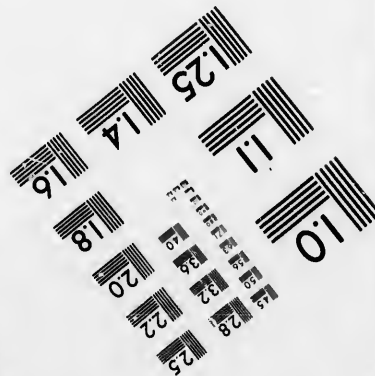
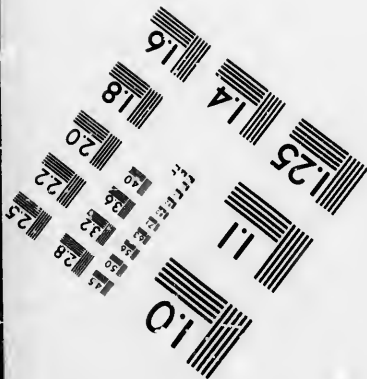
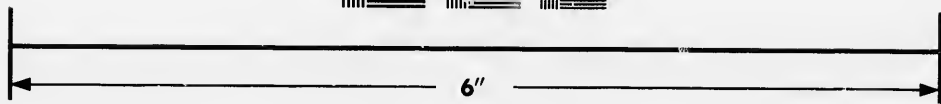
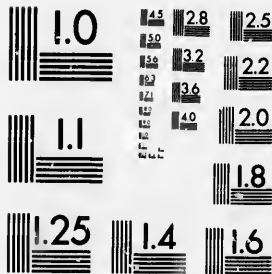


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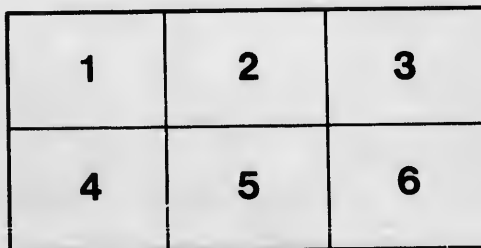
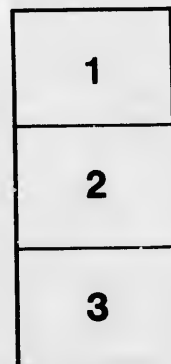
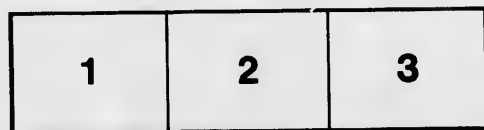
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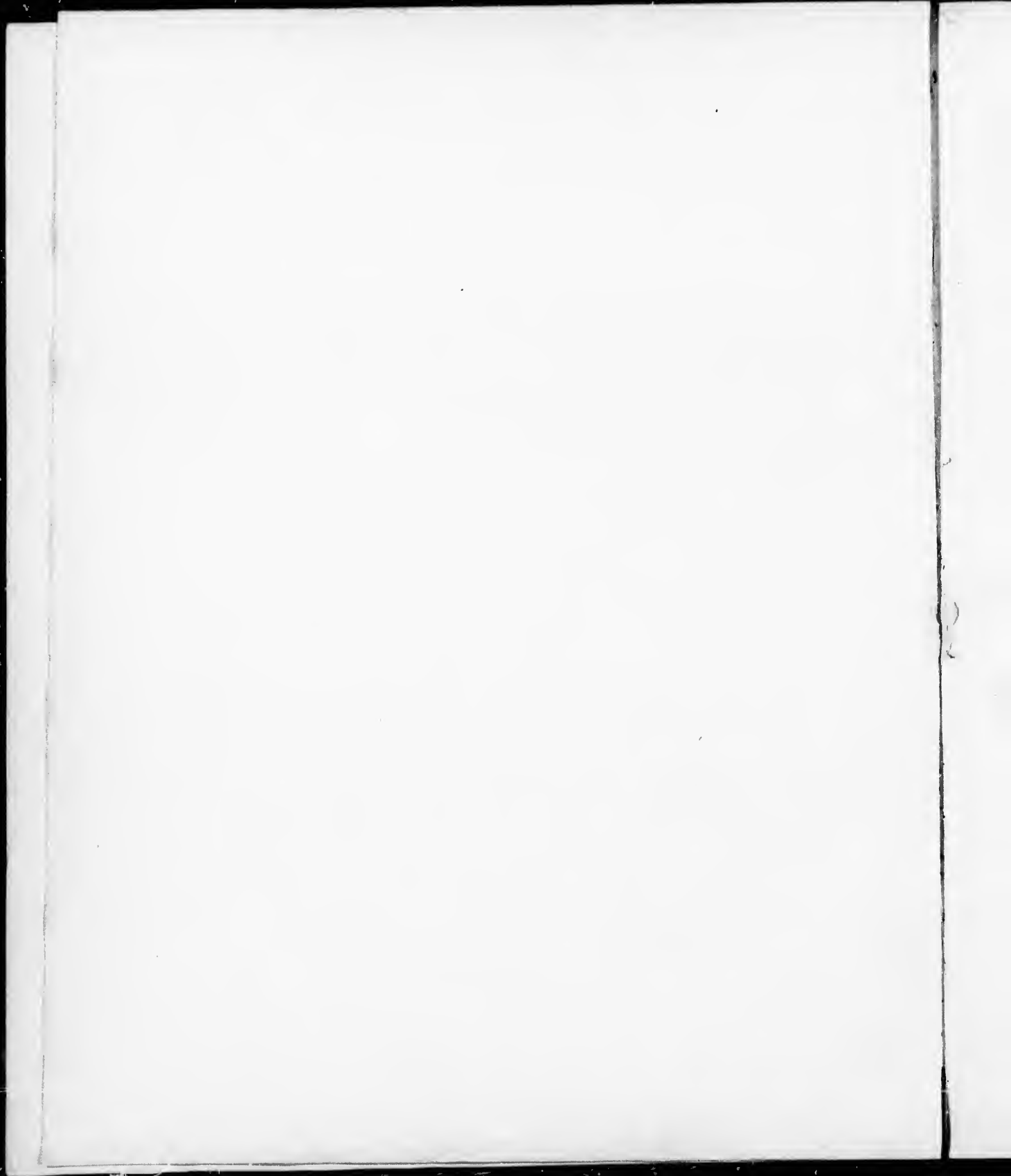
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NOTES

ON

THE GEOGRAPHY AND GEOLOGY

OF

LAKE HURON.

By JOHN J. BIGSBY, M.D. F.L.S. M.G.S.

MEMBER OF THE MEDICO-CHIRURGICAL SOCIETY OF LONDON, HONORARY MEMBER OF THE AMERICAN  
GEOLOGICAL SOCIETY.

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From the TRANSACTIONS of the GEOLOGICAL SOCIETY of LONDON.

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XIV.—Notes on the Geography and Geology of Lake Huron.

By JOHN J. BIGSBY, M.D., F.L.S., M.G.S.,

MEMBER OF THE MEDICO-CHIRURGICAL SOCIETY OF LONDON, HONORARY MEMBER  
OF THE AMERICAN GEOLOGICAL SOCIETY.

[Read Feb. 21, March 7 and 21, 1823.]

SECT. I. GEOGRAPHICAL SKETCH OF LAKE HURON.

LAKE HURON is the third from the Atlantic Ocean of the great chain of lakes, which occupy the four *plateaux* of the upper part of the valley of the St. Lawrence. It receives the waters of Lake Superior by the Straits of St. Mary, the small lake George, and, finally, by a series of basins and currents; the whole connecting channel being about 39 miles long. It discharges into Lake Erie\* by the river St. Clair, Lake St. Clair, and the Detroit River, 26, 25, and 24 miles long, respectively.

Lakes Huron and Michigan are parts of the same body of water, being separated only by the strait of Michilimackinac. Their magnitude entitles them to the denomination of independent lakes †.

The country to the north and north-east of Lake Huron is sterile, rocky, and uneven, full of morasses, creeks, and ponds. It is always hilly, but seldom rises more than 500 feet above the level of the lake; and then in ridges, rarely in cliffs. The higher grounds are naked rocks, with pine and birch springing up in their fissures; while the borders of the marshes and streams (often of a clayey soil mixed with decayed vegetables) produce a profusion of willows, poplars, shrubs, and long grass.

In these desolate regions, scanty tribes of Indians exist by the chase, disposing of their furs to the wandering traders who visit them from Lower Canada.

The tract bordering the southern shore of this lake, and that also which lies between Lake Michigan and the waters of St. Clair and Detroit, is highly fertile. It is low and undulating, with frequent swamps and small lakes,

\* Lake Michigan has no outlet but by the St. Clair: when, however, the waters exceed their usual level by a few feet, a communication takes place with the Mississippi by the Illinois river.

† Mr. Hutchins, late geographer to the United States, calculated Lake Huron to cover 5,009,920 acres, and assigned to Michigan more than double that surface.



and showing occasional traces of limestone and sandstone. The mountains delineated on some of the maps of this district are purely imaginary. Among its forest trees are the oak (white and black), ash, walnut, elm, poplar, maple, and various pines. The magnificent nation of Ottawas at *L'Arbre Croche*, and the Indians on the river Saguina, have long raised excellent vegetables.

The country on the south-east or Canadian shore, from the St. Clair to Cabot's Head, is, on the south, low and damp, with extensive pineries; but northerly it becomes stony and rugged, and its rivers are rapid. It is little known.

The height of Lake Huron above the sea has not been ascertained with accuracy, but may, without great error, be stated at 590 feet. The Commissioners for constructing the western canal in the State of New York, estimated Lake Erie to be 560 feet above tide-water in the River Hudson.—Mr. Schoolcraft, who accompanied Governor Cass in 1820 to the supposed copper mines in Lake Superior, gives 29 feet as the difference in elevation between Lakes Huron and Erie,—which must be near the truth\*.

The shape of Lake Huron is so extremely irregular as only to be learnt from the accompanying map. Tracing its main shores loosely with a compass, and omitting the lesser curvatures, its circumference is found to amount to nearly a thousand miles.

The distinguishing feature of this lake is its intersection by the Manitouline chain of islands, which stretches E.S.E. from the promontory of the True Detour, and in longitude  $82^{\circ}$  approaches within two miles of the northern main land, the strait being nearly filled by an islet. The chain then suddenly trends south-east to Cabot's Head.

Of the three portions into which the lake is divided by the Manitouline chain, the two northern are full of shoals and islands, and that to the north-west is comparatively narrow. The southern division is by much the largest, and is deep, broad, and of free navigation.

Besides the Manitouline chain, and these three principal divisions of the lake, the other points in the geography of Lake Huron demanding particular notice are, the island of St. Joseph lately assigned to Great Britain, Michilimackinac and its vicinity and the Gulf of Saguina.

I have twice visited (in the years 1819 and 1820) the islands of St. Joseph and Michilimackinac; and on my second visit passed three months in their vicinity. In 1819 I descended the French river from Lake Nipissing to Lake

\* One-third of the distance is horizontal; straight and tolerably unobstructed rivers occupy the remainder.

Huron, and coasted in a canoe the north main of the latter lake to the Falls of St. Mary. I have been several times on the south coast, and off the Gulf of Sagouina. The rest of the lake I know only from the communications of my friends.

The accompanying Map is a reduced copy, with additions, of one of four times the size, compiled by David Thompson Esq. British Astronomer under the 6th and 7th Articles of the Treaty of Ghent, from surveys made by himself, and by Captain Owen, R.N., and from a map of the lake by Mr. Smith, late Surveyor General of Canada. Mr. Thompson, assisted by the American Astronomer Mr. Bird, and party, himself surveyed the north-western arm of the lake and the Manitouline Isles as far east as the river Missasaga and the western end of the Grand Manitou. He also determined the position of the False and True Presquisles, Point aux Barques, the commencement of the River St. Clair, Cape Hurd, the fourth Manitou, Point Colles, and the Hill Islands. Captain Owen's survey comprehends Cabot's Head and its vicinity.

I have added the Georgian Bay and the Straits of Michilimackinac from Purdy's map of Cabotia, and part of Lake George from my own knowledge. I have omitted many islands on the north shore, between the French and Missasaga rivers, from their positions not being yet determined. Mr. Smith's map is only to be trusted in a very general way; the printed maps of the Lake are very erroneous.

I shall now describe those parts of Lake Huron which have been just enumerated.

The appellation of "Manitouline" or "Sacred" Isles is first observed in Lake Huron; and thence westwards is met with in Superior, Michigan, and the vast and numerous lakes of the interior.

The islands of that name in Lake Huron are four in number, Drummond, the Little, the Grand, and the Fourth Manitou, exclusive of the Isle of Coves, and the other fragments of the great ridge that appears to have been once continuous to Cabot's Head. They form a curving line 125 miles long; the direct distance between the extremes being only 97 miles.

Drummond Island is 24 miles long, and (on the average) 8 miles broad: the greatest breadth being 12, and the least  $2\frac{1}{2}$  miles. It ranges nearly east; and at the western end approaches the main of the United States, there forming, with the opposite headland, the strait of the True Detour, the principal commercial route to Lake Superior. The strait is scarcely a mile wide, and, being bounded by two promontories, is of very small extent. The coast of the United States is here flat and woody, with morasses; that of the island is uneven, and loaded with large fragments of rock. The general surface of Drummond is irregular; the higher and middle parts rising to the height of

from 200 to 250 feet, and inclining on either side to the water; but often presenting low white precipices in broken lines on the summit or sides of the slopes. The low grounds are swamps, often extensive, and filled with mosses, aquatic plants and decaying timber.

The south coast of the island is broken into small but deep bays, with shoal points; and those on the west containing many islets, one of which has an immense deposit of iron pyrites.

The north coast is distinguished by the magnitude of its bays, and by the groups of islands which crowd the contiguous waters. On one of these, near Drummond, and 8 miles from Collier's Harbour, is the Indian town of Portogannosee, consisting of log-huts and gardens of Indian corn and potatoes. The northern coast is terminated on the East, in the strait called the False Detour, by a calcareous precipice of considerable beauty 500 yards long, and 200—250 feet high. At the top it is a terrace of rock; below it is separated from the lake by a narrow shingle beach. This island produces very fine maple of the bird's-eye and curled kinds, pines, hemlock, cedar, poplar, and birch. Few trees attain great size, as well from the scantiness of the soil as from the frequent conflagrations\*.

The point which forms the west end of Drummond is the northern arm of the bay containing Collier's Harbour, the most distant of the British military posts. This harbour is circumscribed to the diameter of half a mile by islets, surrounding the front of the bay, through which islets there are three entrances. It is oval, and possesses good anchorage; but the wind, which brings a vessel to anchor, either altogether prevents her departure, or renders it very difficult; and there are also many reefs in the vicinity.

On an acclivity in front of the harbour stands a village of about 50 wooden houses and huts, with the barracks of the military built of logs on the right. The land around the village is cleared. It is hilly, and is absolutely buried under enormous accumulations of rocky fragments, consisting principally of very white limestone. They are from a few inches to several yards in diameter, and, at this place almost exclusively, contain the nondescript madrepore represented in Pl. 28. Piles of these fragments, by their fissures and interstices invested with thick moss, render the woods quite impassable.

\* These fires originate in lightning, or in the carelessness of Indians, and spread from the great quantity of dry timber and leaves with which the ground is strown. They are frequently so extensive and numerous in summer, as to cloud the atmosphere as with a fog. In the night I have seen three or four large tracts red with a smouldering flame, which, as the trees fall, shoots up in fiery columns far into the sky. The noise of the falling of the trees, and the crackling of the timber, is heard at a great distance.

Opposite the centre of the harbour, and behind the village, at a short distance, is an eminence called Blockhouse Hill, which has the form of an embankment, and is composed of sand and rolled pebbles of various rocks.

There is a gentle ascent from the water's edge to the distance of from 300 to 500 yards. A sudden rise of from 20 to 30 feet then takes place at an angle of 65°, forming the bluff in question, which presents to the west a front 150 yards broad, and then retires, widening on either side, until after some yards it is lost in the generally increased height of the ground. Its base is strown with masses of primitive rocks, and its summit is covered with large slabs of the limestone of the island. Nothing can be more harsh and desolate than the aspect of this station on a near inspection. The village itself is encumbered with debris of rocks, so numerous and sharp-edged as to render walking very difficult. The sterile vicinity is bristled with black stumps and half-consumed pines\*.

At the bottom of a large *cul-de-sac* in Collier's Harbour, a narrow stream, which falls from a small height in the Lake, communicates with a chain of small lakes running into the interior of the island. The first of these is a mile long, half a mile broad, and is surrounded by a dense forest, growing among reeds and rushes. To the east of this is an opening leading to a second lake, and that to a third.

Drummond Island is separated from the Little Manitou by the False Detour, a strait so called from its being frequently mistaken for the True. It is from 8 to 10 miles long, and its greatest breadth is from 3 to 6 miles. Its depth in the middle is seldom less than from 30 to 40 fathoms. As you enter it from the south the opening is spacious and bold, with three fine capes on the west, and one on the east. On the angle of Little Manitou is a shoal, with a mass of white rocks in the centre: a short way within the strait, close to the last island, are three low marshy isles crowded together. At the northern outlet the shores are very rounded, with precipices on the west, and woody steeps to the east. In front is the open lake, studded with a few islets in pairs, and terminated in the distance by the mis-shapen hills of the northern main. On the north-west is a blue waving line of the heights of St. Joseph, and on the north-east the looming of the isles about La Cloche is just visible.

Little Manitou observes an eastern course. It is of a rounded form, with a diameter of 7 or 8 miles. Its features are the same as those of Drummond, but it is perhaps higher. Frequent conflagrations have destroyed almost all

\* In 1820 this post only escaped destruction, by a fire spreading from the woods, through the great exertions of the inhabitants and a body of Indians.

the well-grown timber (still leaving some uncommonly large hemlock), and have exposed the ascending sides of the island in many places. The shores are loaded with successive banks or stairs of small debris, and have here and there terraces of limestone *in situ*. Mounting upwards, the ground is rugged with protruding strata and rolled primitive masses; and not unfrequently intersected by short ledges, which often crown the greatest heights, affording a table-land of small extent, and better wooded than the surface below, which is only sprinkled with very young poplar-, birch-, and cherry-trees.

There is a convenient harbour on the north side in the second bay from the Third Detour. It is a deep oblong indentation in this bay, and itself contains an inner cove. It is a quarter of a mile broad. The ship entrance is narrowed to a few yards by a shoal that runs from the east angle two-thirds across.

Within this bar a vessel may ride with from 9 to 12 feet water in tolerably roomy anchorage, the depth decreasing gradually towards the bottom of the indentation.

The third detour, between Little and Grand Manitou, is 8 miles long by 4 broad, with high shores, and clear at both outlets. Off the south-east end of the Little Manitou is a very extensive but easily distinguished shoal.

The Grand Manitou may be estimated at 75 miles long, and 8 miles broad on the average. About its middle it is 25 miles broad, and at two places to the west of the widest part, the shores are so deeply indented as nearly to divide the island, only narrow morasses intervening between opposite bays.

The general characters of the Grand Manitou are the same as those of Drummond, but on a larger scale. It is higher, abounds more in precipices, and is more rugged throughout\*. At the western end it is of more majestic features than any of the country which I have seen in other parts of Lake Huron. At the north end of the Third Detour, its shores are lined with ranges of shingle, supported behind by an ascending country of woods.—Toward the centre of this strait, ledges and low precipices begin to appear along the beach, and soon rise to the height of 250 feet, crowned with cedar and pine. These ledges either rise perpendicularly, or are formed of enormous piles of displaced masses, from 7 to 10 yards in diameter, sloping at a high angle. These blocks advance into the water, and afford a hazardous path over their slippery sides, under arches and through winding passages. Within half a mile of the south-east angle of the Detour, a bluff precipice 40 feet high protrudes into the water, skirted by very large cubic masses of rock. Of such masses, resting precisely on one another, the bluff itself is

\* The above particulars I learnt from my friend and companion, Lieut. John Grant, R.N.; having myself only visited the western end of the island.

composed; so that the summit, with much of the land behind, is a platform of naked rock. Out of these natural terraces, knolls of flowering shrubs and clumps of trees arise. Behind them is the dense gloom of impenetrable woods.

Of the strait which divides the Grand Manitou from the northern main I possess no information further than what has been stated. At a time when the Manitoulines were quite unexplored, I sailed through the strait without distinguishing it from the numerous passes in that labyrinth of islands. It has now undergone two surveys.

The strait which divides the Grand from the Fourth Manitou on the north is only one mile broad; but on the average a league. It has been very seldom visited.

Of the Fourth Manitou little is known. It is narrow, and of about one third the size of the Little Manitou; its long diameter crossing the direction of the Manitouline chain. The shores are much indented, and afford a very convenient harbour on its eastern side, which was used in 1821 by His Majesty's schooner *Confiance*, Lieut. Grant.

The fifth and easternmost strait between the Fourth Manitou and Cabot's Head is 14 miles broad, and contains many shoals and islands, of which the largest is appropriately named the Isle of Coves.

The island on which are those singularly shaped rocks called the Flower-pots, has long attracted notice. Accounts differ respecting its precise situation; but it lies probably about 6 miles S.S.E. of the Fourth Manitou. The Flower-pots are several insulated rocks, the greatest 47 feet high, consisting of large tabular masses, placed horizontally one upon the other, and broad at the summit, but narrow below. They stand on a floor of rock projecting into the lake from the lofty island which bears their name.

Cabot's Head, a singular headland, is evidently a continuation of the Manitouline ridge. It lies 144 miles almost due north of St. Clair. It faces north for about 25 miles, and then passes off to the south and east. It consists of much indented limestone bluffs, rising occasionally to the height of 300 feet, and skirted by numerous reefs and islets. On the western side of the headland, and to the south of it, the first 64 miles of coast display a range of calcareous precipices. A little to the north-east of Cape Hurd, the western extremity of Cabot's Head, one of the curvatures of the cliff forms a *cul-de-sac*, 800 yards long and 80 broad, having 7 fathoms water. It thus affords an useful haven in this intricate part of the lake.

In addition to these remarks on the southern extremity of the Manitouline chain, I have only to notice its generally increased elevation in this part of the main, and in the neighbouring isles.

Having completed my geographical observations on the Manitoulines, I shall now proceed to describe the three principal divisions of Lake Huron.

The north-west arm of Lake Huron, which communicates with Lake Superior, is of an oblong shape, the two longer sides at their western extremities converging towards the north. It contains about 400 square miles, and is crowded with islands of all magnitudes. The principal of these is St. Joseph. It is 65 miles in circumference; and, together with the large Sugar Island, is wedged into the end of the channel from Lake Superior, scarcely allowing at the narrowest points the breadth of a mile to the sum of the three outlets from Lake George.

St. Joseph is somewhat triangular in its form, its north and east sides meeting almost at right angles.

Although an undulating ridge called the Highlands of St. Joseph, about 500 feet high, is found throughout the island at the distance of a few miles from the lake, yet the surface is not so broken as that of the Manitoulines; and the whole is better wooded. It has few or no precipices, but it is singularly loaded with the debris of foreign rocks. Its southern point, a picturesque cleared mound, once the site of a military post called Fort St. Joseph, and lately occupied by the British garrison at Collier's Harbour for pasturage, is only six miles from Drummond. The north-west point of the island is 26 miles from this mound, in long.  $84^{\circ}$  and lat.  $46^{\circ} 18'$ ; and the eastern angle lies about 18 miles north-north-east of it by the ship's course.

The waters on the north, west, and south-west of St. Joseph have received distinct appellations. That on the south, bounded also by Drummond, is a large irregularly shaped archipelago, containing sixty-one islands and many shoals.

The part of Lake Huron included between the north-east shore of St. Joseph and the contiguous main, is called the Channel of Pelletau, from the name of a solitary Canadian residing on an isle at its east end. Except towards the western extremity, this channel is almost a clear sheet of water, from 10 to 12 miles long, 6 miles broad at the east end, and about a mile and a half at the west. On the two sides of this channel the aspect of the country is very different. On the south, the verdant acclivities of St. Joseph are trending to the north-west in two large bays. On the north are the black and denuded fastnesses of the main land; an assemblage of greenstone mounds, swamps, and ponds; with the margin of the lake fringed with reefs and rocky islets.

Near the west end, Pelletau's Channel widens into an expanse of 25 square miles, and becomes full of islands, three of which are much larger than the rest; and of these the largest is high, compact, and woody, and nearly blocks

up the lower entrance of the Narrows. The two others are at the north-east angle of this dilatation, close to the main, with which they form an admirable haven, lately selected by the Governor-general of British North America as a military position by the name of Portlock Harbour. It is remarkable for fine scenery. While in Pelletau's Channel, as you approach the harbour, at the distance of a mile or so, there is perceived an opening or break in a high country, expanding as it is neared, and finally disclosing an extensive haven interspersed with rocky islets, and girt by heights starting forth in a series of woody or rocky capes: the whole is supported in the rear by three ridges of hills covered with poplar, birch, and half-consumed pines.

The Narrows or Strait, at the upper end of the Channel of Pelletau, is one of the three outlets from Lake George which may be considered as forming the north-west limits of Lake Huron, since it there begins to be the seat of currents, and of contracted dimensions. This strait is formed by the approach of St. Joseph to within two thirds of a mile of the northern main. This is the extreme contraction, and occurs at the western end; at the east the width is almost a mile and a half. The length of the strait is 2 miles. The main is a line of dark and lofty precipices. This part of St. Joseph is marshy

The small space constituting the Narrows contains eighteen islands; those near the main partaking of its sterile and forbidding character, and sometimes being divided from each other by mural passages only a few feet across. From the summit of the adjoining main is presented a truly scenic and striking combination of high and sombre rocks, scantily clad with pine, and overshadowing a labyrinth of waters. As the islets approach St. Joseph, they become low and woody, with marshy coves and shallow currents in their intervals.

A current prevails in the Narrows, but weak and inconstant. It is strong at their western aperture, and is perhaps sensible throughout the basin into which it leads.

The Narrows have considerable but various depth. At the east end, near an excellent harbour, the lead indicated a depth of 42 feet, and being removed a yard or so gave 96 feet.

The second outlet from the Rapids to Lake Superior is the strait between St. Joseph and Sugar Island, called the Middle Passage, which terminates at the lower end in Muddy Lake. It is from 8 to 10 miles long, having nearly a southerly direction, and about 1 mile broad; but it is contracted to one fourth of that width at the lower end. The current is seldom half a mile per hour.

The Lesser or south-western Nibish Rapid completes the number of the channels that lead to Lake Superior. It is contained by the western shore of Sugar Island, and the southern or United States main. It occasionally ex-



pands into basins, but is usually very narrow. About three miles to the west of Muddy Lake, it is not more than  $\frac{3}{4}$  of a mile broad, and has six or seven islets crowded in it. It is very shallow.

Muddy Lake, bounding the south-west side of St. Joseph, is a fine sheet of water, of irregular shape, 17 miles long, and varying from 2 to 7 in breadth. It has received its name from the nature of its bottom. There is one small isle at the upper end, and a large one called Isle à la Crosse at the bottom, with two or three others. Its shores are deep embayments ending in grassy marshes, especially on the south-east side. There are several shoals; one, having  $6\frac{1}{2}$  feet water, at the foot of the Middle Passage; another somewhat to the south-west, and some dry rocks at the lower end of the lake. Sugar Island and George Island, the former 20, the latter 12 miles long, are the two principal islands west of St. Joseph in the water communication between Lake Huron and Lake Superior. The lower end of Sugar Island constitutes the northern shore of Muddy Lake; that of George Island terminates in the Middle Nibish, and the north-west Nibish rapids.

The Nibish rapids, which are 4 miles long, or more, are separated from one another by these two islands. The lesser or south-western rapid has been already noticed as flowing between Sugar Island and the southern main. The middle Nibish, distant one mile from the north-western point of St. Joseph, divides George Island from Sugar Island, and empties itself principally through the middle passage. The waters of the north-west and north or Little Nibish pass off on the northern side of St. Joseph by two basins of comparatively calm water, 3 and 5 miles long respectively, divided by an imperfect barrier of islands; the lower basin discharging into the Narrows of Pelletau.

The Nibish rapids terminate upwards in a large basin, 8 miles long, and 10 or 12 broad, called Lake George, containing, besides the upper portions of Sugar and George Islands, a multitude of smaller ones.

The Straits of St. Mary, which unite Lake George to Lake Superior, are 17 miles long, and from  $\frac{3}{4}$  to  $\frac{1}{2}$  of a mile broad, and have very violent rapids at a narrow marshy spot about 2 miles above Lake George.

The Michilimackinac, or south-west arm of Lake Huron, has never been examined, or only by the military engineers of the United States, whose labours have not hitherto been communicated to the public. It is connected with Lake Michigan by the strait of Michilimackinac, from 8 to 11 miles wide, and of insignificant length, as being formed only by two opposite promontories.

Its south side presents no peculiarities, except a peninsula, called False

Presquise, 9 miles from the island of Michilimackinac. On its north lies Isle Bois-blanc.

The north side is merely a succession of shingled points and reaches, with a thickly wooded and marshy interior, traversed by several streams.

The island of Michilimackinac is midway from either main, close to the strait of that name. It is 42 miles west of Drummond. It is a long oval about 9 miles in circumference. The ends are broken, crumbling or grassy ridges, while the long sides are lofty precipices declining at each extremity, separated from the lake by rather broad beaches, and picturesquely clothed with maple, cedar and vines, except where projecting rocks show their white and craggy peaks above the foliage.

The view into Lake Michigan from the Indian path which winds among the coppice on the top of the south-west cliff, is particularly pleasing. The land, at first closing on the water at the pretty hamlet of St. Ignace and its corresponding headland, at once dilates into a spacious sound with curving shores and woody capes, and is interspersed in the extreme distance by clusters of islands.

The cliffs of this island frequently break into shallow caves, which actually perforate a projecting point near the south-east angle. Its height (150 feet), its whiteness contrasted with the dark shrubs, and the blue light streaming through the aperture, afford a fine composition for the painter.

Excepting three small farms, little of the interior is cultivated: the heavy timber has been felled; and time has replaced it by flourishing underwood. The surface is high and uneven, often marshy.

The town, consisting of from 100 to 120 decent wooden houses, is at the southern end of the island, on the beach, under a crumbling ridge, on the edge of whose summit is placed a small white fort.

On the south coast of Lake Huron, at about one third of the distance from Michilimackinac to the Gulf of Sagouina, there is an excellent harbour formed chiefly by a peninsula. It is called Presquise; and is in lat.  $45^{\circ} 20' 39''$ ; long.  $83^{\circ} 30' 13''$ .

Little or no information is to be found in the writings of travellers respecting the Gulf of Sagouina. Batteaux, trading between Detroit and the lakes of the west, pass down every summer as far as Traverse Island to avoid crossing its boisterous mouth, where they would lose sight of land.

This gulf and Thunder Bay are much larger than they are represented in Smith's or Purdy's map, and also in the one accompanying these notes; but as I have no documents for laying down this part of the lake with accuracy, I have copied from preceding authors.

Thunder Bay Islands and Middle Islands are flat, calcareous, and well wooded. The lake, as I am informed by Major Delafield, for three quarters of a mile east of Middle Island has only four feet water; indeed all the secondary islands of Lake Huron are surrounded by extensive spits and shallows.

The shore from Point aux Barques to the river St. Clair forms a tolerably straight line of beach with now and then a low cliff of clay. About midway, a large block of white limestone rises from the waters of the lake, well known to *voyageurs* by the name of Rocheblanche.

In describing the Manitouline Isles, I have already noticed Cabot's Head, and the coast in its vicinity.

I have collected very few materials for the geography of the Georgian Bay. It is now under survey by Lieut. Bayfield R. N., assisted by Midsh. Collins. They report it to be crowded with islands and rocks.

Penetanguishene\*, the British naval station in Lake Huron, is situated in an inner bay of Gloucester Harbour. It is sheltered, as its name indicates, by hills of sand and rolled blocks; the coast and neighbouring islands being of similar constitution for 30 miles round, but having a primitive base.

It remains now to add a few remarks on the rivers of Lake Huron.

The principal rivers are the Thessalon, Missassaga, French, Severn, St. Clair, and Saguina†. There are multitudes of smaller streams unmarked in the map, which pour a brownish red water into the lake, and several of considerable size to the east-south-east of Cabot's Head.

The river Thessalon flows into a deep bay on the north coast. It is 50 yards wide at its mouth; and in three or four miles becomes a mere creek. I have noticed it because it is usually thought larger.

The river Missassaga at its entrance into the lake is  $\frac{1}{2}$  a mile wide, and passes through a large swampy country, apparently alluvial. For five or six miles the breadth rather increases as we proceed upwards. The current, though usually sluggish, is at times rapid. Its borders are covered with long grass and willows. Indians say that its source is a lake of the same name, lying twenty days' journey to the north.

The French River from Lake Nipissing to Lake Huron, an interval of 75 miles, possesses peculiar characters. It less resembles one stream, than a confused assemblage of rivers flowing, with frequent inosculation, among lengthened ridges of rock. Its shores seldom present continuous lines, bounding a

\* Long. 79° 35', lat. 44° 57'.

† There is another large one marked in the map in long. 82° 7', lat. 46° 10', or thereabouts. I never heard of it.

compact body of water, but are excavated with deep and narrow bays obscured by high walls of rock and dwarf pines.

Its breadth therefore is variable ; sometimes extending more than a league, and occupied by every diversity of island.

Few American prospects exceed in grandeur and singularity those which are here afforded by groups of long and lofty islets, extending in giant rays from a centre into some dark bay, the clear water reflecting their rugged outlines and wild foliage, amid the solemn stillness pervading these solitudes.

Two cataracts occur. By one it leaves Lake Nipissing : the other is 20 miles below, and is called the Recollet. It is about 10 feet high, and is narrow. It is divided into three parts by two fragments of rock. The adjacent red feldspathose eminences, and the black crags in the midst of the foaming waters, beset with living and dead pine, impart great beauty to the scene.

There are many rapids ; the most serious of which is that of Brisson, remarkable for its thirteen wooden crosses, commemorative of as many fatal accidents.

The current is always strong ; perhaps 2 miles per hour.

The river Severn, about 25 miles long, and issuing from Lake Simcoe, is  $1\frac{1}{4}$  mile broad at its mouth near Penetanguishene. It has two falls, and undergoes a total descent of 80 feet from that lake\*.

The St. Clair is the only river of discharge possessed by Lakes Michigan, Superior and Huron, which have a surface of  $38\frac{1}{2}$  millions of acres, and are fed by numerous rivers many times larger than the St. Clair, and issuing from lakes of great dimensions. The evaporation must consequently be immense. No hygrometric observations have yet been made.

The River St. Clair is 300 yards broad at its commencement. It flows through a luxuriant alluvial country, with an average breadth of 1000 yards. It is 26 miles long ; with a straight course and smooth and equable current of about 2 miles per hour. At its head there is a rapid for  $\frac{3}{4}$  of a mile at the rate of 5 miles per hour. It enters Lake St. Clair by a multitude of shallow changeable mouths.

The River Saguinaw (as I am informed by the Rev. Mr. Hudson, missionary to the Saguinaw Indians,) is 180 yards broad for 24 miles, flowing through a level and heavily timbered district. It then divides itself into three small and very circuitous branches, one of which is called Flint River. The River Saguinaw is 120 miles from Detroit through the woods, and perhaps 220 by water.

\* This calculation places Lake Simcoe more than 400 feet above Lake Ontario, distant 30 miles. The ascent is almost imperceptible, as I am informed.

Its neighbourhood has recently been surveyed, preparatory to sale by the Government of the United States.

SECT. II. ON THE GEOLOGY OF THE COUNTRY BORDERING ON  
LAKEHURON.

§ 1. ON THE ROCKS *IN SITU*.

I will not apologize for the deficiencies that may be remarked, nor for the inaccuracies that future observation may detect in the following pages. They are in a manner natural to the efforts of a first observer in an unknown, vast, and savage country.

The northern shore of Lake Huron, with its nearest isles, consists principally of the older rocks; the secondary occupy the rest of the lake. The primitive rocks are part of a vast chain, of which the southern portion, extending probably uninterruptedly from the north and east of Lake Winnipeg\*, passes thence along the northern shores of Lakes Superior, Huron, and Simcoe, and after forming the granitic barrier of the Thouraud Isles at the outlet of Lake Ontario, spreads itself largely throughout the state of New York, and then joins with the Alleghanies and their southern continuations.

The geology of that part of this primitive chain which borders on Lake Huron is but imperfectly known. I shall give such detached information concerning it as I am possessed of.

The French River flows over a granular gneiss at its source and mouth; and over red and feldspathic gneiss about the falls of the Recollet. Its shivered and dislocated state, its mossy coating, and the astonishing quantity of native debris prevented my ascertaining the direction of the strata, although I landed more than once during my passage down the river.

The low and sandy beaches of the south shore of Lake Nipissing are crowded with mounds of gneiss unmixed with any other rock. The direction, from its great irregularity, I was unable to determine.

The rocks of the north coast, and its contiguous islands east from the French River, consist of gneiss, with occasional mixture of hornblende†.

From the French River westwards to the islands of La Cloche, about 50 miles distant, the lake near the shore is studded with innumerable islets. In the first 20 miles they commonly consist of gneiss, are barren, and surrounded by shoals, and are often, in fact, a heap of ruins. This is particularly the case

\* Vide *Geological Transactions*, vol. v. Part II. page 607.

† Communicated to me by Lieut. Grant.

very near the main ; but further out in the lake they are loftier, and sometimes girded with a belt of flat ground, richly wooded. This belt was in many instances visibly supported on an horizontal dark slaty rock, which afterwards proved to be shell limestone. The primitive rocks of these islands retained their wonted sterility. Both the islands themselves, and most of the ridges of which they are composed, have a south-west direction ; and individual masses of gneiss were observed to dip either vertically or more or less to the south-east ;—a coincidence in position with the gneiss of the whole valley of the St. Lawrence, worthy of being remarked.

The Isles of La Cloche form a charming contrast to the bleak hills of the main, in their forests and grassy vales, diversified, like an English park, by clumps of fine trees. Some of them are composed, as I am informed (for I did not see it), of a dark rock, which when struck sounds like a bell.

From La Cloche to the river Missassaga, a distance of 60 miles, is another assemblage of isles ; but principally, I believe, within 6 miles of the shore. In the first five leagues from La Cloche, they are woody, except those near the shore, which are barren, and composed of gneiss. Landing here on the main, I found issuing from a morass a round smooth mass (probably a vein), 50 yards broad, of crystalline quartz rock, running south-west, and containing nests of silvery mica and galena. The former in some parts combining with the rock, rendered it fibrous.

Twenty miles from La Cloche, and four from the main, is a chain of five or more short islets, parallel to each other, and having their long diameter to the north. They are composed of genuine granite ; and are bare, low, and smooth.

Further to the west, soon after this, a multitude of small sterile islets, loaded with debris, occur for 20 miles along the shore, composed chiefly of hornblende rock. They are of a deep black colour, and in one instance had the glazed lustre occasional in this mineral. The rock varies in its constituents. On the east it is moderately pure, but seldom very crystalline. Further west, it takes a green tinge, and in certain spots feldspar or quartz is visible in grains. It is often traversed by beautiful and strong veins of quartz, clouded green and red. The compact black species contains much olivine, and some elongated crystals of hornblende.

From hence to the river Missassaga, another appearance is noticed. The islets of granite return, intermingling with the trap, both rocks being in the form of low oblong smooth mounds ; the granite taking a northerly direction, and the trap running south-west. Some of the islets possessed the calcareous girdle before mentioned.

Being delayed at a point 10 or 12 miles west of the Missassaga, for thirty-six hours, I examined the beach of the mainland for one or two miles.

I here met, protruding from the woods into the lake, a rock, which is an intermixture, on a large scale, of a light-coloured greenstone, and a compound of white quartz and red feldspar minutely blended, but the latter predominating. These two aggregates mutually penetrate and traverse each other in the most capricious forms (as in marbled paper). They are in equal quantities; each being indicated by strongly contrasting configurations, knotty, straight, waved, or stellular. Ramond compares the contortions and confused appearances of certain rocks in the Pyrenees, to the effect produced by a mixture of differently coloured glutinous liquors, issuing from separate vessels at the same time, or to convolutions of smoke. These comparisons apply well to the masses under consideration\*.

These mounds exhibit no tendency to stratification; but their long diameter appeared to be always directed to the north-west. They are found westward for some miles near the shore, accompanied by a few granitic mounds, holding a northern course.

The limits of this rock are not known. It is succeeded on the west by the morasses about Thessalon river. It has given the name of *Le Serpent* to that part of the north shore in which it occurs. Greenstone slate †, lying beneath a granular quartz to be noticed hereafter, is found in one of the islands forming the insular groups north of False Detour. The granular quartz of Green Island is succeeded on the west, after a small interval of marsh, by various greenstones, extending along the north side of the channel and narrows of Pelletau.

At the lower end of the broad promontory constituting the east side of Portlock Harbour, and in the small isles on its east, the greenstone is dark and compact, but here and there rendered slaty by weathering. It contains, in patches, numerous masses of the red ingredient of the rock of *Le Serpent*, from one to eighteen inches in diameter; all bearing positive marks of attrition to a moderate degree, and sometimes becoming so plentiful as to make the rock a decided conglomerate. Proceeding still westwards, by degrees the red ingredient disappears altogether, and the greenstone resembles a splintery slate, commonly of a dark leaden hue, which runs however either rapidly or gradually into cream-colour, red, blue, or light green. Its course is distinctly

\* A somewhat similar rock appears to have been found by Dr. MacCulloch in the Isle of Arran, not far from Glenleg. Vide *Western Isles of Scotland*, vol. ii. p. 399.

† The greenstone slate of the northern shore breaks, often, with a very sharp edge and conchoidal fracture.

north-west; and it dips at a high angle to the north-east, when not absolutely vertical.

The greenstone of the large island close to Portlock Harbour varies much. In one part it is nearly pure hornblende, splitting into cubic blocks; in another it gradually resumes its conglomerated state, the nodules being small and rare. At the south-west end it is very slaty for a square mile.

At the place where the hornblende abounds, thin waving veins of ligniform asbestos are common. The centre only of the vein is pure, the sides passing into greenstone. Vertical seams of quartz, with drusy cavities of quartz crystals, are often met with; and thready veins of galena also. I found a mass of this ore loose, on the opposite side of this channel, weighing one pound and a half.

The precipices and steeps of the main in the Narrows of Pelletau are also greenstone; but, as usual, of different aspects. The bluff at the lower end is only slightly slaty. It contains a confused mass of quartz veins, with a small quantity of copper pyrites, and the carbonate of that metal. The middle portion of these cliffs is extremely splintery, and appears to be ferruginous. At the head of the Narrows the greenstone is much less disintegrated, and dips into the clear and deep waters in compact black walls. I have passed a league into the interior from the Narrows and Channel of Pelletau, without finding any remarkable difference in geological structure between the interior and the shores. The contiguous islets are of a similar formation, and are composed of aggregated ridges rising to a great height.

These greenstones dip from the secondary strata on the south, in the same manner as at Malbay, 90 miles below Quebec, gneiss and mica-slate dip from, and abut against, a horizontal calcareous conglomerate full of organic remains, and, among others, of three species of orthoceratite.

Having now described, as far as my information extends, the primitive rocks of Lake Huron, I proceed to notice the secondary rocks of the same district. They are a portion of an immense basin, which, extending probably without interruption from the southern shore of Lake Winipeg, spreads itself over the greater part of Lakes Superior\*, Huron, and Simcoe, the whole of Lakes Michigan, Erie, and Ontario, much of the western part of the state of New York, the whole of the states of Ohio, Illinois, Indiana, and Michigan, and the rest of the valley of the Mississippi. In describing the southern boundary of the primitive chain, I have already traced the northern and eastern limits

\* Dr. Wright, Inspector of Hospitals, has a specimen of chalk from the neighbourhood of Lake Superior.



of the basin in question : its southern limits, as far as I am aware, are only to be found in the Gulf of Mexico, with numerous interruptions, however, from the older rocks in Pennsylvania, Virginia, Alabama, &c. On the west it is bounded very irregularly by the primary districts that lie to the west of the Mississippi (from which it does not deviate far), and to the south and west of Lake Superior. The basin has been represented to extend as far westwards as the rocky mountains ; but Mr. Schoolcraft has shown that the rugged country about the mouth of the Missouri consists of gneiss, with primitive limestone intermixed ; and on further research, primary rocks will probably be found still further southwards.

The connexion of the secondary with the primary rocks of Lake Huron has been very imperfectly examined ; and, in fact, is almost wholly concealed by the thick vegetation of those islets where the contact of the two formations does occur : or, in other cases, by the wide intervening tracts of water.

I shall first notice those rocks, which, though not primary, possess less decidedly a secondary character.

About the river Thessalon, on the large island opposite to, but seven miles distant from, its mouth, and in the insular groups of the lake, north of False Detour, my friend Major Delafield (American Agent under the 6th and 7th Articles of the Treaty of Ghent) observed a granular quartz, forming the north points of the islands, and dipping north, at an angle of  $45^{\circ}$ . On one isle it was remarked to run imperceptibly into the greenstone slate that lay beneath it. In High-cliff Island the granular quartz forms a precipice 100 feet high. On this island limestone containing orthoceratites is met with, which appeared to Major Delafield to alternate with the quartz. This quartz rock is frequently seamed with white quartz, of which blocks, containing much chlorite earth, lie loose on the shores. It is always hard, minutely granular, and now and then very crystalline. It contains no petrifications.

This rock extends westward as far as Green Island, and is then succeeded by the greenstones on the north of the Channel of Pelletau.

Immediately on passing into the Lower Basin discharging into the Narrows of Pelletau, a quartz rock shows itself obscurely among the marshes about St. Joseph ; but from the insular barrier to Lake George, it is abundant, and has a north-west course, and a dip which is either vertical or not discernibly otherwise. At the barrier it consists of minute grains of vitreous quartz, cemented by the same substance, rather powdery, opaque, and white. It is somewhat easily frangible. Its fissures are sometimes lined with brilliant red quartz crystals.

The islands on the north of the Upper Basin, about the Narrows of Pelle-

tau, are of the same rock, with the same direction, but possessing more compactness. At the foot of Lake George it is often crystalline, dense, slightly translucent at the edges, conchoidal in fracture, but frequently also foliated; the fragments then becoming schistose, with a shining lustre. It is here very commonly a conglomerate rock, of great beauty, studded with nodules of red and brown jasper, averaging an inch in diameter, and usually arranging themselves in the form of belts or stripes, from one to five feet in breadth. Black and brown hæmatite occur sparingly at this place.

Two broad strata of greenstone occur in this rock, three miles apart; the lowest five miles from the Narrows, whose rock it resembles, though it is more syenitic.

The character of the sandstone, which I am now about to describe, appears both in the position of the strata and in the texture of the rock itself, to be decidedly different from the preceding.

The greater part of Lake George, as well as of the Straits of St. Mary, rests (I believe) on a horizontal red sandstone. I have observed in various parts of this lake, large slabs of this rock, with sharp fresh edges, most of it soft, and of dull lustre; but frequently quite crystalline, and remarkably hard, and white with large ferruginous red spots.

Coasting the northern shore of Lake George, towards dusk, in a canoe, I fell in with a number of islets, with cliffs of brownish horizontal sandstone strata, breaking into parallelepipeds. At the portage of the Falls of St. Mary, this rock prevails *in situ*, especially in the half-inundated islets surrounding the Rapids.

It is in horizontal layers, eighteen inches thick. It is soft, splits readily, and its principal colours are red, brown, or dull white, with frequent spots or circlets of yellow.

The sandstone is environed by morasses, but re-appears largely on the south side of Lake Superior; and an active search would perhaps discover it *in situ* near Michilimackinac, where I have seen much of its debris, and where there is gypsum.

The shores of the main and islands near Michilimackinac present, for the most part, only beaches of shingle, and rarely afford traces of rocks *in situ*. At the Isles of St. Martin, however, we find a large deposit of gypsum. It is an extensive bed, of the granular kind, white, gray, and brown, interspersed with frequent masses of red, white, and brown selenite, occurring in shapeless lumps, in veins, or in small and very thin tables, having three or more sides, and sharp angles.

The horizontal sandstone, above described, in its general characters, and

in its association with gypsum, is closely allied to the red marl of English geologists, and to the old red sandstone of Werner; and in these particulars it agrees with the sandstone of the Genesee, in the state of New York, pronounced to be the old red sandstone of Werner by the very eminent Maclure.

Connected probably with the horizontal sandstone are the calcareous rocks of the island of Michilimackinac. Their character is well developed at the end of the north-east cliff, adjacent to the fort. At the top of the cliff a few horizontal strata, very thin, white, and soft, appear: but immediately below, the limestone loses the appearance of stratification, and becomes yellow and ragged. The texture of much of it is compact; but it is more usually vesicular (as if from bubbles of air), the sides of the vesicles being encrusted with crystals of quartz, in botryoidal clusters. A few of these vesicles are 3 or 4 feet in diameter, and contain several series of smaller cavities. About the middle of the western side of the island there is a cave, about 7 feet deep, formed by the confluence of several of these bowl-shaped hollows or vesicles, whose interior is here also subdivided into smaller cavities.

Other parts of the limestone, contiguous to the vesicular, are an aggregate of short angular fragments of slaty limestone and broken flints, in the greatest disorder, the interstices being empty, and lined with quartzose crystallizations. The fragments are from 1 to 8 inches in diameter, and they also are of an ochry yellow colour. The vesicular limestone and the breccia are nearly equal in quantity.

The bottom of the cliff consists of horizontal and moderately thick strata of limestone-slate, of a white or blueish-white colour, very soft—so much so as even to write. In some parts of the island the limestone contains a few blue and white striped flints. The limestone-slate forms the floor of the lake for miles around, and in some part of the island or other may be found at every level. After a careful search, I met with no organic remains in this limestone. A friend met with a single bivalve, which may have come, however, from a distance, as I observed on the isle several loose fragments, bearing the incisions observed in the limestone of the Little Manitou.

The cavernous and brecciated limestone of Michilimackinac seems to be allied to the magnesian breccia, which, at Bristol and in other parts of England, is connected with the red marl. I have stated that this limestone is probably connected with the red horizontal sandstone of Lake George. My reasons for being of this opinion, independent of those founded on the local proximity of the two formations, are, that in all the other lakes, and in Lower Canada, throughout the whole of the valley of the St. Lawrence, in the lake and territory of Michigan, and in the Illinois, similar beds of horizontal sandstone, sup-

porting beds of horizontal limestone, are found to be the exclusive and predominating rocks.

The remaining secondary beds, which I have to describe, are calcareous. I shall divide them into two species,—the limestone of St. Joseph and the isles on the northern shore, and the limestone of the Manitoulines; not intending thereby to decide that they belong to formations essentially different, but only to distinguish the one from the other, by reason of their difference in character, in organic remains, and in geographical position.

The limestone of St. Joseph and the northern isles, is, wherever I have examined it, horizontal. It occurs usually in weathered crumbling ledges, seldom exceeding six feet in height; or it floors the beaches in broken pavements, advancing far into the shallow waters.

This species assumes various aspects in distant parts of the same level; but it is most commonly of different shades of brown and green. It is earthy, rather soft, knotty and slaty.

In the Channel of Pelletau it is granular, passing into compact, and then differs little in hand specimens from the Dudley Rock in Staffordshire; having, like it, much disseminated calcspar.

In this channel, and in the isles near St. Joseph, it is frequently an aggregate of microscopic globules, opaque, and of a Dutch-green colour, mixing in spots with limestone of the granular or crystalline texture. In the Narrows, this oolitic species presents translucent nodules, less than a pin's head, which I believe to be quartz; especially as a quartzose conglomerate is immediately at hand. On Green Island the green colour is often very strong; and the stratum contains a number of brown oblong nodules, as large as millet-seeds. The rock rests upon a blackish-brown limestone-slate, seen only under water, and as truly schistose as that of Niagara.

The limestone of Thessalon Isle, in which the new species of orthoceratite (Pl. XXV. fig. 1, 2, 3) is found, is decidedly magnesian; and in the compact parts of it has the saccharoid texture belonging to dolomite. Its cavities, and those of the organic remains, are lined with primitive rhomboids of the triple carbonate of lime and magnesia.

There is little doubt but that the secondary belts of the primitive rocks in the islets about La Cloche and the French River, are of the St. Joseph species of limestone. The limestone here lies in horizontal beds; it is much darker than that of St. Joseph. Its texture internally is firm; but it crumbles into knotty flakes. I only observed bivalves in it, but others have seen orthoceratites in some of the westernmost of the isles\*.

\* The occurrence of similar belts of secondary strata, crowded with organic remains, and rest-

Rhomboidal pearlspar and dog-tooth calcspar are the only accidental minerals I have met with in the limestone of St. Joseph.

This bed is rich in organic remains and some of them are new. Their substance is not silicified, but remains calcareous.

Wherever this limestone occurs, orthoceræ are very abundant, lying heaped thickly together in small patches through the rock; so that when the surface is exposed, innumerable sections of them are displayed. They are accompanied by milleporæ, madreporæ, encrini, shells, &c. The orthoceræ are never entire upwards; but it is by no means uncommon to find the lower termination complete, the chambers and the siphuncle extending regularly to the bottom. They vary much, not only in their absolute size, but in their proportions. They are seldom less than 2 inches broad at the larger end, and are usually from 10 to 18 inches long. Some taper so imperceptibly, as in short pieces to appear almost cylindrical; and I have seen specimens only 3 inches broad at the top, that were 4 feet long: generally, however, they are broader in proportion to their length. Major Delafield and others have seen them 6 feet long.

† Their lower termination is either acute, as in the specimen, Plate XXVI. fig. 5, from St. Joseph's; or round and obtuse, as in the specimens, Pl. XXVI. fig. 3 and 6, from an island off the northern shore, near Thessalon.

ing in undisturbed horizontality upon the older rocks, is common in both the Canadas. Thus, at the Falls of Montmorenci, 7 miles below Quebec, gneiss dipping south-east, almost vertically, is covered by horizontal layers of limestone breccia and limestone, the latter containing the *Conularia quadrisulcata* of Sowerby, and, among other species of trilobite, that figured in Plate IV. fig. 5, 6, 7, 8, of the *Mémoire sur les Crustacées Fossiles*, by MM. Brongniart and Desmarest, from specimens found at Llandeilo, and preserved in the Ashmole Museum at Oxford.

Limestone breccia reposes horizontally on highly inclined mica-slate at Malbay. Repeated instances of the same kind are met with in the St. Lawrence among the Thousand Isles, the great breach of Lake Ontario. Here both sandstone and limestone in horizontal beds overlie gneiss, the limestone being without organic remains, but having imbedded in it splendid masses of sulphate of strontia. I have seen each rock in contact with the gneiss, in places 40 miles apart, but at the same level.

A decidedly crystalline texture often prevails in the limestones of the Canadas, but rather in the higher layers than in the inferior; and this crystalline limestone is universally crowded with organic remains. Thus at the Falls of Montmorenci, and at Point aux Trembles, 30 miles above Quebec, it is seen loaded with organic remains, and particularly with large pointed orthoceratites, 300 feet above the St. Lawrence, capping a succession of horizontal beds of black and brown granular limestone, with few organic remains. At the Bridge of Jacques Cartier, and at the Falls of the Chaudiere on the Ottawa, crystalline limestone is found in a similar position: it abounds at the east end of Lake Ontario. The crystallization in these cases is genuine, and does not depend on the presence of encrinitic remains: the facets are rhomboidal. The limestone is fetid.

† Excepting figures 3, 6, and 11, all the drawings are of the natural size.

Their transverse section is more frequently oval than circular; but both forms occur.

The column is divided into chambers from the top to the bottom by septa, which are usually concave toward the larger end; but in three specimens, which I am inclined to consider as orthocerae, Pl. XXVI. fig. 3, 6, and 11, found by my friend David Thompson Esq. in the island above referred to, near Thessalon, the septa are convex upwards.

The interval between the septa, or the depth of the chambers, is for the most part either constant in the same individual, or diminishes toward the lower part of the column; but in two specimens (see Pl. XXVI. fig. 3 and 9), the former from the island near Thessalon, the latter from St. Joseph's, the depth of the chambers varies irregularly in different parts of the same column. In different individuals of the same species, the greater the column the greater is the depth of the chambers; but in different individuals of different species, the depth of chambers bears a variable proportion to the size of the column. In one of the specimens above referred to, fig. 11, the column of which is five inches broad, and diminishes rapidly, the chambers are very shallow and numerous. Figures 2 and 3 are in the most usual proportion.

In some species the siphuncle is near the centre, in others near the circumference; and when eccentric, in those species that are oval, it is usually placed in the shorter axis of the section. In the same species the diameter of the siphuncle is in proportion to that of the column, but in different species the proportion of the two diameters is very variable. In Pl. XXVI. fig. 8 and 1, the siphuncle is larger in comparison of the column, and in Pl. XXVI. fig. 10 is smaller than is usual.

The siphuncle, longitudinally considered, is in some instances a continuous tube, regularly tapering from the top to the bottom; in others it is contracted in its passage through the septa, and enlarged in the intervals between them (see Pl. XXVI. fig. 2), as in the *O. cordiformis* of Sowerby. An orthoceratite from Malbay has the same character.

In figure 7 there is the appearance of a small interior tube within the siphuncle.

In figures 1 and 8, where the siphuncle is large, there are peculiar markings at the upper end, which doubtless are connected with the organization of that part. I have seen other instances of this in larger specimens.

In fig. 6 the siphuncle is marked along the side by a series of broad arrow-heads, pointed upwards, and diminishing as they descend. They are merely superficial markings, corresponding in number with the chambers. This specimen is 5 inches broad at the top, and 13 inches long.

Among the specimens that I have seen, are some which strongly resemble the following species figured in Sowerby's *Mineral Conchology*: viz. *O. flexuosa*, *O. Steinhaueri*, *O. gigantea*, and *O. cordiformis*.

In the magnesian limestone of Thessalon Island are found many casts of orthoceræ of a conical form, with blunt hemispherical terminations and concave septa, resembling in their general external outline many of the known species; but having a siphunculus of a very remarkable structure, which differs from any thing known respecting this part in any of the chambered shells. Pl. XXV. figures 1, 2, 3, are drawings of different specimens of this fossil.

The siphuncle is large, placed laterally, and has an enlargement in each interval between the septa. A tube runs down the axis of the siphuncle, to the sides of which, at the middle of each enlargement, it sends off, at right angles to itself, a number of radii, in verticillations, like spokes from the centre of a wheel. The radii appear to vary in number, and cannot be accurately counted, owing to the state of their preservation, as they are covered completely with small crystals of pearlspar. Their number, however, is about 16. In those places whence the radii spring, the tube has enlarged rings: between these rings are elevated longitudinal ridges leading to the radii. The tube diminishes in size toward the lower end of the column; but does not always taper regularly, nor, in different specimens, to the same degree.

Small branched corals are common, and I have found retiperæ and chain-coral: turbinoliæ of large size, and well preserved, are abundant.

Cylinders, slightly conical, perfectly smooth externally, from 1 to 2 inches in diameter at the large end, and from 3 to 18 inches long, are frequently found among the remains of orthoceræ. I have not seen their terminations. They consist, within, either of granular limestone, or of confusedly crystallized white calcspar, not radiated as in belemnites.

Neither any root nor head of an encrinite has been found on Lake Huron, nor, to my knowledge, in America. The columns of encrini are exceedingly numerous in the limestone of St. Joseph and the north; but they are without lateral arms.

The *Entrochus lævis*, *annulatus*, *verrucosus*, and *prominens* of Miller are the most abundant. Their diameter is the same as is usual in English specimens, and their length from 8 to 14 inches. Several specimens are covered with a coralline net-work.

Pentacrinites are common, but very small. The bivalves have not received attention: terebratulæ are met with. Among the univalves, euomphali and cirri have been found.

Several new species of trilobite have been found at St. Joseph's, one of which is represented in Plate XXVII.

I am obliged to Charles Stokes, Esq. for a communication respecting the specimen fig. 1: for which see the Appendix to this Paper, page 208.

The Manitouline limestone is separated on the west and north from that of St. Joseph by waters, low woods, and morasses, nothing being visible near the promontory of the True Detour for many miles around, on the shores of the main, and of the neighbouring islands, but limestone-shingle, white, slaty, and devoid of petrifications. On the east the Manitouline limestone is connected by a chain of high and rocky islets with Cabot's Head. I have seen numerous specimens from both extremities of this ridge; but it is with Drummond, Little Manitou, and the west end of the Grand Manitou, that I am personally conversant.

Thick vegetation, debris, and the displacements usual in uncultivated countries, prevent an accurate examination of the different successive beds of this chain; which are to be considered, however, as belonging to one formation, —from their intimate geographical connexion, from their regular horizontal position, and from their containing in distant parts of the chain the same organic remains: but, as is the case with secondary rocks in all parts of the world, their character differs perpetually in places situated on the same level, or even in juxta-position. This limestone is distinguished from that of St. Joseph and the north by its greater compactness and hardness, by the difference of its organic remains, and by the silicified state in which they are found; all the fossils of Drummond being quartzose or chalcedonic, those of the Little and the Grand Manitou, and of Cabot's Head and its vicinity, being less purely so\*.

This limestone rises usually to the height of 250 feet above the level of the lake, rarely at once in one abrupt precipice, but oftener in confused stair-like ledges.

The beach at Collier's Harbour in Drummond Island is in some parts floored with a brown, compact, hard limestone; almost, if not entirely, devoid of organic remains. It is massive: its surface is usually full of conical cavities, often confluent, about an inch in diameter, and from 1 to 6 inches deep. Their interior occasionally contains a series of similar cavities. A very simi-

\* The substance of the testaceous remains found about Cincinnatus, in the state of Ohio, in parts of Lake Michigan, and in the route from that lake by the Wisconsin river to the Mississippi, consists of fine white quartz. The cellular and chain madrepores, turbinolizæ, tubipores, retipores, and shells of the north-east end of Lake Erie, resemble those of Dudley in Staffordshire, and are cherty.



lar stratum occurs, at the level of the lake also, at the north-west end of the Little Manitou, and at the south-west angle of the Grand Manitou. In the Little Manitou it contains anomia, which abound at the south-east angle of the island.

On proceeding inland, at Collier's Harbour, at an elevation of 100 feet, we find ledges of very hard quartzose white or light brown limestone, piercing the sides of the slope, and finally, in somewhat slaty and squared blocks, contributing to form Blockhouse Hill. The fractured surface of this rock sparkles with what the frequent crystallizations in cavities and fissures show to be quartz. It is in this neighbourhood that the nondescript madrepora hereafter to be described is principally found. The angle of Drummond, on the north of the False Detour, and part of the western end of the Grand Manitou, rise in cliffs 250 feet high. The rock, in both cases, resembles the quartzose limestone of Collier's Harbour. Major Delafield found the summit of the former to be a platform, crowded with ammonites and anomia. The latter, to judge from its debris, contains the same organic remains as Blockhouse Hill. It abounds with astrea, and chain-coral, 2 or 3 yards in diameter. Its fissures are frequently lined with honey-yellow talc-spar. To the south of Drummond is an isle, almost wholly composed of iron pyrites, mixed with some brown calcareous matter and quartz nodules.

In parts of the Little and of the Grand Manitou, the limestone on the shore is of a blueish gray or light brown colour, very finely granular, and extremely slaty. It divides into small fragments no thicker than paper, which are arranged by the wave, edgeways, in undulating lines round the shoulders on the beach. I could not find in it any organic remains; but trilobites have been met with in a rock so similar, found in loose fragments on the shores of Drummond, that I believe them to occur imbedded in this limestone-slate.

Immediately above this slaty bed, or alternating with it, in both Manitous, is a stratum, which occurs in thin broken patches, and is brown, and almost black in parts. It is very soft, of coarse texture, and full of knots of all sizes. These knots in the Little Manitou are very fetid, and often send off several short round branches. They often bear strong marks of cellular madrepora. This is by no means so slaty as the contiguous bed. It abounds in organic remains, some of which are peculiar to it: others are common to the Manitoulines.

In the middle of the north side of the Little Manitou, 30 miles east of Collier's Harbour, and 100 feet above the level of the water, in low interrupted cliffs, we find a dull-brown granular limestone, rather hard and slaty, fetid, and free from shells. We have the same rock at the same level in the Grand

Manitou; but there it is not fetid. Specimens from Cabot's Head, the Flower-pots, and the Fourth Manitou, resemble the fetid limestone of the Little Manitou: they are darker, coarser, very fetid, and abound in the petrifications common to this range.

The fissures and surfaces of the limestone strata of the Little Manitou are marked by singular scarifications, not observed in any other part of Lake Huron. They are narrow and shallow, as if made with a penknife, and occur either singly at hazard, or forming a multitude of parallel incisions, placed together promiscuously. They crowd the surface of the rock and of the various organic remains. Their greatest length is an inch, their ordinary length much less. Sometimes they are only punctures, of triangular, rhomboidal, oblong, or semicircular shape.

On the south-western shore of Lake Huron, at Presquise, the limestone is only seen at the bottom of the harbour, forming a broken pavement, on a level with the waters of the lake. It differs little in appearance from the fetid limestone of the Little Manitou, being brown, granular, and tolerably hard; but I did not ascertain its feter. It contains the organic remains prevalent in the limestone of the Manitoulines\*.

The limestone of Middle Island resembles that of Presquise, and is full of organic remains.

The organic remains of the Manitouline limestone have been collected principally in Drummond, and chiefly through the persevering exertions of Mr. M. White of the Army Medical Staff. This island having been assigned

\* I found at Presquise a loose fragment of limestone, having the peculiar suture observed in that of Kingston on Lake Ontario. This limestone is subdivided, not only by the horizontal planes which render it schistose, but by other planes which also are horizontal. The upper and lower surfaces of these partitions are covered with a brown or black shining matter. They are extremely rough, from their mutually sending forth innumerable processes of the most irregular shape, protruding from half an inch to 2½ inches, which are received into corresponding depressions in the opposite surface. A section of the partition resembles the suture of the human cranium: like which, the limestone suture can be taken asunder and replaced without fracture.

The 11th stratum from above, at the Table Rock of the chasm of Niagara, is intersected 5 or 6 times in this manner. This suture has also been observed on Lake Erie, in white granular limestone; and in Lower Canada, at Point aux Trembles and Point Levi, in brown fetid crystalline limestone. It has been found also in the river St. Clair, in loose fragments of black fetid crystalline limestone.

At Point Levi, and in several of the strata at the great chasm of Niagara, it is very minute, and leaves the horizontal direction, wandering about in the most fantastic curves. It often extends only to a little distance, and disappears as a very small fissure, coated with a thin black scale.

by the Commissioners under the Treaty of Ghent, to the United States, the British garrison will be withdrawn; and as it will not be held as a military post by its present owners, it will be long, probably, ere its fossils again become the object of research.

The first of the organic remains which I shall describe, are some corals found in the quartzose limestone at Collier's Harbour, and at the west end of the Grand Manitou, differing from any that have yet been discovered in a recent or fossil state. Their variations of external form are such as to have led me to separate them into five species; and as it is in that particular alone that they differ, it is of one only, and that the most abundant, that I have given a detailed description; contenting myself, as to the rest, with pointing out those changes of form which distinguish one species from another. The figures are all of the natural size.

*Species I.*—The corals of the species represented in Plate XXVIII. fig. 2, have in their general appearance a considerable resemblance to vertebræ. They are columns, tapering from the top, composed of similarly formed joints, which diminish downwards both in length and breadth, though not in regular gradation. The length of each joint in this species is about an inch, and the breadth exceeds the length. The transverse section is circular. The lower and middle part of each joint is cylindrical, or slightly conical; the upper part swells out, and is inflected inwards at the top, so as to meet entirely the base of the joint next above it. This dilated part is, in different species, in very variable proportion to the rest of the joint. The lower part of one joint is inserted, to some little depth, into the upper part of that next beneath it, so as to attach the joints firmly to one another. The external surface is covered over with a thin smooth coat; but this is rarely preserved, and then only in small portions. The surface is usually without this coat, and is then longitudinally striated.

Where the joint is most dilated, a thin horizontal septum, formed by the abrupt inflexion inwards, and coalescence of the upper and lower parts of the outer coat, passes transversely across the joint; as is seen in two of the joints in figure 2.

The section represented in fig. 6 shows the radiating lamellæ peculiar to madreporæ, and the congenerous lamelliferous corals. These lamellæ are longitudinally disposed, and radiating from the axis of the column to its parietes, there form the external striæ.

In the axis of the column is a hollow tube; but the whole interior of the column is in most specimens obliterated, being filled with dark granular lime-

stone, or with quartz, having carious holes or cavities, lined with rock crystal. The substance of the coral itself is silex, with a slight calcareous admixture.

Including all the species, I have seen sixty specimens of this fossil; but in no instance has either the base of the attachment, or the upper extremity of the column, been preserved. The greatest length of any column that I have seen is 27 inches. The columns are not found in groups, but single, mixed with turbinoliæ, chain-coral, encrinites, &c.

*Species II.* Pl. XXVIII. fig. 1.—This species is the largest. The greatest length that I have seen in any joint has been  $1\frac{7}{8}$  in.; of which the diameter at the base was  $1\frac{5}{8}$  in. The greatest diameter I have seen at the base of any joint, has been  $2\frac{3}{4}$  in., the length of the joint being  $1\frac{1}{2}$  in. The upper part of each joint is much less inflated in this than in the first species.

*Species III.* fig. 3.—In this species, which is the smallest I have met with, the column tapers more rapidly, the upper part of each joint is more enlarged, and is greater in proportion to the rest of the joint, than in the two foregoing species.

*Species IV.* fig. 4.—In this species the plane passing through the line of the base of each joint, is oblique to the axis of the column.

*Species V.* fig. 5.—In this species the cylindrical part of each joint disappears, and the joint assumes the form of an oblate spheroid.

Many other species of coral are also met with in Drummond Island.

Of *astrea* I have seen six or seven species, one of them considerably resembling the lithostrotion of Llywd.

Of the genus *Porites*, or *madreporæ* of Lamarck, one species.

Of *Caryophyllia* one species, which merits a more detailed notice. It is represented in Pl. XXIX. figures 1 and 2. The former figure shows the outside and the base of the coral, and exhibits a peculiarity which is quite new, I believe, to corals of this genus. Tubes appear branching from the outside, and communicating with the interior. Most of these are broken off; but one of them remains, which is three-fourths of an inch long, and takes an ascending direction. In fig. 2, tubes are seen near the base, which take the contrary direction. It is difficult to imagine what purpose these branches could serve in the former case; but in the latter they might assist in strengthening the base of attachment of the coral. I have in my possession a specimen from Collier's Harbour, containing a group of eleven of these corals, closely crowded together.

Turbinoliæ abound in Drummond. The different species vary in size, from  $\frac{1}{4}$  in. to 10 in. in length; the larger being sometimes 4 inches broad at the upper end. I have seen 21 of these corals in one mass, each 10 inches long.

One species, which is common, resembles that from Italy figured in Parkinson's *Organic Remains*, pl. iv. fig. 9.—Plate XXIX. fig. 3. represents the smallest species. Figure 4 is remarkable for the spiral curvature around the centre of the radiating lamellæ. Other species are represented in figures 5 and 6.

The chain-coral (*Tubipora catenula*, Gmelin; *Catenipora escharoides*, Lamarck) is common; as also the *Tubipora* Strues, Park. *Org. Rem.* pl. ii. fig. 1, and *Tubipora ramosa*, *Ibid.* pl. iii. fig. 1.

Small retiporæ, and milleporæ, are abundant.

Of shells there are many species of terebratulæ found near Collier's Harbour, and a large species is common near the True Detour, and in the cliffs near the False Detour, where it is accompanied with ammonites.

Of orthoceræ there are some remains; but they are not so abundant in Drummond as in St. Joseph's or Thessalon Islands. Among them one species has a considerable resemblance to *O. annulata* of Sowerby. Pl. XXX. figures 1 and 2, represent two fragments, which resemble those figured in Breynius's *Dissertatio de Polythalamis*, tab. 6, fig. 1 and 2.

Another class of fossils from Collier's Harbour differs from any thing I have seen. They are columns, usually tapering rapidly, composed of circular discs, with rounded edges, placed one upon the other. Each disc is from  $\frac{1}{2}$  to  $\frac{1}{8}$  in. thick, and from  $\frac{1}{4}$  to 2 in. in diameter. They vary much among themselves. Thus Pl. XXX. fig. 5, is of considerable length, and tapers very gradually. In fig. 3 the diminution is rapid. In fig. 4 there is a sudden diminution from a large to a small size. In fig. 6 the column is curved; in fig. 7 the discs are placed obliquely.

The entrochites mentioned among the organic remains of St. Joseph and the north occur in Drummond also, but sometimes of twice the size. The Pentacrinite is also met with.

The Little Manitou, in addition to the turbinoliæ, and most of the other corals of Drummond Island, possesses several species of organic remains, which are found no where else throughout the Manitouline chain. They occur in the knotty stratum: but as they are but obscurely defined, I shall pass them over.

#### *On the Foreign and Native Debris of Lake Huron.*

The shores and bed of Lake Huron appear to have been subjected to the violent action of a flood of waters and floating substances rushing from the north. That such a flood did happen is proved, not only by the abraded state of the surface of the northern mainland and scattered isles of the Manitou-

line range, but by the immense deposits of sand and rolled masses of rock which are found in heaps at every level, both upon the continent and islands: and since these fragments are almost exclusively primitive, and can in some instances be identified with the primitive rocks *in situ* upon the northern shore; and since, moreover, the country to the south and west is secondary to a great distance, the direction of this flood from the north seems to be well established.

The boulders of granite, gneiss, mica-slate (rare), greenstone porphyry, syenite, and various amygdaloids, are principally of such varieties of these rocks as I have not met with *in situ*, either in the neighbourhood of Lake Huron, or in a journey of 600 miles which I made to the east and north-east of the lake, through the forests of the river Ottawa.

Of mica-slate I met with only two fragments, of a brown colour, among the trap isles. A fragment of serpentine was found in Drummond, on Blockhouse Hill.

The greenstone porphyries have a light-coloured base, and contain crystals of red or white felspar—seldom of both in the same block. I have seen boulders of the porphyry with red felspar, on the Ottawa, 500 miles to the east of Lake Huron. The syenites are the same as those of Europe.

The amygdaloids are often coloured brown by iron, and then contain almond-shaped masses of epidote only. The green varieties contain nodules of agate\* and red jasper, white amethyst, epidote radiating upon layers of quartz and small garnets.

It can scarcely be doubted that these rocks will be found *in situ* somewhere on the northern shore of Lake Huron, between the Missassaga and Pelletau's Channel. It is there and on the Isle of St. Joseph that their boulders most abound. Together with the fragments of the above-mentioned rocks, are found others of trap, greenstone-slate, greenstone-conglomerate, jasper-conglomerate, and quartz rock. These occur in every part of the lake, but most abundantly near their parent rocks. The conglomerates closely resemble those which have been found on the northern shore *in situ*. The base of the conglomerates is either quartz or greenstone. Of the quartzose conglomerate the nodules consist rarely of white translucent quartz, sometimes of greenstone; and more commonly of red, green, brown, black, or parti-coloured jasper. In some instances pieces of quartz—rarely of greenstone—are mixed with those of jasper. The greenstone conglomerates contain nodules, either

\* Agates, jaspers, &c. are found abundantly as pebbles, on Lake Superior and about the Mississippi.

of quartz, of greenstone, or of the red ingredient found in the rock of Le Serpent. This latter conglomerate has been noticed as occurring *in situ* in the Channel of Pelletau.

It is only about the Narrows of Pelletau that the rock of Le Serpent has been seen in a rolled state. Breccias similar to the conglomerates are not uncommon; but I have never found them *in situ*.

Pebbles of red sandstone, and quartzose or slaty limestone, have a very limited range: they only now and then wander as far as the Manitoulines, the southern shore, or Michilimackinac.

I have already noticed the quantity of primitive boulders found on the Isle of St. Joseph. The beach of the rivers Thessalon and Missassaga is covered by boulders of black trap, granite, gneiss, and jasper-conglomerate.

The Georgian or Penetanguishine arm of the lake is loaded to excess with sand and rolled pebbles. Penetanguishine, and much of the south-east coast of this arm of the lake, is a collection of sand-hills, enveloping quartzose, granitic and amphibolic blocks of all sizes, and in vast quantity.

Passing into the southern division of the lake, 6<sup>4</sup> miles south of Cabot's Head, the limestone cliffs of the Manitouline range are succeeded by cliffs of clay. From this point beds of clay, covered towards the upper part of the river St. Clair by thick beds of sand, extend for 150 miles to Lake Erie, and thence along the northern shore, which presents a series of clay cliffs and sand-hills, to the north-eastern extremity of the lake. The whole of the intervening shores and woods are strown with rolled blocks of gneiss, porphyry, conglomerate, and greenstone, such as prevail on the northern shore of Lake Huron. In a south-westerly direction, the clay-beds prevail over the Michigan territory, and the states of Indiana and Illinois, to an unknown distance. In the two last-mentioned states (which I have not visited) rolled blocks abound.

The argillaceous and sandy banks of the southern shore of Lake Huron are conspicuous near Point aux Barques, in the Gulf of Sagouina, and about Presquise. The debris of the rocks of the northern shore are here rare, and much rolled.—Staurotide was picked up on the southern shore by Mr. Schoolcraft.

Besides the sand and boulders before spoken of, which are ancient, and have travelled from a distance, there are fragments of another character, which may be called *native*, reposing on the parent rock, or not far removed from it. This debris is comparatively recent, having been detached by various natural causes, such as torrents, change of temperature, &c. The latter agent operates either by the expansion and contraction of the rock itself, or of the water

contained within its fissures. In the spring the nocturnal frosts and diurnal thaws are very violent. In the winter the thermometer is frequently  $50^{\circ}$  below the freezing point, and in summer it ranges from  $60^{\circ}$  to  $90^{\circ}$  of Fahrenheit. I once saw it at noon, on the 20th of June, 1820, at  $101\frac{1}{2}^{\circ}$  in the shade.

These recent fragments, whether of the older or newer rocks, are angular and mostly small, and cover their parent rocks, as well in the high as in the low grounds, often to the depth of several feet. Examples of this are seen in the slaty greenstone of the Narrows, in the quartzose limestone of Drummond, and in the quartz rock at the foot of Lake George.—All the countries to the north of Lake Huron are loaded with similar debris. The French river, in one wild spot, the scene of an Indian massacre, is almost choked with it. In Lake Nipissing, near its southern shore, there is a large heap of square clean masses of gneiss piled together promiscuously.

An instructive fact is presented by many parts of Lake Huron, and very strikingly in the channels of Pelletau. It shows that the recent debris is nearly stationary. The opposite shores of this channel consist of different rocks, the one being limestone, the other greenstone. Each shore is lined with its own debris, without any admixture, except that of rolled pebbles of granite, pudding-stone, or greenstone, left by the debacle on the calcareous beach.

In the spring the ice occasionally removes fragments of great size: the inhabitants of Quebec annually see them transported in this manner down the St. Lawrence. During the winter the ice surrounds the blocks that are upon the shallows; and on being broken up in May, it carries them by a rise of water to some other shore. Remarkable instances of this are found on the islets near the south end of St. Joseph; where, a few yards from the water, and a little above its level, rolled stones, many feet in diameter, are found deposited, with a furrow extending from the water to their present place of rest.

That changes in the level of Lake Huron have occurred, and that its surface once stood much higher than at present, is proved by the traces of ancient beaches and zones of rolled stones and sand that are found in the neighbourhood of the lake. Such an occurrence has been noticed in Collier's Harbour, at Blockhouse Hill, which has the appearance of a beach, and of having formed the west end of the Isle of Drummond, when the lake stood higher than at present. Similar alluvial ridges are found surrounding the other lakes and rivers in Canada. These may be accounted for partially by the effects of the wind; which, blowing strongly from certain quarters for a few days, accumulates the water on the leeward coast, the waves there washing up the shingle in scalar ridges to the height of 6, 8, or 10 feet.

On concluding this Memoir, I have to express my grateful acknowledgements.



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APPENDIX.

I. On a Trilobite from Lake Huron.

BY CHARLES STOKES, ESQ.

“ In breaking away the rock from a specimen of trilobite found at St. Joseph and now in my possession, a fortunate fracture exposed a small part of the under side of the fossil; and encouraged me, as the rock was of a favourable texture, and the fossil in a good state of preservation, to attempt a further dissection, in the hope of laying open some parts of the animal with which we have hitherto been unacquainted; and I discovered the part forming the entrance into the stomach. Its structure, which considerably resembles that of the analogous parts in some recent crabs, will be best explained by the accompanying drawing (Pl. XXVII. fig. 1. b.) I have frequently attempted to cut away the rock from specimens of trilobite from Dudley; but owing to its hardness, I have not yet succeeded in developing any thing similar.”

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II. List of some of the Recent Shells of Lake Huron.

I am obliged to I. E. Gray, Esq. of Burton-street, Burton Crescent, for the names of some recent shells which I collected in Lake Huron.

Helix albolabris, . .	Say <i>Amer. Conchol.</i> T. i. fig. 1.
— alternata, . .	————— T. i. fig. 2.
— angulata? . .	Rackett <i>Linn Trans.</i> vol. xiii.
Planorbis trivalva, . .	Say <i>Amer. Conchol.</i> T. ii. fig. 2.
Lymnæa Catascopium,	————— T. iii. fig. 3.
— heterostropha,	————— T. i. fig. 6.
— (Nov. Spec.)	
Physa (Nov. Spec.)	
Valvata (Nov. Spec.)	
Cyclostoma tricarinata,	Say <i>Amer. Conchol.</i>
Cyclas (Nov. Spec.).	

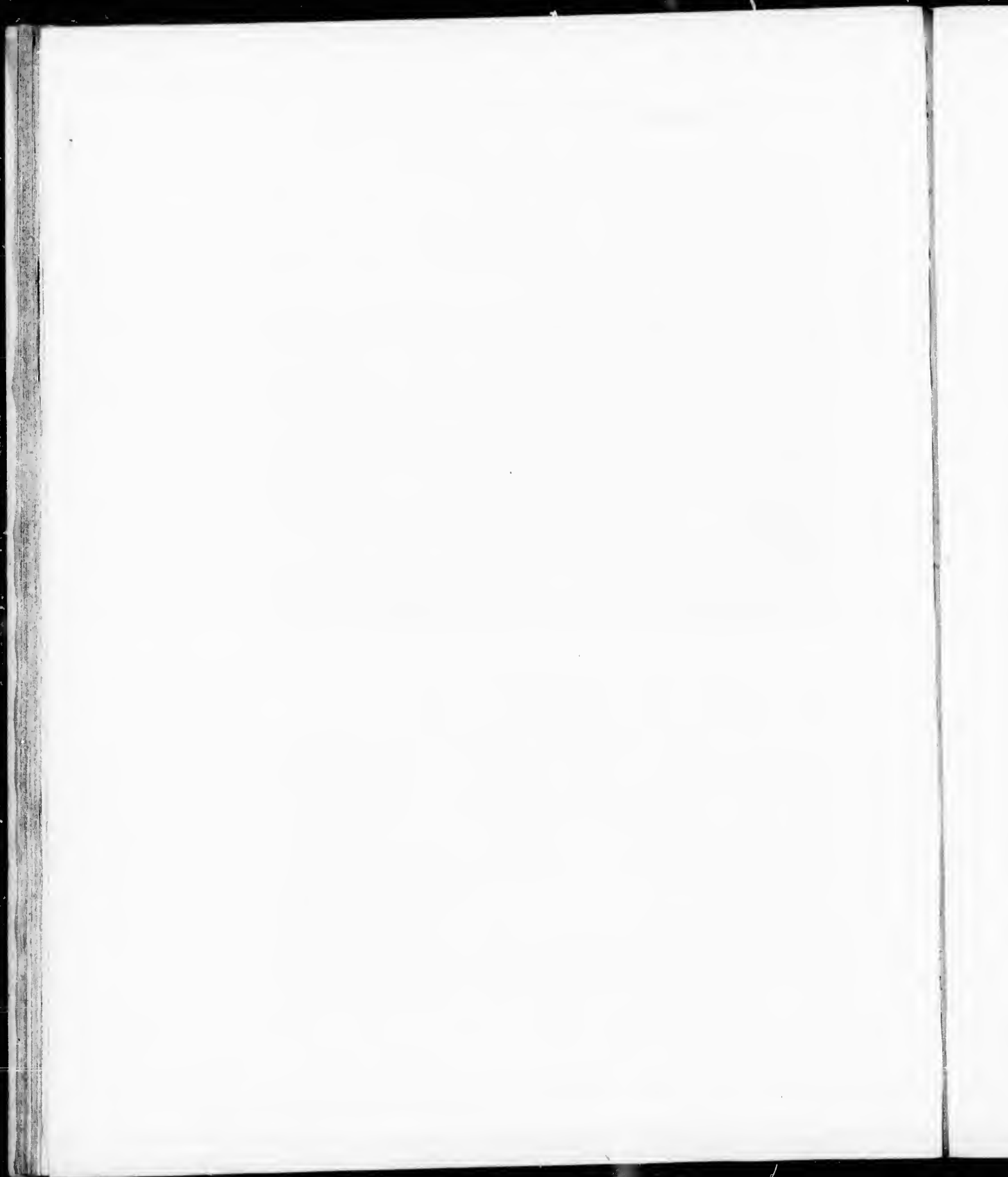
III. *Account of an Explosion in a Vein of Pyrites.*

This explosion took place, sixteen years ago, in the township of Yonge, near the Lake of the Thousand Isles in the St. Lawrence. At the time, a man was seeking his cow in the woods, within a short distance of the spot. On a sudden he was startled by a tremendous explosion, attended by volumes of smoke, and sulphurous odours.

Three years since, on being informed of these particulars, I visited the place. It is half a mile within the woods north of the road from Brookville to Kingston, near to the easternmost of two creeks, about ten miles from the former town.

I found, on the summit of a quartzose mound from 30 to 40 feet high, a round cavity, 12 feet deep, 12 long, and 9 broad. Its sides consisted of very shattered quartz spotted brown by oxide of iron, and covered profusely with acicular yellow and white crystals of sulphur. The lower parts of the cavity were studded with masses of iron pyrites, of which there is a vein at the bottom of the cavity. It is a foot and a half thick, and disseminates itself into the surrounding quartz. This vein may be seen, running east with a very high dip, to the distance of a yard and a half.

Similar phenomena have been noticed in a mountain in Vermont (vide *American Journal of Science*, for Feb. 1821), and in the country towards the head of the Missouri (vide *Travels of Captains Lewis and Clarke*).



## EXPLANATION OF THE PLATES.

### PLATE XXV.

Fossil Orthocerae from Thessalon Island, Lake Huron : page 198.

The three figures in this plate (drawn of the natural size) belong to the same species, and exhibit a remarkable structure in the siphuncle, which is large in proportion to the size of the shell, and is dilated between each of the septa. It contains within it a tube running throughout its whole length, diminishing towards the lower end of the shell, and having radii in verticillations connected with the sides between each enlarged portion of the siphuncle.

*Fig. 1.* shows the external form of the lower part of the shell ; and in the upper portion, the siphuncle laid open, and the verticillated radii distinctly separate from each other.

*Fig. 2.* represents the siphuncle laid open, but the radii have not been preserved in this specimen. The interior tube diminishes irregularly towards the smaller end, and seems to indicate that this part was formed of a substance which could be dilated or contracted. This figure is drawn in an inverted position.

*Fig. 3.* represents the form and size of the shell and siphuncle, with its internal tube. The radii are wanting in this specimen.

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### PLATE XXVI.

Orthocerae from Lake Huron : page 196.

The figures in this plate exhibit varieties in the external form of the shells, and of the form and proportionate size of the siphuncle. There is also great difference in the size of the chambers as shown by the different distances between the septa. These differences are sometimes considerable in the same specimen, as in figs. 3 & 8.

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### PLATE XXVII.

Four views of the natural size, of a new species of Trilobite, named by Mr. Stokes, *Asaphus platycephalus*, from St. Joseph's Island, Lake Huron : p. 199. 208.

*Fig. 1. a.* Upper view of the anterior part, showing the position of the eyes, and the lines of the sutures ; which, as in all the species of this tribe, divide the shelly crust at the eyes, and pass in a curved line near to the anterior margin ; at the centre of this margin another suture joins the curved one, and passes round to the under side.

*Fig. 1. b.* Under view of the same. From the centre of the anterior margin, the straight suture above mentioned passes along the middle of this under side, till it meets another suture, where a plate, of the peculiar form represented in the figure, is attached. This plate of peculiar form has been detached at its suture by compression. Its upper margin is rounded at each side, and its lower part has a deep tumulated indentation, which was evidently the entrance into the stomach. This is the part mentioned in page 208.

## EXPLANATION OF THE PLATES.

*Fig. 1. c.* Side view of the same, showing the remarkably flat form of the specimen, from which peculiarity the specific name has been taken. The shelly crust of the under side joins the upper at the sides. This is usually the case with trilobites in this anterior portion of the animal.

*Fig. 2.* Posterior part of the same species.

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### PLATE XXVIII.

Fossil corals of the genus *Huronia*, from Drummond Island, Lake Huron.

These corals are described in page 202.

*Fig. 1.* *Huronia Bigsbei*.

2. ——— vertebralis.

3. ——— turbinata.

4. ——— obliqua.

5. ——— spheroidalis.

6. Section of *H. vertebralis*.

The generic character of these corals is thus described by Mr. Stokes, who has given them the above names :

Polyparium stony, forming a straight jointed column of single cells placed one over the other ; each joint having been in succession the habitation of the living individual. The remarkable peculiarity which establishes these corals as a particular genus is, that as a new generation arises, it forms its cell precisely over the preceding one, covering its upper surface entirely, and lengthening the column of the coral by a new joint in a continuous line with those previously formed.

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### PLATE XXIX.

Fossil corals from Drummond Island, Lake Huron.

*Figs. 1, 2. a. 2. b.* represent a species of *Caryophyllia*, remarkable for the tubes proceeding from it, as described in page 203.

*Fig. 3.* Very small species of *Turbinolia*.

*Fig. 4.* A species remarkable for the arrangement of the plates in the centre.

*Fig. 5.* Another species of *Turbinolia*.

*Fig. 6.* A species of *Caryophyllia*.

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### PLATE XXX.

*Figs. 1 & 2.* Two species of *Orthocera*, mentioned in page 204.

The other figures in this plate represent the columns of circular discs mentioned in page 204 ; but it has not yet been ascertained to what class of fossils they belong.

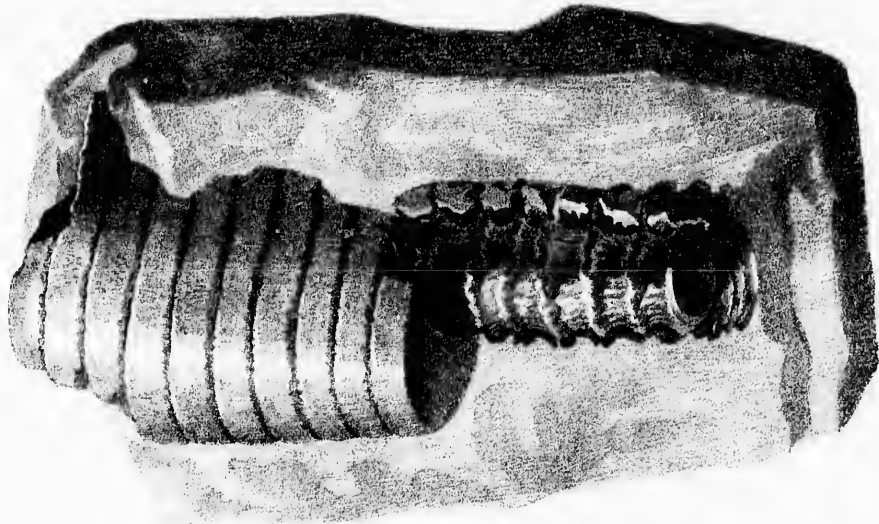
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### PLATE XXXI.

Map of Lake Huron.

For the authorities from which it is compiled, see p. 177 of this volume.

Fig. 3



Prepared by J. Hillman and del.

Fig. 2

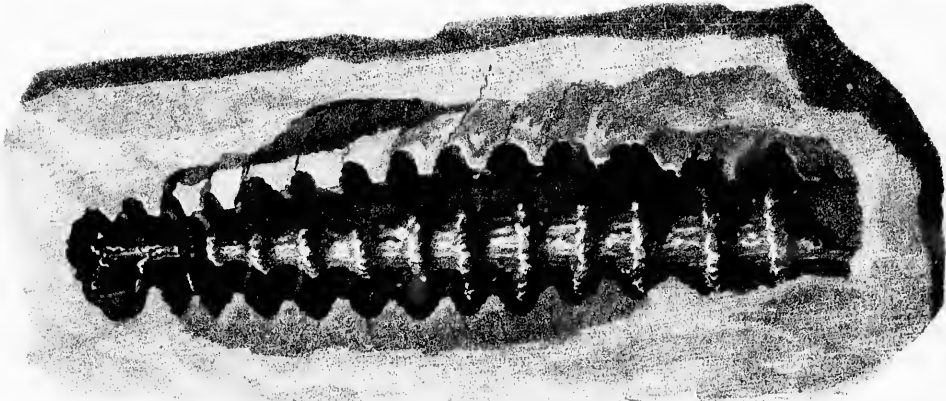
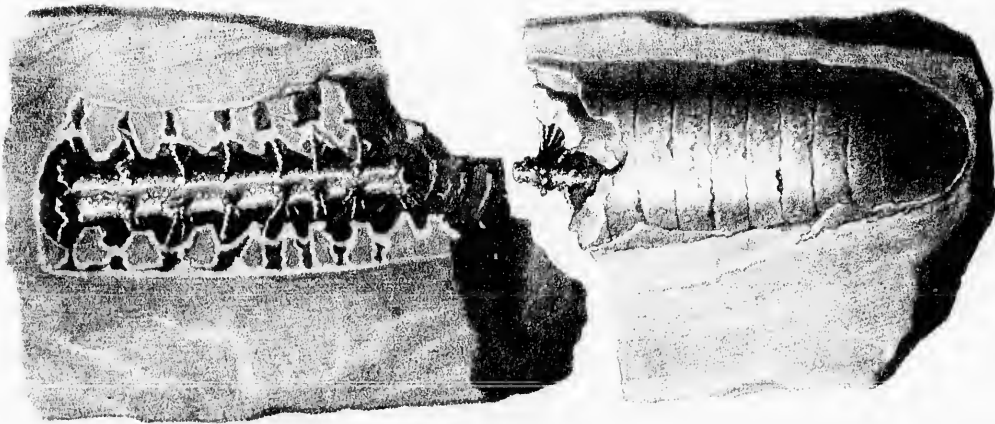


Fig. 1



FOSSIL ORTHOCERA.  
FROM THESSALON ISLAND, LAKE HURON.

G. Schuchert del. et litho.

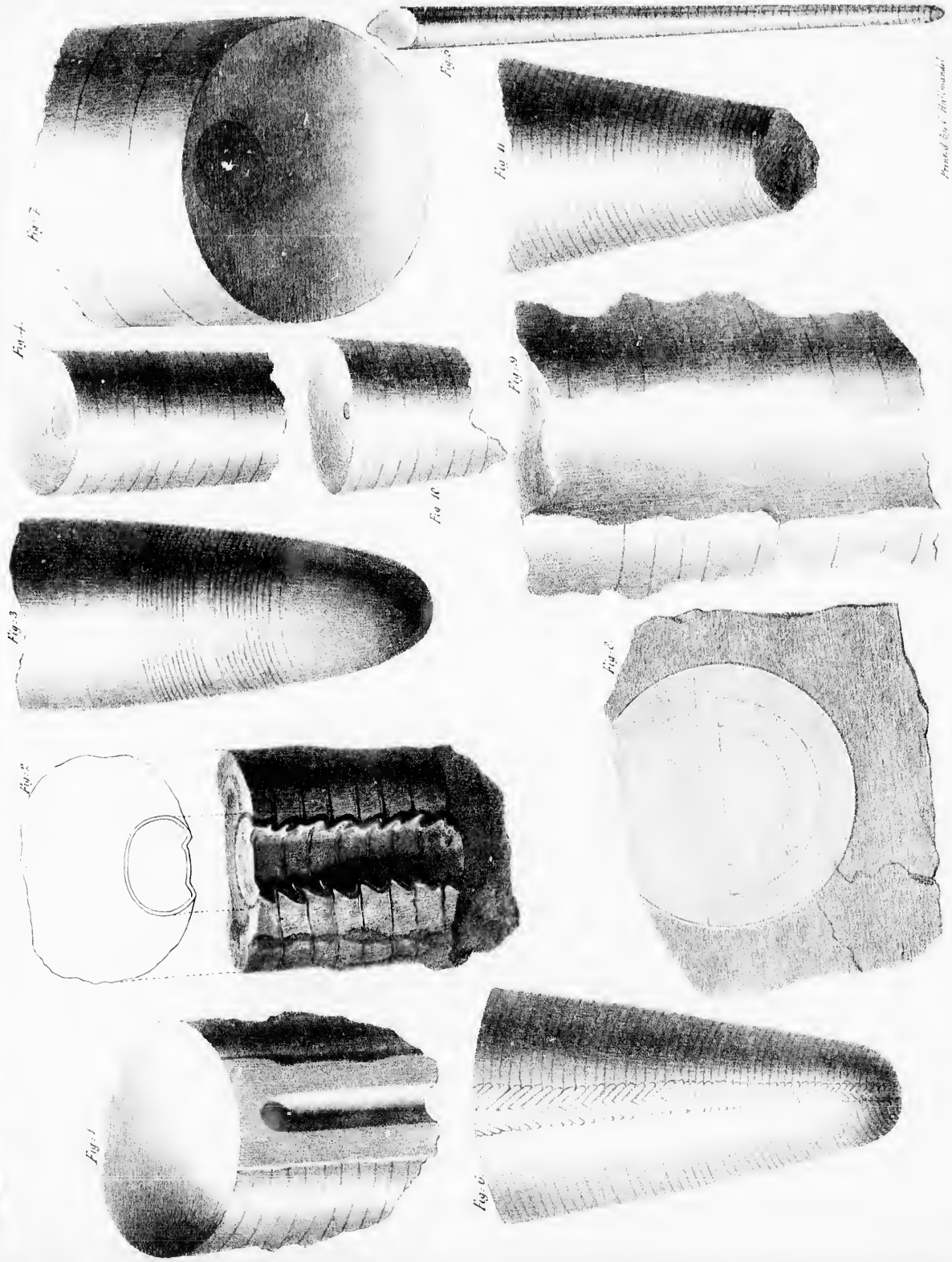
Fig. 2

Fig. 3

Fig. 4

Fig. 7





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ORTHOIERE, FROM LAKE URON

J. Richardson





Fig. 1. a



Fig. 1. b

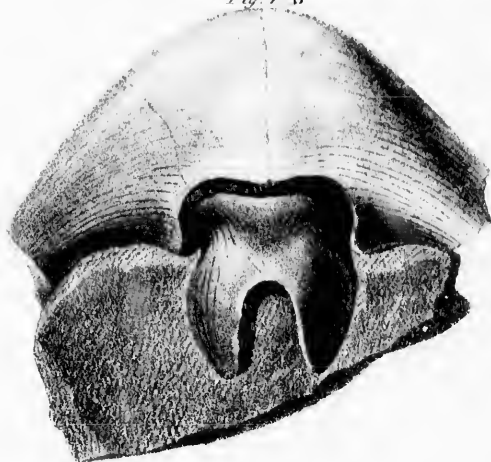
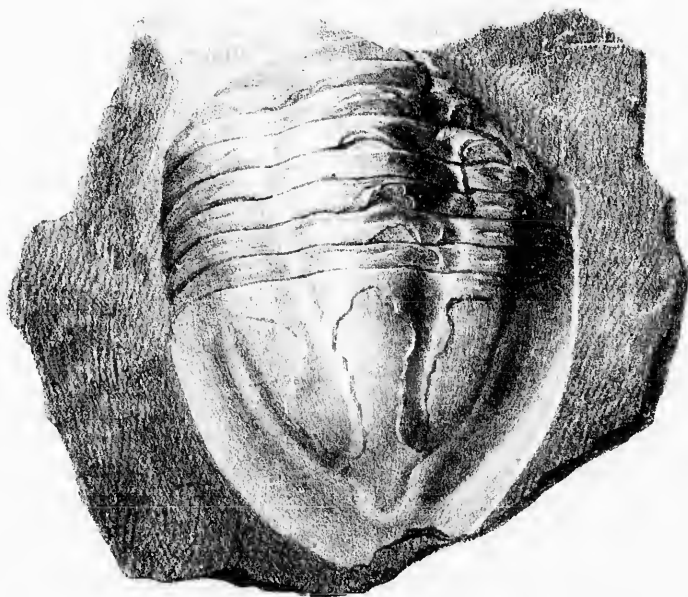


Fig. 1. c



Fig. 2



G. Schuch del. et lithog.

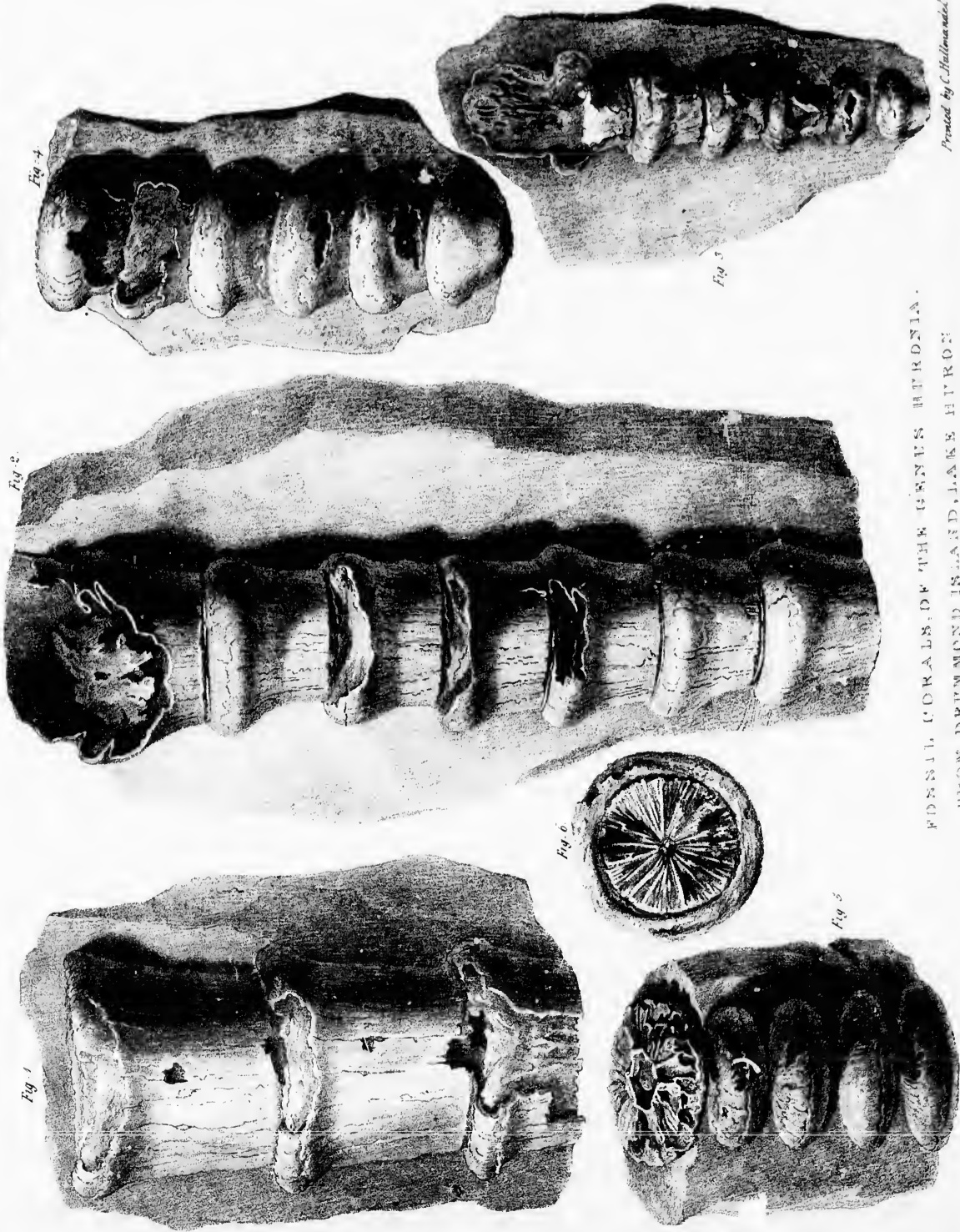
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ABAPRUS PLATYCEPHALUS.  
FROM ST. JOSEPH'S ISLAND LAKE HURON

*Fig. 2.*



*Fig. 1.*



Fossil Corals, of the Genus *Hydrina*,  
from Drummond Island, Lake Huron

Printed by C. H. Wallcut.

G. Scharf del. et Litho

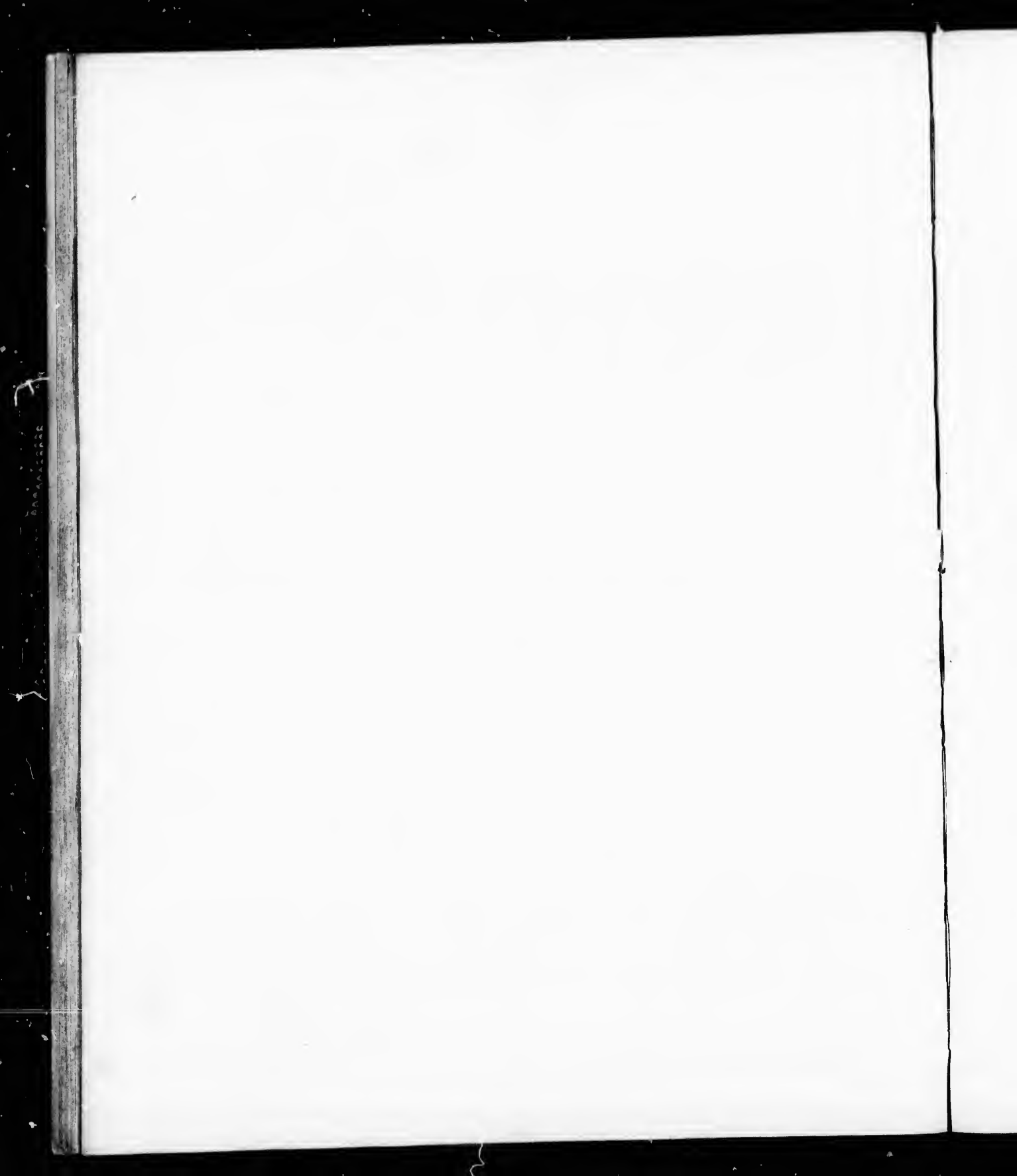


Fig 1



Fig 1



Fig 2



Fig 3

Fig 4



Fig 5



Fig 6



*S. Schan'schei*

*S. Schan'schei*

FOSSIL CORALS FROM DRUMMOND ISLAND,  
LAKE HURON.



Fig. 1



Fig. 2

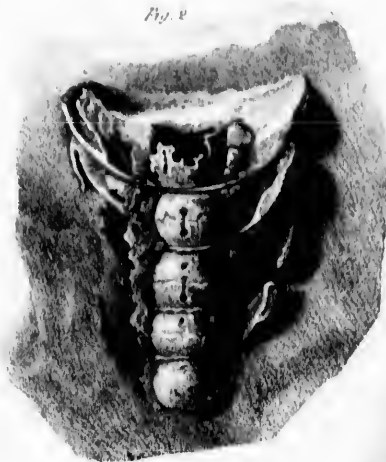


Fig. 3



Fig. 4



Fig. 5



Fig. 6



Fig. 7

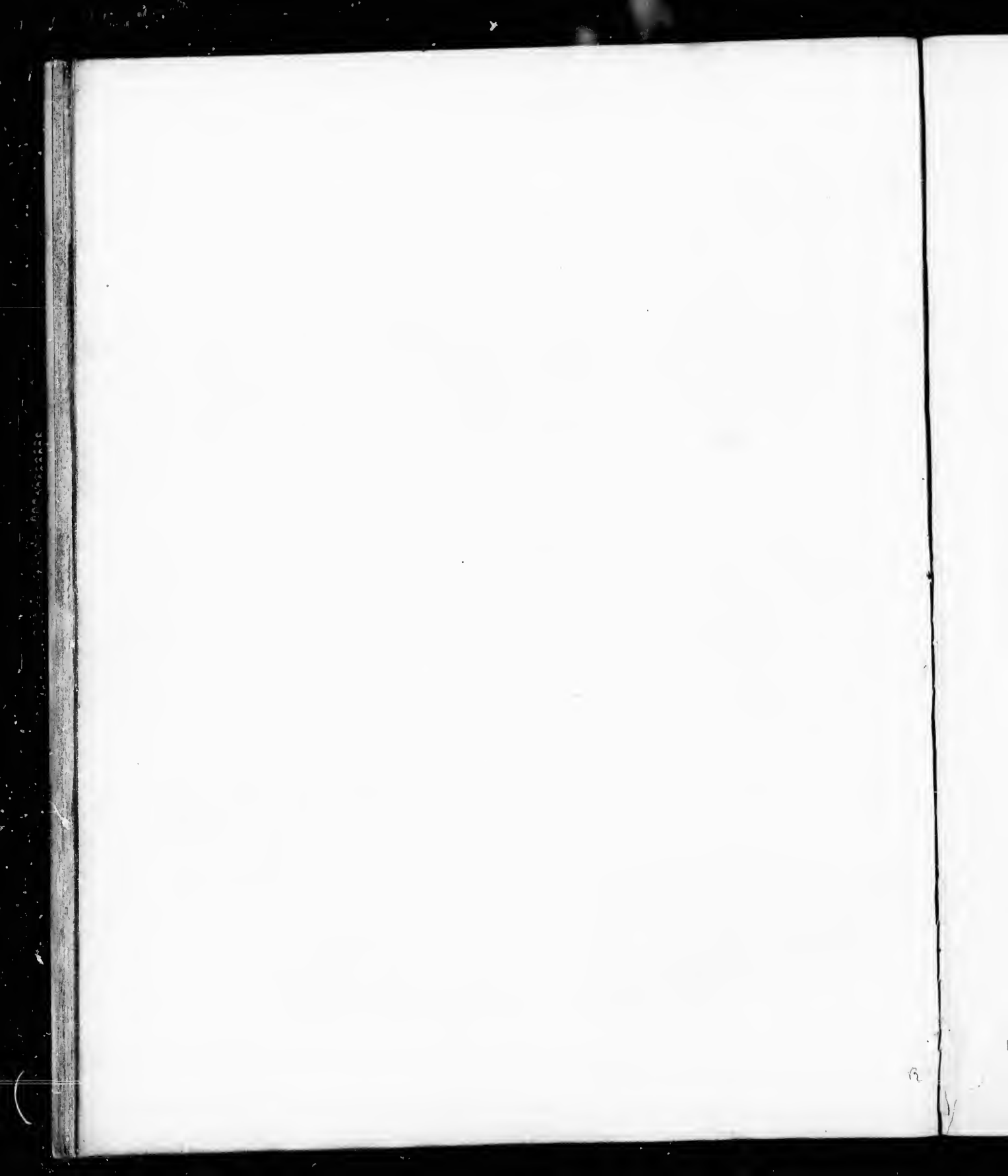


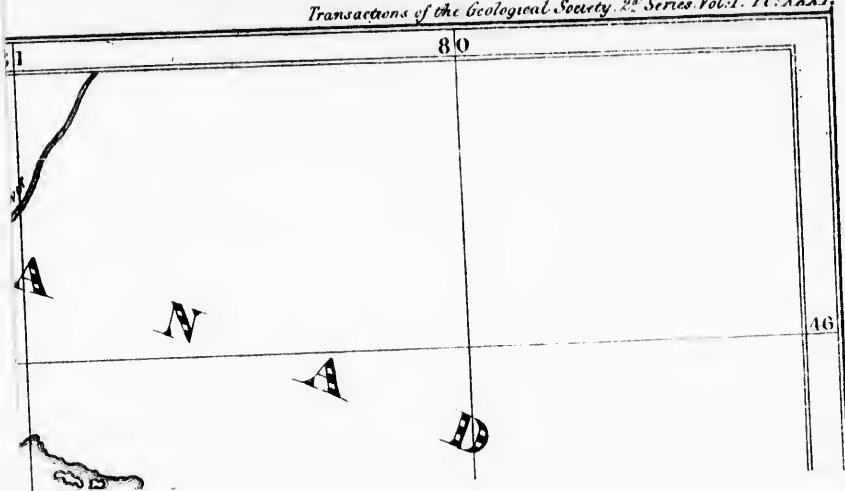
G. Scharf del. et lithog.

Printed by H. Muller and Co.

FOSSILS FROM DRUMMOND ISLAND.











Boundary Line between Upper Canada and The United States

Barques

U  
N

M  
I  
C  
H  
I



R. Saginaw

White Rock

(continued) Riv. St. Charles

43 J J Bigsby del

84

85

F. Gratiot

82

B. R. Parker Lithog.



N  
A  
B  
A

*Map*  
to accompany  
**D<sup>r</sup> BIGSBY'S PAPER**  
ON  
*The Geography and Geology of*  
**LAKE HURON.**

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82

81

80

43

*Chilmandel's Lithography*







