Lake Coast

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

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

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

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

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

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

Soils and Timber

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

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

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

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

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

The *out-crops* of the limerock are found to lie in several distinct ranges, extending through the county in a northeast and southwest direction. The outer range, commencing at the southeast corner of town of Whiteford, forms there a ridge or step, having a rise above the general surface of 15 feet in a breadth of 2 miles. It passes thence in a nearly northeast course to Brest, occasioning those intermediate hillocks or protrusions of rock which occupy areas of from

one-half to two square miles. At Stony Point it comes out upon the lake in the ledge before mentioned, and still further on in the same direction makes its appearance on the islands at the mouth of the Detroit straits and the neighboring shores.

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

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

From all the data that could be obtained, the deposite of blue marly clay in the intervals between these ranges does not exceed in thickness 20 feet. Upon this rests a brown or yellow clay, similar to that which overlies the blue in Wayne county.[36] It has a thickness of 3 to 10 feet. This clay constitutes the basis of more than three-fourths of the soil of the timbered lands. Sand loams occasionally alternate with it, and in the town of Milan a rich black sand loam constitutes three-fourths of the soil.

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

[36] An analysis of 100 grains of these clays showed—

	Upper Clay	*Lower Clay*
Siliceous matter	9.25	23.00
Alumine	67.25	44.00
Carb. lime	23.50	31.16
Iron	.00	1.84
	100.00	100.00

by a sudden descent. Similar ridges may be observed on the plains near Sandy creek, town of Raisinville.

Marshes and Wet Prairie

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

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

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

the nature of the soil to be dealt with is properly understood.

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

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

Peat

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

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

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

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

Limerock

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

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

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

Stone of a similar character appears a mile northeast of Brest, (section 24,) and has been quarried to small amount.

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

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

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

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

The city of Monroe is underlayed by limerock at depth of from two to five feet. The rock is quarried to small extent in the bank of the Raisin, near the city. Extensive quarries have been opened in the valley of Plumb creek, half a mile south of the city. The excavations reach to the depth of nine feet. The succession of strata passed through, presents a variety of characters. The vesicular limestone observed at Point au Peaux again appears associated with siliceous portions and compact strata, variegated with yellowish and blueish spots and veins, having the appearance of veined marble. These bear a tolerable polish, and might serve for ornamental purposes. At depth of nine feet a stratum occurs of dark blue color, and veined.

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

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

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

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

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

Near the centre of the township it appears twice over surfaces of two-thirds a square mile. These have been penetrated

several feet, and are found to consist of a very siliceous rock, composed of an aggregate of grains of quartz cemented by lime. The upper portions, which lie in loose masses, are calcareous and are alone suitable for burning.

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

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

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

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

Associated with this stratum, is a gray siliceous limestone which is fossiliferous.

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

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

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

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

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

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

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

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

at Monroe. It will compare in appearance with the much admired Ohio stone. This locality is said to afford the best lime in the county.

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

Lime

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

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

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

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

Sand

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

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

Clay

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

The manufacture has been conducted extensively at Frenchtown, opposite Monroe. But few were made the past season.

During the season previous so far as could be ascertained, about 1,600,000 were burned at the several kilns. The clay is impure from the lime contained.

A single kiln of bricks has been burned at Brest.

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

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

Marl

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

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

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

A deposite of shell marl was observed in town of Ash, (town 6 south, range 9 east,) section 9. It occurs in a marshy swale, overlayed by two feet of muck or peat. The bed is about a foot in thickness and occupies an area of an

acre. Similar swales are numerous throughout this section as well as in other parts of the county, and the proximity of the limerock warrants the conclusion that beds of marl may be found deposited on low spots, charged with springs.

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

Sulphur Springs

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

The famous sulphur spring in the Bay settlement, emerges from a low mound of similar formation, situated in the edge of the large marsh bordering the bay. It occupies a circular basin of 150 feet diameter by 45 deep. A stream flows from

it which at its head is 10 feet wide and 3 feet deep, and has a considerable current. The odor of sulphur may be perceived at distance of half a mile, though the water is not of extraordinary strength. A bathing-house was in contemplation at this place, but the unusual rise of the lake caused an abandonment of the project.

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

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

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

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

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

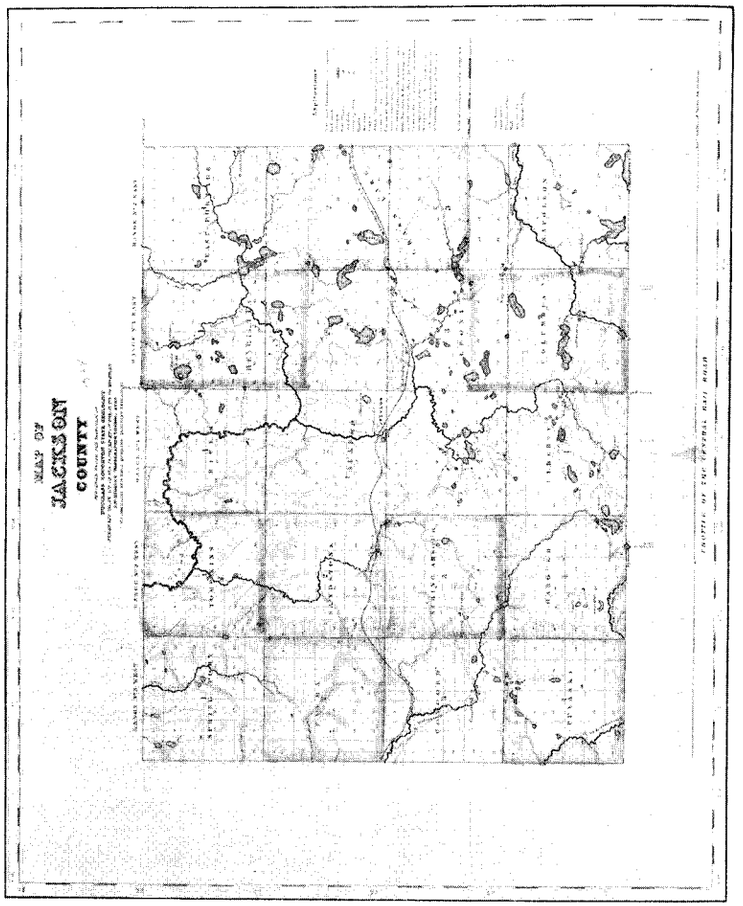
On Swan creek, town of Ash, are springs impregnated with sulphur and iron. One on section 36 ascends in a curb several feet above the level of the stream.

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

Streams and Springs

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

Water is obtained generally without difficulty from wells and springs affording a good supply, extremely hard. It is



occasionally impregnated with sulphur and iron, owing to the proximity of the limerock.

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

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

Bog Ore

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

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

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

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

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

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

Indications also exist in township of London and elsewhere.

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

Boulders

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

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

. *Phenomena Accompanying the Limerock*

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

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

Marks of Diluvial Action.—Upon the surface of the broad, flat ledges of limerock at Point au Peaux, was observed a beautiful exhibition of the *grooves and scratches* supposed to

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

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

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

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

BELA HUBBARD,
Assistant Geologist.

Detroit, January 26, 1839.

GLOSSARY

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

Alluvial. The adjective of alluvium.

Alluvion. A synonim of alluvium.

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

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

Amorphous. Bodies devoid of regular form.

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

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

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

Arenaceous. Sandy.

Argillaceous. Clayey.

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

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

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

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

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

Blende. Sulhpuret of zinc. A common shining zinc ore.

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

Botryoidal. Resembling a bunch of grapes in form.

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

and generally differ from the underlying rock in the neighborhood.

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

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

Calcareous Rocks. A term synonymous with limestones.

Calcareous Spar. Crystalized carbonate of lime.

Carbon. The combustible element of coal.

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

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

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

Chalybeate. Impregnated with iron.

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

Chlorite. A soft green scaly mineral, slightly unctuous.

Chloritic Slate. State containing chlorite.

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

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

Coal Formation. Coal measures. These terms are considered synonymous, and refer to the great deposite of coal in

the older secondary rocks, which has been called the "independent coal formation." There are, however, deposites of carbonaceous matter in all the geological periods, and several of them might also be called coal formations.

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

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

Cretaceous. Belonging to the chalk formation.

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

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

Delta. Alluvial land formed at the mouths of rivers.

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

Deoxidize. To separate oxygen from a body.

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

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

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

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

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

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

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

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

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

Exuviæ. In Geology, fossil remains.

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

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

Ferruginous. Containing iron.

Fluviatile. Belonging to a river.

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

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

original body both remain. In casts the exterior form alone is preserved. Fossils are also called organic remains.

Fossiliferous. Containing organic remains.

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

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

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

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

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

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

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

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

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

Grit. A coarse-grained sandstone.

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

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

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

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

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

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

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

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

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

Littoral. Belonging to the shore.

Loam. A mixture of sand and clay.

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

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

Mammoth. An extinct species of the elephant.

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

Marly clay. Clay containing carbonate of lime.

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

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

Megatherium. A fossil extinct quadruped resembling a gigantic sloth.

Mechanical origin, Rocks of. Rocks composed of sand, pebbles or fragments, are so called, to distinguish them from

those of a uniform crystalline texture, which are of chemical origin.

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

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

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

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

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

Muriate of soda. Common salt.

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

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

Nodule. A rounded, irregular shaped lump or mass.

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

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

Organic Remains. See *Fossils.*

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

Out-crop. See *Crop out.*

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

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

Palaeontology. A science which treats of fossil remains.

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

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

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

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

Productus. An extinct genus of fossil bivalve shells.

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

Pudding Stone. See *Conglomerate.*

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

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

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

Sandstone. A rock composed of aggregated grains of sand.

Saurians. Animals belonging to the lizard tribe.

Schist. Slate.

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

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

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

Selenite. Crystalized gypsum.

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

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

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

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

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

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

Siliceous. Containing silex.

Silt. "The more comminuted sand, clay and earth, which is transported by running water."

Simple Minerals—Are composed of a single mineral substance. Rocks are generally aggregates of several simple minerals cemented together.

Slate. A rock dividing into thin layers.

Stalactite. Concreted carbonate of lime, hanging from the roofs of caves, and like icicles in form.

Stalagmites. Crusts and irregular shaped masses of concreted carbonate of lime, formed on the floors of caves, by deposites from the dripping of water.

Stratification. An arrangement of rocks in strata.

Strata. Layers of rock, parallel to each other.

Stratum. A layer of rocks; one of the strata.

Strike. The direction in which the edges of strata crop out. It is synonymous with *line of bearing.*

Syenite and *sienite.* A granitic rock in which hornblende replaces the mica.

Synclinal line and *synclinal axis.* When the strata dip downward in opposite directions, like the sides of a gutter.

Talus. In geology, a sloping heap of broken rocks and stones at the foot of many cliffs.

Tertiary Strata. "A series of sedementary rocks, with characters which distinguish them from two other great series of strata—the secondary and primary—which lie beneath them."

Testacea. "Molluscous animals, having a shelly covering."

Tepid. Warm.

Thermal. Hot.

Thin out. Strata which diminish in thickness until they disappear, are said to *thin out.*

Trap—Trappean rocks. Ancient volcanic rocks, composed of feldspar, hornblende and augite. Basalt, greenstone, amygdaloid, and dolomite, are trap rocks.

Travertin. "A concretionary limestone, hard and semi-crystaline, deposited from the water of springs."

Tufa Calcareous. "A porous rock, deposited by calcareous waters on exposure to air and usually containing portions of plants and other organic substances incrusted with carbonate of lime."

Tufaceous. A texture of rock like that of tuff.

Tuff or *Tufa.* "An Italian name for a volcanic rock of an earthy texture."

Unconformable.—See conformable.

Veins. Cracks and fissures in rocks filled with stony or metallic matter. Most of the ores are obtained from metallic veins.

Zoophytes. Coral sponges and other aquatic animals allied to them.

REPORT OF THE COMMITTEE OF THE SENATE ON MANUFACTURERS, TO WHOM WAS REFERRED THE COMMUNICATION OF THE STATE GEOLOGIST, RELATIVE TO SALT SPRINGS AND THE SALINES OF THE STATE

(Senate Documents, 1839, No. 3)

Your committee beg leave to report, that having bestowed on the above subject, a portion of that attention which its magnitude requires, they have adopted the following conclusions:

1st. That an act ought to be passed by the legislature immediately, making an appropriation sufficient to enable the geological corps to progress with the improvements that have been already commenced at Grand and Tittabawassa rivers, and to pursue them to a final result, and also to enable said corps to continue such examinations of our salt springs in general, as the legislature shall direct.

2d. That some proper person ought to be authorized to take charge of the lands attached to said springs, and prevent, as far as may be, the loss of timber on them by intruders or trespassers.

3d. That as the lands attached to the salt springs, are at present wholly unproductive to the state, and from the waste of timber that is committed on some of them, there is danger of their value being reduced, and the examination of the State Geologist will soon enable him to determine what portion of those lands will be necessary for the manufacture of salt—that the state should memoralize Congress and ask the

privilege of selling such of the salt springs lands as will not be required for supplying fuel or other conveniences in the manufacture of salt.

4th. That of the seventy-two sections belonging to the salt springs, there have been forty-five sections located—twenty-six of which have been confirmed by the general government, and there is yet twenty-seven of said sections to be located, and less than one year to do it in; it is therefore very necessary that there should be vigilance used on the part of the state officers to make those locations in due time, otherwise the lands will be forfeited.

Your committee would further report, that as the reference of this subject to them plainly indicates that the Senate fully anticipate the manufacture of salt and its transportation to its destined market—, they have been led to take into consideration the saline district of the state, and to some reflections upon the probable advances that will be wanted for the general accommodation of the inhabitants of the country, and upon the plan for obtaining the means of opening and improving those communications.

Your committee are of the opinion, that from recent examinations, the saline or salt bearing rock, is found in the northern part of the state, where the remainder of the salt springs will most probably be found, and as that part of the state, for about two thirds of its whole length, belongs to the United States, they are, therefore, fully impressed with the propriety of petitioning Congress for a grant of land of each alternate section of unlocated land, ten miles in width, commencing at the center of the south line of Michigan, running north to the straits of Mackinaw, for the purpose of defraying the expenses of constructing a road on said line; for the same reasons, they recommend, that Congress be memoralized for a like grant of land of ten miles in width, commencing on the west side of Saginaw bay, taking each alternate section of unlocated land, and running west through the vicinity of the salt springs at Tittabawassa to Lake Michigan, for the like

purpose of defraying the expenses of constructing a road on said line.

All of which the committee would respectfully submit, with the following preamble and resolution.

[See Proceedings of January 15, 1839]

COMMUNICATION FROM THE STATE GEOLOGIST RELATIVE TO THE GEOLOGICAL SURVEY

(Senate Documents, 1839, No. 25)

Office of State Geologist,
Detroit, March 7, 1839.

To the Hon. Senate of Michigan:

In compliance with the requisitions of a resolution from the Honorable Senate of Michigan, instructing the State Geologist to report "with all convenient dispatch,"

"1st. If there exist any outstanding contracts? and if any, what?

"2d. What loss, injury or detriment might result from a temporary suspension of said geological survey.

"3d. If in any respect such injury should be likely, in the opinion of said Geologist, to be incurred, then that he report what part of said survey, in particular, would be prejudiced by such suspension?" I would respectfully report:

That contracts have been entered into with that part of the appropriation arising from the general fund, or rather orders have been sent abroad for the fixtures of a lithographic press, paper, &c., for the use of the topographical department, as also for sundry items, such as instruments, &c., preparatory to a commencement of the work with the opening of spring. As no bills of these orders have as yet been received, I am unable to lay before you an accurate estimate of the amount of these orders.

As it is inferred that no portion of the resolutions are directed to that part of the work connected with the improvement of the salt springs, I will only briefly add with respect to this department, that contracts are considered as closed for some heavy portions of the work.

2d. "The loss, injury or detriment which might result from a temporary suspension of the geological survey," may be regarded as of such a character as would eventuate in an almost total loss of what has been already accomplished, and would, without doubt, prove fatal to the whole work.

In carrying forward a work of this character of that under consideration, it is indispensible that the heads of the several departments, or those who are eventually to be called upon for connected reports, remain unchanged, for the reason that many, and in fact a large proportion of the comparative data from which conclusions are drawn, being unfinished, are not in such a condition as to be either comprehended or understood by a third person, unless he pass through the very same steps of observation. In this respect the work may be compared to a long series of half solved mathematical problems, which a third person would be incapable of completing without passing over the same ground, a step which would be necessary, even for the very person first engaged in the work, should he fail to pursue the subject to a close while fresh in his mind.

The chief assistants employed in the geological survey are men who have left lucrative professions with a simple desire of aiding the work in progress. They have engaged with an enthusiasm that is deserving of the highest respect, and they have labored to collect matter for the elucidation of their several departments, which will, no doubt, if carried to completion, be creditable to themselves while it will prove of practical utility to the people.

Had the several assistants taken charge of the separate departments from mercenary motives, and without any hope of originating a result that would be creditable to themselves

while it would benefit the people, the circumstances would be very different; but as it is, having engaged with motives and inducements of a higher character, I can safely say that not a single one of the heads of the departments would desire to remain in the work a single hour, were he to entertain the idea that the fatigue, anxiety and labor which had been devoted to the subjects under his charge, were to be scattered to the winds. The reflection that this may be the result, has already acted as a blight upon their operations, for they have felt that there was no inducement whatever to carry forward the examinations which they had so fondly hoped to complete.

The temporary suspension of the survey will necessarily destroy the present organization; the assistants will return to their professions, and certainly without any desire of again undertaking a task which it might be feared would only end in disappointment and disgrace. The organization of a competent board of assistants for conducting operations of this character, is only made with the utmost difficulty, and were the one now acting dissolved, we could scarcely hope to affect a reorganization in such a manner that each would understand his duty in less than a year's time; and in fact it may be doubted whether, under those circumstances, competent assistants could be induced to undertake the task; and should the work be again commenced, it would be necessary to pass a second time over a large portion of the road which has already been traveled.

In obedience to the instructions contained in the act of March 23, 1838, I nominated Dr. John Wright as botanist to the geological survey, and the same was duly confirmed. Dr. Wright was at the time engaged in a lucrative practice of his profession in Troy, New York, and it was only after the most urgent solicitations, and at much pecuniary sacrifice upon his part, that he was induced to accept the appointment; relying upon the faith of the state to complete the work which he had been induced to undertake. The duties assigned him have been performed with a devotion and success

hardly to have been anticipated, and which, if continued, could not, it is conceived, fail to lead to important results. Even the most temporary suspension of the work would eventuate in the loss of the scientific and practical matter which has been collected in this department of the survey, while it certainly would be acting in no good faith to the head of that department.

The same in fact would prove to be the result in the several departments, were the work to be temporarily suspended. The assistants have performed their duties from a devotion to the subjects in which they are engaged, and certainly without any prospect of pecuniary advantage; they are men who would immediately find an active field of labor, were they separated from this work, and who, in all human probability, could never be induced again to undertake the task in which they are now engaged. To reorganize a corps of assistants would in fact be equivalent to commencing the work anew.

The present time is an exceedingly favorable one for conducting operations in the geological and topographical departments, for while the United States surveyors are engaged in subdividing the northern part of the peninsula, we are enabled to procure, through them, a vast amount of information; and in fact through that source an amount of labor may be accomplished very far exceeding that, which under other circumstances, could be done. Those United States surveys will probably be completed during this and the ensuing year, and the time will then have passed for gaining the assistance of those persons who are engaged in this work.

There still remain of the salt lands granted our state by the general government, thirty sections to be located. The judicious location of these lands will involve a large amount of labor; yet that labor would be of such a kind that two objects would be gained, viz: the location of the land and the survey of the country. Should a special agent be appointed to make the selection of the lands, only one of those objects

would be gained, at the same time that much difficulty might occur in making the proper selections.

Thirdly, "I am instructed to report what part of said survey, in particular, would be prejudiced by said suspension," to which I would answer unhesitatingly, *all parts of it*. The work is of a character which to be rendered really valuable, requires to be conducted as a whole; and to cut off any portion would not only leave a defect, but would cripple the operations of other departments, for those remaining could scarcely conduct the balance of the work in such a manner as to be creditable either to themselves or the state.

In answering that all the departments of the survey would be prejudiced by a suspension, I would call your attention to an *attached* duty, perfectly independent of the geological survey proper, the relation of which to our other duties, would appear to be but imperfectly understood: I allude to the collection of specimens of natural history.

It is well known that the regents of the university felt a deep anxiety to embrace the opportunity afforded by the work in progress, to supply the students of the state university with facilities for the study of natural history, unequaled by any institution in our country. The progress of the geological survey offered facilities for carrying this into effect, at a comparatively small expense. The geological board were directed to preform the duty, and the act directs the regents to refund to the state the sum of four thousand dollars, the estimated cost of these collections.

The duties incident upon the collection of specimens, in the manner directed, have much increased the labor of the work; yet they have been performed with pleasure, from the hope that these collections might prove of value to our state institutions. Yet the very industry which has been used for a faithful compliance with the requisitions of the act, would appear not only to have brought discredit upon the whole work, but also to have given rise to a variety of epithets, certainly of no very dignified character, which are in no

wise calculated to extend the usefulness of those persons to which they are applied. It would be to those engaged in the geological survey, no small relief to be spared the labor of making these collections, and this portion of the work may be suspended without any detriment to the legimate duties of those engaged in the survey; but since, if the amount required for making these collections be repaid from the university fund, nothing would be gained in economy to the state, no good reason can be conceived why the university should be denied the facilities offered for enriching her cabinet of natural history.

All which is respectfully submitted.

DOUGLASS HOUGHTON,
State Geologist.

1840

REPORT OF THE STATE GEOLOGIST, RELATIVE TO THE IMPROVEMENT OF SALT SPRINGS

(House Documents, 1840, No. 2)

Office of State Geologist,
Detroit, January 6, 1840.

To the Honorable Speaker of the House of Representatives:

Sir—I have the honor to transmit to the house of representatives the accompanying report from this department, in relation to the improvement of the state salt springs.

I am, very respectfully,
Your obedient servant,

DOUGLASS HOUGHTON,
State Geologist.

Office of State Geologist,
Detroit, January 6, 1840.

To the Honorable Senate and House of Representatives of Michigan:

In compliance with the requisitions of an act approved January 28, 1839, directing the State Geologist to "continue the works already commenced at the state salt springs", I would respectfully beg leave to submit the following report:

The details of the plan adopted for the improvement of the state salt springs, (so far as such details were deemed important,) we laid before you in a previous report; and a repetition of such details being at this time unnecessary, I would refer you, for information on that subject, to a report from this department, dated January 7, 1839.

Immediately upon the receipt of instructions to continue the work under consideration, (which had been partially

suspended,) it was recommenced, and steps taken preparatory to the erection of such machinery as would be required to carry into effect the design of the act.

A conditional contract was early made with a mechanic residing at Kenawha, Va., competent to conduct the practical part of the boring, who had stipulated to complete to the extent of the estimates, at a certain rate per foot; the state to furnish all such machinery as should be required in carrying forward the operations. Under this contract I had hoped to complete, with less trouble and expense than otherwise could have been done, a considerable portion of what had been directed to be preformed. This contract, I regret to say, was not complied with, upon the part of the contractor, in consequence of assigned fears as to the health of the country; a circumstance which operated unfavorably upon the work since it had given rise to delay, and after which the adoption of a course totally different from that originally intended, became necessary.

I had already made a journey through portions of Ohio, Pennsylvania and Virginia, for the express purpose of examining the character of improvements adopted at the salines in those states, as well as for the purpose of contracting for the improvements contemplated in our own. The failure of the contractor, as above stated, to fulfill his contract, left me in a situation of great embarrassment, which was much increased in consequence of the difficulty of procuring competent persons to take charge of the mechanical part of the labor.

The duties which my office as state geologist, has required me to preform, have been of so onerous a character, that a *personal* direction of the improvements in progress at the salt springs was impossible unless accompanied with a complete relinquishment of the *legitimate* duties of my office. Thus, during the past season, the progress of the geological survey made it necessary for me to devote nearly three months of my time upon surveys in progress in the northern peninsula several hundred miles distant from the salt springs, and

under such circumstances that it was impossible for me to visit them during that time. And even while engaged in the survey of the southern portions of the state, the duties were such as to prevent my taking that personal supervision of the mechanical portion of the work, which could have been desired. The work was necessarily left in charge of superintendents; and the fact, that I was almost constantly in the field, and at such points that it was difficult, and at times impossible, to communicate with these superintendents, for weeks, and even months, together, has rendered the trust a subject of very great embarrassment. It has also served to retard, in a measure, the progress of the works, for the reason that delays have occurred, in awaiting answers required to communications requiring action where any considerable expense would be involved.

These facts are presented at this time, to enable you more fully to appreciate the manner in which the *attached* duties connected with the improvement of the salt springs, have conflicted with the legitimate duties of my office. In fact, I may say, that the duties arising from an attention to the mechanical part of the work at the salt springs, are almost incompatable with a faithful discharge of the other duties assigned me. These representations are not made in a spirit of complaint, but from a firm conviction of the impossibility of the performance of both trusts in a manner which will best subserve the interests of the state.

Since the date of my last report on the condition of the state salt springs on Tittabawassee river, sufficient additions have been made to the buildings to render the situation of the workmen employed, comfortable; a carpenters' shop, blacksmiths' shop, and engine house have been erected, a steam engine set up and put in successful operation, and nearly the whole machinery required for the operation of boring is upon the ground. The work at these springs, in consequence of their distant situation from settlements, has rendered a considerable expenditure for boats, &c., for the transportation of material and provisions necessary, as also the purchase of many articles which, under other circumstances would not have been required. The expense incident upon the transportation of the many bulky articles of provisions and forage for cattle, induced me to cause those articles to be raised upon the ground, and the result has shown the course to have been an economical one.

In continuing the shaft commenced at this place, much difficulty has been encountered from the influx of water; but the condition is such that this difficulty may now be easily overcome by properly sinking tubes. All is in readiness to progress with rapidity, and the whole outlay for materials having been involved, the remaining expense for completing the work will be comparatively small. A quantity of wood is also on hand, nearly if not quite sufficient to supply the engine for the completion of the work.

At a depth of little less than fifty feet, a considerable vein of salt water was opened, but so intermixed with veins of fresh water as to make it impossible to determine the absolute quantity of saline matter contained in it. This mixed water was nevertheless found to contain nearly double the amount of salt that is contained in the waters of those springs in the vicinity of the shaft. Although this water is not of sufficient strength to admit of its economical use for the manufacture of salt, it nevertheless serves to add confidence to the hope before expressed, of eventual success in obtaining the office sought, if the plan proposed be carried out.

At the salt springs on Grand river a steam engine has also been set up, and is nearly in readiness for operation; the necessary buildings have been erected, and the works secured by the erection of a dock, which is, however, only partially filled. The great mass of machinery and implements required for completing the boring, are already on hand.

The sinking of a gum (upon the same plan as that adopted at Kenawha, Va.,) has been commenced, and the gum is settled within about three feet eight inches of the rock. The great

influx of water rendered the sinking of this gum exceedingly difficult, but this portion of the work is now so far completed that little difficulty can occur in fully commencing the operation of boring.

Much delay and considerable loss were sustained in consequence of the destruction by fire of a building erected for a blacksmith shop, in which tools and some machinery were stored; a loss which was felt the more severely for the reason that we were compelled to supply the place of the articles so destroyed with others procured in Detroit, thereby giving rise to much delay and expense. This fire is supposed to have originated from the hand of an incendiary.

In consequence of the embarrassments existing in the internal improvement fund, it became necessary to suspend operations in the month of September. This suspension of work would have taken place at an earlier day had not duties connected with the geological survey prevented my visiting the salines during the interval which elapsed from June to September; that space of time having been devoted to work upon the northern peninsula.

The necessity for this suspension, I trust, can be appreciated; but occurring at the time and under the circumstances it did, it cannot be considered otherwise that exceedingly prejudicial to the interests of the improvements under consideration. The main portion of the preparatory expense had been involved; persons had been brought from a distance to carry forward the work, and that point was just reached where the expenses would have been comparatively trifling.

At each of the salines a man is left in charge, on very limited pay, to preserve the machinery from injury, as well as to prevent loss from other causes.

The chief portion of the machinery having been completed, and the materials for the continuance of the work being on hand, the amount required to bring it to a close will be comparatively small. An estimate of the amount required has been attempted, but the data before me are so unsatisfactory, that

I have deemed it unnecessary to lay the estimate before you at this time.

In connection with this subject, I cannot withhold again referring to the embarrassments which a failure to receive the instalments of the appropriation has caused, for I have been compelled, so far as was in my power, to provide means from my private resources, to comply with the spirit of the contracts entered into. This difficulty, added to the onerous character of the other and *principal* duty assigned me, have rendered this portion of my *attached* duties a constant source of embarrassment.

I trust you will also appreciate the motives with which I repeat what was said on a former occasion, viz: that the charge of the mechanical portion of the duties connected with the improvement of the salt springs, is nearly incompatible with the other duties I am directed to perform; and however anxious I may be to perform faithfully the duties assigned, very nature of those duties is such as to preclude an absolute personal supervision. I am, in consequence, held responsible for the faithful performance of a trust, without the power to devote to it that constant and unwearying attention it requires.

This will be the more readily understood, when you reflect that to the office of state geologist certain duties are assigned, which if faithfully performed, should occupy his complete time and attention. After these duties had been defined, the charge of the improvement of the salt springs was also added, thus attaching a duty which of itself requires the complete energies and attention of a single individual.

In view of these difficulties and embarrassments, I would respectfully suggest to your honorable body, the policy of so far modifying the present duties of the state geologist, as to release him from the duties and responsibilities connected with the disbursements and superintendence of the improvements at the salt springs.

I would again, respectfully beg leave to call your attention to the condition of the salt spring lands. The "location" of the seventy-two sections of salt lands, granted our state by the general government, is now completed, and the sum expended in the improvement of the salt springs, may be regarded as an amount advanced, to be hereafter replaced from the liberal donation already made by the United States. With this view, no doubt can exist but the earliest measures should be taken to render the lands available, and the conditions of the grant as such as only to admit of their lease. Numerous applications have been made for the lease of portions of those lands, which will never be required for salt purposes; but no power exists to lease or place them in any condition by which profit may accrue to the state.

Nor am I aware that any power has been delegated, by which depredations upon the timber of those lands can be prevented. Extensive depredations have been committed upon the timber of some of the lands, and this in the most bold manner; for they have been committed without any apparent fear of consequences. It is unnecessary to represent to you the great injury thus done to the lands.

An exhibit of the condition of the fund placed under my control, will be laid before you at as early a day as a due regard to accuracy will permit.

All of which is respectfully submitted.

DOUGLASS HOUGHTON,
State Geologist.

STATE GEOLOGIST'S ACCOUNT CURRENT FOR THE YEAR 1839, THE SAME BEING THE SUBJECT MATTER OF THE THREE PRECEDING REPORTS

(Senate Documents, 1840, No. 18)

Office of State Geologist,
Detroit, January 10, 1840.

To the Honorable President of the Senate:

Sir—I have the honor to transmit to the honorable senate, the accompanying accounts from this department for 1839.

Full vouchers substantiating the same, have this day been transmitted to the honorable the house of representatives.

I am, sir, very respectfully,

Your obedient servant,

DOUGLASS HOUGHTON,
State Geologist.

The State of Michigan, in account with Douglass Houghton, State Geologist.

DR.

1839.				
Jan.	1,	To cash paid Emerson, Moore, & Co., as per bill rendered		$450.00
	do	J. L. Wheeler	$18.00	
	2, do	G. & J. G. Hill,	13.98	
	6, do	Detroit Iron Co.,	68.00	
				99.98
	12, do	Jas. Watson,		283.54
	21, do	H. Williams & Co.,	102.65	
	22, do	J. Roberts & Co.,	8.35	

25,	do	J. J. Riordan,	$40.79	
30,	do	Sundry items of postage on letters	.59	
				$152.38
Feb. 11,	do	John Kenyon,	20.00	
19,	do	DeGraff & Townsend,	12.00	
21,	do	F. Chubb,	113.26	
28,	do	Postage on letters for Feb. 1839,	1.02	
				146.28
Mar.	do	Jas. A. Kent,	4.44	
6,	do	DeGraff & Townsend,	4.50	
	do	Randolph & Brother,	20.00	
	do	McGraw & Knight,	1.56	
12,	do	J. B. Garland,	16.25	
13,	do	R. H. Renwick,	5.00	
15,	do	A. Bruno,	83.31	
17,	do	A. G. Pratt,	196.55	
	do	Loren Parsons,	99.13	
				430.74
	do	J. J. Riordan,	85.58	
18,	do	Wm. H. Nelson,	135.00	
25,	do	C. Wilse,	67.50	
	do	S. Barnes,	10.00	
	do	C. Cronkwright,	31.00	
				329.08
	do	Thos. McCarty,	30.00	
	do	A. F. Hayden,	100.00	
	do	O. Crane,	6.50	
26,	do	H. Williams,	75.80	
	do	Jas. Fraser,	20.50	

30,	do	for board of men, (no receipt,)	$2.37	
31,	do	Postage, ac't for Mar.,	.82	
				$235.99
April 2,	do	A. Bruno,	83.31	
9,	do	Wm. Merrill,	21.45	
	do	S. L. Rood,	2.88	
	do	G. & J. G. Hill,	3.75	
13,	do	Wm. Darby,	45.37	
19,	do	DeGraff & Townsend,	153.50	
				310.26
	do	J. L. Whiting & Co.,		1,167.98
20,	do	J. L. Whiting & Co.,	41.41	
30,	do	Postage and sundry other small items,	3.59	
				45.00
May 1,	do	Wm. H. Nelson,	135.00	
	do	Wm. H. Nelson,	125.49	
	do	Geo. H. Powell,	79.35	
	do	Samuel Westbrook,	14.38	
	do	James P. Allen,	63.87	
				418.09
	do	Geo. Myers, as per bill rendered,	41.77	
	do	John C. Allen,	68.23	
	do	Loren Parsons,	59.45	
	do	J. J. Riordan,	43.03	
	do	A. G. Pratt,	34.36	
	do	W. D. Whitlock,	130.13	
				376.97

3,	do	A. T. Nelson	$48.88	
	do	Luke Wellington,	14.08	
	do	Thos. Nelson,	199.66	
4,	do	Wm. Renwick,	7.19	
	do	A. F. Hayden,	24.00	
	do	Geo. Davis,	1.13	
	do	D. Lyon,	8.00	
				$302.94
	do	T. L. Howe & Co	5.19	
	do	A. F. Hayden,	218.73	
	do	N. Little	76.19	
	do	John Bruno	49.31	
	do	Gordon & Baker,	21.00	
	do	Geo. Raby,	7.50	
	do	T. L. Howe & Co.	31.32	
				409.24
	do	G. D. & E. Williams,	100.97	
	do	A. Van Haun,	22.75	
5,	do	E. Jewett,	7.88	
6,	do	A. D. Nelson,	142.88	
11,	do	Keeny & Mullett,	667.90	
	do	J. T. Holmes,	10.75	
				953.13
14.	do	J. J. Riordan,	7.61	
	do	P. G. & Mather,	4.38	
	do	W. N. Carpenter & Co.,	12.88	
15,	do	John Owen,	24.06	
	do	David Thompson,	30.00	
16,	do	James Stewart,	42.05	
	do	F. Moore,	8.70	
				129.68

	do	S. Davis,	$9.80	
20,	do	John Wescott,	15.32	
21,	do	Myron Roy,	31.00	
	do	J. F. Chubb,	45.34	
	do	J. J. Malden,	1.13	
22,	do	Z. Bemis,	8.81	
	do	Robert Howlett,	24.56	
				$135.96
23,	do	Smith, A. & Evans,	39.97	
	do	Cooke & Evans,	26.66	
24,	do	Wezo Roys,	1.00	
25,	do	S. Hosmer,	3.00	
	do	S. Wright,	2.00	
	do	H. Gardinier,	2.00	
	do	A. Ducher,	3.00	
	do	Jas. W. McChesney,	200.00	
	do	C. S. Hart,	134.09	
	do	B. B. Huntingdon,	98.00	
	do	Jacob Lawrence,	196.27	
				633.36
	do	N. Hathaway,	8.75	
27,	do	J. W. McChesney,	126.53	
	do	Z. Bemis,	16.50	
	do	R. Howlett,	28.00	
	do	Blake and Osgood,	22.19	
28,	do	W. O. Lyon,	1.53	
	do	James Watson	370.70	
				574.20
	do	Blake and Osgood,	6.68	
	do	Loyd & Nelson,	36.25	
	do	A. Sturgess,	122.37	
29,	do	Cooke & Evans,	3.62	

30,	do	Z. Bemis,	$16.50	
31,	do	A. Ducher,	5.00	
	do	postage, cartage, &c., for May,	9.77	
				$200.19
June 1,	do	W. W. Peterson,	2.00	
	do	James Watson,	1.75	
	do	R. Morris,	6.00	
	do	Cook & Evans,	9.75	
	do	S. Harmon,	6.00	
				25.50
	do	S. Wright,	6.00	
	do	Wm. Peterson,	.50	
	do	J. T. Holmes,	6.98	
	do	J. Watson,	.50	
4,	do	J. Watson,	1.75	
5,	do	B. B. Huntingdon,	12.00	
7,	do	J. J. Baxter,	10.00	
				37.73
7,	do	L. Gray,	15.00	
8,	do	Norman Little,	38.00	
	do	Cook & Evans,	3.00	
9,	do	H. Gardinier,	5.00	
11,	do	A. C. Pierce	10.25	
13,	do	W. D. Whitlock,	21.85	
				93.10
	do	Cook & Evans,	1.69	
14,	do	Detroit iron company,	6.00	
18,	do	L. Parsons,	17.00	
20,	do	E. Green,	14.35	
22,	do	Blake & Osgood,	12.56	

24,	do	Lake Michigan lumber company,	$8.34	
				$59.94
	do	H. Gardinier,	5.00	
26,	do	Wm. H. Nelson,	243.17	
	do	A. A. Lull,	4.84	
	do	Geo. H. Powell,	26.73	
	do	S. Westbrook,	46.11	
	do	N. M. Barker,	135.77	
	do	A. T. Nelson,	13.31	
				474.93
	do	H. G. Williamson,	33.58	
	do	Thomas Smith,	122.82	
	do	James P. Allen,	21.52	
	do	John C. Allen,	46.11	
	do	George Myers,	46.80	
	do	A. G. Pratt,	36.69	
	do	W. Sibley,	29.19	
				336.71
28,	do	E. Jewett,	31.13	
	do	T. L. Howe & Co.,	43.67	
30,	do	Postage, &c., for June	6.31	
				81.11
July 1,	do	Jas. Watson,	.48	
2,	do	Chas. Wheeler,	1.00	
3,	do	F. Manyhan,	5.00	
	do	Wm. Roberts,	1.00	
	do	R. Carroll,	3.00	
	do	Geo. Rice,	2.00	
	do	James May,	1.25	
				13.73

	do	F. Hills,	$1.25	
	do	H. Gardinier,	7.00	
	do	N. Gilden,	1.00	
	do	C. Sawyer,	2.00	
	do	E. Curtis,	1.00	
4,	do	S. A. Cook,	.75	
				$13.00
	do	Jas. Watson,	5.71	
5,	do	Wm. Brooks,	1.00	
8,	do	Jas. Fraser,	65.87	
9,	do	R. Sawyer,	6.75	
	do	J. W. Hopkins,	4.00	
14,	do	Jas. McCabe,	30.00	
16,	do	D. Hubbard,	12.00	
	do	John Bloom,	22.00	
19,	do	Wm. N. Carpenter,	36.68	
				184.01
22,	do	Jas. Watson,	31.79	
23,	do	N. Hathaway,	69.09	
	do	C. Smith,	27.00	
	do	Wm. Allen,	6.00	
	do	F. Manyhan,	7.00	
	do	W. D. Foster,	1.50	
24,	do	A. E. Sargeant,	21.00	
	do	R. Morris,	66.00	
	do	O. Wiltley,	70.00	
				299.38
25,	do	Jas. Fraser,	1.94	
	do	A. Middleton,	7.79	
26,	do	Smith, Aldrich & Evans,	1.25	
	do	J. W. Robbins,	9.00	
	do	Wm. Renwick,	1.87	

27,	do	R. More,	$2.00	
	do	J. Wheeler,	2.00	
				$25.85
	do	R. Sawyer,	3.00	
	do	R. Brooks,	1.00	
	do	N. M. Sykes,	1.00	
	do	H. West,	2.00	
	do	L. H. Main,	1.00	
	do	J. McDonour,	1.00	
	do	Wm. Brooks,	1.00	
27,	do	R. Carle,	10.00	
	do	N. Bliss,	9.00	
				58.58
	do	A. G. Pratt,	29.58	
28,	do	John C. Allen,	29.44	
29,	do	R. More,	4.00	
	do	D. McMahon,	13.50	
	do	Lyman Curtis,	.50	
30,	do	A. McFarlin,	1.00	
	do	E. Ferrin,	12.00	
	do	N. M. Sykes,	1.50	
				61.94
	do	D. Norton,	1.00	
	do	P. Guelot,	30.50	
31,	do	Wm. Allen,	1.50	
	do	James May,	2.50	
	do	D. Govin,	1.50	
	do	T. Hansey,	3.00	
	do	Postage and amount paid for draft,	9.29	
				49.29

Aug. 1,	do	M. Church, as per bill	$3.00	
2,	do	R. Carroll,	15.00	
5,	do	Higgenson & Wendell,	2.50	
	do	J. W. Pierce,	2.88	
	do	E. Jewett,	6.00	
	do	Z. Marion,	1.00	
7,	do	D. E. Fisher,	5.00	
	do	L. French,	1.00	
	do	James Page,	.50	
	do	T. Hand,	2.00	
	do	H. West,	1.00	
	do	Ira Wheeler,	1.50	
				$41.38
	do	R. Brooks,	5.50	
	do	Ira Curtis,	1.00	
	do	Joseph B. Copeland,	5.50	
8,	do	Cooke & Evans,	15.75	
9,	do	Jas. P. Allen,	24.80	
12,	do	Wm Miller,	1.25	
	do	R. More,	1.00	
13,	do	C. Smith,	1.50	
				56.30
	do	C. Metty,	1.00	
	do	R. Brooks,	1.50	
17,	do	C. Sawyer,	3.00	
	do	R. Sawyer,	5.00	
	do	D. E. Fisher,	21.50	
26,	do	J. W. Pierce,	.75	
	do	R. More,	2.00	
	do	J. H. Ganies,	1.50	
31,	do	Postage account for the month,	1.10	
				37.35

Sept. 2,	do	Lewis & Godfrey, as per bill,	$50.00	
4,	do	M. F. Dickinson,	45.29	
	do	DeGraff & Townsend,	171.20	
				$266.49
	do	Kenny & Mullett,		832.19
16,	do	F. Manyhan,	10.00	
	do	E. Linnon,	79.30	
	do	C. S. Hart,	53.49	
	do	Sylvester Harmon,	50.00	
	do	A. Edgerly,	22.00	
				213.89
16,	do	Joseph Baxter,	193.00	
17,	do	J. L. Wheeler,	13.12	
	do	John Patrick,	5.00	
	do	H. Osgood,	43.50	
	do	George Wrykert,	45.00	
	do	Lk. Mich. lumber co.	15.39	
	do	N. Hathaway,	34.30	
				349.31
	do	Ketchum & McRay,	42.53	
	do	L. French,	13.50	
	do	R. Carroll,	61.75	
	do	J. Holmes,	1.63	
	do	Wm. P. Steere,	86.92	
18,	do	Lyman Gray,	1.50	
	do	N. Hathaway,	.75	
	do	C. S. Hart,	1.75	
	do	Joseph Baxter,	1.62	
				211.95
	do	Higginson & Wendell,	1.25	
	do	Lewis & Godfroy,	5.00	

	do	S. A. Cooke,	$61.58	
	do	A. Roberts,	4.99	
	do	F. J. Higginson,	5.00	
	do	E. Dalton,	3.75	
	do	M. Roys,	8.75	
	do	D. Willard,	4.00	
	do	J. Wheeler,	4.50	
	do	R. Howlett,	74.87	
				$173.69
	do	D. McMahan,	5.00	
	do	F. Manyhan,	27.00	
	do	B. Copeland,	3.00	
	do	James Watson,	48.06	
	do	N. Ringnet,	16.00	
				99.06
	do	A. Goutier,	22.00	
	do	F. Neat,	12.00	
	do	N. Sleighton,	3.00	
22,	do	George H. Powell,	56.45	
26,	do	Jacob Lawrence,	119.19	
30,	do	Postage for Sept.,	2.10	
				206.74
Oct. 2,	do	N. M. Barker,	190.99	
	do	John Imrie,	23.00	
	do	A. Goldsworthy,	43.97	
	do	H. G. Williamson,	79.17	
	do	George Myers,	80.28	
3,	do	G. D. & E. Williams,	118.62	
	do	H. Williams,	16.17	
				552.20
	do	Peter Guelot,	80.57	
	do	Thomas Nelson,	47.82	

	do	A. T. Nelson,	$47.28	
	do	A. F. Hayden,	30.60	
	do	T. Smith,	135.00	
	do	Samuel Westbrook,	39.87	
	do	T. L. Howe & Co.,	32.16	
	do	Chas. L. Richman,	4.25	
				$417.55
	do	Richman & Lyon,	3.51	
	do	A. Lull,	48.94	
	do	C. Cronkwright,	10.87	
4,	do	Wm. H. Nelson,	240.92	
	do	E. Jewett,	23.20	
	do	W. P. Little,	65.19	
8,	do	A. E. Sargeant,	417.01	
9,	do	J. W. McChesney,	184.48	
16,	do	J. L. Whiting & Co.,	513.19	
				1,507.31
29,	do	Higgenson & Wendell,	24.50	
Nov. 11,	do	J. Stewart,	234.65	
30,	do	Postage for the month,	00.56	
Dec. 30,	do	Postage,	00.75	
				260.46
		Amount carried forward,		$14,898.29

The State of Michigan in account with Douglass Houghton, State Geologist,

CR.

1839.				
Feb.	1,	By cash of state treasurer,	$5,000.00	
May	4,	" do do do	5,000.00	
				$10,000.00
Sept.	24,	" Warrant of auditor general on which 12 months' post notes were rec'd,	1,000.00	
Oct.	8,	" Warrant of auditor general on which 12 months' post notes were rec'd,	700.00	
				1,700.00
Nov.	14,	" Warrant of auditor general on which nothing has as yet been rec'd,		3,300.00
				$15,000.00

DR.

To amount brought forward from debit account, being the sum total of disbursements,	$14,898.29
Balance which, when received, will be on hand,	$ 101.71

DOUGLASS HOUGHTON.
State Geologist.

THIRD ANNUAL REPORT OF THE STATE GEOLOGIST

(Senate Documents, 1840, Vol. II, No. 7)

Office of State Geologist,
Detroit, February 3, 1840.

To the Hon. Speaker of the House of Representatives:

Sir—I have the honor herewith to transmit to the hon. house of representatives, the third annual report and accompanying documents from this department.

I have the honor to be,
Sir, your obedient servant,
DOUGLASS HOUGHTON.
State Geologist.

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

I have the honor again to lay before you the progress which has been made in the geological survey of our state, together with the general condition of the department that has been placed under my charge.

I do not propose to enter into a minute detail of all that has been accomplished, for to lay before you *at this time* these undigested and unfinished details would seem to be in a measure unnecessary, from the fact that I am called upon at the close of the work to embody in a connected and uniform report, the complete results of all that may be accomplished.

Since the date of the last report which I had the honor to transmit to you, the geological and topographical portions of the work entrusted to my charge have progressed as rapidly and steadily towards completion, as the circumstances connected with the immense labor to be performed, would permit. These labors have extended over a large portion of the organized counties of the state, and of many of these the complete field notes for the surveys have been returned. The minute

examinations of these counties has chiefly been assigned to the geological assistants, Messrs. Douglass and Hubbard, and their reports embracing a programme of their labors, for the season, are hereto appended. As these reports refer to many of those practical subjects which would be considered, were I to report upon my own labors in these counties, I have deemed it unnecessary at this time to refer particularly to the geology of this section of the state.

NORTHERN OR UPPER PENINSULA

General description and Topographical features

In addition to the duties performed in the southern peninsula of our state, a portion of the season has been devoted to an examination of the southern slope of that part of the upper or northern peninsula, extending from the Sault de Ste. Marie, to the mouth of Monominee river of Green bay; a district of country, which with very few exceptions, is a perfect wilderness, but which, nevertheless, is deserving of all the labor which has been bestowed upon its examination.

A general description of that portion of the northern peninsula, lying between the foot of lake Superior and the mouth of the Monominee river of Green bay, since the country is but little understood, may not be misplaced, though it had been my intention to avoid *at this time,* all details, except such as might be directly connected with the progress of the work under consideration.

The district of country alluded to, is, perhaps, more variable in its topographical features, in the composition of its soils, and the character of its timber, than any portion of equal extent of the southern peninsula, and cold and inhospitable as the climate has been wont to be considered by our citizens, there are many of the elements of competence and wealth contained in it.

The very extremity of the peninsula, embracing most of that country lying east of a line drawn from the Sault de Ste

Marie to the island of Mackinac, compared with the more westerly part of the upper peninsula, is either flat or slightly undulating, and it embraces marshy districts of large extent. Most of the coast is skirted by islands, giving great beauty to the scenery. The immense number of these islands, skirting the easterly portion of the coast, is beyond conception, for they form, as it were, an almost inextricable labyrinth, giving rise to narrow and intricate channels, and again widening into what may, with propriety, be called small lakes. This feature of the coast has served to render the published maps of this district more imperfect than those of any other portion of our state, for which reason, an unusual degree of labor has been devoted to a correction of these geographical inaccuracies.[37]

But in no portion of the country is this insular character so largely developed as in that arm of lake Huron, which forms, as it were, the embouchure of the Ste Marie river. Here are literally hundreds of islands, varying in size from those composed of a mere point of rock, to those of many thousands of acres in superficial extent.

The soil and adaptation of these islands to the purposes of agriculture, is as variable as their size. Yet, while portions of them are adapted to use for agriculture, by far the larger proportion will scarcely admit of this application.

In the vicinity of Pte Detour of lake Huron, the country is flat, with ridges only slightly elevated, and with intervening marshes; but as we proceed westerly, it gradually becomes more elevated, until (a little east from the island of Mackinac,) it rises in abrupt hills to a height varying from one hundred and fifty, to three hundred feet, and these hills in the vicinity of the straits, approach near to the coast.

The range of hills, of which these outliers may be considered the commencement, continue in a somewhat broken

[37] In my labors to produce correct maps of this difficult section of country, invaluable assistance was rendered by Jas. L. Schoolcraft, Esq., whose intimate knowledge of the country, and minute observations, recorded through a series of years, have enabled me to reach a much greater degree of perfection than otherwise could have been done.

chain, usually at no very great distance from the coast, as far west as Little bay du Noquet; from whence they bear north-westerly, stretching towards lake Superior. These hills usually form great undulations, with their sides sloping away gradually, but occasionally naked cliffs of limestone appear. Usually the cliffs are of no great altitude, and at no place did I observe them so largely exposed as upon the coast of Great and Little bay du Noquet, upon the easterly side of the former of which, they attain an altitude of from one hundred to one hundred and fifty feet.

The bays, just alluded to, forming as they do, deep indentations from the head of Green Bay, give a peculiar feature to this part of the coast. They furnish a complete shelter for shipping, and being surrounded by a country which is mostly well adapted to agriculture, their importance of position cannot fail, eventually, to be appreciated.

The soil of the southern slope of the upper peninsula, passes almost imperceptibly, through all the shades of variety, from a whitish silicious sand and sandy loam, (not unfrequently mixed with gravelly limestone,) to that composed wholly of pebbles of limestone. Clay soil is exceedingly rare, and when it does occur, contains a very large proportion of lime in its composition.

The timber of this district has all the variety which would be looked for on soils of so changeable a character. It varies from the scrubby pines which characterize the pine barrens, to beautifully timbered tracts of sugar maple; the latter timber having almost invariably interspersed with it white cedar and spruce, these latter, together with birch, in fact, forming the larger proportion. White pine occasionally occurs, though more frequently in the westerly than in the easterly portion of the country alluded to. As a whole, the western portion is much more favorable to agriculture than the eastern.

The upper portion of the peninsula being of no great width, furnishes but few streams of any considerable size. Among

these, the Monominee, Monistique and Menecockien rivers are more particularly deserving of notice. The two former, from their greater size, together with the peculiar advantages which exist at their points of embouchure, will only be considered.

The Monistique river, which enters lake Michigan near its north-westerly angle, at a distance of about thirty-five miles north-easterly from Pte Detour of Green Bay, has its place of embouchure in a small bay, that serves to afford a partial protection from the heavy surf of the lake. The stream, at its immediate mouth, has a width of a hundred and twenty feet; but this width is subject to considerable variation in consequence of the sands which are subject to drifting, from the effect of the currents of the lake and river. Ascending the stream but a few rods, it suddenly expands into a beautiful sheet of water, giving rise to a small lake, that has a length somewhat exceeding half a mile, and a width varying from one-fourth to one-third of a mile. This small lake, which furnishes a safe and convenient harbor for vessels, is surrounded by moderately elevated and undulating sandy plains, sustaining a sparse growth of small yellow pines. The channel of the stream will admit the entrance of vessels drawing from seven to seven and a half feet of water. Monistique river enters this small lake at its northerly end, and has here a "rapid" over limestone *in place*, which will furnish a fine hydraulic power, so situated that it may be nearly approached by vessels, and which cannot fail eventually to be of vast importance in advancing the settlement of the surrounding country.

The Monistique river has its source in the highlands north-easterly from its mouth, and its sources interlock with the head waters of the Tonquoimenon river of lake Superior. In its course to lake Michigan, it frequently expands into small and beautiful lakes. It passes through a country, a large portion of which is well adapted to the purposes of agriculture, and which, at those points where the soil has

been cultivated by the Indians, produces abundant crops of corn, potatoes, &c.

Monominee river of Green bay, one portion of the defined boundary between our own state and Wisconsin, is a much larger stream than that just alluded to. Its embouchure into Green bay is by a broad mouth, that may, in fact, be regarded as a narrow lake, which has a width varying from forty to one hundred rods, and a length somewhat exceeding one and a half miles. The shores, at the immediate mouth of the stream, are flat and marshy, with narrow ridges of sand, but at a distance somewhat more than half a mile above, they begin gradually to rise, until they finally attain an elevation of from ten to twelve feet above the water of the river.

At a distance of somewhat more than one and a half miles from its mouth, the stream which is here much diminished in width, forms a "rapid" over a ledge of limerock, having a fall of ten to twelve feet in a distance which may be estimated at half a mile, thus giving rise to an amount of hydraulic power, which, at this point, cannot fail to be of great value.

Above these rapids, the river, for a distance of twenty-five miles, has a width varying from two hundred and fifty to four hundred feet. The bottom is chiefly composed of gravel, but there are occasional rapids over limerock *in place*.

The soil in the vicinity of the mouth of the stream, is chiefly composed of a dark colored sand, or sandy loam, largely impregnated with lime, and it produces good crops of wheat, barley, rye, oats, potatoes and corn. The extensive Indian fields, now mostly uncultivated, show this to have been the residence of a numerous band of Indians, and that they must have depended largely on the products of the soil for subsistence. The miserable remnants that remain of these original proprietors of the soil, have almost completely abandoned its cultivation, having placed their dependence for subsistence, through most of the season, upon the fish which are taken abundantly in the stream.

Upon the Wisconsin side of the Monominee river, two saw mills have been erected, one of which has been in operation for several years, and two or three families of whites are resident there. Extensive field have been put under cultivation and have not failed to yield an abundant return of crops.

The bar at the mouth of the Monominee river may be passed at ordinary stages of water, by vessels drawing from seven to eight feet, and after this bar be passed, the largest class of vessels may ascend nearly to the rapids before mentioned.

The many advantages existing at the mouth of this stream, taken in connection with the pine timber that occasionally skirts its upper portions, cannot fail eventually to render its mouth a place of much importance.

Most of the smaller streams occurring between the Monominee river and Mackinac, have brisk currents and furnish abundance of hydraulic power, but with one exception this is, as yet, unapplied. A saw mill has been erected on the Esconnauby river of Little bay du Noquet, and here are the only signs of civilization between the points mentioned, being an extent of more than two hundred and fifty miles of coast.

In laying before you this hasty outline of a portion of the upper peninsula of our state, I cannot refrain alluding to the immense wealth that may be made to flow from the fisheries by which it is surrounded.

The inducement offered by this branch of industry for a handsome return of profit must, I feel assured, eventuate in the direction of a large amount of capital to this business, and will no doubt exert a powerful influence upon the settlement of the more favored portion of the coast. It is well known that while the waters of the whole line of coast alluded to, furnish whitefish and trout more or less abundantly, there are, nevertheless, many points which, from their peculiarly favorable location, yield a more abundant return.

A portion of that coast, lying between point Seul Choix of lake Michigan, and Little bay du Noquet of Green bay, offers

many exceedingly advantageous situations for conducting this branch of enterprise, and "[this ground]" appear to have been wholly neglected, or at least none of the usual evidence of its having been appropriated to this purpose, exist.

In connection with this important branch of industry, which has for the last few years been so steadily, yet imperceptibly increasing, extending as it does around the areas of both of our peninsulas, it may not be misplaced to call your attention to the immense importance which it must eventually hold in our state. As yet, all knowledge of its returns depends upon vague rumors, for no accurate data of its value or extent have as yet been made. The census to be taken during the current year offers a favorable opportunity, if the proper measures be taken to obtain all the statistics which may be required on this subject, and these statistics, if obtained, may be the means of enabling the state hereafter to extend to this branch of industry the fostering care which its importance deserves.

GENERAL GEOLOGY OF THE SOUTH AND SOUTH-EASTERLY PART OF THE UPPER PENINSULA

The rocks of the district of country under consideration are but little varied; the separate portions, occupying, for the most part, an extensive range, and in chemical and mechanical composition, bearing a close analogy to each other. They chiefly consist of a series of well defined limestones, and shales, that occupy the complete range from Drummond's Island, of lake Huron, to Monominee river of Green bay.

These limestones and shales are less perfectly developed in their easterly prolongation; or in other words, the separate portions of the formations thin out as they approach the primary region of the Ste Marie river. As we proceed towards the northern declivity of the upper peninsula, the red sandstone of lake Superior, makes its appearance, underlaying the groups of limestones and shales before mentioned.

These sandstones together with the series of overlaying limestones and shales, are bounded on the east by a range of hills composed of primary rocks, chiefly of quartz, hornblende and greenstone. The boundary between the primary and sedimentary rocks, is very nearly defined by the course of the Ste Marie river, which stream, through nearly its whole course passes very near to, or directly along the line of junction of these rocks. Thus it will readily be perceived, while the limestones, shales and sandstone fall mostly within the United States, the primary rocks are chiefly embraced within the British possessions.

Primary Rocks

It has already been stated that the development of the series of primary rocks, falls chiefly easterly and north-westerly without the region of country under consideration; for which reason such allusion only will be made to them as will aid in more clearly understanding these rocks embraced within our own territory.

Commencing with the main land at the first, or lower point of contraction in the Montreal channel of the Ste Marie river, (which contraction is formed by the near approach of the island of St. Joseph, to the main land, and is the lowest point at which any observations were made,) these primary rocks stretch in a westerly direction across the northern part of the island just mentioned; when, curving northerly, they appear on the south-easterly end of Sugar island from which point they pass to the main land, north, and skirt the easterly side of Great lake George, forming here a somewhat elevated range of hills. This range of hills, after reaching the head of lake George, pursues a westerly course, departing from the river, until it reaches Gros Cap of lake Superior.

The immense primary region of which the line described may be considered, as it were, a single point, stretches nearly continuously many hundred miles north-westerly, skirting a

portion of the shores of lake Superior, and in conjunction with the trap rocks constituting the highlands between that lake and lake of the Woods. From these highlands it stretches a little east of lake Winnipeg, far to the northwest, finally constituting the immense "barren grounds" of the British possessions. It is also well known that this range of primary rocks stretches in an easterly direction through the interior of the upper province of Canada.

The primary region of the Ste Marie river and its vicinity is characterized by the occurrence of rounded knobs and hills, usually of no very great height, though sometimes attaining an altitude of several hundred feet, frequently including basins which usually contain more or less water, thus giving rise to a multitude of marshes, ponds, and more rarely to small lakes. Portions of the rocky surface are absolutely destitute of soil, the otherwise bare rock being usually more or less covered with a variety of lichenes, among which the reindeer moss, (Cenomyce rangeferina,) most largely abounds. The soil occurring in the lower portions of the basins intervening between the knobs of rock, is sometimes composed of vegetable matter mixed with silicious sand and gravel, washed from the higher levels; while that upon the hills is more usually made up of a coarse, siliceous sand, arising from the disintegration of the rocks, and is of a very unproductive character. These soils are covered more or less densely with a forest, in which evergreen timber largely predominates.

This primary district, as a whole, is of a most forbidding character, and in it the agriculturist would find little of interest; for the constant succession of bare rocks and barren soils, form a striking contrast with the country of transition rocks lying south from it.

At that point in the Montreal channel before alluded to, the first perceptible current was noticed, and this may, therefore, in reality, be considered as the termination of this arm of lake Huron, as well as the commencement of Ste Marie river. The stream is here divided by a great number of islands, and these

islands continue to form an almost inextricable labyrinth for a distance of many miles.

On the main land at these "narrows," and extending for several miles, the knobs are composed of compact greenstone, occasionally partaking of a sub-slaty character, and under which circumstances, the rock bears a close analogy to some of the varieties of primary argillite.

Minerals are of rare occurrence in this greenstone. Occasional minute chrystals of quartz, feldspar, imperfect asbestus, with some indistinct traces of carbonate of copper, were only observed.

In ascending the river, this greenstone was observed to pass, by almost insensible degrees, into a well defined hornblende rock, which was noticed to form low hills upon the main land, as well as several of the islands in the stream.

On the northern part of the island of St. Joseph, a fraction of the south-eastern part of Sugar island, and a portion of the main land on the east, the place of the hornblende rock is supplied by granular quartz rock, usually white, but sometimes passing to a reddish or deep red color. In character, it varies from a sub-chrystalline rock, translucent at the edges and breaking with a conchoidal fracture, to a granular or almost conglomerate quartz rock. Small quantities of hemetitic iron ore, and rarely micaceous oxide of iron, were the only simple minerals noticed associated with this rock.

In the range of hills bounding the easterly side of Great lake George, talcose slate was observed, but to what extent it exists, I am unable to say.

The only district occupied by this primary range, within the line of boundary between our own territory and that of Great Britain, is that before mentioned, upon the south-easterly part of Sugar island. The rock is, here, a light colored, granular quartz, and it occurs, forming a few low knobs, that occupy but a very small extent of surface, and that at the very extremity of the island. For the most part, it is hidden from view by detrital matter mingled with large angular blocks of quartz

rock, and nearly the whole tract is clothed with a dense growth of timber.

Sedimentary Rocks

This district of country stretching westerly and southerly from the primary tract alluded to, is characterized by the occurrence of the red sandstone of lake Superior, on the north, the series of overlaying limestone and shales, heretofore mentioned, on the south. The contrast, in general contour, between this and the primary region, is, in all respects, characteristic of the different formations. Thus, while the predominant feature of the primary region is that of a rugged, knobby, and for the most part, barren country, the district south and south-westerly from it, rises in gradual swells or undulations, covered with a heavy growth of forest trees, and possessing many tracts of soil which are inviting to the agriculturist.

Lake Superior Sandstone

Although but a small angle of that country, which is referable to the red sandstone formation has been examined during the past season, yet in order to a better understanding of its range and extent, it may not be misplaced to refer to the fact that a large portion of the northern slope of the upper peninsula, is referable to this rock formation. Its continuity upon the southerly shore of lake Superior, being only broken by the occurrence of a comparatively limited range of primary and trap rocks.

This lake Superior sandstone, in its easterly prolongation, rests against and upon the primary range of the Ste Marie river, before described, while on the south, it is seen to pass beneath the limestone at the Nebeesh rapids of the boat and canoe channels of that river. The rapids or falls of Ste Marie river are formed by the passage of the waters over the outcropping edge of the sand rock, which inclines or dips

from this point southerly; thus passing *conformably* below the limestone before alluded to.

No cliffs of sandrock occur in the immediate vicinity of the Ste Marie river, nor was it noticed, at any point, to rise many feet above the surface of the water. In fact, no opportunity offered for a satisfactory examination of the rock except in the vicinity of the Sault, at which point, a "race" for conducting the waters to a saw mill, has been excavated, in part, through it. The rock here, varies from a light gray to a brick red color, not unfrequently being gray, with red or reddish spots, and in structure it varies from a compact sandstone, occurring in layers of several inches thickness, to that of a shelly or sub-slaty character. Through this sandrock a large portion of the contemplated canal around the falls must be excavated, and occurring, as the rock does, in strata of no great thickness, but little difficulty will be encountered in the excavation, and the work, when once completed, will be of a permanent character.

This sandrock, as a material for the structure of works exposed to the action of the elements, is of an inferior quality, and will without doubt, undergo more or less rapid disintegration, when exposed to the conjoined action of moisture and frost. As a material for the construction of ordinary walls, it will answer a good purpose.

I allude to this subject the more particularly, at this time, for the reason that a great amount of rock, of a suitable shape for the construction of the walls of the locks required for the Ste Marie canal, will be thrown out during the process of excavation, and which may appear to be an inducement for its use in that work. In a climate like that of the Sault de Ste Marie, this error should be carefully avoided; for if the sandrock be used for that purpose, but few years will elapse before the locks will require reconstruction. An example, illustrative of the effect of moisture and frost upon a rock of similar composition, is exhibited on the Erie canal, of New York, in the old aqueduct over Genesee river, and in several

of the locks upon that great work. During the few years which have elapsed since the construction of these structures, the disintegrating action of the causes alluded to, has been rapidly at work, and some of those expensive structures are in so precarious a condition as already to require reconstruction.

In the immediate vicinity of the surveyed line of the Ste Marie canal, transported masses of granite, hornblende, sienite and quartz rocks abound, and they may be economically employed for the construction of the proposed locks and will make an enduring structure.

The lake Superior sandstone, in its easterly prolongation, does not attain a very great thickness, but in proceeding westerly this thickness is vastly increased, attaining on the south shore of lake Superior to several hundred feet.

So far as my examinations, during the past year have extended, the rock is destitute of fossils, and in fact after a careful examination, (several years ago,) along its whole line of outcrop, on the southerly shore of lake Superior, I have never been able to detect in the rock, a single contained fossil.

Limerock and Shales

Passing from the sandstone of lake Superior to, or near to the southerly slope of the upper peninsula, we come upon a series of limestones and shales, resting upon and concealing the former rock. These limestones and shales along the whole line of coast, from Drummond's island of lake Huron to Monominee river of Green bay, have a slight inclination to the south, or more nearly to the south south-east. Thus while these rocks dip, in such a manner as to form the basins of lakes Huron and Michigan, their upraised edges form, as it were, the barrier that sustains the waters of lake Superior at their present level.

The Nebeesh rapids of the Ste Marie river, at least in the two westerly channels, is in part over the very lower portion

of these limestones, and by far the larger portion of the small streams along the coast, intervening between Pte Detour of lake Huron, and Monominee river of Green bay, have a more or less rapid descent over some portion of the limestone series, usually at points not very far from their place of embouchure.

The limestones and shales will, in the following descriptions, be separated into two groups, reference being had to their constant embraced fossils and chemical character. The immediate line of junction between these groups is usually not particularly distinct, but in the main they are readily distinguished by the most hasty glance.

Lower Limerock and Shales

Without, at this time, attaching to that portion of the limerock series that immedately overlies and rests upon the red sandstone of lake Superior, any characteristic name, the rocks as a whole, will be considered simply with reference to the *position* they occupy in relation to the overlaying and more southerly limerocks; nor will the several beds in which the group may be divided be considered separately.

The lower limerocks and shales in the district of country under consideration, occupy a comparatively small portion of the district, and do not appear upon the coast except at very few and distant points. The complete group may be described as a series of compact and shaly limestones, with interstratified, argillaceous, blue colored shales; the shales, more particularly in the western prolongation, forming a large portion of the whole mass. The group is more or less fossiliferous through its whole range, being characterized by the presence of several species of the genera, Orthis, Atrypa, Delthyris, and Strophomena, and more rarely by Calymene, Asaphus and Encrinus. In the western prolongation of these lower limestones and shales, as has before been mentioned with respect to the lake Superior sandstone, the thickness be-

comes very much increased; while in their near approach to the primary of the Ste Marie river, on the east they thin out and nearly disappear.

The lower portion of a range of hills stretching along parallel to and not far distant from the southerly side of Little bay du Noquet, in consequence of their somewhat abrupt termination at the bay mentioned, expose a series of rocky cliffs of exceeding interest. The immediate line of this coast is bounded in part by perpendicular or overhanging cliffs, not usually having an elevation of more than thirty to forty feet. The rocks of these cliffs are referable to the lower group of limestone and shales, while the hills rising abruptly immediately inland are capped by the overlaying or upper limestones. The cliffs immediately bounding the bay are made up of a series of argillaceous limestones in thin strata, with intervening soft argillaceous slate of a blue color; this slate constituting by far the larger proportion of the cliffs. These shales which are rapidly disintegrated by the action of moisture and frost, have been thrown down, and swept away by the waters below, while the harder and more compact strata of limestone having resisted the action of these causes, are left in projecting and overhanging cliffs. Some portions of the layers or strata of limestone are almost wholly composed of congeries of fossils, of the genera before mentioned, while in others, no fossils have been detected. The same remarks respecting the fossils may also apply to the slaty portions of the group.

Between Little bay du Noquet and Drummond's island, the lower group was not noticed *upon the coast,* but in ascending the Ste Marie river, it was seen at the Nebeesh rapids, Sailor's encampment island, and also on the easterly end of the island of St. Joseph. Nearly, if not the whole of the more elevated parts of the island last mentioned, are composed of the upper lime-rock.

In pursuing the course of out-crop of the lower group, from the Nebeesh rapids, where after thinning out, as has been before

stated, it is seen in the bed of the river resting immediately upon the sandstone; it stretches in an easterly direction across great Sailor's encampment island, and the boat channel, and still further easterly it no doubt comes in direct contact with the primary rocks of the southerly part of Sugar island, as well as those of the northerly part of St. Joseph island. After leaving little Sailor's encampment island, this rock disappears beneath the highlands of the St. Joseph, but again re-appears in close proximity to the primary, on the eastern side of that island, about five miles below Bears' encampment island, of the Montreal channel. The rock, as observed at these points, is not only reduced very much in thickness, but has also lost nearly the whole of its associated shales.

At Sailor's encampment island, where the rock scarcely rises above the water, it has the character of a calcareous sandstone, with comparatively few fossils; while on the easterly part of St. Joseph, where it rises to a height of about five feet, above the water, it takes the character of a flaggy bituminous limestone, of a dark brown color, and is composed almost entirely of a mass of those fossils which characterize the formation.

Upper Limerocks

Upon the group of lower sandstone and shale, and differing from it not only in continued fossils, but also in physical character, rests a series of limerocks, extending from the Manitoulin islands of lake Huron, to, and including the southerly cape of Green bay. A *strict* consideration of the subjects connected with this extended group of rocks, would perhaps call for a division of the mass into three parts, viz: the lower, or Pentamerus portion; the middle, or Polypyferus portion, and the upper, or Mackinac and Manitoulin portion. But for all the purposes of the present report, it is sufficient to consider these separate rocks as a single group.

The most casual observer of the maps representing the northern and eastern parts of lake Huron, can scarcely fail

to notice the immense numbers of islands that are there represented. The larger of these, and in fact nearly the whole of them, are composed of limerocks, referable to the group under consideration.

Commencing with that group of islands known as the Manitoulin chain, of which Drummond's island may be considered the termination westwardly, the upper limestone is observed to pass to the main land, forming the bed of the lake in the itermediate space, and to appear at intervals upon the coast, as we proceed westwardly. The upper portions of the rock form the base of that group of islands, east from Mackinac, known as the Cheneaux, as well as the island of Mackinac and the range of hills extending westward on the main land, commencing with the bare point of rock, known as the Sitting rabbit.

The middle and lower portions of the group appear at many points along the coast, forming the head of lake Michigan, as well as the Great bay du Noquet, and also cap the hills upon the easterly side of Little bay du Noquet of Green bay. They also give rise to the islands at the entrance of the bay last mentioned, and compose at least the whole upper part of the elevated cliffs forming the southern boundary of that bay.

It will thus be observed, that the line of bearing of the upper group of limerocks is very nearly east and west, while the general inclination, as has been before stated, is south, or perhaps more nearly south south-east. The inclination of the whole of the rocks described being southerly, offers a sufficient explanation for the fact, that in proceeding northerly from the coast, we soon pass from the upper to the lower limestone and shales, and by continuing still farther north, we come upon the red sandstone of lake Superior.

Drummond's island, the only island of the Manitoulin chain that falls within the territory of the United States, is composed of the lower and middle portions of the upper limestones, and the characters which are applicable to it here will sufficiently characterize it through its whole range.

At Collier's harbor, (the site of the old British fort,) near the western extremity of the island, the lower portion of this series is seen to form the bed of the lake. The rock rises almost imperceptibly to the surface, forming the immediate shores of the small bay mentioned. The rock, which here rises only a few feet above the water, is exceedingly compact, of a light brown color and sub-granular struction, and is nearly destitute of fossils. Its surface is indented with numerous small and somewhat regular spherical cavities, which give to it a very singular appearance.

After leaving Collier's harbor, the rock is concealed by detrital matter until we reach the central and elevated part of the island, where the rock belonging to the middle portion of the group and overlaying that before noticed, appears. This rock differs widely in appearance and composition from that at Collier's harbor. It has a course granular or subchrystalline structure, and is of a light buff color, which at times approaches nearly to whiteness. The rock is usually compact, though it sometimes partakes of a slatiness of structure.

This last rock constitutes the range of hills stretching in an easterly and westerly direction across, and forming the elevated portions of the island, attaining an elevation varying from eighty to one hundred and twenty feet.

The middle rock of the group is here characterized by the abundance of its contained fossils, chiefly Polyparia, which also mark its complete range westerly. The most abundant of these, embrace several species of the genera Calamopora, Catenipora, Syringopora, Aulopora and Strombodes, together with several species of Orthocera. This limerock appears at intervals upon the coast, in the direction of Mackinac, but always at a very low level.

The rock which constitutes the island of Mackinac, as well as the range of hills stretching in a westerly direction, on the main land, belongs to the upper portion of the group, and since it was more particularly noticed in the second annual report

from this department, will be passed by with this simple notice.

Westwardly from the straits of Mackinac, this upper portion of the limestone continues to cap the hills, while the middle and lower portions of the same group appear at short intervals upon the coast along the northern end of lake Michigan to point Detour and Great bay du Noquet of Green bay, along the easterly side of which bay they form abrupt and perpendicular cliffs, varying from forty to one hundred and twenty feet in height. The lower rock of the series, as has been before stated, caps the elevated hills on the easterly side of Little bay du Noquet.

Economical Geology of the upper and lower limestones and shales

The two groups of limerock under consideration, may be made to furnish an abundance of material, admirably adapted for use as a building stone, and also for the manufacture of quick lime.

On the eastern part of Drummond's island, the elevated range of hills which traverse that island, terminate abruptly in a series of cliffs elevated from one hundred to one hundred and twenty feet. Portions of the limerock forming these cliffs are admirably adapted for use as a building stone, as well as for the manufacture of lime; and from the fact that vessels may approach almost directly to the coast, and load with safety, its value is much enhanced. Near by, and in fact, almost in contact with the rock, is a small perfectly "land locked" harbor, that has been rendered secure from storms by a narrow "spit" of gravel, which is covered with forest trees.

The cliffs at this point of Drummond island, are made up of a series of strata, as follows, *in ascending order:*

1. A brownish, light colored limestone, of extreme fineness, and separating into layers, varying from one to four or five

inches in thickness; well adapted for use as a flagging stone, and for the manufacture of lime. Rises to a height of about twelve feet above the water.

2. Resting upon this flaggy limestone is a compact, light buff colored, granular, occasionally sub-siliceous limestone. It separates into layers, having a thickness of from five to six feet, and blocks may be obtained of almost any required size. This rock occupies about sixty feet in height in the bank, and is so situated as to admit of being quarried with the utmost facility. As a material for building, it is of superior quality, being well calculated to resist the action of disintegrating agents, and when the thickness of the separate strata, with the ease with which the rock may be quarried, together with its peculiarly advantageous situation, are considered, I trust the great value of this quarry may be appreciated.

3. Above, and resting upon the granular rock just described, is a fine grained, light colored, compact limestone, occupying about twenty feet of the hill side, above which the rock was so covered with detrital matter as to prevent observation. This limestone is of a somewhat flaggy structure, and, unfortunately for its application as a building material, it separates into irregular masses; were it upon the ground where required for use, it would answer tolerably as a rough building stone, but will scarcely bear transportation for that purpose; it may, however, be advantageously used for the manufacture of lime.

Limestone of good quality may be quarried with facility at many points on Drummond's island, and I may safely venture the opinion, that at no very distant day, the limestones of this island will obtain the celebrity they so justly deserve.

From Drummond's island to Mackinac, the great mass of limerock upon the immediate coast, lies below the level of the water, and of necessity does not admit of being quarried; but at a few points quarries may be opened to a limited extent.

The rocks of Mackinac, and the vicinity, were described in a former report. These upper rocks possess less compactness than those lying below, and in consequence of their vesiculated structure, are more subject to disintegration; and added to this, the shattered condition of that on the island of Mackinac, will prevent its extensive use for permanent structures.

Limestone of better quality belonging to the same place in the group is found on Round island and also upon the mainland in the vicinity of Pte St. Ignace.

From the straits of Mackinac to Pte Detour of Green bay, limestone may be very advantageously quarried at many points upon the immediate coast. A low cliff of granular, siliceous limerock, attaining an elevation of some twelve to fifteen feet above the water, occurs on the westerly side of Pte Seul Choix, and offers an advantageous situation for obtaining an excellent building stone, in thick strata, at little cost. This rock belongs to the middle portion of the upper group.

Limerock, well adapted for use as a building stone, or for the manufacture of lime, may be quarried in a limited quantity, at the head of the small lake through which the Monistique river, makes its embouchure into lake Michigan. Although not of very great extent, it will prove of much value at this particular point.

In the vicinity of Pte Detour of Green bay, this *middle* limerock may be advantageously quarried at many points upon the coast.

On the easterly side of Great bay du Noquet, the elevated cliffs belonging to the middle and lower portions of the *upper group* may be made to furnish an inexhaustible supply of good building stone. The rock is compact and admirably calculated to resist the action of disintegrating agents, and may be advantageously and readily quarried, of almost any required thickness. The lower portions are composed of thin strata of a fine grained rock, well fitted for the manufacture of quick lime, while the upper portions are of a more granular structure, and occur in strata having a thickness

of from three to five feet. The cliffs and hills rise here, as we have before stated, to a height varying from eighty to one hundred and fifty feet.

On the easterly side of Little bay du Noquet the lower limestone and shales may be made to furnish a tolerable building stone as well as a material for the manufacture of quick lime, but of an inferior quality compared with those before mentioned, and not as easily quarried.

From this brief outline it will be seen that this portion of the upper peninsula, furnishes an abundant supply of a superior material for building as well as for the manufacture of quick lime. Thus, when the soil shall be cultivated, the agriculturist will have an unfailing supply of calcareous manure at hand, and with a soil adapted to its use, by judicious management, he cannot fail to reap an abundant harvest. With these elements of wealth at hand, in addition to the great and important fisheries which surround the peninsula, we may, I trust, lay aside the long cherished idea, that this portion of our state must remain an uninhabitated wilderness.

Mineral contents of Limestones and Shales

The minerals embraced in the *groups* of limestones, of the upper peninsula, are few, and so far as I have been able to determine, even those few are in comparative small quantities.

Gypsum is found forming thin *veins* in the middle and upper portions of the upper group of limestones, and it has been obtained in sufficient quantity to admit of export; but so far as I have been able to determine these veins are of limited extent, and they are chiefly below the present water of the lakes. Veins of gyspum occur in the bed of the lake, near St. Martin's island of lake Huron, and also at several points on the coasts westwardly from Mackinac.

Calcareous spar, and iron pyrites are occasionally met with, and hornstone occurs still more frequently, sometimes forming thin beds in the upper groups of rocks.