

to improve the water of our own springs upon the plan there pursued, would, most assuredly, prove valueless; but when water of sufficient strength and purity, and in sufficient quantity, has been obtained, the policy of management adopted by the state of New York may readily be applied to our own state, and will undoubtedly be preferable to any other which could be devised.

The brine springs of our state, like those of Ohio, Pennsylvania and Virginia, emanate from the rock which lies deep, being covered with a mass of rock and earthy matter, which, (in order to procure salt water that can be economically used,) it is necessary to penetrate. In this respect they differ most essentially from those of New York, for in that state a simple earth excavation has proved amply sufficient to insure an abundant supply of water of a superior quality. In the other states to which reference has been made, I am not aware that any spring has furnished water in quality or strength sufficient for economical purposes, by a simple earth excavation, nor has the water been very materially improved by any work of that kind.

In those portions of the states last mentioned, where the geological arrangement of the rocks is such as to admit of obtaining salt water, the salt rock lies at a considerable depth, and is overlaid by a strata of sandstone, limestone, slate, &c., and through fissures in these overlaying rocks the salt water, much diluted by the influx of fresh water, originally rose to the surface. In order to procure water of sufficient strength and purity, it has been found indispensable to penetrate the overlaying rocks, as well as a portion of the rock from which the salt water flows. The depth to which it has been found necessary to sink, varies from three hundred and fifty to one thousand feet, the deep borings for the most part, furnishing water of a strength superior to the more superficial ones. This variation in the depth to which it is necessary to carry the borings, depends, chiefly, upon the inclination of the salt rock, and by keeping in view

the general inclination of that rock, together with the elevation of the country, can be determined with nearly as much certainty before operations have been commenced, as after they have been completed.

The appearance of a salt spring at the surface, is, of itself, very far from being evidence of the existence of water of value in the rock below; it is only a single link in the chain of facts, for in very many instances water of considerable strength appears at the surface where no permanent supply of sufficient strength and purity to be of any practical value could be obtained by the most complete borings, and some of the most valuable springs have been brought to light by improvements, where, originally, no salt water appeared upon the surface. A complete elucidation of this subject does not properly come within the scope of the present report, and allusion is made to the facts as they exist, simply with a view to rendering the character of the improvements proposed more intelligible than they would otherwise be.

Having called your attention to the close similarity which exists between the salines of our own and the states last mentioned, you will be prepared to appreciate the necessity of adopting a similar method of improvement. Your attention is more particularly called to this subject from the fact that many of our citizens having been familiar with the condition of the salt springs of New York, and erroneously looking upon our own as similarly situated, are unprepared to realize the different character of improvements required. At the Onondaga springs a simple shaft has been found sufficient to furnish an ample supply of water highly charged with saline matter; but improvements of this character, simply, would be of no value at any of the springs I have examined in Michigan, and I can safely say that no point will ever be found in this state, where improvements of that character will, alone, lead to any practical results.

In commencing the improvements directed, it was deemed desirable to select two points for operations, where, all cir-

circumstances combined, rendered it most certain they would lead to a successful termination. Two places were selected rather than one, from the slightly different circumstances under which the salt springs occur; a difference which would still leave the subject in doubt should the experiment result unfavorably at a single point. As a matter of economy, it was considered desirable to pursue both these works at the same time, from the fact that the two improvements can be proportionably much more economically conducted in concert than with either of them alone. Feeling the importance of settling the question fairly, these points were selected with much care, and it is believed they are quite equal, if not superior, to any which have been chosen in the state. The principal facts connected with this subject were laid before you in a former report, from which you will be enabled to draw conclusions as to the probability of eventual success; but since the date of that report, many facts have been elicited which would serve to increase our confidence on that subject. The water of these springs is quite equal in strength and purity to that of any of the springs of the western states before noticed, as they originally existed; the geological situation of the country is such as to lead to favorable conclusions, and should there be a failure of eventual success, it may safely be said it will depend upon causes which could not possibly have been calculated.

The state salt lands on the Tittabawassa river, in Midland county, are peculiarly eligibly situated, being a few miles below the head of navigation of that stream, and embracing the mouth of Salt river. A re-examination of this saline district, showed it to be more extensive than had been supposed, and it was in consequence of this, in connexion with the strength and purity of its numerous springs, deemed a strong point for commencing operations.

The time occupied in making these preliminary examinations prevented the commencement of active operations at the point selected until near the middle of June; and separated

as it is from settlements, it became necessary, first, to make arrangements for rendering those comfortable who should be engaged in the work. A house was first erected and sufficient ground cleared from timber to prevent annoyance from mosquitoes, since which a shaft has been commenced at a point about half a mile below the mouth of Salt river on the direct bank of the Tittabawasse river. Much difficulty was first encountered in sinking the shaft, from the presence of quicksand, but this was at length surmounted, since which the work has progressed with as much rapidity as could have been anticipated.

As this shaft is commenced directly upon the bank of the river, it was deemed advisable, in order to secure the works more perfectly, as well as for other purposes, to erect a wharf, which was accordingly done. It is proposed to sink this shaft, already commenced, to the rock, which may be estimated to lie at a depth of something over one hundred feet, and to secure it carefully from the influx of fresh water. Having accomplished this, the salt rock, which will probably be found, at this point, to lie at a depth of between five and seven hundred feet, will be reached in the usual manner, and until this be fully accomplished, we cannot hope to arrive at any satisfactory conclusion upon the subject.

During a portion of the months of August, September, and October, this work was partially suspended, in consequence of the sickness of those employed in carrying it forward.

Circumstances connected with my other state duties prevented a re-examination of the state salines on Grand river until about the middle of July, soon after which operations were commenced at the point selected, three miles below the village of Grand Rapids and upon the direct bank of the river:— But in consequence of the excessive heat of the season and the exposed condition of the men employed, nearly all those engaged upon the work became unfit for duty by sickness, and more than two months elapsed before I was enabled to renew the work successfully, although other hands

had been employed and sent on in the mean time. They also became unfit for duty from similar cause.

A neat and commodious house has been erected at this place, a portion of the timber for the dock, to secure the works, prepared, and I have men now busily engaged in clearing grounds and taking all the necessary preliminary steps for commencing a shaft. A steam engine has been procured and some of the machinery prepared for commencing work upon the shaft, and this work would have been already commenced had the condition of the appropriation warranted such a step. The distance to the rock being, at this point, comparatively short, the expense of sinking the shaft will not be great, but the amount of rock boring required will not vary very much from that at the Tittabawassa salines. I should also add that a conditional contract has been made with a man of great practical experience in rock boring, at the Kanawha salines, in Virginia, to take charge of that portion of the work in this state, and had the appropriation been sufficient he would have commenced work before this time.

In regard to the importance of this point for the commencement of these improvements, it will probably be sufficient to refer you to my report of last year, on this subject, barely adding that the examinations of this year have added confidence to my hopes of success, if the operations be continued to a final result.

Other points might have been selected where little doubt can be entertained but salt water could be procured, and where operations could be conducted at a less expense, but at this stage it was deemed of the utmost importance to select such springs only as bid most fair, and such as would, in the event of a failure to realize our expectations, render it forever unnecessary to make further attempts. Should the works already commenced prove of value, it will, no doubt, be found for the interest of the state to make similar improve-

ments at other points, but, for the present, those commenced are amply sufficient.

It would hardly have been expected, from the small amount appropriated for improvement of our springs, that very much, except to take the preparatory steps, could have been accomplished, yet under ordinary circumstances no more than this amount would have been required. The sickness of the past season has been such as to embarrass our operations very much, and this embarrassment was increased in consequence of the difficulty of supplying with fresh hands, the places of those who became unfit for duty in consequence of sickness. Compelled to live, for a time, until buildings could be erected, more exposed than usual, much annoyed by mosquitoes, in connexion with the extremely hot weather, the men employed sickened and were nearly all, for a length of time, unfitted for labor. Their places were supplied with fresh hands as soon as circumstances would permit, and the work pressed forward with all possible dispatch.

There has been expended at the works on Grand river, including the expense of erecting a house and the purchase of a steam engine, the sum of one thousand seven hundred and sixty-seven dollars, fifty-two cents; and at the works on the Tittabawassa river the sum of two thousand one hundred and eighteen dollars, sixty-seven cents, amounting in total to three thousand eight hundred and eighty-six dollars, nineteen cents, a schedule of which disbursements, with the proper vouchers, will be duly laid before you.

It will be seen by this statement that the expenditures have exceeded the appropriation in the sum of \$886.19. I had proceeded with the utmost precaution in order to avoid a result of this kind, but the increased expenses incident upon supplying the places of those workmen rendered unfit for duty in consequence of sickness, as well as unlooked for difficulties and expenses connected with the transportation of provisions, &c. rendered it impossible to make accurate estimates, for which reason, after the principal expenses had been incurred,

I was under the painful necessity, either of leaving the work, at a season of the year most favorable to conduct the operations, or to exceed the amount appropriated for that purpose. Had a different course been pursued, the state would have been subjected to great loss and delay in the progress of the works, which has thus far been avoided, and notwithstanding the condition of the funds, I am still continuing the work, though in a manner which will render the expenses inconsiderable.

The commencement of a work of the character of that under consideration, necessarily involves the expenditure of an amount, for the erection of houses and work shops, for clearing grounds, for machinery, for implements, &c. which must render the first expenses much greater than those which will follow. In consequence of the limited amount appropriated for that purpose, only a portion of this has been accomplished, and the sum which will be required for successful continuance of the work will, therefore, be considerably larger than would otherwise be necessary.

With a sufficient appropriation for the current year, we may hope to be able to make such additional improvements in the grounds as will be required, to erect work shops, &c., to complete the shafts to the rock, and secure them from the influx of fresh water, and unless some unlooked for accident should occur, to sink with the auger through four hundred feet of rock at each place, making the sum total as estimated, inclusive of earth excavation, nine hundred and seventy feet. There will be required for this purpose, under a system of rigid economy, the sum of \$12,350, which estimate will include the amount of \$886.19 before stated to have been advanced upon the work in progress.

In closing this subject, I cannot refrain from alluding to the present state of the salt spring lands. The fact that we have a grant of seventy-two sections of land, located in different portions of the state, much of which might be made available, yet producing no revenue, is one which deserves

attention. Situated as these lands now are, they are subject to constant waste from the loss of timber by intruders, — a source of loss which is daily increasing. Some portions of these lands, which will never under any contingency be required for salt purposes, may be made available by lease, at once, the only course which can be pursued in conformity with the act conferring the grant, while the measures now in progress will fully test the condition of the most marked springs, and either lead to a result which will add much to the prosperity of our state, or teach us that some other method will be required to render the large amount of salt lands held by the state of any real value.

It is desirable, therefore, in order that the whole subject may be placed in that situation which will prove most beneficial to the state, that the works now in progress be pursued to a final result as speedily as possible, for until it be done, no decisive steps can be taken with any other than a portion of the lands, and the interest upon the amount which is thus lying idle would soon make a return of the amount expended by the state in making the improvements. With this view of the subject, laborious as is the task of conducting these operations, in connexion with the other severe duties I am called upon to perform, the task is made light by the hope that in the end it may not fail to lead to results of the most vital importance to the prosperity of our young state.

All of which is respectfully submitted.

DOUGLASS HOUGHTON.

REPORT OF THE COMMITTEE ON THE STATE GEOLOGIST'S REPORT IN
RELATION TO THE IMPROVEMENT OF THE STATE SALT SPRINGS

(House Documents, 1839, No. 4)

The select committee to whom was referred the report of the State Geologist, in relation to the improvement of the State Salt Springs, beg leave to report:

That they have had the subject under consideration, and in view of the great interests involved, would recommend the immediate appropriation of a sum sufficient to carry forward the works already commenced.

Our salt springs, we have good reason to believe, may become one of the most fruitful of our internal resources. We trust they will soon provide our citizens with one of the first necessities of life, at a very moderate expense, and prove to be a perpetual source of revenue to our state.

After a thorough investigation of the facts connected with the whole subject, your committee are not only satisfied that it is for the interest of the state to pursue the improvements already commenced to a final result, but also that any delay in doing so must be attended with loss.

The large amount of salt lands which are now unproductive to the state, taken in connexion with the great amount of money which is annually sent abroad for the article of salt, furnishes arguments of the strongest character.

It should be one of our first objects to render state lands productive, and until improvements of the character of those already commenced have been carried forward to completion, it will be imprudent to take any steps to render them permanently available.

We have every reason to believe, that the improvements proposed, will prove successful, but should this fail to be the case, we are satisfied that the lands may be so disposed of as to furnish a permanent revenue, which will, in a very short time, reimburse the state for all she may expend in the improvements now going on.

The amount of money sent abroad for the article of salt, acts as a drain upon our state, which your committee regard as of no small moment.

From data in the hands of your committee, they are led to believe, that the amount annually sent abroad for the article of salt, cannot be less than three hundred thousand

dollars, and probably has considerably exceeded that sum during the past year.

Should the improvements now in progress be successfully carried forward, little doubt can be entertained but that amount of money sent abroad may soon be retained at home, and our salt springs like those of New York, furnish a handsome revenue to the state.

The revenue derived from duties on salt in the state of New York for the space of ten years, after deducting all expenses, has varied from one hundred and fifty to two hundred and fifty thousand dollars per annum, an amount which serves materially to lessen the burthen of taxation in that state.

The work of improvement in our state, is now going forward and the amount which will be required fully to test the subject should, compared with its great importance to the citizens of this state, be looked upon as of minor importance; for in whatever light the subject may be turned, your committee look upon the prompt improvement of our state salines as of the utmost importance.

The embarrassment which the works are now suffering in consequence of the fact, that more than the whole amount of the appropriation of the last year has already been expended, calls loudly for the immediate action of the legislature upon this subject.

The Geologist feels unwilling to involve the expenditure of money in this work without direct instructions upon the subject, while the abandonment of proceedings, even for a short time, would involve an expense in replacing hands in consequence of the isolated position of the springs, which he is very justly anxious to avoid. He has procured a steam engine and other implements for the promotion of the design, and provisions for the winter's support of men now employed, all of which expenditure will mostly be lost, if obliged to suspend operations.

Your committee are also informed by the Geologist, that the work can now be prosecuted to better advantage than at any other season of the year, and that an immediate expenditure is required for pumps, &c. to secure one of the works from an influx of water, which has but recently taken place, and of which, information has been forwarded by express.

The situation of the Geologist under these circumstances is embarrassing in the extreme: not feeling authorized to advance funds for that purpose, and in constant fear lest a failure to supply what is required, may lead to unfortunate circumstances, he cannot fail to feel much anxiety that the most prompt action be had upon the subject.

In fulfilling the duties assigned your committee, they cannot refrain from alluding to the laborious and responsible duties of the State Geologist, and the deep interest manifested by him in the success of his operations, and trust that every facility will be afforded, which is necessary for the development of the resources of our young and rising state.

Your committee would therefore recommend that the amount embraced in the accompanying bill, be appropriated for the works now in progress, to be expended in the manner there directed.

NORMAN LITTLE
NOBLE H. FINNEY
J. GOODWIN.

REPORT OF THE STATE GEOLOGIST, IN RELATION TO THE IRON ORE,
&c., ON THE SCHOOL SECTION IN TOWN FIVE SOUTH, RANGE SEVEN
WEST, IN BRANCH COUNTY

(*House Documents, 1839, No. 21*)

To the Honorable the House of Representatives of Michigan:

In compliance with a resolution from your honorable body, "directing the State Geologist to furnish such information

as he may possess in relation to the iron ore and clay on the school section in township five south, range seven west, in the county of Branch,"

I would respectfully lay the following facts before you, simply premising that all the examinations which were made in Branch county, are of a general or exploratory character, preparatory to the more minute examinations, which are intended to follow.

The school section to which my attention is called, by your resolution is characterized by the appearance of the clay iron stone formation; a formation which has not, as yet, been seen to occur in any other place in our state.

The clay iron stone, or kidney ore, appears in the usual form, being composed of thin concentric layers of the carbonate and hydrate of iron, deposited upon nodular masses, mostly composed of lime.

These masses of iron ore are imbedded, (in somewhat regular strata,) in a tough semi-indurated and stratified clay, which at first might easily be mistaken for rock. Neither the clay or iron has, as yet, been submitted to a minute chemical examination, nor in fact, is it considered, in this instance, of sufficient importance, to prevent our arriving at conclusions sufficiently accurate for general purposes.

It is well known that the presence of lime renders clay unfit for the manufacture of stone ware, fire bricks, &c., for the reason that the clay, by this admixture, is rendered fusible at a low temperature. The clay in question, is nearly, and in some instances, quite destitute of lime, and only differs from that which is denominated pipe clay, in its color and geological position. It is admirably adapted to the manufacture of stone ware, fire bricks, &c., and no further exploration is required, to render it certain that this article exists, in sufficient quantity, to furnish all that will ever be required for those purposes.

The iron ore is of the same kind as that which is almost exclusively used in some of the great furnaces of Ohio; and

most of the English iron imported into this country, is manufactured from a similar one. The kidney ore from the readiness and cheapness with which it may be reduced, may be said to be one of the most valuable ores which is ever found in a secondary country; and occurring under the circumstances it does in Ohio, it constitutes one of her great sources of wealth; in a large way it has been found to furnish, upon reduction, from thirty to thirty-seven per cent of cast iron.

The ore occurring in Branch county may safely be said to be fully equal in purity to that of Ohio.

As before stated, the examinations which I have made, of the extent of this ore, are only of a general character, in consequence of which it is wholly impossible for me to define either its boundaries, the extent of the formation, or the amount of ore a complete exploration would bring to light. In regard to its extent, sufficient is already known, to satisfy me that it is sufficiently extensive to be made available for practical purposes, (provided the expense of raising it shall not be too great,) for I have already traced it over an area of from eight hundred to one thousand acres. In order to determine the expense of raising the ore, it will be imperatively necessary that sufficient excavation be made to determine the amount of ore which can be obtained from a given area; a character of examination which would involve an expenditure that I do not conceive myself authorized to make, nor would it be for the interest of the state to direct it to be made in this manner.

The Superintendent of Public Instruction, very properly, after the examination had been made, withheld the school section from sale, and were he the individual owner, I have no doubt he would refuse to sell the tract until further examinations should be made; and since the school interest in this instance must be looked upon in the same light as that of an individual, I can conceive of no reason why he should not be authorized to expend from the school fund an amount suf-

ficient to enable him to arrive at some satisfactory estimate of the value of the land in question.

DOUGLASS HOUGHTON.

*Office of State Geologist, }
January 28, 1839. }*

SECOND ANNUAL REPORT OF THE STATE GEOLOGIST

(House Documents, 1839, No. 23)

*Office of State Geologist }
Detroit, Feb. 4, 1839. }*

To the Hon. Speaker of the House of Representatives:

Sir: I have the honor to transmit to the legislature the accompanying reports and documents, setting forth the progress which has been made in the geological survey for the current year ending February 3, 1839.

I am, very respectfully,

Your ob't serv't,

DOUGLASS HOUGHTON

State Geologist.

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, 1838, 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 Maskego²⁰, 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 three and four west, and towns twenty-two and twenty-three north. These lakes are almost completely surrounded by nearly impenetrable swamps, covering a large portion of the area from seven to eight 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

²⁰Muskegon—Editor.

mentioned lake, in town ten north, range seventeen 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 land 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 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 forty to fifty 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 from a height of from twenty to forty or even fifty 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 have 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 unable to say. The navigation of the latter stream is obstructed near its mouth by a series of 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 white pine, which will serve to render this portion of the state of some importance. Yellow pine, well adapted to 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 com-

mencement, 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 proceed 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 limestone, 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 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 Cheboigan 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 as 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 description will, therefore, be almost exclusively confined to those points at which the *outcrop* 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 of 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 southwesterly, 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 character of the separate portions of the group are 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 silicious a character to admit of use for that purpose.

Limestone still more silicious 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 embedded 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 an 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 *out cropping* 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 embedded 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 the 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 deposit, 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 will 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 south-easterly 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 observer 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 frosts, 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, identical, in geological position, with that upon the islands last 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 Mackinac, 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 *croops 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 grayish 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 argillaceous 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 overlaid 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 laminae 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 imbedded hornstone 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 four 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 Marquette 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 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 graveling 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 deposits, 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, occupying but a limited extent; while others are spread over a large area of country. Of these deposits, 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 deposits.

The great thickness of the exposed portions of these *tertiary* beds, upon the northwest part of the peninsula, afford ample opportunities for examining this interesting series of deposits. 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 deposit was made unconformably upon an unequal surface, its thickness must be subject to very great variation. In the vicinity of Detroit it has been sunk completely through and found to have a thickness of 118 feet.

This lower deposit of clay, in the southeastern part of the state, is usually overlaid 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 earthen 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 deposits 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 earthen 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 north-westerly 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 shiploads 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 deposits 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 by no 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 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."²¹

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 favorable, 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 necessity in determining the complete range between high and low water.

²¹The 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.

For the last two years my attention has been more particularly called to the coasts 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. 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 which 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 waters 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 manner. 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 affected, 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 in a very limited number of places in the United 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 excess of 34.53 inches, or a fraction over 2 feet and 10½ inches 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 1816 to 1826 inclusive,²² was 364.43 inches, and from 1827 to 1837 inclusive,²³ 451.05 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,²⁴ was 202.83 inches, and from 1828 to 1832 inclusive,²⁵ was 228.17, showing an increase during the last five years estimated, of 25.34 inches, or a fraction over 2 feet 1 1/3 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.

²²Eleven years, embracing the complete time from which the waters had perceptibly commenced falling, until they had again nearly attained the same altitude.

²³Eleven years, during most of which time the waters have been steadily increasing in height.

²⁴Five years, embracing the time of low water.

²⁵Five years, during most of which time the water was increasing in height.

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;²⁶ 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 fact 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 level.

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 cannot be looked upon as second to any county in our state, is 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

²⁶It 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.

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 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 deposit occurs, which may probably be referred to one portion of the carboniferous group, though this connection has not absolutely been shown to exist.

The deposit 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 deposit 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* does, 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 portion 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 Coldwater 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 sandrock. 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° Fahrenheit.

The counties of Branch, Hillsdale and Jackson, like that of Calhoun, abound in beds of shale 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 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 *out-crop*, 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 out-cropping 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 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 out-crop 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 state. 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 government, 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.

Abraham 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 fellowmen; 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 inquiry. 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."²⁷

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

²⁷Governor Marcy's report to the legislature of the state of New York, on the subject of the geological survey of that state.

well as what is now embodied in abstract works upon those subjects. While an attempt will be made to render this of value to the man of science, the subjects of general 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 state 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.

The board of regents have already furnished ample rooms, in this city, as a temporary place of deposit 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;²⁸ a size which

²⁸This 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 under his direction.

will 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 hand, 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 platted, 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 the 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 acknowledgments 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 development 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 development 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 interests, 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. Soricidae. 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 Insectores—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

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

Setophaga cucullata. Sw. Hooded flycatcher

Dumecola [?] *Wilsonii*. Sw. Wilson's flycatcher

Sylvicola americana. Sw. Blue yellowbacked flycatcher

discolor. Sw. Prairie warbler

coronata. Sw. yellow crowned warbler

castanea. Sw. Baybreasted warbler

- icterocephala*. Sw. Chestnutsided warbler
Blackburnaeae. Sw. Blackburnian warbler
virens. Sw. Summer yellowbird
Canadensis. Blackthroated blue warbler
Vermivora pinus. Sw. Pine warbler
 chrystoptera. Sw. Goldenwinged warbler
 rubricapilla. Sw. Nashville warbler
Mniotilta varia. Veill. Black and white creeper
Parus palustris. L. Black cap tit
Trichas personatus. Sw. Maryland yellow throat
 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. Bluejay
 Fam. Sturnidae
 Sub-fam. Scaphidurinae
 Quiscalis versicolor. Veill. Crow blackbird
 Scolecophagus ferrugineus. Sw. Rustle grackle
 Sub-fam. Icterinae
 Icterus Baltimore. Daud. Golden oriole
 spurius. Bon. Orchard oriole
 Sum-fam. Aglainae
 Dolichonyx orizivora. Sw. Rice bunting
 Agelaius phoeniceus. Bill. Swamp blackbird
 Molothrus pecoris. Sw. Cowpen
 Sturnella collaris. Bill. Meadow lark
 Fam. Fringillidae
 Sub-fam. Coccythraustinae
 Coccyborus ludovicianus. Sw. Redbreasted grosbeak
 Carduelis americana. Sw. Yellow bird.
 Sub-fam. Tanagrinae

- Phoenisoma rubra*. Sw. Summer red bird
Pipilo erythrophthalmus. 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. Whitethroated sparrow
 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. Redheaded wood-
 pecker
 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. Trogloditinae
 Thryophorus palustris. Veill. Marsh wren

- Troglodytes europeus. Winter wren
 Fam. Cuculidae
 Sub-fam. Cuculinae
 Erythrophrys domenicus. Sw. Blackbilled cuckoo
 Coccyzus americanus. Sw. Yellowbilled cuckoo
 Tribe 4th—Tenuirostres
 Fam. Trochilidae
 Trochilus colubris. L. Humming bird
 Fam. Halcyonidae
 Ispida alcyon. Sw.
 Fam. Caprimulgidae
 Caprimulgus vociferous. L. Whippoorwill
 Chordeiles americana. Sw. Night jar
 Fam. Hirundinae
 Cypselus pelagius. Temm. Chimney swallow
 Hirundo purpureus. L. Purple martin
 Fam. Hirundo rufa. Gm. Barn swallow
 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. Ardeidae
 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 tatter
 macularius. Temm. Spotted sand-piper
 chloropygius. Veill. Green rump sand piper
 Streptopelia interpres. Ill. Turnstone
 Charadriidae
 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
 Anser 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. Canvasback
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
Coluber 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
Menobranthes 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. Esoeces

Esox reticulatus. Les. Pike
estor. Les. Muskelonge

Fam. Siluridae

Pimelodus catus. Lac. Catfish

Fam. Salmonidae

Salmo amethystes. Mitch. Trout

Corregonus albus. Les. Whitefish
Arledi. Les.

Fam. Clupeae

Hyodon tergisus. Les. Herring

Fam. Lepisosteus. Lac.

Order Malacopterygii Subbrachiata

Fam. Gadecides

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.

siliquodidens. 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.

Alasmodonta edentula. Say.

Class Mollusca

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.
 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 1st, 1839

To Douglass Houghton, State Geologist.

Sir—In compliance with the act passed by the state legislature, March, 1838, providing for the 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 in 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 wood 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 them, 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.²⁹ Three-seed mercury
Acer oriocarpum, 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.

²⁹For abbreviations of authors' names, see the end of the catalogue.

Amelanchier Botryapium, Lind. Shad bush. June berry
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
Andropogon 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, Moenchhausen. 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.
 felix-femina, Ww.
 intermedium, Muhl.
 noveboracensis, 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.
 tradescantii, 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 cerneua, Linn.
 frondosa, Linn. Burr marygold. Cuckold
 petiolata, Nutt.
Blephilia ciliata, Rafinesque.
 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
Buchenera 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
Campanula rotundifolia, Linn. Flax bell flower
Cannabis sativa, Linn. Hemp
Capsella bursa-pastoris, Moench. Shepherd's purse
Cardamine hirsuta, Linn.
 pratensis, Linn.
 rhomboidea, D. C.
Carex acuta, Linn.
 alba v. setifolia, Dewey
 ampullacea, Gmelin.
 anceps, Schkuhr.
 aquatillis, Wahlenberg.

aurea, Nutt.
 bromoides, Schkuhr.
 bullata, Schkuhr.
 cephalophora, Ww.
 cespitosa, Linn.
 collecta? Dewey.
 conoidea, Schkuhr.
 crinita, La Marek.
 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, LaMarek.
 limosa, Linn.
 lupulina, Muhl.
 marginata, Muhl.
 miliacea, Muhl.
 nigro-marginata? Schwinitz.
 oderi, Ehrhart.
 paniculata, Linn.
 polytrichoides, Muhl.
 psuedo-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, Muhl.
 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, LaMarek. 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.
 Leutetiana, Persoon. Enchanter's nightshade
Claytonia virginica, Linn. Spring beauty
Clematis virginica, Linn. Virgin's 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
Corollorhiza 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. Hazel-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.

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Dalibarda fragaroides, Mx. Dry strawberry
Danthonia spicata, P. de B. 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