cock
Colaptes auratus. Sw. Flicker
Melanerpes erythrocephalus. Sw. Red headed woodpecker
Centurus carolinus. Sw. Carolina woodpecker
Fam. Certhiadae
Sub-fam. Certhianae
Certhia familiaris. L. Creeper
Sub-fam. Sittinae
Sitta carolinensis. L. White bellied nuthatch
Sub-fam. Troglodytinae
Thryothorus palustris. Veill. Marsh wren
Troglodytes europeus. Winter wren
Fam. Cuculidae
Sub-fam. Cuculinae
Erythrophrys domenicus. Sw. Black billed cuckoo
Coccyzus americanus. Sw. Yellow billed cuckoo
Tribe 4th. Tenuirostres
Fam. Trochilidae
Trochilus colubris. L. Humming bird
Fam. Halcyonidae
Ispida alcyon. Sw.
Fam. Caprimulgidae
Caprimulgus vociferus. L. Whippoorwill
Chordeiles americana. Sw. Night jar
Fam. Hirundinae
Cypselus pelasgius. Temm. Chimney swallow
Hirundo purpureus. L. Purple martin
rufa. Gm. Barn swallow
Fam. Hirundinae
Hirundo bicolor. Veill.
Order Rasores
Fam. Tetraonidae
Bonasia umbellus. Bon. Ruffed grouse
Tetrao cupido. L. Prairie hen
canadensis. L. Canada grouse
Ortyx virginiana. Steph. American quail
Fam. Columbidae
Ectopistes carolinensis. Sw. Turtle dove
migratorius. Sw. Passenger pigeon
Order Grallatores. Waders
Fam. Ardeadae
Ardea herodias. L. Blue heron
Egretta americana. Sw. Egret heron
Butor americana. Sw. American bittern
exilis. Sw. Least bittern
Fam. Rallidae
Fulica chloropus. Gm. Common gallinule
atra. Wils. Common coot
Rallus virginianus. L. Virginian rail
noveboracensis. Bon.
Fam. Scolopacidae
Scolopax minor. Gm. Woodcock
griseus. Gm. Red breasted snipe
Wilsonii. Bm. Wilson's snipe
Limosa fedoa. Veill. Marbled godwit
Tringa pectoralis. Bon. Pectoral sand-piper
minuta. Leisl. Small sand-piper
Wilsonii. Nutt. Wilson's sand-piper
cinerea. Knot
Totanus melanoleucus. Veill. Tell-tale
flavipes. Veill. Lesser yellow shanks
Bartramius. Temm. Bartram's tatler
macularius. Temm. Spotted sand-piper
chloropygius. Veill. Green rump sand-piper
Strepsilas interpres. Ill. Turnstone

Fam. Charadriadae
Charadrius vociferus. L. Kildeer plover
pluvialis. L. Golden plover
Squatarola melanogaster, Bech.
Order Natatores
Fam. Anatidae
Sub-fam. Anserinae
Cygnus musicus. Bech. Swan
Anser canadensis. Veill. Canada goose
hyperboreus. Pall. Snow goose
Sub-fam. Anatinae. River ducks
Mareca americana. Leach. American widgeon
Dendronessa sponsa. Sw. Tree duck
Chauliodus strepera. Sw. Gadwall
Anas clypeata. Sw. Shoveller
Boschas domestica. Sw. Mallard
crecca. Sw. Greenwinged teal
discors. Sw. Bluewinged teal
obscura. Sw. Dusky duck
Dafila caudacuta. Leach. Pintail duck
Sub-fam. Fuligulinae
Fuligula ferina. Steph. Pochard
valisneri. Steph. Canvassback
marilla. Steph. Scaup duck
rufitorques. Bon. Ringneck
Clangula albeola. Rich. Buffelhead
Haralda glacialis. Sw. Longtailed duck
Sub-fam. Merganidae
Mergus merganser. L. Gooseander
serrator. L.
cucullatus. L. Crested merganser
Fam. Colymbidae
Podiceps rubricollis. Lath. Rednecked grebe
cornutus. Lath. Horned grebe
Dasyptilus carolinensis. Sw. Pied dobchick
Fam. Alcadae
Sub-fam. Laridae
Sterna Hirundo. L. Swallowtailed tern

Sub-fam. Larus Bonapartii. Sw. Bonaparte's gull
zonorhynchus. Rich.
glaucus. Brunn.
atricilla. Sw.

CLASS REPTILIA.

Order Chelonia
- Cistudo clausa. Say. Box tortoise
- Emys picta. Schw.
  - geographica. Say.
  - guttata. Schw.
  - pennsylvanica. Harl.
- Chelydra serpentina. Schw. Snapping turtle

Order Ophidia
- Coluber obsoletus. Say.
  - constrictor. L. Black snake
  - sipedon. L. Brown water snake
  - saurita. L. Ribbon snake
  - sirtalis. L. Garter snake
  - proximus. (?) Say.
  - punctatus. L.
  - septemvittatus. Say.
  - heterodon. Daud. Hognosed snake
  - eximius. DeKay. Chicken snake
  - vernalis. DeKay. Green snake
- Crotalus tergeminus. Say. Rattle snake

CLASS AMPHIBIA.

Order Batrachia
- Bufo musicus, Cuv. Toad
- Hyla versicolor. LeConte. Tree toad
- Rana clamitans. Daud.
  - halecina. Daud. Shad frog
  - palustris. LeConte, Tiger frog
  - sylvatica. LeConte. Wood frog
  - gryllus. LeConte. Savannah cricket
- Salamandra symmetrica. Harl.

- Salamandra cinerea. (?) Gr.
  - undetermined
- Menobranches lateralis. Harl.

CLASS PISCES.

Order Acanthopterygii
- Fam. Percoides
  - Perca flavescens? Cuv. and Val. Perch
  - Labrax—undetermined
  - Lucioperca Americana. Cuv. Pickerel
  - Pomotis auritus? Cuv.
  - Centrarchus aeneus. Cuv.

Order Malacopterygii Abdominales
- Fam. Cyprinidae
  - Labeo Cyprinus. Cuv.
  - Catostomus macrolepidotus. Les. Sucker
    - nigricans. Les.
  - 3 species undetermined
- Fam. Esoces
  - Esox reticulatus. Les. Pike
    - estor. Les. Muskelonge
- Fam. Siluridae
  - Pimelodus catus. Lac. Catfish
- Fam. Salmonidae
  - Salmo amethystes. Mitch. Trout
  - Corregonus albus. Les. Whitefish
    - Artedi. Les.
- Fam. Clupeae
  - Hyodon tergisus. Les. Herring
  - Lepisosteus. Lac.

Order Malacopterygii Subbrachiata
- Fam. Gadoides
  - Lota maculata. Cuv. Dogfish

Order Chondropterygii
- Fam. Sturiones
  - Sturio maculosus? Cuv. Sturgeon
- Fam. Cyclostomes
  - Petromyzon nigricans? Les. Lamprey

DIV. MOLUSCA.

CLASS CHONCHIFERA.

Sect. Lamellipoda
- Cyclas similis. Say.
  - dubiosa. Say.
- Naiadae. Fresh water bivalves
- Unio plicatus. Say.
  - alatus. Say.
  - purpureus. Say.
  - fasciolaris. Raf.
  - undulatus. Barnes.
  - multiradiatus. Lea.
  - circulus. Lea.
  - penitus. Con.
  - lapillus. Say.
  - compressus. Lea.
  - triangularis. Barnes.
  - cariosus. Say.
  - fragilis. Raf.
  - subrotundus. Lea.
  - coelatus. Con.
  - iris. Lea.
  - Hildrethianus. Lea.
  - siliquoideus. Barnes.
  - nasutus. Say.
  - rectus. Lam.
  - dilatatus. Raf.
  - tuberculatus. Raf.
  - bullatus. Raf.
  - olivarius. Raf.
  - rubiginosus. Lea.
  - gibbosus. Raf.
  - ventricosus. Bar.
- Anodonta Ferrussaciana. Lea.
  - cataracta. Say.
- Alasmodonta marginata. Say.
  - undulata. Say.
  - edentula. Say.

CLASS MOLUSCA.

Order Gasteropoda
- Phyllidiana
  - Patella

Order Trachelipoda
- Colimacea
  - Helix solitaria. Say.
    - albolabris. Say.
    - zaleta. Say.
    - multilineata. Say.
    - clausa. Say.
    - materna. Say.
    - fallax. Say.
    - hirsuta. Say.
    - perspectiva. Say.
    - palliata. Say.
    - inflecta. Say.
    - thyroidus. Say.
    - fraterna. Say.
    - ligera. Say.
    - fuliginosa. Say.
    - concava. Say.
    - profunda. Say.
    - alternata. Say.
    - tridentata. Say.
    - inornata. Say.
    - elevata. Say.
    - arboreus. Say.
  - Pupa ovata. Say.
  - Succinea ovalis. Say.
    - campestris. Say.
  - Lymneana
    - Planorbis trivolvis. Say.
      - exacuus. Say.
      - campanulatus. Say.
      - bicarinatus. Say.
    - Physa heterostropha. Say.

Physa elongata. Say.
Lymneus columellus. Say.
elodes. Say.
desidiosus. Say.
stagnalis.
Melaniana
Melania virginica. Say.
depygis. Say.
Peristomiana
Valvata tricarinata. Say.
sincera. Say.
Paludina decisa. Say.
ponderosa. Say.

(No. 2.)
REPORT
Of Doct. JOHN WRIGHT, Botanist of the Geological Survey.

Detroit, *January* 1*st*, 1839.

TO DOUGLASS HOUGHTON, STATE GEOLOGIST.

SIR: In compliance with the act passed by the state legislature, March, 1838, providing for a geological survey of the state the undersigned respectfully submits the following

REPORT:

The examinations in the botanical department of the survey, during the past season, have been made in the two most southern ranges of counties of the state, from the Detroit river to Lake Michigan, excepting the county of Monroe; and in St. Clair county.

The extensive requisitions of the bill, making it obligatory on those engaged in investigating the natural history of the state, to collect and preserve, as far as practicable, seventeen specimens of each kind of its products, has been the principal inducement for confining the sphere of action to the above mentioned portions of the state. The bulky apparatus necessary to be conveyed from place to place, during the excursions, for the preservation of the plants in such extensive collections, and the requisite conveniences for drying and protecting them, render it impracticable to examine a very great extent of country, and particularly such portions of it as are unsettled, during a single season, or until the principal mass is collected.

The plan adopted during the past season, was to make the collections in the more inhabited portions, or in such situations of the country as are the most favorable for the preservation of the plants, and get together, as far as possible, the required number of those species which are found in them.

The parts which we have examined, undoubtedly, contain the majority of the whole number of species which grow in the state; and as they are sufficiently settled to possess the requisite facilities for acquiring such extensive collections, we have been enabled to accumulate a large number of specimens, which could not have been collected under any other circumstances; and, at the same time, to include in them the majority of the individual plants of the state; thereby preventing the embarrassing necessity of securing this extensive mass while investigating larger and less inhabited tracts, where these facilities are not offered.

With the able assistance of Mr. George H. Bull, assistant botanist, I have been enabled to examine between eight and nine hundred native or naturalized species of phenogamous or flowering plants; and to collect specimens of each, illustrative of their character, amounting, in all, to about nine thousand, which are now in an excellent state of preservation. More than this number of species were observed growing in the counties examined, but they were not in a proper condition for the selection of specimens for preservation at the time of observation.

A considerable number of cryptogamous or flowerless plants were also noticed and secured.

It has been our object, while making these collections, to select those specimens which will exhibit all the characters of the individuals; and for this purpose, all parts of the plant have been taken, as far as time and opportunity would admit of

The herbaceous plants, when not too large, have been kept entire, including their roots, stems, leaves, and flowers ; and when too large, suitable portions of each have been taken to illustrate them: of the woody ones, small branches with their leaves, and when practicable, flowers and fruit have been selected for the purpose; and it is intended to make the suit more perfect by procuring sections of their trunks, which want of time prevented us from doing, during the botanizing season. The size of the paper sheet used for holding them is 12 by 17 inches; thus allowing of the preservation of ample sized ones, which have accordingly been chosen. It has also been considered necessary to a complete herbarium, that the ripe seeds should be added, and those of a considerable number of species have been obtained for this object.

Observations relating to the individual plants have been made, with reference to their economical and medicinal uses; and to their correct analysis and individual characters. It is not my intention, in this report, to give a detailed account of such observations; for this would obviously be improper, as the investigations are not finished, and, in consequence, not sufficiently complete to allow of their being made at the present time; or, if made, would cause unnecessary repetition in the final report.

For these reasons, I have thought it advisable to confine the notice of the plants, at present, to a catalogue of their names, reserving a detailed account of them for a final report: and endeavor, in the mean time, to collect such facts in regard to the m,as opportunity shall offer, as will be of use both in a practical and scientific point of view.

It is my intention to examine, hereafter, those portions of the state which have not been explored, and render the collections as complete as possible.

The accompanying catalogue embraces the phenogamous and filicoid plants which have been collected.

JOHN WRIGHT, *Botanist*.

CATALOGUE.

A.

Acalypha virginica, Linn.* Three-seed mercury
Acer eriocarpum, Mx. Silver maple
nigrum, Mx. Black maple
saccharinum, Linn. Hard maple. Sugar maple
Achillea millefolium, Linn. Yarrow. Milfoil
Acnida cannabina, Linn. Water hemp. Indian hemp
Acorus calamus, Linn. Sweet flag
Actaea alba, Bw. White cohosh
racemosa, Linn. Cohosh. Black snake-root
rubra, Bw. Baneberry
Actinomeris squarrosa, Nutt.
Adiantum pedatum, Linn. Maiden-hair
Aesculus glabra, Ww. Small buck-eye
Agrimonia Eupatoria, Linn. Agrimony
Agropyron caninum, R and S.
Agrostemma Githago, Linn. Cockle
Agrostis alba, Linn. White-top
clandestina? Sprengel
lateriflora, Mx.
tenuiflora, Ww.
vulgaris, Smith. Red-top
Aira cespitosa, Linn.
Aletris farinosa, Linn. False aloe
Alisma Plantago, Linn. Water plantain
Allium canadense, Linn. Meadow garlic
cernuum, Roth.
tricoccum, Aiton. Three-seed leek
Alnus serrulata, Ww. Alder
Alopecurus geniculatus, Linn. Fox-tail
Amaranthus hybridus, Linn.
Ambrosia elatior, Linn. Hog-weed
trifida, Linn.
Amelanchier Botryapium, Lind. Shad-bush. June-berry

*For abbreviations of authors' names, see the end of the catalogue.

Amelanchier ovalis, Lind. Medlar-bush
sanguinea, D. C.
Amorpha canescens, Nutt. Lead-plant
Amphicarpa monoica, Elliott.
Andromeda calyculata, Linn. Leather-leaf
polifolia, Linn. Wild rosemary
Anemone aconitifolia, Mx.
nemorosa, Linn. Wood anemone
virginiana, Linn. Wind-flower
Andropogon furcatus, Muhl. Fork-spike
nutans, Linn. Beard-grass
scoparius, Mx. Broom-grass
virginicus, Linn.
Angelica atropurpurea, Linn. High angelica
triquinata, Mx.
Anethum foeniculum, Fennel
Anthemis cotula, Linn. May-weed
Apios tuberosa, Moenchausen. Ground-nut
Apocynum androsaemifolium, Linn. Dog-bane
hypericifolium, Aiton. Indian hemp.
Arabis canadensis, Linn. Sickle-pod
laevigata, D. C.
lyrata, Linn.
sagittata, Torrey.
Aralia nudicaulis, Linn. Wild sarsaparilla
racemosa, Linn. Spikenard
Arbutus Uva-ursi, Linn. Bearberry
Archemora ambigua, D. C.
Arctium lappa, Linn. Burdock
Arethusa bulbosa, Linn. Arethusa
Arenaria stricta, Mx.
lateriflora, Linn.
Aristida stricta, Mx.
Arum triphyllum, Linn. Wild turnip. Wake robin
Artemisia canadensis, Mx. Wild worm-wood
Arundo canadensis, Mx. Reed-grass
coarctata, Torrey
Asarum canadense, Linn. Wild ginger
Asclepias incarnata, Linn.

Asclepias lanceolata, Ives.
phytolaccoides, Lyon.
purpurascens, Linn.
syriaca, Linn. Milk-weed
tuberosa, Linn. Pleurisy-root. White-root
verticillata, Linn.
Aspidium acrostichoides, Ww.
asplenoides, Linn.
bulbiferum, Ww.
filix-femina, Ww.
intermedium, Muhl.
nove-boracensis, Ww.
Thelypteris, Ww.
Asplenium angustifolium, Mx.
thelypteroides, Mx. Silvery spleenwort
Aster acuminatus, (?) Mx.
corymbosus, Aiton.
diversifolius, Mx. (?)
laxus, Ww.
paniculatus, Aiton.
salicifolius, (?) Pursh.
sericeus, Nutt.
Tradescanti, Ww.
Astragalus canadensis, Linn. Milk vetch
Atheropogon apludoides, Muhl. Beard-grass

B.

Baptisia alba, Ww.
tinctoria, Brown. Wild indigo
Batschia canescens, Mx. Puccoon. False bugloss
Betula excelsa, Aiton. Yellow birch
glandulosa, Mx. Scrub birch
papyracea, Ww. Paper birch. Canoe birch
Bidens Beckii, Torrey. Water marygold
Bidens cernua, Linn.
frondosa, Linn. Burr marygold. Cuckold
petiolata, Nutt.
Blephilia ciliata, Rafinesque.

Blephilia hirsuta, Rafinesque.
Blitum virgatum, Linn. Slender blite
Botrychium fumaroides, Ww. Grape-fern
virginicum, Swartz. Rattlesnake-fern
Brachyelytrum aristatum, P. de B. False drop-grass
Bromus ciliatus, Linn.
pubescens, Linn.
purgans, Linn.
secalinus, Linn. Chess
Buchnera americana, Linn. Blue hearts

C.

Cacalia atriplicifolia, Linn.
tuberosa, Nutt.
Cakile americana, Nutt. Sea rocket
Calla palustris, Linn. Water arum
Calopogon pulchellus, Brown. Grass pink
Caltha palustris, Linn. American cowslip
Campanula americana, Linn.
erinoides, Muhl. Prickly bell-flower
rotundifolia, Linn. Flax bell-flower
Cannabis sativa, Linn. Hemp
Capsella bursa-pastoris, Moenchausen. Shepherd's purse
Cardamine hirsuta, Linn.
pratensis, Linn.
rhomboidea, D. C.
Carex acuta, Linn.
alba v. setifolia, Dewey.
ampullacea, Gmelin.
anceps, Schkuhr.
aquatilis, Wahlenberg.
aurea, Nutt.
bromoides, Schkuhr.
bullata, Schkuhr.
cephalophora, Ww.
cespitosa, Linn.
collecta? Dewey.
conoidea, Schkuhr.

Carex crinita, La Marck.
cristata, Schwinitz.
curta, Gmelin.
Deweyana, Schwinitz.
disperma, Dewey.
festucacea, Schkuhr.
filiformis, Gmelin.
flava, Linn.
folliculata, Linn.
formosa, Dewey.
gracillima, Schwinitz.
granularis, Muhl.
hystericina, Ww.
lagopodioides, Schkuhr.
lacustris, Ww.
laxiflora, LaMarck.
limosa, Linn.
lupulina, Muhl.
marginata, Muhl.
miliacea, Muhl.
nigro-marginata? Schwinitz.

Œderi, Ehrhart.
paniculata, Linn.
polytrichoides, Muhl.
pseudo-cyperus, Linn.
pubescens, Muhl.
retrorsa, Schwinitz.
scabrata, Schwinitz.
setacea, Dewey.
squarrosa, Linn.
stellulata, Schreber.
stipata, Muhl.
straminea, Ww.
sylvatica
tenera? Dewey.
tentaculata, Muhl.
teretiuscula, Gmelin.
trichocarpa, Muhl.
trisperma, Dewey.

Carex varia?
virescens, Muhl.
xanthophysa, Wahlenburg.
All of the marsh hay made in the state is composed of more or less of the species of the preceding genus.
Carpinus americana, Mx. Horn-beam
Carya amara, Nutt. Bitter-nut
porcina, Nutt. Pig-nut
Cassia marylandica, Linn. American senna
Ceanothus americanus, Linn. New Jersey tea
Celastrus scandens, Linn. Climbing staff-tree
Celtis crassifolia, LaMarck. Hoop ash
Cenchrus echinatus v. tribuloides, Torrey. Burr-grass
Centaurella paniculata, Mx. Screw-stem
Cephalanthus occidentalis, Linn. Button-bush
Cerastium vulgatum, Linn. Chick-weed
Chelone glabra, Linn. Snake-head

Chenopodium album, Linn. Pig-weed
ambrosioides, Linn. Sweet pig-weed
Botrys, Linn. Oak of Jerusalem
hybridum, Linn.
rubrum, Linn.
Chrysosplenium americanum, Swartz.
Cicuta bulbifera, Linn.
maculata, Linn. Water hemlock
Cinna arundinacea, Ww.
Circaea alpina, Linn.
Lutetiana, Persoon. Enchanter's nightshade
Claytonia virginica, Linn. Spring beauty
Clematis virginica, Linn. Virgins' bower
Clintonia borealis, Rafinesque. Wild lily of the valley
Cnicus discolor, Ww. Thistle
glutinosus, Bw.
lanceolatus, Ww.
odoratus, Muhl.
Pitcheri, Torrey.
Collinsia verna, Nutt.
Collinsonia canadensis, Linn. Horse balm

Commelina angustifolia, Mx.
Comptonia asplenifolia, Aiton. Sweet-fern
Convallaria multiflora, Ww. Giant Solomon's seal
Convolvulus Sepium, Linn. Wild morning glory
spithameus, Linn. Dwarf morning glory
Coptis trifolia, Salisbury. Gold thread
Corallorhiza multiflora, Nutt.
verna, Nutt. Coral-root
Coreopsis palmata, Nutt.
trichosperma, Mx.
tripteris, Ww. Tick-seed sunflower
Coriandrum sativum, Linn. Coriander
Cornus canadensis, Linn.
Cornus circinata, Schwinitz.
florida, Linn. Dogwood
paniculata, L'Heritier.
sericea, L'Heritier.

Corylus americana, Walter. Hazle-nut
Crataegus coccinea, Linn. Thorn-bush
punctata, Jacquin. Thorn-tree
Cryptotaenia canadensis, D. C.
Cuscuta americana, Linn. Dodder
Cynoglossum amplexicaule, Mx. Wild comfrey
officinale, Linn. Hound-tongue
Cyperus alterniflorus, Schwinitz.
flavescens, Linn.
mariscoides, Elliott.
phymatodes? Muhl.
strigosus, Linn.
Cypripedium acaule, Aiton. Ladies' slipper
pubescens, Swartz. Mocassin-flower
spectabile, Swartz.

D.

Dalibarda fragaroides, Mx. Dry strawberry
Danthonia spicata, P. deB. Wild oats
Datura Tatula, Linn. Purple thorn-apple
Decodon verticillatum, Elliott Swamp willow-herb

Dentaria diphylla, Mx. Tooth-root. Pepper-root
laciniata, Muhl.
Desmodium acuminatum, D. C.
bracteosum, D. C.
canadense, D. C. Bush trefoil
canescens, D. C ?
ciliare, D. C.
laevigatum, D. C.
marylandicum, D. C.
nudiflorum, D. C.
obtusum, D. C.
paniculatum, D. C.
rotundifolium, D. C.
strictum, D. C.
Diarrhena americana, P. de B.
Diervilla canadensis. Ww. Bush honeysuckle
Digitaria filiformis, Elliott.
sanguinalis, Scopoli. Finger-grass
Dioscorea villosa, Linn. Yam-root
Dracocephalum virginianum, Ww. Dragon-head
Drosera longifolia, Linn.
rotundifolia, Linn. Sundew
Dulichium spathaceum, Persoon. Galingale

E.

Eleusine indica, LaMarck.
Elymuscanadensis, v. glaucifolius, Torrey.
Hystrix, Linn. Hedgehog-grass
villosus, Muhl. Lime-grass
virginicus, Linn. Wild rye
Epigaea repens, Linn. Trailing arbutus
Epilobium coloratum, Muhl.
lineare, Muhl.
molle, Torrey.
Epiphegus virginianus, Barton. Beech-drops
Erigeron bellidifolius, Ww.
canadense, Linn. Flea-bane

Erigeron heterophyllus, Muhl.
philadelphicus, Linn.
strigosus, Muhl.
Eriocaulon pellucidum, Mx.
Eriophorum angustifolium ? Bw.
polystachyon, Linn. Cotton-grass
Eryngium aquaticum, Linn. Button snake-root
Erythronium americanum, Smith. Dog-tooth violet
Euchroma coccinea, Nutt. Painted-cup
Euonymus americanus, Linn.
obovatus, Nutt.
Eupatorium ageratoides, Linn.
amoenum, Pursh.
perfoliatum, Linn. Boneset. Thorough-wort
sessilifolium, Linn.
Euphorbia corollata, Linn.
maculata, Linn.
polygonifolia, Linn.
Equisetum arvense, Linn. Horse-tail
hyemale Linn. Scouring rush
limosum, Torrey.

F.

Fagus sylvatica, Linn. Beech
Festuca duriuscula, ? Linn.
nutans, Ww.
tenella, Ww.
Fragaria virginiana, Linn. Strawberry
Frasera caroliniensis, Walter. Columbo
Fraxinus acuminata, LaMarck. White ash
pubescens, Walter. Red ash
sambucifolia, Ww. Black ash
Fuirena squarrosa, Mx.

G.

Galeopsis Tetrahit, Linn. Flowering nettle
Galium asprellum ? Mx.
boreale, Pursh.
circaezans, Mx.
lanceolatum, Torrey.
Galium obtusum ? Bw.
pilosum, Aiton.
tinctorium, Linn. Wild madder
trifidum, Linn.
Gaultheria hispidula, Muhl.
procumbens, Linn. Wintergreen
Gaura biennis, Linn. Virginian loosestrife
Gentiana crinita, Froelich. Fringed gentian
quinqueflora, Ww.
Saponaria, Linn. Soap gentian
Geranium maculatum, Linn. Crane's-bill
Robertianum, Linn.
Gerardia auriculata, Mx.
flava, Linn. False foxglove
glauca, Eddy.
Pedicularia, Linn.
purpurea, Linn.
Geum rivale, Linn. Purple avens
strictum, Aiton. Upright avens
virginianum, Linn. Avens
Gleditschia triacanthos, Linn. Honey locust
Glyceria fluitans, Brown. Water fescue-grass
Gnaphalium plantagineum, Linn.
polycephalum, Mx. Life everlasting
uliginosum, Linn. Cud-weed
Goodyera pubescens, Brown. Rattle-snake plantain
Gyromia virginica, Nutt. Indian cucumber

H.

Habenaria bracteata, Brown. Vegetable satyr
ciliaris, Brown. Orchis
dilatata, Pursh. Giant orchis
fimbriata, Brown.
grandiflora, Torrey.
herbiola, Brown.
huronensis, Sprengel.
orbiculata, Pursh.
psycodes, Sprengel.
tridentata, Hooker.

Hamamelis virginica, Linn. Witch hazel
Hedeoma pulegioides, Persoon. Pennyroyal
Helenium autumnale, Linn.
Helianthemum canadense, Mx. Rock rose
Helianthus altissimus, Linn.
divaricatus ? Linn.
frondosus, Ww.
giganteus, Linn.
gracilis
strumosus, Linn.
trachelifolius, Ww.
Heliopsis laevis, Persoon.
Hepatica acutiloba, D. C.
americana, D. C. Liver-wort
Heracleum lanatum, Mx. Master-wort. Cow parsnip
Heuchera americana, Linn. Alum-root
Hibiscus trionum, Linn.

Hieracium Gronovii, Linn.
Kalmii, Linn.
marianum, Ww.
paniculatum, Linn.
Scouleri, Hedwig.
venosum, Linn. Blood-wort
Hippophae canadensis, Ww. Sea buckthorn,
Hippuris vulgaris, Linn.
Houstonia ciliolata, Torrey.
Hydrastis canadensis, Linn. Golden seal. Yellow-root
Hydrocotyle umbellata, Linn.
Hydropeltis purpurea, Mx. Water shield
Hydrophyllum canadense, Linn. Rough burr-flower
virginicum. Linn. Burr-flower
Hypericum ascyroides, Ww.
canadense, Linn.
parviflorum, Ww.
prolificum, Linn.
punctatum, La Marck.
virginicum, Linn.
Hypoxis erecta, Linn. Star-grass

Hyssopus nepetoides, Ww. Giant hyssop
scrophularifolius Ww.

I.

Ictodes foetidus, Bw. Skunk cabbage
Impatiens fulva, Nutt. Speckled jewels
pallida, Nutt. Jewel-weed
Inula Helenium, Linn. Elecampane
Iris versicolor, Linn. Wild flag
Isnardia palustris, Linn. Water purslane

J.

Juncus acuminatus, Mx.
Bufonius, Linn.
effusus, Linn. Bulrush
nodosus, Linn.
polycephalus, Mx.
setaceus, Rostk.
tenuis, Ww.
Juniperus communis, Linn. Juniper
virginianus, Linn. Red cedar

K.

Kalmia glauca, Aiton. Swamp laurel
Krigia amplexicaulis, Mx;
Koeleria nitida, Nutt.
pennsylvanica, D. C.
truncata, Torrey.
Kuhnia critonia, Ww.

L.

Lactuca elongata, Muhl. Wild lettuce
sanguinea, Bw. Wood lettuce
Lathyrus ochroleucus, Hooker.
myrtifolius, Muhl.
palustris, Linn. Marsh pea
venosus, Muhl.
Laurus Benzion, Linn. Spice-bush. Fever bush
Sassafras, Linn. Sassafras-tree
Lechea major, Mx. Pin-weed
Leersia oryzoides, Swartz. Cut-grass
virginica, Ww. White-grass. Rice-grass
Lemna minor, Linn. Green duck-meat
polyrrhiza, Linn. Water flax-seed

Lemna trisulca, Linn. Duck-meat
Leontice thalictroides, Linn. Poppoose-root. False cohosh
Leontodon Taraxacum, Linn. Dandelion.
Leonurus cardiaca, Linn. Motherwort
Lepidium virginicum, Linn. Wild pepper-grass
Leptandra virginica, Linn. Culver's physic
Lespedeza angustifolia, Elliott.
capitata, Mx.
polystachia, Mx.
prostrata? Pursh.
reticulata, Persoon.
violacea, Persoon.
Liatris cylindrica, Mx.
scariosa, Ww.
spicata, Ww. Gay feather
squarrosa? Ww.
Lilium canadense, Linn. Nodding lily
philadelphicum, Linn. Red lily
Lindernia attenuata, Muhl. False hedge hyssop
dilatata, Muhl. Pimpernel
Linnaea borealis, Gronovius. Twin-flower
Linum usitatissimum, Linn. Flax
virginianum, Linn. Wild flax
Liriodendron tulipifera, Linn. White-wood, Tulip-tree
Lithospermum officinale, Linn. Gromwell
Lobelia cardinalis, Linn. Cardinal-flower
Claytoniana, Mx.
Kalmii, Linn.
siphilitica, Linn.
Lolium temulentum, Linn.
Lonicera parviflora, LaMarck.
Ludwigia alternifolia, Ww. Seed box
Lupinus perennis, Linn. Wild lupine
Luzula campestris, D. C.
pilosa, Ww.
Lycopus europeus, Linn. Water horehound
virginicus, Linn. Bugle-weed

Lysimachia capitata, Pursh.
ciliata, Linn. Money-wort
hybrida, Mx.
quadrifolia, Linn.
revoluta, Nutt.
stricta, Aiton. Loosestrife
Lythrum Salicaria, Pursh. Milk willow-herb
Lycopodium complanatum, Linn. Ground pine
lucidulum, Mx. Moon-fruit pine

M.

Malaxis liliifolia, Ww. Twayblade
Malva rotundifolia, Linn. Low mallows
Marrubium vulgare, Linn. Horehound
Melanthium glaucum, Nutt.
Menispermum canadense, Linn. Moon-seed
Mentha borealis, Mx. Horse-mint
piperita, Smith. Peppermint
Menyanthes trifoliata, Linn. Buck-bean
Microstylis ophioglossoides, Nutt.
Milium effusum, Linn. Millet.
pungens, Torrey. Dwarf millet-grass
Mimulus alatus, Linn.
ringens, Linn. Monkey-flower
Mitchella repens, Linn. Checker-berry. Partridge-berry
Mitella cordifolia, LaMarck.
diphylla, Linn. Current-leaf
Momordica echinata, Muhl.
Monarda allophylla, Mx.
punctata, Linn.
Mollugo verticillata, Linn. Carpet-weed
Monotropa uniflora, Linn. Indian pipe-Birds' nest
Muhlenbergia diffusa, Schreber. Dropseed-grass
Myriophyllum verticillatum, Linn. Water milfoil

N.

Nasturtium amphibium, Brown. Water radish
natans, D. C.
palustre, D. C.

Nemopanthes canadensis, D. C. Wild holly. Mountain holly.
Nemophila paniculata, Sprengel
Nepeta cataria, Linn. Catnip
Nicandra physaloides, Persoon
Nuphar advena, Aiton
Kalmiana, Aiton
Nymphaea odorata, Aiton. White pond lily
Nyssa multiflora, Walter. Pepperidge

O.

Œnothera biennis, Linn. Scabish
fruticosa, Linn. Sundrops
muricata, Linn.
pumila, Linn.
Onoclea sensibilis, Linn. Sensitive-fern
Onosmodium hispidum, Mx. False gromwell
Orobanche americana, Linn.
uniflora, Linn. Squaw-root. Cancer-root
Oryzopsis asperifolia, Mx. Mountain rice
Osmorhiza brevistylis, D. C.
longistylis, D. C. Sweet cicily
Osmunda cinnamomea, Linn. Flowering fern
interrupta, Mx.
regalis, Mx.
Ostrya virginica, Ww. Hop hornbeam. Iron wood
Oxalis stricta, Linn. Yellow wood sorrel. Sheep sorrel
Oxycoccus macrocarpus. Pursh. Cranberry

P.

Panax quinquefolia, Linn. Ginseng
trifolia, Linn. Dwarf ground-nut
Panicum capillare, Linn.
crus-galli, Linn. Barn-grass
dichotomum ? Linn.
nervosum, Muhl.
nitidum, LaMarck, and varieties. Panic-grass
pubescens, LaMarck.

Panicum virgatum, Linn.
Parnassia americana, Muhl. Flowering plantain
Pastinaca sativa, Linn. Parsnip
Pedicularis canadensis, Linn, Louse-wort
pallida, Pursh
Penthorum sedoides, Linn. Virginian orpine
Pentstemon pubescens, Aiton. Beard-tongue
Phalaris americana, Elliott. Wild canary-grass
Phaseolus diversifolius, Persoon.
Phleum pratense, Linn. Timothy-grass
Phlox aristata, Mx.
Phragmites communis, Trinius. Common reed
Phryma leptostachya, Linn. Lopseed
Physalis obscura, Mx. Ground cherry
Phytolacca decandra, Linn. Poke-berry
Pinus pendula, Aiton. Tamarack. Hackmatack
resinosa, Aiton. Yellow pine. Norway pine. Red pine
strobus, Linn. White pine

Piptatherum nigrum, Torrey. Clustered millet-grass
Pisum maritimum, Linn.
Plantago cordata, LaMarck.
lanceolata, Linn. Snake plantain
major, Linn. Plantain
Platanus occidentalis, Linn. Button-wood. Sycamore
Poa annua, Linn.
aquatica v. americana, Torrey
capillaris, Linn.
compressa, Linn. Blue-grass
eragrostis, Linn.
hirsuta, Mx.
nemoralis, Linn.
nervata, Ww.
pratensis, Linn. English-grass. Meadow-grass
reptans, Mx.
serotina, Ehrhart
trivialis, Linn. Pasture-grass
Podophyllum peltatum, Linn. Mandrake. May apple
Pogonia ophioglossoides, Brown. Snake-mouth arethusa
Polanisia graveolens, Rafinesque
Polygala cruciata, Nutt.
paucifolia, Ww. Flowering wintergreen
paucifolia v. alba, Eights.
purpurea, Nutt.
Senega, Linn. Seneca snake-root
verticillata, Linn. Dwarf snake-root
Polygonum amphibium, Linn. Mud knot-weed
arifolium, Linn.
aviculare, Linn. Knot-grass
Convolvulus, Linn. Bind knot-weed
Fagopyrum, Linn. Buckwheat
lapathifolium, Linn.
mite, Persoon. Tasteless knot-weed
pennsylvanicum, Linn.
Persicaria, Linn. Heart's ease. Lady's thumb
punctatum, Elliott. Water pepper
sagittatum, Linn.
scandens, Linn.
tenue, Mx.
virginianum, Linn.

Polymnia canadensis, Linn. White leaf-cup
Uvedalia, Linn. Yellow leaf-cup
Polypogon racemosus, Nutt.
Pontederia cordata, Linn. Pickerel-weed
Populus canadensis, Mx.
candicans, Aiton. Balsam poplar
grandidenta, Mx. Tree poplar
tremuloides, Mx. White poplar. American aspen
Porcelia triloba, Persoon. Pawpaw. Custard apple
Portulacca oleracea, Linn. Purslane
Potamogeton heterophyllum, Schreber.
natans, Linn. Pond-weed
lucens, Linn.
pectinatum, Linn.
perfoliatum Linn.
zosterifolium. Trinius

Potentilla Anserina, Linn. Tansey cinquefoil, Silver-leaf
arguta, Pursh.
canadensis, Linn. Five-finger
Comarum, D.C. Marsh five-finger
fruticosa, Linn. Shrubby cinquefoil
norvegica, Linn. Cinquefoil
Prenanthes racemosa, Mx.
Serpentaria, Pursh.
Prinos verticillatus, Linn. Winterberry. False alder
Prunella vulgaris, Linn. Heal all. Self heal
Prunus americana, Marshall. Meadow plum
depressa, Pursh. Sand cherry
obovata, Beck.
pennsylvanica, Aiton.
Ptelea trifoliata, Linn.
Pteris aquilina, Linn. Common brake
Pycnanthemum virginicum, Persoon. Virginian thyme
Pyrola elliptica, Nutt. White wintergreen
rotundifolia, Linn. Shin-leaf
secunda, Linn. One-sided shin-leaf
umbellata, Linn. Prince's pine
Pyrus coronaria, Linn. Crab apple
melanocarpa, Ww.

Q.

Quercus alba, Linn. White oak
bicolor, Ww. Swamp white oak
imbricaria, Mx. Shingle oak. Laurel oak
macrocarpa, Linn. Over-cup oak. Burr oak.
rubra, Linn. Red oak
Queria canadensis, Linn. Forked chickweed

R.

Ranunculus abortivus, Linn.
acris, Linn. Crowfoot. Butter-cup
aquatilis, Linn. Water crowfoot
fascicularis, Muhl.
lacustris, Beck and Tracy. Lake crowfoot
pennsylvanicus, Linn.
recurvatus, Poiret
repens, Linn.

Ranunculus sceleratus, Linn. Celery crowfoot
Rensselaeria virginica, Beck. Water arum
Rhamnus franguloideus, Mx. Dwarf alder
Rhus copallina, Linn. Mountain sumach
glabra, Linn. Sleek sumach
radicans, Linn. Poison ivy
toxicodendron, Linn. Poison ash
typhina, Linn. Sumach
venenata, D. C. Poison elder. Poison sumach
Rhynchospora alba, Vahl.
glomerata, Vahl. False bog rush
Ribes floridum, L'Heritier. Wild black currant
gracile, Mx.
triflorum, Ww. Wild gooseberry
Rochelia lappula, R. and S.
virginiana, R. and S.

Rosa carolina, Linn. Swamp rose
parviflora, Ehrhart. Wild rose
Rubus frondosus, Bw. Leafy raspberry
occidentalis, Linn. Thimbleberry. Black raspberry
saxatilis, Mx.
trivialis, Mx. Creeping blackberry. Dewberry
villosus, Aiton. High blackberry
Rudbeckia hirta, Linn.
laciniata, Linn. Cone-flower
pinnata, Mx.
purpurea, Linn.
Ruellia strepens, Linn. Ruel
Rumex acetosellus, Linn. Field sorrel
acutus, Linn.
brittanicus, Linn.
crispus, Linn. Yellow dock

S.

Sabbatia angularis, Pursh. American centaury
Sagittaria sagittifolia, Linn. Arrow-head
Salix Muhlenbergia, Ww. Speckled willow
recurvata, Pursh. Shrub willow
rosmarinifolia, Linn. Rosemary willow

Sanguinaria canadensis, Linn. Blood-root
Sambucus canadensis, Linn. Black-berried elder
pubescens, Persoon. Red-berried elder
Sanguisorba canadensis, Linn. Burnet saxifrage
Sanicula marylandica, Linn. Sanicle
Saponaria officinalis, Linn. Soap-wort. Bouncing Bet
vaccaria, Linn. Field soap-wort
Sarracenia purpurea, Linn. Side-saddle
Saururus cernuus, Linn. Lizard's tail
Saxifraga pennsylvanica, Linn. Water saxifrage
Scheuchzeria palustris, Linn. Less flowering rush
Schoenus mariscoides, Muhl. Water bog rush
Schollera graminea, Barton. Yellow-eyed water-grass
Scirpus acicularis, Linn.
acutus, Muhl.
americanus, Persoon.
autumnalis, Linn.
brunneus, Muhl.
capillaris, Linn.
capitatus, Linn.
Erisphoruo, Mx.
equisetoides, Elliott.

lacustris, Linn.
lineatus, Mx.
macrostachyos, Muhl.
palustris, Linn. Marsh club rush
spadiceus, Linn.
sub-squarrosus, Muhl.
sub-terminalis, Torrey.
tenuis, Ww. Club rush
Scleria triglomerata, Mx. Whip-grass
Scrophularia lanceolata, Pursh
marylandica, Linn. Fig-wort
Scutellaria ambigua, Nutt.
cordifolia, Muhl.
galericulata, Linn. Scull-cap
lateriflora, Linn. Mad-dog scull-cap
Senecio Balsamitae, Muhl. Balsam groundsel
hieracifolius. Linn. Fire-weed
Senecio vulgaris, Linn. Groundsel
Setaria glauca, P. de. B. Fox-tail. Panic-grass
Sida Abutilon, Linn. Indian mallows
Silene antirrhina, Linn. Sleepy catch-fly
stellata, Aiton.
Silphium gummiferum, Elliott. Rosin-plant
perfoliatum, Linn. Ragged-cup
terebinthinaceum, Linn. Prairie dock
Sinapis nigra, Linn. Black mustard
Sisymbrium officinale, Scopoli. Hedge mustard
Sisyrinchium anceps. Cavanilles. Blue-eyed-grass
Sium latifolium, Linn. Water parsnip
Smilacina bifolia, Des Fontaines. Dwarf Solomon's seal
racemosa, Des Fontaines. Spiked Solomon's seal
stellata, Des Fontaines.
Smilax herbacea, Linn. Bohea tea
peduncularis, Muhl. Jacob's ladder
rotundifolia, Linn. Horse brier. Green brier

Solanum nigrum, Linn. Deadly nightshade
Solidago axillaris, Pursh.
canadensis, Linn. Canadian golden rod
juncea, Aiton.
flexicaulis, Linn.
lanceolata, Aiton.
nemoralis, Aiton
rigida, Linn.
serotina, Aiton. Smooth golden rod
Sonchus oleraceus v. aspera, Linn. Sow thistle
Sparganium americanum, Nutt. Lake burr reed
ramosum, Smith. Burr reed
Spartina cynosuroides, Ww. Spiked salt-grass
Spergula arvensis, Linn.
Spiraea lobata, Jacquin.
opulifolia, Linn. Nine bark, Hard hack. Snow ball
salicifolia, Linn. Willow hard hack
tomentosa, Linn. Steeple-bush
Spiranthes cernua, Richard. Nodding ladies' tresses
gracilis, Beck.

Spiranthes tortilis, Richard.
Stachys aspera, Mx. Hedge nettle
hyssopifolia, Mx.
Staphylea trifolia, Linn.
Stellaria longifolia, Muhl.
media, Smith. Chick-weed
Stipa avenacea, Linn. Feather-grass
juncea, Pursh.
Streptopus roseus, Mx. Rose bell-wort

T.

Tephrosia virginica, Persoon. Goat's rue
Teucrium canadense, Linn. Wood sage
Thalictrum cornuti, Hooker
dioicum, Linn. Meadow rue
Thaspium barbinode, Nutt.
Thesium umbellatum, Muhl. False toad flax
Thuya occidentalis, Linn. White cedar. Arbor vitæ
Tiarella cordifolia, Linn. Mitre-wort
Tilia glabra, Ventenant. Basswood. Lime-tree
Tofieldia glutinosa, Mx.
Tradescantia virginica, Linn. Spider-wort
Trichodium laxiflorum, Mx.
scabrum, Muhl.

Tricuspis sesleroides, Torrey. Red-top
Trientalis americana, Pursh. Chick wintergreen
Trifolium pratense, Linn. Red clover
repens, Linn. White clover
Triglochin maritima, Linn. Arrow-grass
palustre, Linn. Marsh arrow-grass
Trillium erectum, Linn. False wake-robin
erythrocarpum, Mx. Smiling wake-robin
grandiflorum, Salisbury.
Triosteum perfoliatum, Linn. Fever-root. Wild coffee
Triphora pendula, Nutt. Three bird orchis
Trisetum purpurascens, Torrey.
Typha latifolia, Linn. Cat tail. Reed mace

U.

Ulmus fulva, Mx. Slippery elm. Red elm
Urtica canadensis, Linn. Canada nettle. Albany hemp
capitata, Linn.
dioica, Linn. Common nettle
pumila, Linn. Stingless nettle
Utricularia fornicata ? LeConte.
gibba, Gronovius.
macrorhiza, LeConte. Bladder-wort
purpurea, Walter.
Uvularia grandiflora, Smith.
sessilifolia, Linn.

V.

Vaccinium pennsylvanicum, La Marck. Whortleberry
resinosum, Aiton. Black whortleberry
Verbascum Blattaria, Linn. Moth mullein
Thapsus, Linn. Mullein
Verbena caroliniana ? Pigmy Vervain
hastata, Linn. Vervain
urticifolia, Linn. Nettle-leaf vervain
Vernonia nove-boracensis, Ww. Flat-top
Veronica Anagallis, Linn. Brook pimpernel
arvensis, Linn. Wall speedwell.
Beccabunga, Linn.
scutellata, Linn. Scull-cap speedwell
Viburnum acerifolium, Linn. Arrow-wood
Oxycoccus, Pursh. High cranberry
pubescens, Pursh.
Vicia americana, Muhl.
caroliniana, Walter.
cracca, Linn. Tufted vetch.
Vitis aestivalis, Mx. Summer grape
riparia, Mx. Odoriferous grape
Viola blanda, Ww. Smooth violet
canadensis, Linn.

Viola cucullata, Aiton. Blue violet
Muhlenbergiana, Genging. Slender violet.
ovata, Nutt.
pedata, Linn.
pubescens, Aiton. Yellow violet
rostrata, Muhl. Beaked violet.

X.

Xanthium strumarium, Linn. Clot-burr
Xanthoxylum fraxineum, Ww. Prickly ash
Xylosteum ciilatum, Pursh. Twin-berry
Xyris caroliniana, Walter. Yellow-eyed-grass

Z.

Zizania aquatica, Lambert. Wild rice, Wild oats
Zizia aurea, Koch. Meadow parsnip
cordata, Koch. Alexanders
integerima, D. C.

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Abbreviations of Authors' names.

Bw..... ..Bigelow.
D. C.....DeCandolle.
Lind.....Lindley.
Linn.....Linnaeus.
Mx.....Michaux.
Nutt.....Nuttall.
Muhl.....Muhlenberg.
P. de B.....Palisot de Beauvois.
R. & S.....Roemer & Schultes.
Ww.....Willdenow.

(No. 3.)
REPORT
Of S. W. Higgins, Topographer.

TO DOUGLASS HOUGHTON, STATE GEOLOGIST, MICHIGAN,

SIR—I herewith present a summary of the proceedings of the department which you did me the honor to place under my charge, with such facts in relation thereto as have been deemed of importance.

It is fortunate for the success of our undertaking, that in the new states the surveys of the general government have superceded the necessity of a large expenditure of time and funds in developing the surface of the country, by means of trigonometrical surveys. In order, therefore, to determine what strictly belongs to this branch, it was presumed that the information which might be obtained by referring to the several land offices, would prove sufficient.

It was thus my first object to make copies of all the records in the state, and collect from every source all the information in my power. For that purpose, after commencing with the Detroit land office, I proceeded to Flint; from thence to Ionia and Kalamazoo, and lastly to Monroe, where this part of my labors terminated, having obtained copies of 763 townships. These I set about compiling immediately into counties, connecting the sectional lines and streams. Copies of the counties, on a lineal scale of two miles to the inch, as well as separate townships on an enlarged scale, have been used by the geological corps successfully in their explorations, for the purpose, not only of noting the geology in detail, but of delineating the true course of the smaller streams, the extent of swamps and marshes, public roads and improvements. Incorrectness will not be owing to the want of labor or attention bestowed, and from the materials in progress of collection, a certainty arises of a more correct execution of the maps to be made hereafter, than of any heretofore constructed.

It is to be regretted that there are so few statistics of the lakes. Many of the particulars which I have inserted appear indefinite for the want of more certain data; particularly their depth. In general, too much is left to conjecture, and until the necessity is urged upon the general government for a thorough hydrographical survey, and accurate description of every part of them, losses and disappointment will check the ardor of enterprize. Much of the destruction of property may be charged to the want of charts, and the losses of a single year will amount to far more than the cost of an entire survey. A commencement of such a survey was made when Gov. Cass occupied the war department, but ceased at the end of two years, having extended from the foot of Lake Huron to Middle Island.*

For a,description of our topographical location, data were readily obtained from the records of the public works in the adjoining states. Their various public improvements have led to the exploration of every point

of importance, and from a comparison of these points, with the records of our own public works, the true position of every required place on the southern portion of the peninsula may be relatively known.

Topographical location of Michigan.

The topography of the state of Michigan, when viewed in relation to its exterior position, being separated by a natural boundary of rivers and lakes on the east and north-east from Upper Canada, from Illinois and Wisconsin on the west and south-west, and from Ohio and Indiana on the south, or only in reference to the space included within its own political and isolated boundaries, presents many peculiar features.

Lake Michigan on the west and north-west, Lake Huron, the river and lake St. Clair, the straits of Detroit, with the west end of Lake Eric on the east and north-east, enclose a peninsula forming a cone, of which the straits of Mackinaw is the apex, the south line or base being one hundred and seventy-four miles east and west, and the length north and south three hundred miles. With this extent of coast, the number of large rivers, and the infinity of small interior lakes, give the utmost facilities to internal

*This survey simply included meanderings.

navigation; add to this the superior quality of the soil, its easy tillage, the heavy and abundant crops, and perhaps the whole is not surpassed by any section of equal extent, on the surface of the globe.

The northern or upper peninsula belongs to a higher level. Beginning at the eastern end of Lake Superior, and running southerly along the Sault de Ste. Marie's river, it lies nearly at right angles with the southern or peninsula proper, and separated from it by a part of Lake Michigan and Green Bay, as far as Menomone river. It thence takes a north-west course to Montreal river, from the mouth of which, it follows the southern shore of Lake Superior to the place of beginning; presenting an irregular and nearly isolated form, varying from twenty to one hundred and twenty-five miles in width.

Michigan, with the states west and south-west, are designated by geographers, as lying west of the great dividing ridge which determines the course of the rivers falling into the Atlantic on one side, and the Mississippi on the other. This Appalachian ridge, rising in Alabama, runs north-east, varying in altitude, to the gulf of the St. Lawrence, in many places spreading out into broad mountainous districts of thousands of square miles in extent. These districts being occupied by subordinate ridges, are often cut through by rivers, causing depressions, or vallies of corresponding depth. If, however, in tracing the continuation of the great ridge, across the St. Lawrence to Labrador, it should be found that the same system continued, then the important fact would be elicited, that it had been cut through by that river, the only occurrence of the kind, from its source in the south, to its termination in the north. The Potomac, the Susquehanna and the Mohawk rivers have their sources on its eastern declivity. The lowest pass across the state of New York on the lice of the Erie canal, is 565 feet above tide water; "the medium height, however, a few miles south, commencing at Catskill, on the Hudson, and terminating at Portland harbor on Lake Erie, is thirteen hundred feet, presenting no height less than nine hundred and eighty-five feet, and the greatest twenty-one hundred and forty-four feet. With these and other surveys, it has been ascertained, that a water communication could not be made across the country south of the state of New York."

Further south the elevation is no where less than twenty-four hundred and seventy-eight feet above the ocean. The Round Top at Catskill mountains, is thirty-eight hundred and four feet, and the High Peak, thirty-seven hundred and eighteen feet above tide water. The western part of the state bordering on Lake Erie, embracing Chautauque and Cattaraugus counties, Warren and McKeen counties of Pennsylvania, and the country southward, are occupied by a mountainous ridge: "Chautauque lake, the largest sheet of water on this table, is twelve hundred and ninety-one feet above the level of the ocean, and seven hundred and twenty-three feet above Lake Erie, though only nine miles distant; its discharged waters descend to the ocean, along the western declivity of the Appalachian range, through the Ohio and Mississippi rivers. T he lowest pass to the east over a swell of land near Cassadaga outlet, in Chautauque county, is seventeen hundred and twenty feet high, and another pass on the same swell, nineteen hundred and seventy-two feet. The lowest niche in the height of land, between Elm and Little Valley creeks, in Cattaraugus county, is seventeen hundred and twenty-five feet, and between Little Valley and Big Valley, the lowest pass is twenty-one hundred and eighty feet above the level of the ocean. Franklinville has an elevation of fifteen hundred and eighty feet, and Angelica fourteeen hundred and twenty-eight feet, although both are situated in valleys. This height of land extends close to the shores of Lake Erie, as it may be seen that the Allegany a tributary to the Ohio, rises within four or five miles of the lake."

To the north this ridge gradually declines, until near the south-era shore of Lake Ontario. Seven miles north of the cataract of the Niagara, it takes its last step to the margin of the lake. The ridge of rocks which forms this step continues eastward, and passes round the border of the lake, being of a uniform elevation of three hundred and nineteen feet; causing not only the cataract of Niagara, but also those of Genesee, Oswego, and the Black rivers. It thence unites with the more elevated spurs of Chateaugay south of Montreal, forming the eastern boundary of the great basins of Lake Erie and Ontario, and giving the direction to the course of the St. Lawrence river through its whole length.

From the foregoing remarks, it is observable that the great basins or depressions of these lakes, are the abrupt terminations of the mountain range, and that we

fall immediately into an extensive district, different in its topographical features, the peculiarities of which belong only to the region of the great lakes which bound the principal part of the northern frontier of the Union.

Leaving Chautauque county and passing around the youth shore of Lake Erie, this ridge falls off to the south-west, curving towards Iroquois county, in Illinois. It gives rise to the Muskingum, Sciota, and Miami rivers, in Ohio, and to the Wabash, in Indiana, on its southern declivity, and to Maumee, emptying into Lake Erie on its northern declivity, while a small swell approaches the south bend of Lake Michigan, giving rise to the Illinois and its tributaries. The height of this ridge at the Portage summit, in Akron, thirty-eight miles south of Cleveland on the line of the Ohio canal, is three hundred and ninety-five feet above Lake Erie and nine hundred and sixty-three above tide water, and the deep cut twenty-eight miles east of Columbus is but seventy-two feet less; at Portsmouth on the Ohio river, where the canal terminates, the elevation is four hundred and seventy-four feet above tide water, and ninety-four feet below Lake Erie. At the summit of the Maumee canal, at Fort Defiance, it is ninety-eight feet above the lake. It then falls to seventeen feet west of Chicago on the line of the ship canal, thence it pursues an uninterrupted course northward to the Portage at Fort Winebago, between the Wisconsin and Fox rivers, an elevation of one hundred and twenty-one feet above Green Bay, and one hundred and thirty-four above Lake Erie.

At this point the Wisconsin river, after flowing one hundred and seventy miles from its source in the north, suddenly turns to the west, and falls into the Mississippi near Prairie Du Chien, one hundred and sixty miles; the Fox river, rising to the east, runs westwardly, approaching it within eighty-two hundred feet, and turning, takes its course again eastwardly, and falls into Green bay. The surface of the water in the Fox is usually three feet lower than that in the Wisconsin, but in time of floods, passages are made from one to the other in boats. The following table will show the elevation of this summit above Lake Michigan and Green bay, the distance by the military road being 124 miles.

	Feet.	Descent.
From Portage to Lake Winnebago,		30
Winnebago Rapids,*	10.5	40.5
From Winnebago Rapids to Grand Chute,	3	43
Rapids Grand Chute,*	25	68
From Grand Chute to Little Chute,	6	74
Rapids at Little Chute*	1.5	75.5
From Little Chute to Grand Cacalin,	5	80
Rapids at Grand Cacalin,*	31	111
From Grand Cacalin to De Perre,	3	114
at De Perre dam and level Green Bay,*	6	120
		121 ft.

The same swell continues to rise with about the same uniform degree of elevation, approaching the northern peninsula of Michigan, until it can be seen from Lake Superior, bounding the southern horizon. It divides the waters that run north into that lake, and those of the south into the Mississippi, Green Bay and Lake Michigan, one of the most elevated ridges receiving the appellation of Porcupine Hills. Swells branching off to the eastward, and having their bases washed by the waters of the lake, present mural precipices, and assume different names. Those of the Pictured Rocks ore said to he the most imposing. Rome of these cliffs are three and four hundred feet high. From the Porcupine Hills, the country slopes eastward to the Sault de Ste. Marie, the outlet of Lake; Superior; this river is obstructed by a rapid 4,500 feet long, with a descent of eighteen feet.

Table of the height of Lake Superior, with the intermediate lakes above, and their distances from tide water.

Route.	Miles.		Feet.	
St. Lawrence river up to tide water,		450		
Level Lake Ontario,	200	650		232
Level Lake Erie,	175	825	333	565
Level Lake Huron,	340	1165	13	578
Level Lake Michigan,				578
Level Lake Superior,	240	1405	18	596
West end Lake Superior,	490	189		

* Ascertained by instrumental survey.

From the above data we infer the following curious fact; that if a barrier eighteen feet high, existed across the foot of Lake Huron, near Fort Gratiot, lakes Huron and Michigan would rise to a level with Lake Superior; or if a. similar barrier was placed of thirty one feet, across the foot of Lake Erie, at Buffalo, the singular result would follow that four of the great lakes would become one uniform level and merged in one immense inland sea.

By an examination of the foregoing table, we see a striking peculiarity of this region of “broad rivers and streams”—its vast extent—commencing at the gulf of St. Lawrence and extending in a south west direction up that river; thence into the basin of Lake Ontario, at an elevation of 232 feet above the ocean; thence again rising by the Niagara river and cataract, 333 feet to the level of Lake Erie ; (the first in the central subdivision, including lakes Huron and Michigan, of the great basin.) forming an angle at the western end of that lake in the estuary at the mouth of the Maumee river, it thence runs nearly north through the straits of Detroit, the lake and river St. Clair into Lake Huron, rising 13 feet; thence by a north westerly course, through the straits of the Sault de Ste. Marie, rising 18 feet to the west end of Lake Superior, a distance of 1895 miles. The whole depression contains an area of 400,000 square miles, 94.000 of which is occupied by water, still leaving an extent sufficient to sustain a population of more than seventy millions of inhabitants.

The following will show, in a condensed form, estimates of the mean length, breadth, depth, area, and elevation of the several collections of water:

	Mean Length. Miles.	Mean Breadth. Miles.	Mean Depth. Feet.	Elevation Feet.	Area in square miles.
Lake Superior,	400	80	900	596	32,000
Green Bay,	100	20	500	578	2,000
Lake Michigan,	320	70	1000	578	22,400
Lake Huron,	240	80	1000	578	20,400
Lake St. Clair,	20	18	20	570	360
Lake Erie,	240	40	84	565	9,600
Lake Ontario,	180	35	500	232	6,300
River St. Lawrence,			20		940
					94,000

Michigan occupies a central position, between the extremes, and uniting with the upper division of the St. Lawrence basin, having an area of forty-three thousand five hundred square miles on the lower, or peninsula proper, and twenty seven thousand square miles on the upper peninsula; making an aggregate of seventy thousand five hundred square miles.

The Lakes and Lake Coast.

These constitute a prominent feature, and must be of great and increasing interest, connecting the agricultural with the commercial enterprize of Michigan. As no state with a location so distant from the seaports, has done more in the same short period to develope the advantages to be derived from its internal resources, none can be in a situation better to reap the advantages arising from an extended inland coast.

If the distance by meanders of the shore of the lakes, and indentations of the bays, were to be made the standard for the length of the coast, it would amount to more than twice that of another, run without regard to the sinuosities of the shore.

The exact distance from the foot of Lake Huron, (near Fort Gratiot) at a point where the north line of township number six north, and range number 17 west, intersects the water, to Middle Island, by meanders, is 315 miles, including Saginaw bay. The same distance on a direct line is only 143 miles. Thence to Mackinaw, 97 miles; but by meanders, including the False and True Presque Isles, the distance would be increased to 150 miles; making a total by meanders of 495 miles; and by a direct line, 240 miles.

If the eastern shore of the peninsula appears so irregular and deeply indented with bays and harbors, the western is not less so, particularly in the northern part. The difference will be proportionally greater, as the Little and Grand Traverse bays are larger, excepting Saginaw bay, than the largest bays on the eastern side ; but as a small part only of the western shore has been surveyed, the subject will not admit of a more extended notice at this time.

Many doubts have heretofore existed in relation to the number and convenience of harbors. A minute examination of the shores, has, however, removed much of the prejudices against the navigation of the lakes, and there is probably no line of coast of equal extent, (being 700 miles,) that will, with inconsiderable improvements, furnish a greater number of good harbors. Much of the apprehended danger has arisen therefore, from ignorance of these facts, and the localities of the numerous sheltered bays which would afford protection at all seasons; and as but few if any attempts have been made by actual navigators to explore for themselves, and being without charts, it is no wonder that representations of danger should have obtained, and the dread of shipwreck on an apparently desolate coast, magnify in a great degree, the fears attendant on crossing these inland seas.

Depth of the Lakes.

The depth of the lakes has been a subject of speculation, from the earliest period of their discovery by Europeans. Tables have been constructed, and the areas and contents of each, endeavored to be ascertained. Errors have been made in these as well as in their elevation above the ocean; in the latter case, however, little is left to conjecture.

Lake St. Clair, an expansion of the straits between lakes Huron and Erie, 18 by 20 miles, is much the shallowest, the average depth being only 20 feet. Lake Erie does not exceed 84 feet. An ordinary storm disturbs its bottom, and its waters appear turbid. These lakes may be considered as receiving the detritus brought down by the rivers flowing into them, and deposited there. This in particular is apparent, around the head of Lake St. Clair, where alluvion islands are constantly forming, and in spring choke up the numerous channels at the mouth of the St Clair river, extending in the form of a delta far into the lake. The same remark may be made in respect to the west end of Lake Erie, where detritus extends some miles from the mouth of Maumee river; the channel is often devious, and a prevailing westerly wind reduces the lake to less than one fathom.

Lakes Michigan and Huron have undoubtedly the deepest chasms. Receding from the shore, their waters deepen uniformly, and there exist no central shoals or islands, showing in any manner a broken or alpine formation at their bottoms. It is only in the straits of Mackinaw, and above and around the Georgian or Manitou bay of Lake Huron, that islands and shoals make their appearance. The channels among these islands, however, are only chasms through rocks, caused by abrasion from the waters of the lakes. Soundings have been made to the incredible depth of eighteen hundred feet, without reaching the bottom, and the most experienced ship masters do not hesitate to assert the average depth to be more than one thousand feet. Lake Superior, though larger, cannot be considered deeper than the others, for reasons already assigned. It abounds with islands, many of which are large; Isle Royal is one hundred miles long. Primitive masses of rock lie disrupted above and below its surface, in every direction, and a permanent impression is left that a chasm, shapeless in its exterior, as well as its interior dimensions, fed by springs and tributary

rivers, are the great features of this lake, at a depth of nine hundred feet.

Mountain districts, as has been heretofore observed, may be cut through by rivers, causing deep vallies and depressions, but no where on the continental surface of the globe can be found so deep chasms as the basins of these lakes. Though elevated 596 feet above, their bottoms are more than 400 feet below the level of the ocean. Their superficial area is 94,000 square miles, and they contain 1.1,300 cubic miles of water; a quantity more than half of all the fresh water on the earth.

Interior Peninsula Lakes.

Neither is the subject of the lesser interior lakes on the peninsula, so far as their number and magnitude are ascertained, to be overlooked, forming as they do by their frequency, a great contrast in the topography of this, to that of the other states.

From the Ohio and Indiana line on the south, up to range line number seven north, including ail south of the northern railroad, an extent of 9,688,320 square acres, there are 1,425 of these lakes, occupying areas of from one to thirty-five hundred square acres each. Their waters are remarkably cool and transparent, and give to the landscape a highly picturesque appearance. To apply the principles of hydrography in ascertaining their aggregate extent, becomes the more difficult, since, in addition to their great number, no two are of the same dimensions. The following, however, will be found to approximate the truth; allowing each lake an area of 160 rods square, we shall give to the whole 228,000 acres, an extent equal to nearly ten townships, and somewhat larger than Lake St. Clair; and a proportion of about one acre of water to every thirty-nine of dry land.

All the rivers in the state have their sources in groups of these lakes, and they are the fountains of the unremitting volumes that flow through the thousand channels of our streams. While the rivers of neighboring states have measurably disappeared during the drought of the last summer, and caused derangement in their commerce, ours have suffered comparatively little diminution.

Periodical Rise and Fall of Water in the Lakes.

This interesting question has given rise to a variety of curious speculations. The inference drawn from the following data, it is presumed, will not be altogether inconclusive.

Calculations may be made sufficiently accurate to determine nearly the amount of surface drained, “and if our climate shows a successive series of cold and moist years, and a series of warm or dry ones, mutually following each other,” variations in the volume of water, cannot but necessarily be great.

Taking into our account only the central and upper divisions of the St. Lawrence valley, from Niagara, to the northwest angle of Lake Superior, embracing all the country whose streams are tributary to the lakes, we have by the following table of sections, 248,755 square miles of surface, besides that of the lakes.

Superfices drained by the central and upper divisions of the St. Lawrence basin.

		Medial length.	Medial brea'h.	Area in sq. miles.
Peninsula E. & S. E. of L. Huron, & N. of L. Erie, from Iroquois bay to Niagara,		123	88	10,455
N. & N. E. from Iroquois bay, to the Ottawa river,		300	200	60,000
N. E. of Lake Superior, from Mackinaw to Nipigon river,		320	60	19,200
N. W. of Lake Superior, from Nipigon to St. Louis river,		310	55	17,050
S. W. & S. of Lake Superior, from St. Louis river to Desert lake and Portage,		300	200	60,000
W. side Lake Michigan, from Portage to head Des Plaines river,		150	100	15,000
Peninsula between Lakes Michigan and Huron, and west end Lake Erie,		325	174	56.550
South of Lake Erie to Niagara,		300	35	10,500
Add area of Lake Superior,	32,000			
“ Green Bay,	2,000			
“ Lake Michigan,	22,400			
“ Lake Huron,	20,400			
“ Lake St. Clair,	360			
“ Lake Erie,	9,600			86.760
Total square miles,				335,515

The floods in Lake Ontario are generally the highest by about two feet, and for the obvious reason, that it receives the successive accumulations of all the other lakes, from the Niagara to the head of the St. Louis river.

From the year 1814, we can speak with some degree of confidence of the rise and fall of these waters. During that year, the upper lakes were full. This was the case in 1815, with the central and lower lakes. In 1819 and 1820, the water is said to have been at an unusually low ebb in the same lakes.

The difference in the time of the apparent rise between the upper and lower division, may be accounted for on the principle that the largest bodies of water are on the upper level, and as these are discharged, the lower division would be comparatively high, while the upper would be reduced to low water mark.

From 1820, the water again began to rise, and continued to increase, until 1828 ; since which time, A E. Hathon, Esq. civil engineer of Detroit, has given the subject particular attention. His first observations were taken at the old hydraulic works, at the time when the pipes were being laid for furnishing the city with water from the Detroit river; he has since transferred it to the top of the water table of the tower, at the new hydraulic works. The surface of the river at the time of the transfer, August 21, 1838, was 3.21 feet below that base: this will serve as a reference for the future.

It appears from his journal, that the water was low in the spring of 1830, having fallen about two feet since 1828. In June following, it had again risen two feet, or to the level of 1828. From that time, its rise was gradual, until June, 1836, at which time it was found to have attained the height of one foot and eight inches. In June, 1837, it rose seven inches; in June 1838, nine inches, and on the 21st August following, three inches ; making the rise 3 feet 3 inches since June, 1830, and 5 feet 3 inches since March in the same year.

Table showing the rise of water from March, 1830, to Aug. 1838.

	Feet.	Inches.	Rise.
			2.00
June, 1830,	1	8	3.8
June, 1836,		7	4 3
June, 1837,		9	5.00
June, 1838,		3	5.3
Aug. 21, 1838.			

Some allowance ought to be made for the sudden rise of two feet from March to June, as from observation, it is believed that winter has the effect of producing a partial decrease.

On the 21st November, 1838, the water had fallen 12¼ inches, and on the 2nd February, 1839, 3 feet 8 inches.

Many conclude that the present high flood is greater than has been known for at least a century, from the fact, that orchards have been killed along the St. Clair and Detroit rivers, in consequence of the lands being overflowed. In some instances, forest trees have been destroyed by the overflowing water, and upon counting the concentric circles in sections obtained from their trunks, they were found to exceed a hundred.

In order to estimate the enormous accumulations of water during the time of the highest flood, and which is discharged through the river, it will only be necessary to refer to the table where 5¼ feet appears to be the maximum of the rise. A transverse section of the river taken opposite Detroit, where it is contracted to 52.80 of a mile, of this depth contains 18,018 cubic feet ; and allowing the current a velocity of one mile an hour, which is known to be less than its ordinary current, there would be discharged 95,135,040 cubic feet per hour, or 1.535,558 cubic feet per minute, an amount sufficient to supply fifty-eight canals of the dimensions of the Clinton and Kalamazoo,* or thirty five of the Grand Erie canal, and more than sixteen times the amount contained in the Cedar river, and Sycamore creek, Ingham county, Deer creek and Grand river, Eaton county, Shiawassee river, Livingston county, and Rabbit river, Allegan county.†

We are not prepared to say that there are sixteen times as many rivers, (as those above enumerated,) at the north, which have changed their course, and discharge in directions contrary to their former ones, thus filling the basin of Lake Superior, and causing the periodical rise of the lakes; nor is it reasonable to suppose that rivers, discharging so great a quantity, can be found in that region. We must, therefore, look for the cause to the quantity of rain which has fallen, and to the melting of the snow, in spring, upon the immense surface drained by these lakes.

Rivers.

Streams receiving the appellation of rivers in the state are numerous. This name, however, is applied to none unless of sufficient magnitude to be considered worthy of meandering on both sides; accordingly, instructions to that effect have been given by the Surveyor General to his deputies, in the prosecution of the government surveys. The Grand, Muskego and St. Joseph, will bear a comparison in length with many of the western, and no small number of the eastern rivers, of the first and second class. Their width and depth are not in proportion to their length, arising from the fact of their uniform descent. This characteristic will apply to all the other streams on the peninsula. They are unbroken by cataracts, and but little obstructed by rapids. The number in the surveyed part, and discharging into the lakes, is twenty;—of these the Grand river is the largest.

*27,313 cubic feet is required per minute, for this canal. See rep. of J. Hurd, engineer.

†These rivers discharge in the aggregate, 98,846 cubic feet per minute, at the places designated. J. Hurd's report.

This river rises in Hillsdale and the south part of Jackson counties, in a cluster of more than fifty lakes, that interlock with the Kalamazoo and St. Joseph, each emptying into Lake Michigan on the west, and with the Raisin, which empties into Lake Erie, on the east. These, with the Little St. Joseph, St. Joseph of Maumee, and Tiffins, or Bean creek, running south, have their sources on the highest table land in the southern half of the peninsula, being an elevation of six hundred and forty-six feet above Lake Erie. From its source in a northerly direction to Jacksonburgh, is twenty-five miles; its level here being three hundred and twenty-five' feet above Lake Michigan. From Jacksonburgh, it is fifty-three miles to Red Cedar river, thirty to Looking-glass river, and eighteen to the Maple river. At this point its elevation is fifty-six feet above the lake, where it takes a westerly course of fifty miles to Grand rapids, and forty more to its mouth—making its entire length two hundred and sixteen miles. It conveys the surplus water of 2,949,120 square acres. There are many other large tributaries besides those above mentioned, which it receives from the north—among these are the Flat and Rogue rivers, no inconsiderable streams. Its width the first forty miles from its mouth is 800 feet, and for fifty miles further, to Lyons, on the Maple, it is 500 feet in spring, floods raise the river about ten feet overflowing and enriching its valley, which is densely covered with a heavy and beautiful growth of forest trees.

The St. Joseph has for its source more than twenty-five lakes, and as before mentioned, has its origin in Hillsdale and Branch counties; it runs a northerly course, afterwards passing to the southwest, and crossing the south boundary of the state, enters Indiana; again curving northwardly, it re-enters this state and falls into Lake Michigan, receiving many large tributaries, among which are the Paw Paw, the Dowagiac, Elkhart, Prairie, Pigeon and Fawn rivers.

From its mouth to the line of Indiana, the distance is forty-eight and a half miles, at a level of sixty eight and a half feet; after running forty-three miles in Indiana, and at an elevation of ninety-nine feet, it recrosses the state line ; the distance to Three rivers is twenty-three and

three-fourth miles, rising thirty-five feet, thence twenty-six and one-fourth miles to Sturgeon lake, and twenty and a half to Union city, making the whole distance one hundred and sixty miles from its mouth to this place, and its height above Lake Michigan two hundred and eighty-five feet; the entire length of the river is two hundred and eight miles, its width is nine hundred feet at its mouth, and carries the surplus waters of 2,327,040 square acres.

The Kalamazoo river drains nearly all the remainder of the surface on the western declivity, (situated between the Grand and St. Joseph rivers above described,) or about 1,382,400 square acres. Its tributaries are not many or large; its average width is about two hundred feet; its source is in a group of twenty lakes. Farwell's lake is six feet above the source of Grand river, though hardly forty rods distant, and so near do the rivers rising on this plateau approach each other, that the waters flowing east, west and south, might easily be made to mingle at this point. Its course is more direct than either of the others mentioned.

The distance from its mouth to Allegan is thirty-eight miles, with a current of three miles an hour; thence twenty-five miles to Kalamazoo, where it is one hundred and forty-eight feet above the lake; thence to Albion, at the Forks, thirteen miles, rising nine feet, making a distance of one hundred and sixteen miles, and at an elevation of three hundred and forty-five feet from the Forks to its source is thirty-four miles; its entire length is therefore one hundred and fifty miles.

The rivers discharging on the eastern coast of the state, within the surveyed district, have a less volume, and may be described together as having similar features, or if there be an exception, it is in the length. The length of all is abridged, however, by having a space to traverse only of about forty to sixty miles; the dividing ridge being so much nearer the eastern than the western side of the peninsula.

The river Raisin heads in a series of fifty lakes, the nearest of which is but a few rods from the head of Grand river. Its whole length may be computed at 85 miles.

The head waters of the western branches of the Huron also rise near those of Grand river, while its eastern sources inosculate with the Clinton. This river and the Clinton have their sources in by far the greatest number of lakes; they are no less than 200, and some of them large, embraced in the area of Oakland, Livingston and Washtenaw counties.

The Saginaw river receives the discharged waters of the Cass, Flint, Shiawassee, and Tittabawassa rivers, twenty-five miles from its mouth. These rivers with their tributaries descend from every point of the compass—the Tittabawassa from an unsurveyed district in the north; the Shiawassee from the western declivity of the summit in Oakland county in the south; the Flint and Cass from the summit of the same swell, in Lapeer and Sanilac counties, on the east and southeast. Their average length is ninety miles.

United States Survey.

These are progressing with rapidity, and if continued during the next two years, the whole peninsula will have been surveyed. The highest point to which they have been carried is town 26 north, embracing 180 townships. The facilities are reported by the surveyors, to be as favorable as those of any other new country, and equal to those of earlier surveys, for carrying forward their work; maps of these surveys have been collected, in part, for the future use of the geological department. An inspection of them exhibits in the general outlines, a similarity to the southern portion of the state; the variety and number of small lakes, the great length of the principal streams, with an undulating surface, are the principal features.

It is understood that contracts will be made for commencing on the upper peninsula, at the opening of next season, and it is probable that the standard lines will be run, and the completion of the eastern half, from Chocolate river on Lake Superior to the head of Green bay, during the same time.

The lands heretofore held in reserve, and which are by treaty to be sold, have been subdivided. These reserves are among the best locations in the state. The avails, after deducting the surveys and other expenses, go to the Indians.

Little will be left after the survey of the state shall have been completed, requiring adjustment. The simple rectangular method adopted by the general government, first, in subdividing the country into townships of six miles square, and these again into sections of one mile, give a character of mathematical accuracy which is excelled by no other system; the width and course of all streams crossing these lines, and their distance from the nearest corner, are noted, as well as the entrance into and distance across marshes and swamps; it will therefore require but little attention to draft the streams not meandered, as well as the marshes, in the interior of the sections, by personal examination, with sufficient accuracy for correct topographical maps.

Levels.

Information of the most valuable kind has been obtained from the board of commissioners of internal improvement; copies of the surveys of the central and northern railroads have been furnished, and by a resolution which passed that board in 1837, they will continue to furnish copies of all the surveys connected with the public works; these, with the surveys of the different railroad and canal companies, will leave but few points, the elevation or depression of which may not be known, either in reference to the lakes or the ocean. Vertical sections connected with correct lineal drawings,

are appreciated by the geologist, and have an interest with him as great as with the engineer.

Accompanying this report you will receive a map of the state made by your direction for general reference. Upon the same sheet, projections of all the levels which have been made across the state, are constructed. A slight inspection will show at once the vertical relation of almost every important point throughout the territory included in the survey. The surface of Lakes Huron and Michigan is made the plane of reference; these are 578 feet above tide water.

By a reference to the heights, it appears that there is a swell of land, which may be called the true watershed, running from Point aux Barques south forty-five degrees west, and passing out of the state into the northeast corner of Indiana, about equidistant from Lakes Erie and Michigan. It attains its greatest elevation in Hillsdale county, seven miles cast from Jonesville, where it is 633 feet above the plane of reference. Its summit on the central railroad at the division line between Jackson and Washtenaw counties, fourteen miles east of Jacksonburgh, is 437 feet. In the village of Pontiac, in Oakland county, on the summit level of the Clinton and Kalamazoo canal, it is 335 feet. It then again rises, and at the head waters of Belle river, in Lapeer county, is 414 feet. From this point it gradually falls off, and with a few rills descending on its north and eastern slope, sinks to the level of the beach of the lake. This swell will present but few elevations above the actual surveyed levels, exceeding fifty feet, and these knobs, where present, are located without design, and without uniformity of range.

On the line between Oakland and Livingston counties, a branch diverges to the northwest, giving rise to the Red Cedar, Lookingglass and the Maple rivers, on its western declivity, while the Shiawassee rises at the point of divergence, and runs northwardly parallel to its eastern side. The lowest pass across this swell is 95 feet above Lake Huron. Leaving this point and ascending to township 10 north, of range 5 west, its course is changed to the north, and it rises to its greatest elevation at the sources of the Muskego river in Lake Otisco, in town 22 north. From an inspection of the map an apparent design appears to have marked the future communication between Lakes Huron and Michigan, from the broad and deep indentation of Saginaw bay over this narrow and low pass.

From the dividing swell, the country lies in one plane on each side, inclining gently and uniformly to the margin of the Jakes, with the exception of a slight corresponding elevation on the western side of the state. This may be traced from the great bend of Grand river to where it crosses the Kalamazoo west of that village; thence curving with the shore of the lake, terminates at the South Bend, where it diverts the St. Joseph river through a part of Indiana. Its average height at Grand river is 80 feet, 200 at Kalamazoo, and 75 at South Bend, above the level of the surrounding country. It need not be stated that the inferior peninsula lakes partake of the highest elevation, when reference is had to their being situated at the sources of all the rivers, and that the summit in Oakland and Livingston counties abounds with the greatest number.

From tables in which I have collated the elevation of places, I have selected a few remote from each other, which may serve to show the uniformity of the surface generally. Conclusions from this table cannot be drawn, however, in detriment to the healthy and rapid, and not unfrequently precipitous flow of all our streams.

Outlet of Grass lake, Jackson county,	377 feet.
Village of Barry, do do	362
Head of Spectacle lake, Calhoun county,	373
Head of Mill creek, St. Clair county,	368
Kalamazoo river at Albion, Kalamazoo county,	351
Sandstone creek, Jackson county,	347
Outlet Gillet's lake, do	354
Village of Newberry, St. Clair county,	284
West end Prairie Ronde, Kalamazoo county,	278
Rice creek near Marshall, Calhoun county,	280
Honey creek, Washtenaw county,	266
North branch Raisin river, Lenawee county,	276
Hasler's creek, Lapeer county,	265
Geddes, Washtenaw county,	220
Flint river at Lapeer, Lapeer county,	238
Huron river, Dexter, Washtenaw county,	232
Old Fort Holmes, Mackinaw,	219
Kalamazoo river near Augusta in section 35, town 2 south, range 8 west, Kalamazoo county,	187
Branch St. Joseph, 30 miles south section 35, town 6 south, same range, St. Joseph county,	187
Kalamazoo river, Kalamazoo village,	154
Thirty miles south southern railroad crossing, St. Joseph river, St. Joseph county,	138
Shiawassee river at Owasso, Shiawassee county,	145
Fort Mackinaw, Mackinaw,	150
Cliff, Robison's Folly, Island Mackinaw,	128
Ypsilanti, Washtenaw county,	130
Bank of Lake Michigan, New Buffalo, Berrien county,	100
Huron river at Ypsilanti, Washtenaw county,	100
Paw Paw river, Lafayette village, Van Buren county,	106
Brush creek near Mason, Van Buren county,	76
Bank of Galien river ten miles east New Buffalo, Berrien county,	74
Stoney creek, crossing northern railroad, Ionia county,	82
Mouth Maple river, Ionia county,	56 feet
Bass river, crossing northern railroad, Ottawa county,	56
St. Joseph river at Bertrand, Berrien county,	53
Half way house, Wayne county,	54
Crossing southern railroad four miles west Monroe, Monroe county,	49

A fact may also be inferred from the collated levels, that the average height of the peninsula is 160 feet above the surface of the lakes.

Maps, &c.

Much of my time has been occupied, as will be observed, in making collections preparatory to the final publication. They are intended to embrace the geology

as well as the topography and geography of every section of the state. Twenty counties are in a state of great forwardness, five of which may be said to be finished in detail, viz: Wayne, Monroe. Jackson, Eaton, and Ingham. It was thought unimportant to enter into a description of these in this report, as during the next year a large number will be added and a report including the whole will then be made. Drawings will also be given of such remains of ancient works and tumuli as are scattered through St. Joseph, Kalamazoo and some other counties. These are more rare in this, than in some of the states south and west; sufficient evidences remain, however, of a former population remote to the oldest traditions of the inhabitants. The time is not distant when the curious will be gratified with the system they pursued, and the facts it unfolds relative to the uses for which so much labor has been expended by an ancient people, upon the different structures found in the west. Public attention is being directed to their developement, and when the position and dimensions of those that remain shall have been determined, elements for a history will remain, as perfect as may be collected in the absence in part of tradition or written documents.

Here let me publicly acknowledge the hospitable intercourse of the citizens of the state, and the polite regards of gentlemen in the different public offices, in affording every facility, and giving access to the records in their charge.

S. W. HIGGINS,
Topographer of the Geological Survey.
Detroit, 2d February, 1839.

(No. 4.)
Report of C. C. Douglass, Assistant Geologist

To Douglass Houghton, State Geologist:

SIR: I have completed the detailed survey of so much of the district which you assigned me, as is embraced in Ingham county, together with a portion of Eaton and Jackson counties. Much lime having been occupied in tracing and examining the coal, formation, in order to arrive at satisfactory conclusions as to the probable extent of this valuable deposite in the district, it is thought advisable to defer the report of a part of Eaton and the whole of Jackson county, until the work shall have been more nearly completed. The examinations of the coal district resulted in the collection of many important facts, some of which cannot be properly made use of until more extended examinations have been made. But it may be observed, that these have been sufficiently satisfactory to place beyond doubt the existence of this valuable substance in sufficient quantity to be of much prospective value to the state.

The maps of the counties under consideration, have been found to be exceedingly incorrect, and in accordance with your instructions, I have been able to accomplish much towards correcting the numerous geographical errors upon the maps, now being constructed. These, according to your instructions, having been transferred to the topographical department, can only be generally noticed in this report.

One of the most prominent characters of the county under consideration, when compared with the more southern counties, is, its remarkable uniformity of surface. Although the whole country may be considered as gently undulating, it has no great irregularity of surface, except in those sections traversed by streams, where gorges, frequently of considerable depth, are sometimes found.

Occasionally some few isolated hills and ridges are seen, but they, with a few exceptions, are hardly worthy of notice. In township three north, range one east, a series of isolated ridges commences on section thirty-four, and extends in a northeast direction, across sections thirteen, twenty-three, twenty-four, twenty-six and twenty-seven, having an altitude of from twenty to eighty feet.

A second and nearly parallel elevation was noticed, commencing on section three, in the same township, and extending to section thirty-four, in the adjoining town, having an elevation varying from twenty to forty feet.

A third commences in the south part of Vevay, and extends in a northwest direction, nearly through the town, varying from ten to eighty feet in height. At the village of Mason, the Sycamore creek passes through a ridge of diluvion composed of stratified coarse sand and pebbles, slightly united by a calcareous and ferruginous cement.

About three-fifths of the county of Ingham consists of timbered land, while the remaining two-fifths are oak openings and plains. That portion of Eaton county embraced in this report, consists of timbered lands.

Timber.

The timber upon the less elevated bottom lands extending along Grand river consists of sycamore, black ash, elm, black walnut, &c. Upon the inclined uplands, connecting the bottom with the table lands, a general mixture of the usual hard wood timber is found.

The table lands are mostly timbered with the varieties of oak, beach, maple, lynn, hickory, cherry and whitewood; with sycamore, butternut, black walnut and elm on the margins of the streams.

Ingham county occupies a very central position in the state, and possessing as it does a rich soil, valuable quarries of sandstone and extensive deposites of bituminous coal, it promises to become one of the most important counties in the state,

Soil.

The prevailing soil of Ingham county and that part of Eaton county lying in township four north, ranges three, four, five and six west, is sandy loam and loamy sand over an extent of more than seven-eighths of the surface. Limited tracts of a stiff loamy clay, with occasional hillocks and ridges of fine yellowish sand, occur, and were observed more especially near the small lakes and streams.

Beds of sand and gravel are sometimes seen to alternate with those of loam and marly clay in such a manner that a field of a few acres may exhibit almost every variety of soil from a fine sand to a stiff marly clay.

The art of the farmer may be here put in requisition to modify the natural texture of the different soils and fit them to receive nutritive and stimulant manures with the greatest advantage. The stiff heavy clays may be dressed with sand and the light soil with loam or clay, (marly where it can be obtained,) with a view to transform, the whole into a loam of such a texture as to make a pulverulent soil, and yet leave it sufficiently argillaceous to retain a desirable quantity of water. Yard manure, composts mixed with lime, ashes, and muck of the marshes and swamps, if thrown into heaps with quick lime and allowed to undergo a more perfect decomposition, would make a valuable manure for the light soils. Lime is essential to the fertility of the light soils, and as shell marl is within the reach of nearly every farmer, it being found in many of the lakes and marshes, no reason can exist why these light soils may not be made and retained of the most fertile character. The marl may be taken from the pit in the fall and winter or at any leisure season, and spread over the land in the same manner as fine yard manure. Experience must determine the quantity best adapted to each particular soil.

The marly clays of Ingham and Eaton counties may be employed with advantage on the light soils, for they will not only add consistency to the soil, but will also furnish the necessary lime.

Marshes and Swamps.

Many extensive marshes exist in both Ingham and Eaton counties, and probably may be said to extend over an area of about one-ninth of the surface. Many of these marshes have originated from the stoppage of water in the streams, having been dammed by the beaver which formerly existed in the country in great numbers.

Two marshes of this character commence near the south line of township two north, range one east. That on the west of the township, extends in a northeast direction nearly to the corner of town three, having a length of twelve miles and an average width of eighty rods.

The one on the east extends north two to three miles into the adjoining township, having a length of seven miles and an average width of half a mile.

A vegetable deposite of from one to eight or nine feet thick, frequently tremulous when wet, occurs in many of these marshes. This deposite is mostly underlayed by marly clay which is sometimes covered to a slight depth with sand and gravel and in some instances with shell and tufacious marls. This vegetable matter being imperfectly decomposed, forms a light fibrous peat.

A large majority of these marshes can be readily drained, and will, by proper culture, become fertile meadows or even arable lands. Many of them when filled with water arc tremulous. Most of the swamps and marshes are covered with a luxuriant growth of sedge, tamarack and cranberry vines.

Springs and Wells.

Most of the springs and wells in these counties furnish water containing the salts of lime, and constitute what is termed hard water. The country is generally well watered, though during the past season, owing to the drought, some portions were nearly destitute. Along the vallies of the streams and through the whole extent of the sandstone formation, water is abundant, rising to the surface in springs and collecting in the low grounds, forming numerous small streams.

In the township of Onondaga the sand rock occurs at various depths, and water is generally obtained at the surface of the rock or by penetrating it a few feet. Many of the springs contain large quantities of carbonate of lime in solution, which, as the water comes in contact with the air, is deposited in the form of tufa or a fine pulverulent marl. When the quantity is small, the porous vesicular deposite, called tufa, is found, but when the water is abundant, or the springs rise in a level tract or swamp, it is deposited in the shape of marl.

The most copious springs of this kind are along Grand and Cedar rivers. Nearly all the small streams, as well as most of the lakes and marshes (which do not originate from beaver dams) have their origin in springs.

The water of most of the springs noticed, aside from the lime it contains, is remarkably pure and limpid, but occasionally chalybeate springs occur. The springs last mentioned not unfrequently give rise to very limited beds of bog iron ore.

Streams.

Grand and Cedar rivers are the two principal streams in Ingham county; the first watering only a small portion of the western townships, while the Cedar, entering on the east, completely traverses the country.

There are, beside these, numerous small streams varying from a few links to sixty links in width.

Among the largest of these are the Sycamore, Willow, Mud and Deer creeks, and the east branch of the Cedar river.

It will be noticed by reference to the map, that all the streams have a bearing to the north, excepting the few north of the Cedar river.

These streams furnish the country with a tolerable supply of hydraulic power.

Marl

An extensive deposite of shell marl was noticed on section fifteen, township one north, range one west; occuring near the source of a small stream. It is chiefly in the state of a compact and beautifully white powder, containing an abundance of recent shells. The stream before noticed passes through an extensive marsh, much of which is underlayed by the marl, covered with peat and vegetable muck, of from two to six or eight feet thickness.

Marl also occurs in a basin shaped hollow, on section thirty-three, in the town of Leslie.

I was informed by Mr. Woodworth, that an extensive bed of marl occurs on section thirty-five, township two north, range one west.

Calcareous tufa was noticed at several places in the counties, but not in sufficient quantity to be of any practical value.

Bog Iron.

Several deposites of bog iron were noticed in Ingham county, which, however, are of not sufficient extent to be of any practical value. These were in most cases noticed along the streams, outlets of marshes, and in connection with chalybeate springs.

The most extensive deposite observed in Ingham county, was on section eighteen, township three north, range two east, in the bank of a small stream. It consists of coarse and fine grains, forming masses in the soil, which is of a sandy loam.

A deposite of an argillaceous ochre, was noticed on section twenty-two, in the town of Leslie, covering an area of four square rods, and from a few inches to three feet thick. It is very unctuous, containing but a small proportion of sand and gravel. Mr. Woodworth informed me that he had made use of it as paint, and found it to answer a good purpose.

On section eleven, in the town of Stockbridge, was noticed a deposite several rods in extent, and from a few inches to one foot in thickness, varying from a deep to a light red color, unctuous, and containing sand and gravel in small quantity.

Another deposite was noticed at the outlet of a marsh, in the southwest corner of Onondaga.

Crag.

On section three, township four north, range three west, in the bank of Grand river, sand, cemented with calcareous matter, occurs, and has been mistaken by the inhabitants for a ledge of sandstone. It has an elevation of fifteen feet, but is not extensive. It is covered with a light colored clay soil. The sand from which the crag is formed is considerably extensive, and will afford a good sand for mortar.

Boulders.

Primary boulders were noticed at numerous points in these counties, particularly along the streams, where they occur in great numbers.

Boulders occur more frequently upon the surface of the plains than on the timbered lands. They are not unfrequently seen in great numbers upon the summits of the most elevated hillocks and ridges.

On section thirty-one, township four north, range two east, several small angular boulders of light colored limestone, containing fossils, were seen.

Clay.

Blue and variegated clays, inferior in quality, are not unfrequently met with in Ingham and Eaton counties. A variegated marly clay, of fine texture, was observed on the wrest side of Pine lake, and will afford an excellent manure for the light neighboring soils.

An analysis of two hundred grains of this clay gave the following results:

Carb. lime,	66,00 grs.
Alumine,	120,00
Silex,	14,00
	200,00

This bed of clay has been found to be twelve feet thick at a well on the west side of Pine lake, and to repose on fine sand.

Clay was again noticed on section thirteen, township four north, range two west and two east, in the banks of the Cedar river. This clay contains only a small portion of lime, is free from gravel and will afford a tolerable material for brick.

Blue clay, containing gravel and pebbles, occurs at intervals along the banks of Grand and Cedar rivers.

Clay suitable for brick was observed in the town of Leslie, near the village of Leslie. In the town of Stockbridge, on section eleven, clay that will afford a good material for brick was also noticed.

Building and Flagging Stone.

The great sand rock formation embraces the only rock found in place in Ingham and the north and east, parts of Eaton counties. It is exposed at many points along the Grand and Cedar rivers, forming in some cases perpendicular cliffs. It is also seen at a distance from the river, in the beds and banks of the small streams. At

many points in the county the rock is found covered by only a slight depth of soil, and it may reasonably be supposed that as the settlement of the county advances, the rock will be found to approach sufficiently near the surface for quarrying, at many points where it is now wholly unperceived.

Southwest from the mouth of the Cedar river, on section nineteen, a compact, grey, calcareous sandstone occurs in the bed and banks of Grand river.

An analysis of this sandstone showed it to be composed of

Siliceous sand with mica,	60,00 grs.
Calcareous matter,	40,00
	100,00

Embraced in this micaceous sandstone is a compact, white, quartzose sandstone, cemented with lime. Both these varieties of sandstone will afford a valuable material for building. The upper portion of the calcareous sandstone is composed of thin layers, which would answer a valuable purpose as a flagging stone.

In the southwest part of township three north, range two west, a sandstone well adapted for building purposes was noticed in the bed and bank of Grand river. It is regularly stratified, the layers being from two inches to twelve inches in thickness. It may be quarried in blocks of several feet superficial extent. It contains numerous remains of extinct plants. This rock is analogous to the calcareous sandstone near the mouth of Cedar river.

In the town of Onondaga, Ingham county, on section seven twenty-eight, and twenty-nine, a coarse, quartzose, micaceous sandstone was examined, some portion of which will afford a good building material.

On section thirty-six, township four north, range two east, in the bed and banks of the Cedar river, a white, coarse grained, micaceous sandstone occurs. It is friable when first taken from the quarry, but hardens upon exposure to the atmosphere.

Tills outcropping edge of sandstone embraces a bed of bituminous shale and coal.

An outcrop of the sandstone was examined in the bank of Deer creek, near the surveyed line of the canal, on section fourteen, township three north, range one east, Ingham county. This sandstone resembles, in appearance, the calcareous sandstone at the mouth of the Cedar river, is very much shattered, and some of the blocks have nearly a vertical position.

Sandstone was again noticed on section twenty-two, town of Leslie, and is apparently well adapted to economical uses. It resembles in texture the sandstone at Napoleon.

Sandstone of a friable nature was noticed on section sixteen twenty and twenty-one, in the town of Vevay, from one to two miles south of Mason. The quality of the stone cannot be well known until excavations are made.

Sandstone also occurs on Grand river, Grindstone and Coal creeks, in Eaton county, in mural walls of from ten to forty feet in height, and extends along each of these creeks for the distance of a mile, and along Grand river for a distance of from one and a half to two miles. These sandstones embrace a succession of coal fissile shale and iron ore. They also contain many remains of plants.

Some portions of the sandstone will afford a good material for building, as also for grindstones.

On section twelve, in the same township, forming the bed of Grand river and occasioning a strong rapid, is a fine grained andstone cemented with lime, and characterized by the appearance of numerous vegetable impressions.

A good material for building and grindstones, and embracing a bed of bituminous shale, was noticed in the bed and banks of Grand river, on section twelve town one north, range three west, Eaton county, and section seven, town one north, range two west, Ingham county. It extends north along the valley of the Grand river into the adjoining township. It is here overlayed by a thin bed of coarse red sandstone that has an irregular dip of about four inches to the foot.

Coal.

The whole rock formation of Ingham and Eaton counties may be referred to the coal bearing series, and several beds of this material, which may be looked upon as valuable, have been examined. The level and unbroken character of the country which brings the rocks but rarely to the surface, together with the disintegrating nature of the rock, (the latter serving to cover those edges, which under other circumstances, would be exposed,) render it difficult to follow these beds in a continuous manner, but no doubt can be entertained but they exist over a large area of the counties.

The most extensive beds of coal were noticed in township four north, range one and two east, in Ingham county, and ranges three and four west, in Eaton county.

Coal also occurs in the valley of Coal aid Grindstone creeks, and on section three, ten and 11, on Coal creek. The coal is here comprised in four beds, having a thickness of four, ten, twelve and twenty inches, and neither bed exceeds two feet at any one point.

It was examined at several places along the table lands, and in the bed of the stream, for a distance of one and a half miles, where in consequence of its dip, I was unable to trace it further.

The coal is embraced in a succession of fissile shades, and compact and friable sandstone, varying in thickness, from live to forty feet. I was enabled to remove several bushels from the different localities, that proved to be highly bituminous, and of very good quality, though occasional pieces were observed slightly contaminated with iron pyrites. It ignites easily, burns with a light

flame, and leaves only a small quantity of earthy residuum.

The coal on Grindstone creek is a continuation of the coal on Coal creek, and was traced in the immediate vicinity of Grindstone creek, across the eastern parts of section three, ten and eleven, where a part of the coal had but a thin covering of soil, making a distance along the stream of one and a half or two miles. The coal here consists of a single bed, having an average thickness of eighteen inches, and at no one point, exceeding two feet. Other beds of small extent, were noticed along the same stream.

In the north bank of Grand river, in township before mentioned, a thin bed of coal occurs, having an average thickness of three inches, and not exceeding six inches at any one point. This coal which is also embraced in a succession of fissile shale, compact and friable sandstone, varying from ten to thirty-five feet in thickness, was traced across section two, three, ten, eleven and twelve, where in consequence of its being covered with debris, I was unable to trace it farther.

A bed of bituminous coal, more than two feet thick, of a superior quality, in town four north, range two east, occurs in the bed and bank of Cedar river, Ingham county. It was traced along the stream, for nearly half a mile, where, in consequence of its dipping below the stream, I was unable to trace it further. This coal is overlayed by a broken down sandstone and fissile shale, varying in thickness, from five to ten feet. In consequence of its appearance in the bed of the stream, and the friable condition of the sandstone, I was enabled to remove several bushels of coal, which proved to be bituminous and of an excellent quality, containing but very slight traces of iron pyrites. It is compact, has a glossy lustre, ignites easily, burns with a light flame, and leaves only a small quantity of earthy residue.

I was informed by Mr. Haden, that in excavating to repair Mr. Ingersoll's mill, on the north bank of Grand river, in township four north, range three west, coal was penetrated upwards of a foot. The coal has a covering of coarse sand and pebbles, twelve feet thick. Some of the coal was examined, which proved not inferior to that on Grindstone creek, Eaton county.

I may here be allowed to express my obligations to many gentlemen, for the information which they have rendered, and hospitality which has been extended to me.

COLUMBUS C. DOUGLASS,
Assistant Geologist

Detroit, January 28, 1839,

(No. 5.)
REPORT
Of BELA HUBBARD, Assistant Geologist.

TO DOUGLASS HOUGHTON, STATE GEOLOGIST.

SIR—In compliance with your instructions, entrusting to me the geological supervision of the counties of Wayne and Monroe, I completed, late in the season, a detailed examination of those districts, the most prominent results of which are now submitted. It is hardly necessary to add, that as the annual reports are designed to embrace only subjects of immediate utility, considerations of a theoretical nature have been avoided.

Collections as extensive as was practicable, and which illustrate the subjects treated in the report, are deposited in the cabinets attached to this department.

In the furtherance of your plans, much attention has also been bestowed towards a correction of the minute topography of the country; a task rendered peculiarly difficult in the older counties, on account of the imperfections of the original surveys. It is however believed, that sufficient accuracy and completeness have been attained to furnish greatly improved maps of this section of our state.

WAYNE COUNTY.

Topographical Features.

Nearly the whole of Wayne county is included within that portion of the peninsula, constituting its eastern border, in which no considerable prominences occur, and the descent to the coast is gradual and uniform. In this county, consequently, if we except the township in its northwest corner, the general level is varied only by gentle undulations or isolated sand ridges, forming no continuous ranges and seldom exceeding the relative height of 20 feet.

The greatest elevation of coast from Milk river point on the St. Clair, down to the Rouge, is about 20 feet; from the Rouge to the mouth of the straits 10 feet.

Along the whole eastern border of the county the altitude attained at distance of six miles from the coast varies but little from 33 to 38 feet. At a single point only, in the vicinity of Detroit, it attains to 45 feet above the river; the general level of the table land at this place being about 28 feet.

A portion of this belt, three miles in width, extending through the towns of Hamtramck, Greenfield and Springwells, falls from the general level and is proportionately wet. Below the Rouge this belt becomes intersected by wet prairies, extending over the west half of Ecorce to the Huron river.

Throughout that portion of the county comprised in the belt above mentioned, the streams flow with but moderate current, have generally deep channels, and

frequently spread into broad marshes near their embouchure, and even in high stages of the "water, to the distance of several miles inland. These borders of marsh alluvion are frequently many acres in extent; as at Grand Marais of Lake St. Clair; on the Rouge, Ecorce, Brownstown and Huron rivers.

Beyond the belt above described the land rises more rapidly, attaining at the western line of the county to about 140 feet above the straits. The streams are rapid and furnish abundant water power.

Two-thirds of the county are flat, heavily timbered lands, producing a stout growth of oak, elm, white wood, maple, beech lynn (bass,) ash, hickory, butternut, black walnut, &c. Chesnut is found on sandy ridges in the towns of Dearborn and Van Buren. The remaining third is undulating oak openings, or plains interspersed with wet, grassy prairies; the latter obtaining a proportion of about one-fifth. The proportion of actual swamp is small, and probably little or none exists that may not be reclaimed by a course of drainage properly conducted.

Soil, and Agricultural Character.

Clay and sand loams constitute the soils of the timbered land. These occupy nearly equal proportions of surface and often alternate within short distances. The former derives its character from a bed of yellow or brown friable clay, which reposes upon the extensive blue clay deposits immediately overlying the limerock.

Clay is reached throughout the portions characterized by sandy soil at a depth of from 5 to 12 feet.

The upper clay has an average thickness of 5 feet. The lower clay is of a variegated blue color, gravelly, and intersected by layers or strata of quicksand and gravel. This clay sometimes approaches the surface, as in the vicinity of Detroit. Its average thickness must exceed one hundred feet.

These soils are excellently adapted to agriculture. Silex enters largely into their composition. Both clays generally contain a large portion of lime,* which adds to their fertility. The contained gravel assists to conduct away the surface waters and prepare the ground for tillage, while the retentive powers of the clay render it little liable to suffer from drought. Thus, while the sand loams may be cultivated to wheat and other grains, the greater portion of the clay lands is natural meadow, adapted to grazing. Its value for this purpose is beginning to be understood, and it is probable that were its merits fairly tested by a system of dairy farming, it would prove productive of a profit to the husbandman second to none in the state.

The sandy oak openings and plains are generally productive. They possess the advantage of being easily tilled, and are well adapted to grain and root crops. Some portions produce good wheat. This soil contains only a minute proportion of lime.

No part of the county can be said strictly to have a limestone soil. The great limerock formation approaches the surface at several points in Brownstown and Monguagon, but is in general too deeply covered by the clays to allow it to characterize a large extent of soil.

In the town of Plymouth a different character of country prevails from any yet described. This town and part of the two ad-

*An analysis of 100 grains of the clays, taken at random, showed—

	Upper Brown Clay.	*Lower Blue Clay.*
Sand and siliceous matter,	51,50	27,50
Alumine,	23,95	52.30
Carb. lime,	18,55	18,98
Oxide iron,	00	1,22

joining, may be considered as lying without the border portion of the peninsula, in which I have described Wayne Co. as included.

This township presents a surface more roiling, and broken into frequent ridges. They rise often from 60 to 80 feet from the plain, with a steep declivity, and having no apparent uniform direction. They are composed of gravel associated at the surface with a clay loam. For the production of wheat, probably this soil is not excelled.

The boundary between the land of this character and the more level tract which constitutes the whole remainder of the county, is strongly marked by a low gravelly ridge, the supposed former shore of the lake. Its course is southwest through a corner of the town of Livonia, entering Plymouth between sections 12 and 13, passing a little to the east of Plymouth corners; thence through section 33 into town of Canton, which it leaves on section 30. As but a small portion of this ridge is found in Wayne county, a particular description is deferred to a future report.

Boulders.

No part of the county can be denominated stony. Imbedded in the clays, and occasionally found grouped upon the surface, are water-worn boulders or fragments of the primary rocks. A species of reddish granite predominates, occurring frequently of more than a ton weight. Boulders are found in great numbers in the town of Plymouth, a large proportion being of fossiliferous limerock. Limestone boarders are also numerous in the bed of Huron river, sometimes of large size. Occasional banks of *cobble stones* were found heaped along its sides, of a size suitable for paving.

An interesting locality of boulder rocks was met with at Raw-son's mills, town of Van Buren. An excavation in the river bank had exposed a bed of limestone and clay-slate rocks, thickly deposited rear the water's edge, to the depth of several feet. The slates were often of two to three feet diameter, of dark color, fissile, and containing iron pyrites.

Marshes or Wet Prairies,

Comprise extensive tracts; they are of generally similar character, being low portions of the sandy openings that have been subjected to an overflow of water for a sufficient period to allow a deposition of muck or *peat*

from vegetable decomposition. This peat supports a growth of wild grass, destined to add annually to its accumulation. Thus what were ponds, become by this process extensive beds of vegetable soil, varying in humidity with the seasons. These beds have a depth of from one to six feet, and upwards.

Indications are apparent which prove that very many at least, of these peat marshes had their origin in the labors of the beaver, aided by the natural conformation of the surface. They occupy gently rolling tracts, in which ridges of sandy "openings" and detached prominences or *islands* of the same are intersected by long bands of marsh. Nearly all the streams of the border townships head in these tracts, and it is easy to conceive how the portions now converted into marsh might have been flooded by the obstruction of those natural channels.

If this view be correct, the practicability of drainage becomes at once established; and such conclusion is verified by actual results.

The following comprise the principal marshes of the county.

About fourteen sections, two-thirds of which are in the town of Hamtramek and the remaining third in, Oakland county, are of the character above described: but not more than one-half this extent is actual prairie. This yields an abundant growth of wild hay. The marsh is now in the progress of successful drainage. A thickness of fibrous peat is disclosed, averaging four feet, succeeded by a subsoil of gray sand, nearly free from aluminous and vegetable matter.

Prairie of similar character occurs in towns of Greenfield Red-ford and Royal Oak. It covers 8 sections, one half of which is in Oakland county. Comparatively a small portion consists of dry openings, and one half bears a dense growth of small tamarac. Its soil varies in depth from 3 to 6 feet, and is in many places so charged with water as to be tremulous. It produces large quantities of cranberries.

Prairies of a different character occur in the lower part of the county, over a surface of 46 sections, of which 18 are included in town of Ecorce, 11 in Brownstown, 7 in Romulus, and 10 in Huron.

Branches of the Ecorce and Brownstown creeks meander this tract. These, flowing with little descent through lines of level prairie, are ramified in every direction, and form a net work or connected chain of marshes over the whole surface. The dry portions consist of sandy plains, frequently but little elevated above the surrounding marshes, and producing a scattered growth of yellow and white oaks. They sometimes assume the form of ridges, which continue unbroken for many rods, and without any uniform direction. The marshy portions, which generally predominate, have a soil of black muck, intermixed with sand washed from the adjoining plains, averaging 2 to 3 feet in depth. This is covered by a few inches of light, fibrous peat. Subsoil is sand. In a few instances clay was found approaching the surface, and it undoubtedly underlies at no great depth.

Wild hay is cut on these marshes in considerable quantities.

According to reports of the Indians, beavers disappeared from this region thirty years ago. Their numbers previous are said to have been incredible.

Few trials have been made in drainage. A shallow ditch, or even a passage cut through a beaver dam, has in two or three instances effected great improvement. I observed vegetables growing upon a piece thus ditched, and it is said that wheat succeeds well.

This tract is owned mostly by "non-residents." Several untenanted houses gave evidence that a few families who had commenced a settlement have deserted to more favorite spots. Ditching had not been attempted. The expense of this kind of improvement is comparatively small, and I do not doubt that were less than half the ordinary labor in "clearings" bestowed upon a course of drainage, these lands, instead of their present little estimation, might soon be accounted amongst the most fertile in the state.*

In the southeast quarter of range eight cast, town of Huron, marshes occupy, it is supposed, two-thirds of the surface. They have a peat soil, averaging two feet, but occasionally much deeper and inclined to bog. Cranberries grow abundantly. Branches of Swan creek meander this tract in such manner as to facilitate drainage; and the comparatively dry character of a large portion will render the cost of ditching moderate.

*Ditches may usually be cut, of 3 feet wide by 2 deep, for from two to four shillings per rod; perhaps less. The main ditches of the extensive marshes in Hamtramck, owned by Judge Conant and others, are 6 feet by four, and cost $1 per rod.

Smaller marshes occur in the county, though not frequent, and of little general account.

Encroachments of the River and Lakes.

Extensive damage has been occasioned by the unusual height of the lake waters during several past seasons. From the St. Clair to Huron river, the coast, which is mostly gravelly blue clay, with alternations of sand, has been abraded to such an extent, since 1835, as to remove the entire line of coast, where unprotected, several yards to the westward. Along the coast of Hamtramck, above Detroit, scarcely a vestige of the old river road remains. Near Milk river point the waters are said to have advanced inland 150 feet within the past two years. Below Detroit the depredations upon the coast have been less severe, but sufficiently so to render a portion of the road below, the Ecorce unserviceable and deprive the already narrow turnpike above of several yards of its width. Along the Gibraltar front, at the mouth of the straits, where the bank is from 6 to 10 feet in height, the waters have advanced 10 feet inland.

This abrasion of the coast has been in progress riot only for the past two or three seasons, but to some extent through the fluctuations of level in the lakes during a much greater term of years. While the configuration of the straits preserves the Canada shore in a great degree from erosion by the current, its whole force is felt upon the western coast; a much greater abrasion being prevented only by the low and shelving character of a large portion.

From the same cause the marshes bordering the shores have been greatly extended. Many acres of former arable land, both in Wayne and Monroe, are now embraced by the waters. Numbers of orchards, the growth of a century, have become a prey to the flood, and families of the old French inhabitants are driven from homes till now occupied from childhood. The United States road from Detroit to Monroe has been rendered impassable at no less than three points, and the travel forced into other and circuitous routes.

Leaving to an abler pen the investigation of the causes of this unprecedented rise, it may not be amiss to notice, briefly, such remedies as have been tried, or may be proposed to check the devastations occasioned by it. Should those causes continue to operate in maintaining the present elevation of the waters, the subject will become of vast importance to the interests of this portion of our state. Every foot of coast now suffered to waste away, involves a loss much exceeding that already sustained. The inconvenience now felt from the diminished breadth of the river road below Detroit, calls for one of two remedies; either the road side must be protected by a dock along nearly its whole extent, or a new and broader road must be opened in the rear and beyond such a probable future contingency. The former method, owing to its expense, will, it is presumed, never be resorted to by public authority, nor by individuals to much extent.

Although the erection of docks is undoubtedly the only permanent protection, more simple remedies may to some extent prove of avail. Quantities of brush, strewed thickly along the exposed bank, afford a considerable protection against the direct force of the waves, and also aid, by the retention of the sand and gravel brought up, to form a beach along its foot. A heavy log or fallen tree, placed at right angles to the shore, serves to accumulate a beach, and thus often affords protection.

These remedies are not invariably successful; but they are easily attainable, involve but small expense, and will be properly estimated if they tend to preserve even a small portion of the wealth of the landholder from the devouring wave.

Clay.

Clay suitable for bricks and pottery, is found at numerous plaices in the county, though the value of much of it is deteriorated by the presence of lime. The manufacture of bricks is conducted at several points.

At Springwells a brick yard has been established for several years. The clay used is from the blue clay deposits, and is tolerably free from grit. The sand is taken from a cap or hill lying above the clay, with strata of gravel interposed. The bricks find a market at Detroit. About 500,000 are manufactured annually, worth $5 00 per thousand.

A superior clay for brick is found in the banks of the valley of the Rouge, and several kilns are established in the towns of Spring-wells and Ecorce. At a yard belonging to Mr. Abial Wood, on the south side of the river, (farm No. 601.) the clay employed is of a light blue color, free from grit. It improves with the excavation. At depth of six feet, I observed it of a lighter color, sometimes veined with white. About 300,000 bricks were manufactured this season.

At a yard of Mr. Wood, on the opposite side, about the same number have been made. This yard has been established three years. The blue clay is used, and is said not to improve with the depth. The overlying yellow clay is considered inferior. A cap of sand overlies of 2 to 4 feet.

Two adjoining brick yards have manufactured about the same number each;—an amount this season less than usual, on account of the prevailing sickness.

A fine blue clay appears near the river bank at Flat Rock, from which brick is made. Its quality is said to be impaired by lime. About 500,000 have been burned.

At Morris', three miles above Mt Pleasant, a brick yard is commenced--clay said to be of good quality. The yard is oil the summit land adjoining the river, at a height of 50 feet.

Two yards are established on the middle branch of the Rouge, in the town of Nankin. At Wilkinson's, near Schwarzburg, clay appears in a stratum running along the bank, and is here two and a half feet thick. Portions contain too much lime to be used with advantage. Good bricks are manufactured of the clay taken from the river bottoms, at Swifts, section 11.

A bed of clay occurs in town of Plymouth, section four, from which bricks and earthern ware are manufactured. It consists of strata of the blue and yellow varieties, underlying probably 8 acres, with an average thickness of 4 feet. A cap of sand, of 2 feet thickness, overlying, is used in the manufacture. Sand and gravel underlie the bed of clay, which are unfit for use from the lime contained. The bricks are of good quality, 100,000 were made this season, worth $5 00 per thousand. The pottery ware receives a good glaze, and is durable.

A bed of clay exists west of Plymouth corners, section 27. It is supposed to cover 80 acres. Considerable lime is contained; 500,000 bricks are made from it each season.

A bed of fine blue day exists on section 11. The above were the only deposites observed in this township.

Blue clay appears at the surface in the town of Canton, which is free from lime.

In the town of Huron a fine blue clay underlies the low lands bordering Swan creek, at small depth, and frequently comes to the surface.

The blue and yellow clays make their appearance at every bluff along the Huron. They are in general very marly and seldom free from grit. A kiln was erected in a ravine of Woods' creek, section 36, Van Buren, but the clay proved so calcareous that the works were abandoned.

Limerock.

The great limerock formation, upon which the clay deposites of the county rest, makes an *outcrop*, or appearance at the surface, through the townships of Monguagon and Brownstown. It forms the bed of the strait near its mouth, as well as a foundation to the islands.

The most easterly point at which the rock appears above the level of the water, is at Stony island. This is wholly constituted of the rock, covered by only a few inches of soil. Limerock was formerly quarried upon this island, as is testified by numerous pits, but the fractured surface stone only appears to have been removed. These fragmentary blocks seldom exceed a foot diameter, are of a white color, compact, and afford good lime. The island is but little above high water level, and the pits are now flooded.

Quarries have been opened at the lower end of Grosse Isle. The rock makes its appearance in a slightly elevated ridge, at some distance from the shore. Trenches are opened for quarrying in no place more than 5 feet deep. The upper layers are of a few inches thickness, removable in irregular pieces of a size suitable for rough building. One of the trenches exposes a stratum of 3 feet thickness, for the distance of 300 feet. This stratum is compact and may be broken out in nearly square masses.

Sulphate of strontian, in large chrystals, is abundant in the upper layers. No fossils were discovered.

In section seven, of Monguagon, is a protrusion of the rock in a ridge, occupying a surface of a dozen acres. Quarries have been extensively worked, chiefly for lime. The rock is in strata of from 6 to 10 inches thickness, of gray color, chrystalline, and eminently fossiliferous. The quarries have extended to the depth of 6 feet. The color of the stone deepens into blue, and its hardness increases with the depth. Calcareous spar is contained in chrystals, lining small geodes and fissures. Thin layers of indurated bituminous matter, approaching coal, are contained between some of the strata. The largest masses of stone observed to be quarried in good condition, were two feet in length by about eighteen inches wide. Whether larger slabs might not be obtained by proper care, I was unable to learn. It is fully equal in beauty to the much admired building material brought from Ohio, but its superior hardness renders the dressing and polish much more expensive.

From 9,000 to 12,000 bushels of lime are manufactured annually at this quarry.

Limerock makes its appearance in Brownstown creek, one and a half miles west from Gibraltar, and has been used to a very limited extent for domestic purposes.

Rock is said to appear at the water's edge on the lower end of Celeron island.

Limerock forms the rapids in the Huron at Flat Rock. It appears in a smooth, almost unbroken bed, for the distance of forty rods, forming a foundation to the dam above, and disappearing in deep water below the mills. The rock is of dark gray color, occasionally porous. A specimen contained hornstone.

Rock was also occasionally found forming the bed of the channel from Flat Rock till within two miles of Mt. Pleasant, and large tabular masses, but little worn, appeared even farther up, proving the existence of rock in place at no great distance.

A very slight general *dip* in the limerock of this county, northwesterly, is observable.

Marl.

The only deposites of shell marl known to exist in this county in sufficient quantity for economical purposes, are in the town of Plymouth. The following deserve notice:

On section 22 (at Deacon Purdy's,) is a small deposite which occupies two-thirds of an acre. As other beds occur in the township of similar origin, it may be advisable to notice the circumstances of its formation. Upon a gentle slope a protuberant bog has formed, which is wet and slightly tremulous. It consists of peat, or Vegetable matter, having a depth of about 3 feet. Below this is found the marl, which has here a thickness of from one to three feet. It is a plastic substance of a milky gray color, perforated by roots, and may be cut out in masses like clay. The presence of lime is indicated at the surface by a calcareous deposite upon moss.

Beds thus formed originate chiefly in deposition from water of springs highly charged with lime; circumstances under which *tufa*, or indurated deposites of lime, usually occur. Lime is favorable to the formation of shells, which are generally associated in abundance, but do not constitute the bed as when it occupies the former bottom of a lake. Several species of the genus Helix (snails) are most numerous, with Lymnea, Planorbis, &c.

As the producing causes are still in operation, marl existing under these circumstances may be supposed still in progress of formation.

Eight hundred bushels of lime have been manufactured at this bed. Much of it beautifully white and of good quality.

The marl furnishing this number of bushels was taken from an area of three square rods. Should the deposite

cover but half an acre, with the depth of a foot, (a low estimate,) the amount of lime it is capable of furnishing would be 21,833 bushels. Five hundred bushels of the lime cost in the digging and manufacture 57 days' labor. Reckoning these as so many dollars, and the lime at two shillings per bushel, (average price,) there will appear a profit of more than one half the price brought by the article.

On farm of Caleb Herrington, Esq. sections 5 and 8, a very extensive deposite was exposed in digging a drain to remove the water from a tamarac swamp. At several places a pole was thrust into the bed, without passing through, to the depth of six feet. From the indications apparent, I am led to believe that the entire area of the swamp (30 acres) is underlayed by the marl. It is compact, heavy and plastic. This marl is well adapted to the manufacture of lime, but has not yet been applied to that purpose.

On land of Sylvanus Taft, section 4, is a bed of an acre or more in extent, with an average thickness of two feet. It is compact and of good quality. No lime has been manufactured, but much of it used in its natural state, by the neighbors, for plastering and whitewashing, is said to have fully answered the purposes of kiln-burnt lime.

Numerous other indications of marl occur through the township. A bed is said to exist on section 27. Also on farms of Mr. Holmes and others, probably to a small extent.

A small bed was found on land of Wm. Yerkus, section 2.

Upon the surface of a knoll at Waterford, a considerate quantity of a dry pulverized marl was observed.

On the farm of Pitz Taft, on the Base line, within the boundary of Oakland county, is a deposite which may be noticed in this connection. It covers two acres, with an average depth of six feet. It is a tufaccous shell marl, in coarse particles, with a stratum of tufa underlying, and occurs under circumstances similar to those of the deposite on section 22, first noticed.

Ten square rods have been excavated, out of which were manufactured 3,000 bushels of lime of good quality. It sells at three shillings per bushel.

Assuming the above proportion, the quantity of marl may be estimated at 31,680 cubic feet. The amount of lime which the bed is capable of furnishing at 98,000 bushels.

Marl, in small quantity, has also been found in town of Canton, section 9.

No experiments have been made in the employment of marl as a *manure*, in this county, nor, so far as I am informed, elsewhere in the state. This is somewhat a matter of surprise, since trials of plaster (gypsum) and quick lime are acknowledged to have produced extraordinary results. It is, however, scarcely known to our farmers that marl, or *bog lime*, may be used with equal profit while it has the advantage of being obtained at a much cheaper rate. It deserves to be made the subject of immediate and ample experiment, particularly upon sandy soils and those which are found to contain but small proportion of that essential ingredient, *lime*. This is often the case with the lands in the immediate vicinity of the marl beds.

Peat.

Peat, or vegetable alluvion, is found in considerable bodies in town of Plymouth, overlying the marl, and in the marshes or wet prairies of Greenfield, Hamtramck, Ecorce, Brownstown and Huron. These latter deposites have been already noticed under the head of Marshes.

The greater proportion of peat found in this county belongs to the variety called *fibrous*, being a mere mass of spongy fibres of grass roots, partially decomposed and elastic to the tread. A small proportion is of the *sphagnous* or peat moss variety. Comparatively little is *compact*, or in a state which would render it of much value for fuel.

A bed in the tamarac swamp on sections 5 and 8, Plymouth, to the depth of five feet, was found to consist chiefly of the kind denominated *ligneous*. It disclosed a half decomposed mass of tamarac logs, with moss, roots, &c. At depth of several feet, I found entire stumps, trunks and limbs of a former growth of timber, retaining their form, but so soft as to yield readily to the spade.

The body of fibrous peat which composes the marshes in Hamtramck, includes about 1,900 acres, with an average depth of four feet.

The adjoining marsh, in Greenfield and Royal Oak, comprises about 3,000 acres of this deposite, with the same average depth. Probably a portion of this peat is of ligneous origin.

From 3,000 to 4,000 acres of fibrous peat, with average depth of two feet, are contained in the marshes of West Huron.

Of the other smaller deposites of peat noticed under marshes no estimate could be made.

None of these beds of peat have yet been esteemed of importance as an article either of fuel or manure. The wants of our population do not demand any present consideration of its value for the former purpose. But in the latter capacity, it will be found serviceable and cheap, and it is desirable that fair trials of it be made. It may not prove sufficiently decomposed for the purpose until mixed in the compost heaps and consolidated by the application of quick lime. This disposition of it might be made with peculiar facility where it occurs as in Plymouth, imposed upon beds of marl.

Bog Iron.

Deposites of bog ore occur in limited quantities at numerous places; their origin being apparent in the presence of highly ferruginous soils.

In the township of Greenfield, deposites of ore occupy a considerable extent, chiefly on sections four and nine,

where I traced it at intervals over an area of one half a square mile. It follows mainly the course of two brooks discharging into a large tamarac marsh, on section ten, and embraces the intervening ash swales. It is distributed over this area in beds of a few yards wide and irregular patches. The deposite consists of an exceedingly compact bed of a foot thickness, which is broken out in large masses, and it is mostly of inferior quality, being what is technically known as an *old ore*. This is succeeded by from two to six inches of the variety called shot ore, which is apparently rich. The covering of soil is from a few inches to two feet in thickness. This is by far the largest deposite in the county. Time would not permit a very accurate analysis of the ores of this county, but a more detailed account of their composition may be expected, at a future period, in treating of the other ores of the state. One hundred grains, however, subjected to a rough analysis, gave,

Siliceous and aluminous matter,	26.50
Per-oxid of iron,	73.50
	100.00

In township of Livonia, section twenty-eight, bog iron occurs in a low, wet swale, which serves as the outlet to a series of small marshes. The bed follows the lowest portion of the swale for about half a mile, with a width varying from two to four rods, and a thickness of six to eighteen inches. It consists mainly of a bright colored *shot ore*. Peaty muck overlies, of two feet average depth.

Estimating the average thickness of the deposite at one foot, and its width three rods, will show a proximate result of 130,000 square feet of the ore. From the position of the low grounds following the course of the outlet, it is not improbable that other deposites of this mineral may be found below. The ore is a very rich one, and is well deserving a more extended investigation by the proprietor.

In township of West Huron, section twenty, is a small deposite occupying an area of thirty rods long, by one wide. It forms a compact body six to ten inches in thickness, mostly "dead ore."

On section twenty-one, a narrow deposite of bog ore occupies the bed of a small run connecting marshes. It is similar to the above, and of small extent.

Other indications of ore occur in this township; probably of but little account.

Much of the soil of the township of Plymouth is found charged with iron.

Strong indications also exist in the towns of Canton and Nankin, among the wet prairies of Ecorce and along the bottoms of the Huron, in the township of Van Buren.

Chalybeate Springs,

occur in several of the above townships.

One in Canton, section 5, has formed a considerable mound by deposite of calcareous matter from the water.

A spring, much impregnated with iron issues from the river bank, near Rawson's mills, town of Van Buren.

Sulphur Springs,

of considerable strength, occur, but are not numerous.

A very large one rises in the bottom of the Huron, in the Wyandot reserve. It occupies a hollow of an oblong shape, 360 feet by 150. The water deposites thin films of sulphur.

In town of Ecorce, section 22, is a spring very strongly impregnated. It occupies a basin of 100 feet diameter. This spring, with the one above mentioned, probably exceeds in strength any others in the state. They are favorite resorts fur domestic cattle, as well as for deer and pigeons.

On section 20, town of Dearborn, several sulphur springs issue copiously from the bank of the Rouge. Their waters also contain iron, which imparts an inky color to surrounding surfaces, by combination with the characteristic acid of their vegetable portions.

A spring of considerable strength issues from the bank of the Huron a mile below Flat Rock.

On section 29, Brownstown, a spring, strongly impregnated, rises in the edge of a tamarac marsh, forming a large basin. The stream issuing is sufficiently large to overspread a considerable tract. Indications of salt and lime were present.

Strong sulphur springs abound in the neighborhood of the marshes around Gibraltar. Their vicinity is strongly colored by a milk white precipitate.

The source of these springs is noticed under the geology of Monroe county.

Brine Springs.

Springs of brackish water are found occasionally through the northern and western townships; but their position in regard to the true saline district of the state, would probably not warrant the expectation of profit resulting from them in the manufacture of salt.

Several "licks" were visited in the towns of Springwells, Redford, Canton and Nankin; but they contain, mostly, the salts of lime.

A spring, impregnated with saline matter, rises on the bank of the Rouge, in town of Redford, section 27. The discharge from it is about 60 gallons per hour.

In an early state of the country, salt was manufactured here by the Indian and French settlers. A hollow gum was sunk, which has long since rotted away. Furnaces were constructed of brick. An attempt was made a few years ago, at considerable expense, to revive the manufacture. The result was the manufacture of a small amount, half a bushel of which was sold in Detroit as table salt. Sickness occasioned discontinuance of

operations, which the diminished price of salt has since rendered unprofitable.

In town of Nankin, section 11, springs occur, at one of which a well is now sinking preparatory to an attempt at salt manufacture. The excavation has proceeded eight feet, being protected by a strong curb of wood. I was informed by the proprietor that an ordinary pail full of the brine produced a gill of saline residuum.

An analysis of 100 cubic inches of water from this spring, furnished in the first annual report of the State Geologist, shewed 38,47 grains of muriate of soda, (common salt.) combined with muriate of lime and other matters. This result exhibits a strength equal to only one-fourth that of the brine springs at Grand Rapids, and less than one-tenth that of the springs of the Tittabawassa, the points at which operations are commenced for the state salt manufacture.

In regard to the conduction of operations by individual enterprise, we would refer to the whole subject of brine springs as presented in that report. It may thus be seen under what conditions only certain reliance can be had of ultimate success; nor should it appear surprising that expectations, not the result of a thorough understanding of the subject, may end in disappointment.

Water, Wells and Springs.

The county may be considered as in general, well watered, by streams discharging into the straits at intervals of a few miles. Their waters, like that of the lakes, are *soft*. The River Huron alone forms an exception, which passing over limerock and through marly clays, becomes *hard*, or charged with lime.

The early French settlers dug no wells. They clustered about the streams, and partook from those natural fountains. The surface waters thus in most cases obtained, and from streams often winding sluggishly along low and marshy banks, afforded but an indifferent beverage.

Numerous wells have since been sunk, and with various success. The thick bed of blue clay which underlies the county at small average depth, though charged with gravel, is not sufficiently pervious to admit the peroclation of large underground streams. For this reason springs do not abound, and a large portion of the water of wells is a more drainage from the surface. Some springs, however, exist in the clay district, as on the Bloody run. They are more frequent and copious beneath the caps of sand and through the openings, as at Springwells, (La belle Fontaine of the French.) Mt. Pleasant, &c. on the Huron.

But, though the obtaining of water from living springs throughout the clay district, is thus in a degree rendered uncertain, excavations for water have been generally successful. Occasionally copious streams are opened, discharged through seams of gravel and sand. Usually water percolates slowly through a gravelly stratum of the clay, and is sweet and pure, and in sufficient quantity for ordinary purposes. Well-diggers assert that such a seam of gravel, at depth of twenty feet, is very general.

These experiments determine: first, that a reasonable prospect exists of obtaining good water by digging; secondly, that a very deep excavation cannot be recommended.

Wells of from five to twenty feet, frequently afford an abundant supply, rising from below; while excavations in the same neighborhood of from fifty to one hundred feet, through a hard, dry, reddish blue clay, yield no water or are filled from the surface. The boring at Detroit, which extended to depth of two hundred and sixty feet, one hundred and thirty-three feet of which was in rock below the clay, failed to furnish the desired supply. Instances have occurred, however, from diggings in the vicinity of the limerock, of a very copious discharge from an unusual depth.

Much of the bad effects of stagnant water might be avoided by occasional cleansing of wells. A fresh supply should be obtained by thoroughly draining the well of its contents, whenever an approach to putrefaction is perceived.

Might not a quantity of lime or charcoal, whose antiseptic qualities are well known, thrown in, be a useful auxiliary in preserving purity?

No purer water perhaps exists than that of our immense upper lakes, the whole body of which passes through the straits of Detroit. It is exceedingly soft, and in its under current of almost uniform coldness throughout the seasons.

Detroit denied herself the enjoyment of this luxury, when, by an unfortunate policy, the supply that should have been sought in that volume which flows pure and icy cold in the depths of its channel, is transferred to the reservoir from the warm, contaminated surface, at the docks.

A remedy is obtained by removal of the works above the city and the substitution of iron pipes for wood; but it is suggested whether another improvement might not be effected by extending the supply pipe from its present mouth, at five feet below the surface, into the deep recess of the channel.

Plymouth, which borders on the flat clay district, is the only township that abounds in numerous and copious springs of the purest water. Through this tract of broken, gravelly hills, single springs occur sufficient to give rise to considerable streams.

Roads.

The importance of good roads to Wayne county, particularly in the flat clay district bordering on Detroit, has been long felt, and much labor and expense have been bestowed towards their improvement. Nor can the value of a universal highway, passable with safety and expedition at all seasons, scarcely be over estimated. The soil of this heavily timbered region, it is true, is but ill adapted to such roads as are required, but great

improvements might be effected in their present management.

The importance of the subject will excuse, in these pages, an allusion, though necessarily brief and imperfect, to improvements of this nature; more especially as such only will be referred to as impose no additional expense, but occasion an actual reduction of present outlays to a vast amount.

Heavy taxes are annually assessed for construction and repair of roads. These frequently fall into the hands of men who are ignorant or careless of essential facts, and are appropriated without the oversight of those who are most interested. Or, a requisition is made upon the districts once or twice a year for personal services, on which occasion the whole amount of tax is expended, and the road passes without attention the remainder of the year.

Instead of this inadequate method, we would advise the appointment of a road overseer of at least some practical science. It should be his constant occupation to smooth the ruts and repair every damage as often as they shall occur. A permanent, uniform surface should be preserved. This may be effected by means of a broad road scraper and a few hands, only, employed as an occasion requires. The work will then be more effectually accomplished, and will require less than one half the time, labor and cost ordinarily expended.

In road construction it should be borne in mind, that a liberal breadth is favorable to the preservation of a uniform surface. It removes the necessity for a constant use of the same track; thus such portions of the road are avoided from choice as are otherwise cut into continually deepening ruts and hollows. No small advantage also results in the increased facilities for evaporation due to a wider exposure to the sun and a more free circulation of air, as well as in the convenience of ample sidewalks for foot passengers.

The necessity for free removal of water from the side ditches, by drains, conducting to lower levels, is also an urgent consideration. While these are essential to the perfect accommodation of the soil to agriculture, it is also evident that if the roads are left to dry solely by the slow and uncertain process of evaporation, no continuance of labor can be completely effectual.

It may be important to consider whether the elevated crowning given to some of our roads, be not useless as well as expensive, for the steep sides and uneven draught thus created, force all the travel into the only safe path, at the top of the grade. The Grand river road, which was thus constructed for a few miles, at great expense, is probably in worse condition at all seasons than if the travel were permitted to shift at will over the same extent of more level surface. A rise of one inch in three feet is thought by the most skilful road engineers more than sufficient for purposes of drainage, and it is evident that as ruts are longitudinal to the direction of the road, an increase of elevation cannot assist to conduct off the water which inevitably settles into these convenient receptacles.

The primary expense of the excavation and embankment would provide all the moderate applications needed on a flat road for a great length of time.

The use of brush or logs as a foundation, can be of permanent service only while a constant solid covering of earth is maintained. This cannot be effected but by continual oversight and attention to the considerations above presented,

Possessing, as does the tract of country under consideration, such slender amount of good materials for road construction, it may be well to enquire whether the loads of gravel removed from the river coast and used to fill in the docks, together with the broken stone and pebbles brought as ballast in vessels, might not be employed to public profit, particularly in the streets of Detroit.

These hints touch but very partially the improvements susceptible in our roads. We aim only at directing attention to the subject. Road making has become a science, and to engineers, of whose profession it is more properly a study, we leave its full elucidation.

MONROE COUNTY.

Topography.

The county of Monroe partakes of the general uniformity of surface of the eastern border district of the peninsula. This general level is here interrupted by no sudden prominences exceeding 20 feet in height. The rise from the lake is gradual and nearly uniform, attaining at the western line of the county to about 115 feet. The streams descend with a rapid flow, furnishing numerous mill sites.

Lake Coast.

The very gradual ascent of the coast renders a border of many acres liable to be overflowed, and has occasioned broad marshes along nearly its whole extent.

From the same cause, the streams, after flowing with a lively current, on approaching the coast subside to a level and are affected by the fluctuations of the lake to the distance of two and three miles inland.

This joint action of the tide and current has given origin to several extensive deltas. Thus the approach to the city of Monroe, three miles inland, is through a circuitous channel, among islands of low alluvion, making a passage of six miles. A cut effected by the ship canal, now in progress, will shorten this distance one half. The unfavorable impression produced by the Raisin and other streams, at their entrance to the lake is, however, removed on tracing their course through the rich and varied interior.

At least one half of the whole line of coast presents a border of marsh, irreclaimable, except at the will of the lake.

The most elevated portion of the coast is at Point aux Peaux and Stony Point, near Brest. About one mile in extent has here an altitude of 5 to 8 feet, occasioned by an outcropping ledge of limerock.

The effect of the surf breaking upon the outer edge of the alluvial fields and islands is to accumulate detritus, brought up by the lake, occasioning sand beaches. These by successive additions assume the form of ridges, generally elevated about 4 feet Beaches thus formed skirt the outer edge of the delta of the Raisin. A narrow ridge of sand is frequently seen protecting low marshy tracts in their rear. In a similar manner a spit of sand, four miles in length, forms the barrier to Ottawa bay. This has probably a base of limerock, with clay superimposed, which has been protected from the erosive action of the lake by the cover of sand at the same time deposited from its waters.

Soils and Timber.

The county is bordered on the east and west by heavily timbered clay lands, having a width varying from two to nine miles. This timbered tract, on the west, continues into the adjoining county.

The whole included portion, in width from 8 to 14 miles, and extending in northeast and southwest direction into the adjoining counties on the north and Ohio on the south, consists of sandy "openings" and plains, with a large proportion of wet prairie or marsh.

The heavily timbered tracts produce a large growth of oak, white and black ash, elm, lynn, beech, maple, whitewood, black-walnut and sycamore, evincing a rich and very durable soil. Cotton wood is found in swamps, on the western edge of the county.

The timber of the plains and openings is mostly a yellow and white oak, often a thin and scattered growth, upon a meagre soil. Some clayey and more fertile portions produce hickory, and through Frenchtown and Raisinville, burr oak and chesnut are abundant.

The entire county may be said to be characterized by the great limerock formation, which is found to lie at no great depth throughout, and approaches the surface in at least twenty different places. Beds of clay and sand repose upon it. The former every where evince the proximity of the limerock by their extremely marly character and the numerous, imbedded, angular fragments of the rock.

The *outcrops* of the limerock are found to lie in several distinct ranges, extending through the county in a northeast and southwest direction. The outer range, commencing at the southeast corner of town of Whiteford, forms there a ridge or step, having a rise above the general surface of 15 feet in a breadth of 2 miles. It passes thence in a nearly northeast course to Brest, occasioning those intermediate hillocks or protrusions of rock which occupy areas of from one half to two square miles. At Stony Point it comes out upon the lake in the ledge before mentioned, and still further on in the same direction makes its appearance on the islands at the mouth of Detroit straits and the neighboring shores.

The second range, from the town of Whiteford where it apparently approaches the range first mentioned, passes through the northern part of the town of Ida, in a nearly direct line to Flat Rock.

West of this range, rock again appears on the Macon river, in the reservation, and in the Raisin at Dundee.

From all the data that could be obtained, the deposite of blue marly clay in the intervals between these ranges does not exceed in thickness 20 feet. Upon this rests a brown or yellow clay, similar to that which overlies the blue in Wayne county.* It has a thickness of 8 to 10 feet. This clay constitutes the basis of more than three-fourths of the soil of the timbered lands. Sand loams occasionally alterate with it, and in the town of Milan a rich black sand loam constitutes three-fourths of the soil.

*An analysis of 100 grains of these clays shewed—

* An analysis of 100 grains of these clays shewed--

	Upper Clay.	*Lower Clay.*
Siliceous matter,	9,25	23,00
Alumine,	67,25	44,00
Carb. lime,	23,50	31.16
Iron,	00	1,84
	100,00	100,00

The sand of the openings and plains has a depth probably not exceeding 10 feet on the general level. Its surface is slightly undulating, and in a few instances considerable ridges rise abruptly. One of these was observed bounding the heavily timbered lands of the town of Erie, succeeded by others having no uniform direction and varying in height from 6 to 15 feet; wet, grassy swales intervening. I traced one of them for a mile in a northerly direction. A sand ridge borders the prairies in the southwest corner of Ida. It continues for half a mile in a northeast course, attaining to 15 feet in altitude, with the breadth of 100, and terminates by a sudden descent. Similar ridges may be observed on the plains near Sandy creek, town of Raisinville.

Marshes and Wet Prairie,

characterize the plains, or whole central portion of the county, comprising nearly one fourth their surface. They prevail under several modifications, and may be classed as the larger or wet prairie, occupying frequently an extent of several miles, and the smaller or swales, seldom exceeding an area of 20 acres. They differ also in character according to the nature of their substratum. The latter class have generally a subsoil of clay, with a covering of peat or muck deepening proportionally to its extent. Its average is one foot. They afford a coarse grass, (a species of Carex,) much relished by cattle. Where the substratum is sand, a small wiry species generally prevails, considered of inferior quality. Beneath this sand stratum, however, clay will without doubt be found at no great depth.

Prairies of much greater extent occupy a large portion of the town of Ida, the southern part of Summerfield and the eastern part of Whiteford. About five sections of the latter townships are of this character; nine sections in Summerfield, and eighteen in Ida. The soil is a fibrous peat, of one to two feet, and occasionally much greater depth, generally reposing upon sand. It produces a rank growth of wild grass but little valued.

These marshes are portions of a connected chain and have outlets discharging into considerable streams. Facilities thus exist for rendering them available to agriculture by a proper system of drainage, and at comparatively inconsiderable expense. The experiment has been made to some extent in the town of Whiteford, and a tolerable soil for tillage produced. A crop of wheat is said to have been grown upon the tract known as "White's marsh." But it should not be cause for discouragement if several years are required to test fully the value of such experiments. No such cause will exist when the nature of the soil to be dealt with is properly understood.

Similar marshes exist around the head branches of Swan creek in Exeter, uniting with those described in town of Huron, Wayne county. They are supposed to occupy one half of the surface of of the township north of Stony creek.

Small ponds of the lily and other aquatic plants are numerous upon these prairies. A large proportion of the prairies and swales are dry only at midsummer.

Peat.

The upper soil of the marshes and swales above mentioned is of the kind denominated fibrous peat; an accumulation, simply, of the annually decaying vegetation. On drying, it will be found a light spongy substance, which may be reduced to an impalpable powder; a character but ill fitting it to become, singly, a fertile soil. When, therefore, it occurs unmixed with argillaceous or siliceous matter, it is to be doubted whether the most thorough drainage will render it permanently available unless care is taken to subject it to irrigation at proper seasons, by closing the drains, and it be united with a proportionable admixture of earths. This admixture may often be effected by bringing up the subsoil by deep ploughing. The washings from the sandy plains adjoining, when cultivated, will further assist the process.

A coat of lime sown upon the surface would prove a most useful auxiliary. This would exert the triple effect of absorbing moisture, hastening the decomposition and bestowing one of the most important ingredients of a good soil.

The application of this peat to the soil of the plains, much of which is sterile, would be productive of very important benefit. To effect this, it ought first to be carried to the manure heap and there become thoroughly decomposed by mixing with quick lime. When applied, this should be at once ploughed under. The fine fibre of peat would dry and dissipate if left upon the surface.

When the comparative expense of cutting drains to that of clearing timbered lands, the immediate applicability of these tracts, and their utility in furnishing manure to the sterile soil adjacent are considered, it will be apparent that the value of these portions of the county is not over-estimated.

Limerock.

The ranges of this rock before described, have a direction through the county which corresponds to the line of bearing, or is at right angles to the inclination of the strata. The dip is, consequently, northwest, or northwest by north; very obvious in the outer range, and about 5° in amount.

The color varies from light shades of gray to dark blue. It is mostly compact, but exhibits all that variety of character for which the "mountain limerock" is distinguished. This will best appear in the following more extended notice.

It occurs in the bonk of Swan creek, at Newport, and in its bed for the distance of two miles above, where to a small extent it has been quarried for economical purposes. The stone is of dark, gray color.

Stone of a similar character appears a mile northeast of Brest, (section twenty-four,) and has been quarried to small amount.

At Point au Peaux it exhibits a vesicular or slightly oolitic structure in the lower layers. Superimposed are four feet of disruptured masses, of a more compact character.

Limerock appears in the bed and bank of Stony creek, at Brest, where it has been penetrated to depth of four feet. The thickest stratum opened was of three feet. It has a light, gray color, approaching white. It is compact, and some portions siliceous; considerable hornstone is contained. The stone is quarried in irregular, small blocks, suited to rough building.

The ledge appearing at Stony point, resembles in character the rock on Swan creek. It contains sulphate of strontian.

Limerock forms the bed of Sandy creek, at distance of two miles from the lake.

The city of Monroe is underlayed by limerock at depth of from two to five feet. The rock is quarried to small extent in the bank of the Raisin, near the city. Extensive quarries have been opened in the valley of Plumb creek, half a mile south of the city.

The excavations reach to the depth of nine feet. The succession of strata passed through presents a variety of characters. The vesicular limestone observed at Point au Peaux again appears associated with siliceous portions and compact strata, variegated with yellowish and blueish spots and veins, having the appearance of veined marble. These bear a tolerable polish, and might

serve for ornamental purposes. At depth of nine feet a stratum occurs of dark blue color and veined.

The stone is said to improve with depth, both for lime and building purposes. If this be the fact, it may be advisable to excavate lower down the creek where, owing to the direction of the dip, these more valuable strata may be supposed to lie nearer the surface.

The stone is mostly quarried in angular pieces of small dimensions, but slabs are said to be obtainable of size sufficient for door and window sills, &c.

Limerock forms the bed of Otter creek, at Winchester, and for the distance of eight miles above. It is hard, of a bluish gray color.

Following the range southwest, we find a ridge or hillock composed of limerock, on sections thirty-one and thirty-two, of Lasalle, and one and two of township of Erie. It appears over an area of more than a square mile, having an elevation of about ten feet above the level on the south. The stone, so far as penetrated, (five feet,) is of a fight color, striped, and portions fissile.

Limerock is met with, in the same range, at not less than four places, in the township of Bedford. In the bed of Bay creek a small quarry has been opened.

Near the centre of the township it appears twice over surfaces of two-thirds a square mile. These have been penetrated several feet, and are found to consist of a very siliceous rock, composed of an aggregate of grains of quartz cemented by lime. The upper portions, which lie in loose masses, are calcareous and are alone suitable for burning.

At the southwest corner of section thirty, limerock appears at the surface and in the bed of Halfway creek. This continues at intervals for a mile west, and in a southwest direction, following Ottawa creek, to Whiteford, in Ohio. It underlies the intermediate spaces at a depth probably not exceeding five feet. A continuation of the ledge may also be traced north, along the whole eastern border of township of Whiteford. The upper portions only could be observed, which appeared to be a pure, compact limestone.

No fossils were found in this range, except Terebratula, at Newport and Stony point.

Another range or series of outcrops passes through the centre of the county, in a direction parallel to the former. It must be considered as the overlapping edge of a portion of the limerock formation, superimposed upon that whose outcrop forms the range first mentioned. This portion of the formation includes several strata of a very siliceous character, approaching in several instances, almost to pure sand rock.

Stone of this description makes its appearance six miles northwest from Monroe, and was traced over a surface of one half a square mile. It disintegrates readily, where exposed, into a pure siliceous sand, which may be seen to be composed of well formed quartz chrystals. Where not discolored by oxides of iron, it is of a pure white. Associated with this stratum is a gray siliceous limestone, which is fossiliferous.

A similar sandrock appears in the bed of the Raisin, at low water mark, section twenty-nine, township of Raisinville, where it forms a ledge of a foot in thickness. Some portions are beautifully white and are nearly pure silex. It breaks easily and is inclined to disintegrate. It has not been used except as a scouring sand.

Near the west line of section 19, rock appears at the surfce and has been quarried superficially. It is a siliceous limerock, of dark color, and when quarried moist and soft, and may be dressed with ease to any required form. Owing to its want of compactness, it may be doubted whether it would be permanent exposed to the action of the atmosphere. It has been employed as a building material at Monroe.

Opposite Lawrence's mill a smooth ledge of limerock forms the bed of the Raisin, and a quarry has been opened on the upland several rods south from the river. The latter furnishes a siliceous limestone, varying in color from a light to a dark mixed grey.

In a southwest direction .from the above, in town of Ida, rock is found at the surface over a small area, on section four. A superficial stratum only has been quarried, of a foot thick, which is said to afford superior lime.

On section sixteen a siliceous limerock appears in the bank of a small pond and has been opened to depth of four feet. It removes readily in slabs three feet in length with thickness of four to six inches. Color light yellowish gray.

A vesicular limerock forms the bank at the head of Ottawa lake, town of Whiteford. It affords excellent lime.

A compact limerock also appears in an inlet, at the foot of Ottawa lake and has been quarried for lime. Portions are siliceous. Considerable calcareous spar is contained.

West of the range just described, limerock makes its appearance on the Macon river just above its mouth, and forms its bed for a mile. It has been quarried extensively, but the excavations have not penetrated below the first solid layer, a depth of eighteen inches. It is mostly of a dark gray color, sparry, approaching a chrystalline texture, and abounds with fossils. Portions give out a very strongly bituminous odor. The stratum exposed is very continuous and has been removed with wedges in pieces 10 feet in length; but the blocks are apt to sever under the chisel. From this locality are said to have been furnished, the caps and sills for the court-house at Monroe. It will compare in appearance with the much admired Ohio stone. This locality is said to afford the best lime in the county.

Rock of a similar character forms the bed of the Raisin at Dundee.

Lime.

More or less has been manufactured at most of the localities of limerock above mentioned.

Three kilns are maintained by the quarries at Plumb creek. Probably 900 or 1000 bushels are made annually.

At the quarry on section 19, Whiteford, 5 kilns have been burned, of 500 bushels each.

At the Macon quarry eight kilns have been burned, of 800 or 1000 bushels each, which sells at Tecumseh for four shillings per bushel.

Sand.

The only locality, particularly worthy of mention, is that of the disintegrated siliceous rock found, as before noticed, in Raisinville on the farm of Mr. Thos. Colwell. This bed was noticed by the State Geologist in his report of last year. It is mostly pure silex, and for the manufacture of glass, superior to any yet found in the state. A specimen of glass manufactured from it, in the possession of the proprietor, was unusually transparent and free from flaws.

Much of the sand of the plains in this vicinity, and even as far down as Monroe, is intermingled with white siliceous grains from this rock.

Clay.

The clays are in general too calcareous to be used with advantage for bricks or pottery. The upper brown or yellow clay is least so, and may be found conveniently for brick at numerous places throughout the county.

The manufacture has been conducted extensively at French-town, opposite Monroe. But few were made the past season. During the season previous, so far as could be ascertained, about 1,600,000 were burned at the several kilns. The clay is impure from the lime contained.

A single kiln of bricks has been burned at Brest

At Mr. White's yard, Newport, 100,000 bricks have been burned. The first two feet of the clay only is sufficiently free from calcareous matter to render it fit for the purpose.

Attempts were made at two places in the town of Dundee to manufacture bricks, but were abandoned from the cause alluded to. Good bricks are said, nevertheless, to have been made from the clay on Saline river, in the town of London. All the clays in this region, that were tested, gave very strong indications of lime, so much so as to deserve the appellation of marly. As the clays, even in proximate situations, often differ much in this respect, it is important to test them with a simple acid. Good vinegar will answer an ordinary purpose. Clay may, no doubt, be found considerably pure; besides that expense and disappointment may often be spared by a previous knowledge of the character of the material employed.

Marl.

A bed of shell marl (*bog lime*) underlies the marshy tract bordering the lake, near the city of Monroe. It has been penetrated to the depth of a foot by ditches, for a considerable distance. The deposite has probably a thickness of several feet, and apparently underlies the whole continuous tract of marsh, an extent of about a square mile.

A tufaceous marl is also deposited in considerable quantities by springs in the vicinity.

In town of Exeter, section 7, a marl is said to have been ploughed up, dry, and crumbling on exposure.

A deposite of shell marl was observed in town of Ash, (town 6 south, range 9 cast,) section 9. It occurs in a marshy swale, overlayed by 2 feet of muck or peat. The bed is about a foot in thickness and occupies an area of an acre. Similar swales are numerous throughout this section as well as in other parts of the county, and the proximity of the limerock warrants the conclusion that beds of marl may be found deposited on low spots, charged with springs.

The economical use of these marls has been noticed under the report of Wayne county. Probably many of the clays may be found approaching so nearly to *marl* as to be of great value as a stimulant manure to sandy soils.

Sulphur Springs.

Two miles below Monroe, near the marshy border of the lake, several springs issue from an immense mound. They are strongly impregnated with sulphur, and form thin white deposites of that substance. This mound occupies an area of 4 to 6 acres, rising about 10 feet above the general level. Its surface is wet and boggy. This mound is evidently a *deposite* from the water of the springs, which running through crevices in the great underlying rock formation, becomes highly charged with lime, and on approaching the surface deposites that substance cither in a soft plastic mass or as a coating upon the moss and surrounding vegetation. Thus *marl* and *tufa* result. This process may be observed now going on. Large quantities of moss, still alive, are covered with a thin calcareous crust. A mile further south are numerous smaller mounds of similar origin. One of these discharges a considerable stream from a spring occupying a large cavity in the centre. Here a foot thickness of white marl is disclosed, overlayed by two feet of crumbling tufa. The spring boils up through a cauldron of calcareous and vegetable matter, into which a pole may be thrust many feet. This mound is circular, 100 feet diameter and 6 feet high. Most of the other mounds consist of a very indurated lime, or *tufa*.

The famous sulphur spring in the Bay settlement, emerges from a low mound of similar formation, situated in the edge of the large marsh bordering the bay. It occupies a circular basin of 150 feet diameter by 45 deep. A stream flows from it which at its head is 10 feet wide and 3 deep, and has a considerable current. The odor of sulphur may be perceived at distance of half a

mile, though the water is not of extraordinary strength. A bathing-house was in contemplation at this place, but the unusual rise of the lake caused an abandonment of the project.

Springs occur in great numbers on Sulphur creek, town of Lasalle. They occasion mounds of the same character as those near Monroe, and discharge considerable streams. A few of these united, formerly supplied a mill.

In Raisinville, section 19, is a strongly impregnated spring, discharging water sufficient to form a brook.

Another, on section 25, forms the head of Plumb creek.

A spring of moderate strength issues from the margin of the Raisin, half a mile below Dundee.

A strong spring of sulphur and iron is said to be found on Stony creek, town of Exeter, section 21.

On Swan creek, town of Ash, are springs impregnated with sulphur and iron. One on section 38 ascends in a curb several feet above the level of the stream.

These springs all afford a copious supply, and are unaffected by a drought which renders dry the channels of neighboring streams. This fact, with that of their rise above the level of surrounding waters, and their strong impregnation with the minerals sulphur, lime and iron, proves that they have distant sources and that they proceed from great depths below the surface.

Streams and Springs.

This county is intersected by a number of considerable streams, following a parallel course to the lake; but small branches do not abound, as in a country of more broken surface. Most of the streams supply a *hard* water.

Water is obtained generally without difficulty from wells and springs affording a good supply/extremely hard. It is occasionally impregnated with sulphur and iron, owing to the proximity of the limerock.

Several wells in the towns of Ash, Lasalle and Ida, sunk twenty feet, to rock, opened veins which filled them suddenly, causing them to overflow.

Wells on the plains which do not descend to the clay are generally soft; so that by proper precautions water free from lime may be obtained in those situations.

Bog Ore.

Several deposites of this mineral occur in the neighborhood of Petersburg and Dundee. The ore is much mixed with siliceous matter, and none of it can be considered of the best quality.

On section nineteen, township of Summerfield, ore is formed on the borders of a marsh of about ten acres. The marsh is fed by springs and is unaffected by droughts. The ore is deposited in loose, amorphous masses, mingled with shot ore. The sandy soil of the neighboring plains is much mingled with particles of shot ore resembling fine gravel. Several hundred loads might be obtained from this locality.

On section twenty-five, ore was discovered in digging a trench through a marshy swale. It is found over about an acre, principally disseminated in the state of shot through the sandy peat soil, in a stratum not exceeding six inches thickness. In the dry border some heavy mamillary ore is found, in loose pieces, some of which weigh several pounds.

On a neighboring farm ore of a similar character was thrown out in ditching. A few loads might be obtained.

Swales similar to the above abound, and other localities of ore will no doubt be found whenever sufficient inducement shall be offered for its search.

Numerous indications of bog iron were seen in township of Bedford. No valuable deposite came under my observation. A locality is said to exist, supposed to be in quantity, on section three, (township nine south, range seven east.)

Indications also exist in township of London and elsewhere.

A bed of sandy red ochre is found on section twenty-one, Bedford, covering about three square rods, with a depth of from one to three feet. It is immediately underlayed by limerock. A small quantity has been applied as a paint and tolerably answers the purpose.

Boulders.

Numerous water-worn fragments of the primary rocks are found lodged on the limestone hillocks, and accompanying the ranges of limerock throughout the country, but seldom occur elsewhere upon the surface. Similar boulders are found imbedded in the blue clay deposite.

A large boulder from the limerock formation was noticed on section four, township of Milan.

Phenomena accompanying the Limerock.

Sink-holes.—In the township of Whiteford occur a number of those bowl-shaped depressions, known by the name of “sinks.” The largest that came under my observation is near the northeast corner of the township. This immense basin occupies nearly one hundred acres, and at the centre is about fifteen feet below the general level. I found the bed to be composed of layers of blue clay and sand, covering at a slight depth limerock.

These *sinks* derive their name from the fact of their being collects for the waters of the surrounding region, which are here absorbed; no outlets being discovered. The waters no doubt disappear in a cavernous aperture of the limerock below. It is stated, on good authority, that when the large sink is filled, a whirlpool may be seen of sufficient force to draw in rails floating near the vortex.

Marks of Diluvial Action,—Upon the surface of the broad, flat ledges of limerock at Point au Peaux, was observed

a beautiful exhibition of the *grooves and scratches* supposed to be occasioned by attrition of hard bodies moving in a strong current. These have a uniform direction, north 60° east In some instances the surface has been worn to a fine polish, which imparts a beautiful light color to the stone, and exhibits the markings as fresh in appearance as if done yesterday.

A similar phenomenon is observable at Brest, and is a fine illustration of the course and moving power of the current. The surface, about twenty square feet of which is exposed, is undulating and worn into curves. Two directions are here observed of the furrows, on contiguous portions of the same ledge; north 50° east and north 65° west.

Facts of this nature, which singly are of little importance, are noted because they have a bearing upon the results of scientific inquiries; a consequence which, though for a time unheeded and "darkly hid," tends to throw clearer light upon the ultimate plan of useful economy.

My acknowledgments are due to many persons in the above counties for hospitalities and assistance rendered in the prosecution of the survey.

BELA HUBBARD,
Assistant Geologist.

Detroit, January 26, 1839.

GLOSSARY

Including most of the Geological terms used in these reports from Lyell's Geology, and other sources

Alluvial. The adjective of Alluvium.

Alluvion. A synonim of Alluvium.

Alluvium. Recent deposites of earth, sand, gravel, mud, stones peat, shell banks, shell marl, drift sand, &c, resulting from causes now in action. This term is generally applied to those deposites in which water is the principal agent.

Alum rocks. Rocks which, by decomposition, form Alum.

Amorphous. Bodies devoid of regular form.

Amygdaloid. A trap rock which is porous and spongy, with rounded cavities scattered through its mass. Agates and simple minerals are often contained in these cavities.

Anthracite. A species of mineral coal, hard, shining, black, and devoid of bitumen.

Anticlinal. An anticlinal ridge or axis is where the strata along a line dip contrariwise, like the sides of the roof of a house.

Arenaceous. Sandy.

Argillaceous. Clayey.

Augite. A simple mineral of variable color, from black through green and gray to white. It is a constituent of many volcanic and trappean rocks, and is also found in some of the granitic rocks.

Avalanche. This term is usually applied to masses of ice and snow which have slidden from the summits or sides of mountains. It is now also applied to slides of earth and clay.

Basalt. One of the common trap rocks. It is composed of Augite and feldspar, is hard, compact, and dark green or black, and has often a regular columnar form. The palisades of the Hudson show the columnar aspect of trap rocks. The Giants' Causeway is cited as an example of Basaltic rocks, and the columnar structure is there very strikingly displayed.

Bitumen. Mineral pitch, which is often seen to ooze from fossil coal when on fire.

Bituminous Shale. A slaty rock, containing bitumen, and which occurs in the coal measures.

Blende. Sulphuret of Zinc. A common shining zinc ore.

Bluffs. High banks of earth or rock with a steep front. The term is generally applied to high banks forming the boundaries of a river, or river alluvions.

Botryoidal. Resembling a bunch of grapes in form.

Boulders. Rocks which have been transported from a distance, and more or less rounded by attrition or the action of the weather. They lie upon the surface or loose in the soil, and generally differ from the underlying rock in the neighborhood.

Breccia. A rock composed of angular fragments cemented together by lime or other substances.

Calc Sinter. A German term for depositions of limestone from springs, and waters which contain this mineral in solution.

Calcareous Rocks. A term synonymous with limestones.

Calcareous Spar. Crystalized carbonate of lime.

Carbon. The combustible element of coal.

Carbonates. Chemical compounds containing carbonic acid, which is composed of oxygen and carbon.

Carbonic Acid. An acid gaseous compound, incapable of supporting combustion, and deleterious to animal life. It is common in caves and wells, and many incautious persons lose their lives in consequence of descending, without first ascertaining its presence by letting down a lighted candle. Man cannot live where a candle will not burn freely.

Carboniferous. Coal bearing rocks. This term has been applied to formations belonging to an ancient group of secondary rocks which contains coal. The term is now used in a more enlarged sense, and may be applied to any rocks containing coal.

Chalybeate. Impregnated with iron.

Chert. A siliceous mineral, approaching to chalcedony, flint and hornstone. It is usually found in limestone.

Chlorite. A soft green scaly mineral, slightly unctuous.

Chloritic Slate. Slate containing chlorite.

Clinkstone. A slaty feldspathic or basaltic rock, which is sonorous when struck.

Cleavage. The separation of the laminae of rocks and minerals in certain constant directions. They are not always parallel to the planes of stratification, but are often mistaken for them.

Coal formation. Coal measures. These terms are considered synonymous, and refer to the great deposite of coal in the older secondary rocks, which has been called the "independent coal formation." There are, however, deposites of carbonaceous matter in all the geological periods, and several of them might also be called coal formations.

Conformable. When strata are arranged parallel to each others like the leaves of a book, they are said to be conformable. Other strata lying across the edges of these may be conformable among themselves, but unconformable to the first set of strata.

Conglomerate, or Puddingstone. Rocks composed of rounded masses, pebbles and gravel cemented together by a siliceous, calcareous, or argillaceous cement.

Cretaceous. Belonging to the chalk formation.

Crop out and out crop. Terms employed by geologists and mining engineers, to express the emergence of rock, in place, on the surface of the earth at the locality where it is said to crop out.

Crystaline. An assemblage of imperfectly defined crystals, like loaf sugar and common white marble.

Delta. Alluvial land formed at the mouths of rivers.

Denudation. A term used to express the bare state of the rocks over which currents of water have formerly swept, and laid the rocks bare, or excavated them to form valleys of denudation.

Deoxidize. To separate oxygen from a body.

Detritus. Broken and removed portions of rock which have been operated upon by waters or the atmosphere; frequently transported by currents to great distances.

Dykes. A kind of vein intersecting the strata, and usually filled with some unstratified igneous rock, such as granite, trap or lava. These materials are supposed to have been injected in a melted state into great rents or fissures in the rocks.

Diluvium and *Diluvion*. Deposites of boulders, pebbles and gravel which many geologists have supposed were produced by a diluvial wave or deluge sweeping over the surface of the earth.

Dip. Where strata are not horizontal, the direction in which their planes sink or plunge, is called the direction of the dip, and the angle of inclination, the angle of dip.

Dolomite. A magnesian limestone belonging to the primary class. It is usually granular in its structure, and of a friable texture.

Dunes. Sand raised into hills and drifts by the wind.

Earth's Crust. The superficial parts of our planet which are accessible to human observation.

Eocene. The strata deposited during the oldest of the tertiary epochs, as, for example, the Paris Basin.

Estuaries. Inlets of sea into the land. The tides and fresh water streams mingle and flow into them. They include not only the portion of the sea adjacent to the mouths of rivers, but extend to the limit of tide water on these streams.

Exuviœ. In Geology, fossil remains.

Fault. A dislocation of strata, at which the layers on one side of a dyke or fissure have slidden past the corresponding ones on the other. These dislocations are often accompanied by a dyke. They vary from a few lines to several hundred feet.

Feldspar. One of the simple minerals, and, next to quartz, one of the most abundant in nature.

Ferruginous. Containing iron.

Fluviatile. Belonging to a river.

Formation. A group of rocks which were formed during a particular period, or which are referred to a common origin.

Fossils. The remains of animals and plants found buried in the earth, or enclosed in rocks. Some of these are but slightly changed, others are petrified and the organic replaced by mineral matter; some have decayed and left the impression of the bodies, while others have been formed by mineral matter deposited in the cavities left by the decay of the organic body. These last are called casts. The term petrifaction is applied to those cases in which organic matter has been replaced by mineral substances. The form and structure of the original body both remain. In casts the exterior form alone is preserved. Fossils are also called organic remains.

Fossiliferous. Containing organic remains.

Galena. An ore of lead composed of lead and sulphur.

Garnet. A simple mineral, which is usually red and crystallised. It is abundant in most primitive rocks.

Gneiss. A stratified primary rock, composed of the same materials as granite, but the mica is distributed in parallel layers, which give it a striped aspect.

Geode. Geodiferous. Geodes are small cavities in rock, generally lined with quartzose or calcareous chrystals.

Geology. A science which has for its object to investigate the structure of the earth, the materials of which it is composed, the manner in which these are arranged, with regard to each other; and it considers the action of all natural causes in producing changes, such as the effects of frost, rain, floods, tides, currents, winds, earthquakes and volcanoes.

Economical Geology refers to the applications of geological facts and observations to the useful purposes of civilized life.

Granite. An unstratified rock, composed generally of quartz, feldspar and mica, and it is usually associated with the oldest of the stratified rocks.

Graywacke, Grauwacke. A group of strata in the transition of rocks; but the term has been so indefinitely applied, that other names will probably be substituted.

Greenstone. A trap rock, composed of hornblende and feldspar.

Grit. A coarse-grained sandstone.

Gypsum. A mineral, composed of sulphuric acid and lime, and extensively used as a stimulant manure, and for making stucco and plaster casts, &c. It is also called Plaster of Paris.

Hornblende. A mineral of a dark green or black color, and which is a constituent part of greenstone.

Hornstone. A siliceous mineral, approaching to flint in its character.

In Situ. In their original position where they were formed.

Laminae. The thin layers into which strata are divided, but to which they are not always parallel.

Lacustrine. Belonging to a lake. Depositions formed in ancient as well as modern lakes, are called lacustrine deposites.

Landslip. It is the removal of a portion of land down an inclined surface. It is in consequence of the presence of water beneath, which either washes away the support of the superincumbent mass, or so saturates the materials, that they become a slippery paste.

Line of Bearing, is the direction of the intersection of the planes of the strata with the plane of the horizon.

Lignite. Wood naturally carbonized and converted into a kind of coal in the earth.

Littoral. Belonging to the shore.

Loam. A mixture of sand and clay.

Mural Escarpment. A rocky cliff with a face nearly vertical like a wall.

Mammillary. A surface studded with smooth small segments of spheres like the swell of the breasts.

Mammoth. An extinct species of the elephant,

Marl. By this term an argillaceous carbonate of lime is usually implied. By custom, its signification is much more extended, and means mineral substances, which act as stimulating or fertilizing manures. There are clay marls, shell marls, and various others.

Marly clay. Clay containing carbonate of lime.

Mastodon. A genus of extinct fossil animals allied to the elephant. They are so called from the form of the grinders which have their surfaces covered with conical mammillary crests.

Matrix. The mineral mass in which a simple mineral is imbedded, is called its *matrix* or *gangue*.

Megatherium. A fossil extinct quadruped resembling a gigantic sloth.

Mechanical origin, Rocks of. Rocks composed of sand, pebbles or fragments, are so called, to distinguish them from those of a uniform crystalline texture, which are of chemical origin.

Mica. A simple mineral having a shining silvery surface, and capable of being split into very thin elastic leaves or scales. The brilliant scales in granite and gneiss are mica.

Mica Slate. One of the stratified rocks belonging to the primary class. It is generally fissile, and is characterized by being composed of mica and quartz, of which the former either predominates, or is disposed in layers, so that its flat surfaces give it the appearance of predominating.

Miocene. One of the deposites of the tertiary epoch. It is more recent than the *eocene*, and older than the pliocene.

Mollusca. Molluscous animals. “Animals, such as shell fish, which, being devoid of bones, have soft bodies.”

Mountain Limestone. “A series of limestone strata, of which the geological position is immediately below the coal measures, and with which they also sometimes alternate.”

Muriate of Soda. Common salt.

Naphtha. A fluid, volatile, inflammable mineral, which is common in volcanic districts, and in the vicinity of the salt springs of the United States.

New Red Sandstone. “A series of sandy and argillaceous, and often calcareous strata, the prevailing color of which is brick red, but containing portions which are greenish grey. These occur often in spots and stripes, so that the series has sometimes been called, the variegated sandstone. The European, so called, lies in a geological position immediately above the coal measures.”

Nodule. A rounded, irregular shaped lump or mass.

Old Red Sandstone. “A stratified rock, belonging to the carboniferous group of Europe.”

Oolite, oolitic. "A limestone, so named, because it is composed of rounded particles like the roe or eggs of fish. The name is also applied to a large group of strata characterized by peculiar fossils."

Organic Remains. See *Fossils*.

Orthoceratite. The remains of an extinct genus of molluscous animals, called Cephalopoda. The orthoceratites are long, straight, conical chambered shells.

Out-crop. See *Crop out*.

Out-liers. Hills or ranges of rock strata, occurring at some distance from the general mass of the formations to which they belong. Many of these have been caused by denudation, having removed parts of the strata which once connected the out-liers with the main mass of the formation.

Oxide. A combination of oxygen with another body. The term is usually limited to such combinations as do not present active acid or alkaline properties.

Palaeontology. A science which treats of fossil remains.

Pisolite. A calcareous mineral, composed of rounded concretions like peas.

Pliocene. The upper, or more recent tertiary strata. This group of strata is divided into the older and newer Pliocene rocks.

Petroleum. A liquid mineral pitch. It is common in the region of salt springs in the United States.

Porphyry. A term applied lo every species of unstratified rock, in which detached crystals of feldspar are diffused through a compact base of other mineral composition.

Productus. An extinct genus of fossil bivalve shells.

Plastic Clay. One of the beds of the Eocene period. The plastic clay formation is mostly composed of sands with associate beds of clay.

Pudding Stone. See *Conglomerate*.

Pyrites. A mineral, composed of sulphur and iron. It is usually of a brass yellow, brilliant, often crystalized, and frequently mistaken for gold.

Quartz. A simple mineral, composed of silex. Rock crystal is an example of this mineral.

Rock. All mineral beds, whether of sand, clay, or firmly aggregated masses, are called rocks.

Sandstone. A rock composed of aggregated grains of sand.

Saurians. Animals belonging to the lizard tribe.

Schist. Slate.

Seams. "Thin layers which separate strata of greater magnitude."

Secondary Strata. "An extensive series of the stratified rocks, which compose the crust of the globe, with certain characters in common, which distinguish them from another series below them, called primary, and another above them, called tertiary."

Sedimentary Rocks--Are those which have been formed by their materials having been thrown down from a state of suspension or solution in water.

Selenite. Crystalized gypsum.

Septaria. Flattened balls of stone, which have been more or less cracked in different directions, and cemented together by mineral matter which fills the fissures.

Serpentine. A rock composed principally of hydra ted silicate of magnesia. It is generally an unstratified rock.

Shale. An indurated slaty clay, which is very fissile.

Shell Marl—Fresh water Shell Marl. A deposite of fresh water shells, which have disintegrated into a grey or white pulverulent mass.

Shingle. The loose water-worn gravel and pebbles on shores and coasts.

Silex. The name of one of the pure earths which is the base of flint, quartz, and most sands and sandstones.

Silicious. Containing silex.

Silt. "The more comminuted sand, clay and earth, which is transported by running water."

Simple Minerals—Are composed of a single mineral substance. Rocks are generally aggregates of several simple minerals cemented together.

Slate. A rock dividing into thin layers,

Stalactite. Concreted carbonate of lime, hanging from the roofs of caves, and like icicles in form.

Stalagmites. Crusts and irregular shaped masses of concreted carbonate of lime, formed on the floors of caves, by deposites from the dripping of water.

Stratification. An arrangement of rocks in strata.

Strata. Layers of rock parallel to each other.

Stratum. A layer of rocks; one of the strata.

Strike. The direction in which the edges of strata crop out. It is synonymous with *line of bearing*.

Syenite and *Sienite*. A granitic rock, in which hornblende replaces the mica.

Synclinal line and *Synclinal axis*. When the strata dip downward in opposite directions, like the sides of a gutter.

Talus. In geology, a sloping heap of broken rocks and stones at the foot of many cliffs.

Terniary Strata. “A series of sedimentary rocks, with characters which distinguish them from two other great series of strata—the secondary and primary—which lie beneath them”

Testacea. “Molluscous animals, having a shelly covering.”

Tepid. Warm.

Thermal. Hot.

Thin out. Strata which diminish in thickness until they disappear, are said to *thin out*.

Trap—Trappean Rocks. Ancient volcanic rocks, composed of feldspar, hornblende and augite. Basalt, greenstone, amygdaloid and dolomite, are trap rocks.

Travertin. “A concretionary lime-stone, hard and semi-crystaline, deposited from the water of springs.”

Tufa Calcareous. “A porous rock, deposited by calcareous waters on exposure to air, and usually containing portions of plants and other organic substances incrusted with carbonate of lime.”

Tufaceous. A texture of rock like that of tuff.

Tuff or *Tufa*. “An Italian name for a volcanic rock of an earthy texture.”

Unconformable. See conformable.

Veins. Cracks and fissures in rocks filled with stony or metallic matter. Most of the ores are obtained from metallic viens.

Zoophytes. Coral sponges and other aquatic animals allied to them.