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A GLANCE AT THE POLITICAL AND COMMERCIAL IMPORTANCE OF CENTRAL BRITISH AMERICA.

BY H. Y. HIND, M.A., F.R.G.S.

Communicated to the Canadian Institute, November, 1863.

The extraordinary commercial activity to which steam and the electric telegraph have contributed of late years, lead us to overlook the enterprise and daring which distinguished the early French colonists of Canada nearly two centuries ago. The history of their successful attempts to open commercial intercourse with Indian nations to the north and north-west, far beyond the present limits of Canada, their journeys of discovery and military expeditions to the shores of Hudson's Bay, appear to have faded from the recollections of their descendants, at a time when the question of extending our civilization into the far interior of the continent is exciting general attention both in England and Canada.

If the proposal were now gravely made to send an armed force of one hundred and fifty soldiers, or one hundred and fifty emigrants, across the uninhabited wilderness between Lake Superior and James Bay, or between Quebec and Hudson's Bay, to establish permanent settlements, a large majority of the public would treat the idea as

simply absurd, and the projectors as probably insane.* Yet these expeditions were actually undertaken when the population of the whole of Canada was less than one-fifth part of the present population of Montreal, and, consequently, less than one half the population of Toronto.

That the early French colonists were pre-eminently distinguished by their desire for the extension of their territory, the following extracts from the Paris documents† will establish beyond doubt, and at the same time convey some idea of their activity and enterprise in the infancy of Canadian history, and also of the projects they formed, and the conceptions they entertained of the extent of the country they intended to colonize as new France, north of the great Lakes, two hundred years ago.

As early as 1646, we read that Sieur Bourdon, with three Frenchmen, was sent overland from Quebec, to take possession of Hudson's Bay for France. The French had already established a trade with the Indians of Hudson's Bay, and in a few years induced them to come to Quebec to barter their furs.

In 1661, the Rev. Claude Dablon set out overland for Hudson's Bay viâ the Saugenay, but he succeeded in reaching only the head waters of the Nebouka, 300 miles from Lake St. John.

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* Persons who pretended to be familiar with the difficulties of the overland route from Canada to British Columbia, were only too ready to predict the disastrous failure of the Canadian emigrant party of 1862 to reach British Columbia in one season, "supposing they escaped the Indians and starvation."

Probably there is no stretch of country in the world exceeding one thousand six hundred miles in continuous length, and wholly in a state of nature, which it would be possible for one hundred and fifty people, including a woman and three children, to traverse during a single season, overcoming such apparently formidable obstacles as the Rocky Mountains have been supposed to present. The simple fact that these emigrants were enabled to take a large number of oxen and horses through the mountains, by an undescribed Pass, supplies a most satisfactory answer to those who have uniformly represented the dangers and difficulties of a route across the continent within British Territory, as insuperable without extraordinary outlay. Here we have an instance of a large party of emigrants, nearly all unaccustomed to the work, effectually combating those difficulties, and proving that they were either grossly exaggerated or in a great part imaginary. Another important fact which this journey has developed, is the ease with which the Fraser river is capable of being navigated by canoes or rafts, as far down the stream as the forks of the Quesnelle, the point from which a road will most probably strike off in a nearly direct line to the Pacific, touching the ocean at one of those deep indentations which form so curious a feature of the British Columbian Coast. There can be no doubt that great privations were endured by many of the party, but at least until they reached the Fraser, there are, happily, no sad memorials left on the route they took, like those which distinguish every mile of the inhospitable desert which separates the valley of the Mississippi from the Pacific States and Territories of the United States.

† Documents relating to the Colonial History of the State of New York.

"In 1663 the Indians of the Bay du Nord (Hudson's Bay) returned to Quebec in further quest of Frenchmen, and M. Davaugour sent thither Sieur de la Couture with five men, who proceeded *overland* to the said Bay, possession whereof he took in the King's name, noted the latitude, planted a cross, and deposited at the foot of a large tree his Majesty's arms engraved on copper, and laid between two sheets of lead, the whole being covered with some bark of trees."

In 1671 Pere Albanel was despatched overland to Hudson's Bay by the Intendant Talon, (*viâ* the Saugenay River); and in the same year (1671) Sieur de St. Lusson was sent by Mr. Talon to Sault St. Marie, where he made a treaty with "seventeen Indian nations." The Intendant in his report states that the place Sieur de St. Lusson reached is not supposed to be 300 leagues from the extremities of the countries bordering on the Vermilion or South Sea. He continues: "The countries bordering on the Western ocean appear to be no farther from those discovered by the French, according to the calculation of the distance made from the reports of the Indians; and by the maps there does not appear to be more than 1500 leagues of navigation remaining to Tartary, China and Japan." Even at so early a period in the history of Canada did the French look forward to establishing communication, overland, with the "South Seas," to command the trade of Western Asia; and in another half century the French government were so impressed with the idea of an overland route to the Pacific that they sent instructions to Quebec to have the exploration effected.

Du Chesneau writes in 1681: "They (the English) are still at Hudson's Bay, on the north, and do great damage to our fur trade."

In 1683 M de la Barre writes to M. de Seignelay: "The English of Hudson's Bay have this year attracted many of our northern Indians, who for this reason have not come to trade to Montreal. When they learned by expresses, sent them by Du L'hut on his arrival at Missilimakinak,* that he was coming, they sent him word to come quickly and they would unite with him to prevent all the others going thither any more. If I stop that Pass (Lake Superior to James Bay), as I hope, and as it is necessary to do, as the English of that Bay excite against us the savages, whom Sieur du L'hut alone can quieten, I shall enter into arrangements with those of

* Michillimakinak, Green Bay, and Lake Huron.

New York, for the surrender to me of any guilty fugitives, but we are desirous to obtain an order to that effect from the Duke of York."

And in the same year (1683) M. de la Barre writes to M. de Seignelay as follows: "A small vessel has just arrived from Hudson's Gulf, 200 leagues further north than the Bay. * * * It is proper that you let me know, early, whether the King desire to retain that post, so that it may be done, or the withdrawal of the French, for which purpose I shall dispose matters in order TO AID THEM OVERLAND beyond Lake Superior, through Sieur Du L'hut, and to send to them by sea to bring back the merchandise and peltries."

In Governor Dongan's Report on the State of the Province, in 1687, we find a notice of the Hudson's Bay in the New York Colonial manuscripts:* "Last spring he (the Governor of Canada) sent one De la Croa with fifty soldiers and one hundred young men of Canada to the north-west Passage, where, I am certainly informed from Canada, they have taken three forts."† In Mr. Nelson's memorial about the state of the Northern Colonies of America, dated 1696, he says "there are actually, this instant, now at Versailles six Sagamoes or chiefs sent from Canada, Hudson's Bay, and Nova Scotia, to solicit such help and assistance against us," &c., &c.

M. de la Verandèrie was sent on an overland expedition by the desire of Count Maurepas, in the year 1738, to discover the Pacific Ocean. He set out with his party from Montreal, passed through Lake Superior, and proceeding nearly due west, ascended the Assinniboine river, and directed his course towards the Rocky Mountains. Without reaching the Rocky Mountains, M. de la Verandèrie was obliged to abandon the prosecution of his expedition. Three hundred miles west of Lake Winnipeg on the Assinniboine river, the French erected Fort la Reine. Three others were built further west, the most remote of which stood on the bank of the River Paskoyac.‡

Mackenzie speaks of Canadian missionaries who penetrated "2800 miles from the civilized parts of the Continent long before the cession of the country to the English in 1763!

The names of several lakes and prominent hill ranges date from the occupation of the country west of Lake Winnipeg by the French

* Documents relating to the Colonial History of the State of New York.

† Governor Dongan refers to Chevalier de la Troye—an account of whose Expedition to Hudson's Bay, in 1686, is contained in Charlevoix's History.

‡ Foot note to New York Colonial Manuscripts; Paris Doc.

prior to the Conquest. Such as Dauphin Lake, Dauphin Mountains; Fort Bourbon, on the Saskatchewan, near the west end of Cedar Lake. The most remote of the French settlements on the Saskatchewan appears to have been, "at Nipawee, in lat. 53½ long. 103."*

When we consider these great enterprises in connection with the population of Canada at the time, we cannot fail to be astonished at the energy of the French colonists, and the desire they exhibited to extend their empire even to the frozen North, and to secure the overland trade with Hudson's Bay and the far unknown west—even to "South Seas."

During the period when they were undertaken, the population of Canada from 1666 to 1738† was as follow:—

1666	....	3418—total population. 1344—men bearing arms.
1667	.....	4312—total population. 1566—men capable of bearing arms.
1668	....	5870—total population. 2000—men capable of bearing arms.
1679	....	9400—total population.
1685	.....	17,100—French inhabitants, men, women, and children. 3000—men capable of bearing arms.
1738	..... .	45,000—population: the year M. de la Verandèire was sent overland to discover the Pacific Ocean.

At the period of which we write Upper Canada and a large portion of Lower Canada was a wilderness, and yet the French sought to extend their territorial jurisdiction to the shores of Hudson's Bay; and some years later, had visions of grasping the Indian and China trade from the shores of the Pacific, which they hoped to reach overland from Canada.

At the present time Canada numbers some 2,700,000 souls, and we have the official statement from the highest authority, that the

* The name "Nipawee" is perhaps the same as Nepowewin or "The Standing Place," the present name of the mission opposite Fort à la Corne. Before the conquest the French had settlements at Dauphin Lake, the Pasquia (near Carrot river or Root river) and at Nipawi, "where they had agricultural instruments and wheel carriages, marks of both being found about the settlements."—*Mackenzie's Voyages.*

† Paris Documents.

best lands in the country have already been sold.* With this unexpected and startling announcement before us, we are justified in assuming that the present surveyed lands of the Province on the north side of the St. Lawrence, determine with considerable accuracy the boundaries of the portion likely ever to be settled with an agricultural population, and, until manufactures spring up, they are a rude measure of the future increase in our population through immigration.

Lumbering operations are constantly retreating farther North, and must soon find their limits; but they merely sweep the wilderness of its best forest growth, and do not lead to permanent agricultural settlements if the soil be not favourable. Emigrants prefer to go farther West in search of good land, and if this is not to be found in Canada they must betake themselves to the United States, or to Central British America. We cannot look to mining enterprise as at all likely to lead to centres of population in the back country north of the St. Lawrence, for very many years to come. Iron and copper ores exist in almost unlimited quantities within a few miles of the shores of the Great Lakes or great rivers, and, indeed, in Lower Canada, within easy reach of the Grand Trunk Railway, and they are much nearer to coal, and to markets, than the mineral wealth of the back country.

That part of the valley of the St. Lawrence which lies within the limits of Canada, occupies about 330,000 square miles, and of this portion 280,000 square miles lie wholly on the north side of the St. Lawrence. By far the greater portion of this vast region is intersected with lakes, and "the profusion in which the lakes exist, with, in some instances, only a short interval of land between them, though they may belong to different river-systems, affords with the aid of birch-bark canoes, a ready means of passing from one navigable stream to another, in whatever part an explorer may be; and then, if he is well acquainted with the country, he can reach almost any position he may wish to attain without any very great deviation from a direct route."†

The length of the Province of Canada from Quebec to the Fort William, on Lake Superior, is about 1100 miles, and the greatest

* It is the fact that the best lands of the Crown in both sections of the Province have already been sold. The quantity of really good land now open for sale, is, notwithstanding recent surveys, much less than formerly, and is rapidly diminishing.—*Report of the Commissioner of Crown Lands for* 1862.

† Report on the Geology of Canada.—By Sir W. E. Logan, F.R.S.

depth likely to become well settled north of Lake Ontario and the River St. Lawrence is 120 miles. On the banks of the Ottawa and some of its tributaries, and of the St. Maurice, this distance may ultimately be increased by a few miles, but on the shores of Lakes Huron and Superior it is far from probable that any but thin and sparse agricultural settlements are possible, even in the rear of the Lakes. Excluding the peninsula portion of Western Canada, the average depth of the country available for agricultural settlements does not exceed 75 miles between Quebec and Fort William. Excluding the North Shores of Lakes Huron and Superior, we have the probable limits of Canada as an agricultural country, defined by a frontier 800 miles long by 100 miles deep, on an average, on the north side of the St. Lawrence. All the best land in Canada is sold; in what direction then can British settlements extend by immigration? assuming that the natural increase of the present population is sufficient to occupy the profitable wild lands already owned by private individuals. The fact is, that Canada is really nothing more than a narrow fertile stripe, 1000 miles long and 75 miles broad on an average,—backed by an undulating mountainous region, susceptible only of agricultural settlements in valleys neither numerous nor broad, considering the immense area occupied by this region.

It is clear then, that in order to preserve our nationality in the face of the astonishing strides towards wealth and political importance which have been made by the United States, we must strengthen our position by extending British civilization where there is room for it to grow and expand.

The North, as an agricultural region, is practically closed against us by the conditions of soil and climate, although it contains abundance of inert wealth, which may yet become productive and valuable.

The East is already preoccupied: the West alone remains to us. We are separated from Central British America by six degrees of longitude, which must be traversed before we can reach a region possessing a soil of remarkable fertility, and occupying a greater extent of surface than the whole available portion of Canada; abounding also in iron ores of the richest description, salt, and lignite coal, and almost entirely unoccupied by man. This barrier has frequently been upheld as an insuperable objection to a practicable

commercial communication between Canada and Central British America, in the absence of correct knowledge of the physical features of the country. The utmost length of the barrier which requires the construction of a road, scarcely exceeds 200 miles. From its western extremity there is an unobstructed navigation, with but one break, to the edge of the fertile prairies of Central British America *via* Rainy River and the Lake of the Woods; and its eastern extremity is connected uninterruptedly with the sea by the Great Lakes and the St. Lawrence. The highest point over which the road from Lake Superior to the northern indent of Rainy Lake must pass, is not 900 feet above Lake Superior; and for the first 30 miles it would traverse a country susceptible of tillage for several miles on either side. Then follows a sudden rise, marked by the great Drift bank of Dog Lake, which forms the Eastern limit of a Drift-covered country stretching in a north-east and south-west direction, and having a breadth of about ninety miles where the road would cross it. This accumulation of Drift covers the height of land to a depth certainly exceeding 150 feet, as shown by the hills at the summit level at Prairie Portage, 885 feet above Lake Superior, and the highest point on the line of road. There are no serious physical impediments to overcome between Lake Superior and the northern indent of Rainy Lake, either for a waggon road or a railway; and this short link of 200 miles completed, the distance between Fort William on Lake Superior and the commencement of the arable prairies of the valley of Red River would be reduced to 200 miles of road or railroad, and 180 miles of steam navigation. Here, then, we see no formidable impediments, which an impression derived from the custom of traversing the country in canoes through the rocky channels of rapid rivers or hill-embosomed lakes, had created in the minds of the few who have traversed that region;—impressions which, too eagerly accepted by the public, notwithstanding the imperfect knowledge of the physical conformation of the country, which a rapid journey without special geographical objects in view is fitted to obtain, have retarded the settlement of the fertile prairies of Red River.

The communication between Central British America, British Columbia, and the Pacific Ocean, is the next point to be considered. The recent successful journey across the Rocky Mountains of the Canadian emigrant party of 1862, by an old and long unused trail,

called the "Old Columbia Trail," with numerous horses and oxen, dissipates all fears for the passage of the Rocky Mountains. Where 70 horses, 130 oxen, and 150 men, women, and children can journey without difficulty, the road still being in a state of nature, it is reasonable to suppose that a small expenditure would convert it into an excellent waggon road.

The Miette Pass and the Thompson's River trail, join Cariboo with the Plains of the Saskatchewan,* and Cariboo is now only seven days' journey from New Westminster—thanks to the energy which has pushed the government roads so rapidly through that "impassable"

* The Canadian Emigrant party of 1862, took through the mountains 130 oxen and about 70 horses. When in the mountains, they killed a few oxen for provisions; others were sold to the Indians at Tête Jaune Câche, on the Fraser; and others were *rafted* down the Fraser River to the Forks of the Quesnelle. At the Tête Jaune Câche, a portion of the party separated from the rest, and, with fourteen horses, went across the country by an old well worn trail to Thompson's River, and thus succeeded in taking their horses from Fort Garry through the Rocky Mountains—through a supposed impassable part of British Columbia, to the wintering station on Thompson's River and Kamloop's Lake, for the pack-animals of the British Columbia gold-seekers.

The Leather, or Miette Pass, lies in latitude 54°, and has long been known to the employees of the Hudson's Bay Company, and as called by them the "Old Columbia Trail," or "Jasper Pass." It will be observed that it forms an immediate and direct connection with the great artery of British Columbia, namely, the Fraser River. The other passes to the south connect with the Columbia River, which flows for many hundred miles through Washington territory. It will not fail to be noticed, too, that the existence of this route viâ the Leather Pass, has only very recently appeared on published maps. It is shown on Arrowsmith's Map of British Columbia, published in 1860; but the success with which its long-established connection with the Fraser was concealed by the late Hudson's Bay Company, is a singular instance of the unity of purpose which has pervaded all the actions of that powerful corporation during their long tenure of absolute control over a portion of British America, containing more land suitable for the abode of man than the Province of Canada itself, and which has already cost in its defence from aggression many millions of money and many thousands of lives. It seems remarkable that the Leather Pass and its easy connection with the Fraser River, escaped the attention of the exploring party sent by the British Government, under Captain Palliser, in 1857, 1858, and 1859. If the existence of this unobstructed communication between the Athabaska Valley and British Columbia had been made known to the world as one of the results of that expedition, probably long ere this the British Government would have taken measures to establish a separate government in Central British America, and open a communication across the continent through British territory. Dr. Hector actually passed the "Old Columbia Trail," but neither his guides nor the people at St. Ann's or Edmonton appear to have informed him of its existence. Fortunately the Leather Pass has now been traversed by men, a woman, children, and numerous oxen and horses:—the Fraser River has been safely descended for four hundred miles from its source, in canoes and on rafts, by a very numerous party, and it has been *ascended* in a boat from Cariboo to the Tête Jaune Câche; and from this last-named place there is a well-known trail for horses to the Thompson River, and thence to New Westminster, which has also been traversed by Canadian emigrants with horses; and more recently, according to Victoria papers, by Lord Milton, with thirteen horses. The difficulties of the Rocky Mountains have in great part melted away, and the "impossibilities" of the overland route have vanished, just as the "uninhabitable deserts and swamps" of the Saskatchewan have given place to boundless fertile prairies, which will probably become—even in our generation—the seat of an enterprising and prosperous people.

wilderness, as to bring the crests of the Rocky Mountains within a week's travel of the Pacific seaboard.

It is not, perhaps, unreasonable to anticipate that difficulties of a political character will arise between the Northern and Southern States with reference to the American telegraph and Pacific railway, as now constructed and contemplated, on and near the 32nd parallel. The route offering most advantages next to that running near the 32nd parallel (the one selected), is the Northern Route, or that lying between the 47th and the 49th parallels. But since the survey of it was made, the passes in the Rocky Mountains have become better known, and there can now be little doubt that the Leather or Miette Pass is between 2,000 and 3,000 feet lower than the pass on the 47th parallel.

It is, however, the remarkable character of the country through which a railway or postal road from the Lake of the Woods to the Miette Pass would traverse, which gives this line of route an extraordinary prominence. The present President of the Southern States, when Mr. Secretary Davis, summed up the comparisons of the different routes in the United States, as regards the character of the country they traverse. The following is an abbreviation of the summary:

	MILES.
Route near the 47th and 49th parallels, from St. Paul to Vancouver..	1,864
Number of miles through arable land.....	374
Number of miles through land generally uncultivable, arable soil being found in small areas	1,490

The greatest number of miles of route through arable land on any one of the lines surveyed, is 670 miles, in a distance of 2,290 miles. The least number of miles of route through generally uncultivable soil, is 1,210, on a line of 1,618 miles in length, near the 32nd parallel.

From the Lake of the Woods, or from Pembina, a line in British territory instead of passing through a desert incapable of supporting human life, would traverse a fertile belt of country, averaging one hundred miles in breadth,* fully able to sustain five times as many

* The arid region of the Missouri valley commences west of the 100th degree of longitude; but the 100th degree of longitude divides the United States into two nearly equal parts on the 40th parallel of latitude. The eastern half is the present fertile and peopled part of the country. The western half is a comparative desert all the way to the Pacific. It is in comparison with this immense desert that the fertile belt at the edge of the woods, stretching in the Saskatchewan Valley from the Lake of the Woods to the Rocky Mountains, stands out in such surprising contrast. Sixty thousand square miles of arable land in Central British America, mark out the true pathway across the continent, which alone is capable of sustaining an efficient means of com-

people as Canada now possesses, and leading directly towards the lowest and by far the most facile pass in the Rocky Mountains.*

Apart from the advantages which Central British America affords as a railroad route over any portion of the United States, the direction and magnitude of its navigable lakes and rivers are of the utmost importance. These border on, or directly traverse, the Fertile Belt, and thus afford a splendid means of access by steamer from Red River to within 200 miles of the Rocky Mountains.†

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munication, whether in the form of a stage road or ultimately of a railway, by the growth of a local population. But the favourable comparison does not rest here. The mountain region, which offers such a difficult barrier to communication between the Pacific and the valley of the Mississippi possesses peculiarities in British America which are in themselves of a very striking character, and quite sufficient to establish the line of route, cutting diagonally the 50th, 51st, 52nd, and 53rd parallels, as far superior in point of physical conformation to any other lines of route which have been explored in British America or the United States.

* Table of comparison between the different passes in the Rocky Mountains, in the United States and in British territory, north of latitude 38°:—

	Altitude of Pass.—Feet.
United States—	
Surveyed Route between the 38th and 39th parallels of latitude	10,032
Route between the 41st and 42nd parallels	8,375
Route between the 47th and 49th parallels	6,044
British territory—	
Kananaski Pass, from the South Saskatchewan to the Kootanie River	5,985
Kicking Horse Pass, from the South Saskatchewan to the Columbia	5,420
Vermilion Pass, from the South Saskatchewan to the Kootanie River	4,944
"Old Columbia Trail," or Leather Pass, from the Athabasca to the Fraser—the Canadian emigrant route—probably below	4,500

The breadth of country forming a continuous mountain region is far greater in the United States than in British America. The United States is crossed by three great systems of mountains, extending generally from north to south. The first system, beginning with the Sierra Madre, and terminating in the Black Hills of Nebraska territory, is partially gorged by the Rio Grande, completely cut through by the North Platte and the Sweet Water Rivers, and turned by the Missouri. It does not extend into British America. The total breadth of mountainous country, in the proper acceptation of the term, within the limits of the United States, varies from 500 to 900 miles. In British Columbia, the greatest length is not more than 380 miles from the Leather Portage to the Pacific; and the actual distance, in an air line, from the Leather Portage to the extremity of Bellhoula Inlet, the possible terminus of a route, does not exceed 460 miles.

† The successive links in a road and steam navigation across the Continent through British America may be as follow:—

1. Road from Fort William to the northern indent of Rainy Lake, *viâ* the MATAWAN River	200
2. Steam from the northern indent of Rainy Lake to the Falls opposite Fort Frances	40
3. Steam from Fort Frances to the north-west corner of Shoal Lake (Lake of the Woods)	130
	370
4. Road from Shoal Lake to Fort Garry	90
5. Steam from Fort Garry to the Grand Rapids of the Saskatchewan	280
6. Steam from Grand Rapids to Edmonton	700
7. Edmonton to the Frazer, *viâ* Miette or Leather Pass, by Road	290
Total distance from Lake Superior to Frazer River—Road, 580; Steam, 1150.....	1730

If an inclined plane or a short canal were constructed at the Grand Falls of the Saskat-

It now remains to glance at the intrinsic worth of the Southern part of Central British America in its agricultural aspects and its mineral wealth as far as known.

The area of cultivable land of the first quality is estimated to be not less than 80,000 square miles, extending from the Lake of the Woods to near the head waters of the Athabasca, and in a narrow stripe on the east flank of the Rocky Mountains as far south as the fiftieth parallel of latitude. The length of this Fertile Belt is about 800 miles, the mean breadth 100 miles, and it is susceptible of cultivation or depasturage throughout. It is capable of sustaining an agricultural population equal to that of the Kingdom of Prussia. The basin of Lake Winnipeg alone, is capable of sustaining an equally numerous population. It contains several million more acres of arable land than the Province of Canada.*

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chewan, there would be an uninterrupted navigation for shallow steamers—such as ply on the Upper Missouri—from Georgetown on Red River, already in communication by stage with St. Paul, and Edmonton, within 200 miles of the Rocky Mountains. The dimensions of the Grand Falls or Rapids of the Saskatchewan are—2¼ miles long, and a total descent of 43½ feet.

* The agricultural capabilities of the Basin of Lake Winnipeg may be summed up as follows:—

	Acres.
On the route from Fort William, Lake Superior, to the Lake of the Woods, including the valley of Rainy River	200,000
The Fertile Belt, stretching from the Lake of the Woods to the flanks of the Rocky Mountains, and as far north as the 54th parallel, on the Athabaska, west of McLeod's River, (80,000 sq. miles)	51,200,000
Isolated areas in the Prairie Plateau, south of the Assiniboine	2,000,000
Isolated areas in the great Plain Plateau, the extension northwards of the great American Desert, and in the valleys of the rivers flowing through it	1,000,000
Total area of Land available for agricultural purposes	54,400,000
Approximate area suitable for grazing purposes	30,000,000
Total approximate area fitted for the abode of civilized man	84,400,000
Approximate area of the Basin of Lake Winnipeg, within British Territory	199,680,000
Area fitted for the abode of civilized man	84,400,000
Desert area unsuitable for the permanent abode of man	115,280,000

Comparing this extent of surface with Canada, we arrive at the following results:—

	Acres.
Area of the Province of Canada (340,000 square miles)	217,600,000
Area occupied by the Sedimentary Rocks (80,000 square miles)	51,200,000
Area occupied by the Crystalline Rocks	166,400,000
If we suppose that one-sixth of the area occupied by the Crystalline Rocks is capable of cultivation, as regards soil and climate, (an estimate probably in excess) the total amount of land in Canada available for the purpose of settlement, will be approximately	78,900,000
Showing an excess of land fitted for the permanent abode of man, in favor of the Basin of Lake Winnipeg over the Province of Canada, of	5,500,000

In Upper Canada, with a population of 1,396,091, there are 13,354,907 acres held by proprietors, of which only 6,051,619 acres are under cultivation, cropped or in pasture. If the

Winter wheat has recently been tried at Red River Settlement with complete success, and all vegetables which will grow in Canada East succeed well at Red River. The mineral wealth of this vast central region is but partially known. Already the existence of extensive beds of Lignite coal on the Upper Saskatchewan and its tributaries have been determined.*

With the lignite coal are also found vast deposits of clay iron-stone. These extend much further east than the lignite layers, which have been removed by denudation, and form a very peculiar and important feature in the rocks west and south of the Assininiboine after it makes its north-westerly bend.†

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whole quantity of land fit for cultivation were occupied in the same proportion, the population of Canada would exceed eighteen millions. At the same ratio of inhabitants to cultivable and grazing land, the Basin of Lake Winnipeg would sustain a population exceeding 19,000,000, or leaving out of consideration the land suitable to grazing purposes, its capabilities would be adapted to support 12,000,000 people. If European countries such as France and Great Britain were taken as the standard of comparison, or even many of the States of the American Union, the number would be vastly greater.

The arid region of the great American desert, which places an uncultivable and uninhabitable wilderness between the present north-westerly settlements in Nebraska and the Rocky Mountains extends into British America only in the form of the apex of the cone shaped figure it has on the map, with its base in the high lands of Texas and Mexico.

* A large part of the region drained by the North and South branches of the Saskatchewan is underlaid by a variety of Coal or Lignite. On the North Saskatchewan coal occurs below Edmonton in workable seams.

A section of the river bank in that neighbourhood shows in a vertical space of sixty feet three seams of Lignite, the first one foot thick, the second two feet, and the third six feet thick. Dr. Hector, who made the section, states that the six foot seam is pure and compact.(a) Fifteen miles below the Brazeau River, a large tributary to the North Saskatchewan from the west, the liguite bearing strata again come into view, and from this point they were traced to the foot of the Rocky Mountains. On the Red Deer River the lignite formation was observed at various points. It forms beds of great thickness; one group of seams measured twenty feet, "of which twelve feet consisted of pure compact coal," (Dr. Hector.) These coal beds were traced for ten miles on Red Deer River. A great Lignite formation of cretaceous age containing valuable beds of coal has a very extensive development on the upper waters of the North and South Saskatchewan, the Missouri, and far to the north in the valley of the Mackenzie. Col. Lefroy observed this Lignite on Peace River, and Dr. Hector recognized it on Smoking River, a tributary of Peace River, also on the Athabaska, McLeod River and Pembina River, all to the north of the Saskatchewan, "thus proving the range of this formation over a slope rising from 500 to 2,300 feet above the sea, and yet preserving on the whole the same characters, and showing no evidence of recent local disturbance beyond the gentle uplift which has effected this inclination."(b)

† The vast deposits of iron ore belonging to the cretaceous series of the Basin of Lake Winnipeg acquire especial importance in consequence of their being associated with equally widely distributed deposits of lignite, and are found not very remote from apparently inexhaustible stores of bitumen and petroleum (on Clear Water River,) which as a fuel adapted to raising elevated temperatures in a regenerating furnace has no equal.

(a) Proceedings of the Geological Society, 1861, page 421.

(b *Ibid*, page 426.

Salt is widely distributed, and the rocks yielding this material have been traced from the boundary line beyond the Saskatchewan towards Lake Athabaska.*

Gold is known to exist throughout the Drift on both the branches of the Saskatchewan and its tributaries. Gold has also been found on the Assinniboine, and on some of the tributaries leading into the Qu'appelle or Calling River, hence, reasoning from known facts respecting the source and direction of the Drift which covers the country within 150 miles of the Rocky Mountains, there is the best ground for the belief that the source of the Assinniboine gold lies on the east side of the Basin of Lake Winnipeg, and will be found in altered Silurian rocks (already recognized) reposing on the Laurentian strata which form the east shore of Lake Winnipeg, and stretch thence towards Lake Athabaska.

The extensive bituminous deposits which occur on Clear Water River belonging to the Athabaska† valley, deserve mention, as valuable deposits in store for future use.

In contemplating the future of Central British America one important feature appears to be neglected, if not entirely overlooked. While Lake Winnipeg is 2500 miles from the sea board of the Gulf of St. Lawrence, and lies exactly in the centre of the American Continent under the 51st parallel, its northern extremity is only 380 miles from the tide waters of Hudson's Bay.

The mouth of the Saskatchewan is as near to the open sea as Fort

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*This important material is distributed throughout a large part of the valley of Red River, the basin of Lakes Manitobah and Winnepegoosis, and thence north-westerly towards the Arctic Sea; the Brine Springs occur at the junction of the Silurian and Devonian rocks of the Winnipeg Basin, and have already yielded salt of excellent quality in several localities. Many years ago (1823) salt was manufactured at Pembina, and more recently at the salt works, Manitobah Lake, by Red River natives, and at Swan River by the Hudson's Bay Company. Springs rich in brine are known to exist in upwards of twenty different places along a stretch of country extending from the boundary line to the Saskatchewan. In the valley of La Rivière Sale, about twenty-six miles from Fort Garry, salt springs are numerous, and the ground in their vicinity is frequently covered with a thick incrustation.

†Although the Athabaska district, as a whole, may be remote from the line of settlements which will be first established across the continent, yet it is a vast territory in reserve, and one which as time rolls on will become peopled with a pastoral race, and eventually exercise an important influence upon the more fertile and arable districts of the North Saskatchewan. As a great grazing country it will early attract attention; and its vast stores of bitumen will be a source of great utility where portable fuel and means of creating artificial light must command a remunerative price, when the increase of population calls into existence those necessaries which belong to civilized communities. The Athabaska district should by no means be shut out of view in contemplating the future of the Basin of Lake Winnipeg. Its proximity to the auriferous valleys of the west and east flanks of the Rocky Mountains will soon secure for it a conspicuous position in the future of the NORTH-WEST.

Garry is to the western extremity of Lake Superior. The passage from Norway House, at the northern extremity of Lake Winnipeg, to Hudson's Bay is made in nine days with loaded boats. It is not unreasonable to suppose that by the introduction of tramways over the portages, the journey may be made in four days, thus bringing Lake Winnipeg within four days of the Sea, yet the nature of the communication now followed is such that it would not admit of vessels much larger than freighter's boats being employed. The navigation of Hudson's Bay for sailing vessels is safe for a period not exceeding six weeks—for steamers it may be double that time. Hitherto the mode of communication adopted by the fur traders between Norway House and Hudson's Bay has been sufficient for the exigencies of the fur trade; it is not at all improbable that more easy means of communication with the sea board exists than those which are now pursued. Under any circumstance it is a fact of the highest importance that Lake Winnipeg is actually within a week's journey of the ocean, over a natural road by which troops have already entered and departed from Central British America. It is more than probable that whenever the necessity arises, the communication between Lake Winnipeg and Hudson's Bay, and thence to the Atlantic, by the aid of steamers, will be made easy and speedy for at least three months in the year.

The outlet by which the waters of the Saskatchewan and Lake Winnipeg reach the sea, is Nelson River. The chief reason which induces the Hudson's Bay Company to send their cargoes of furs to York Factory by Hayes River, is stated to be the difficulties and dangers of the tracking ground on the banks of Nelson River, arising from impending masses of ice on the precipitous banks. The head of tide-water in Nelson River may yet become the seat of the Archangel of Central British America, and the great and ancient Russian northern port—at one time the sole outlet of that vast empire—find its parallel in Hudson's Bay.

It has been shown that the natural resources of Central British America are amply sufficient to sustain a large population. The existence of gold over wide areas in the Drift which covers the country, will ensure a rapidly increasing immigrant population, which, from the nature of their occupation, will necessarily be consumers of agricultural and manufactured products, so that there will be, for some years to come, a home market for whatever the soil can pro-

duce, which will soon extend to home manufactures of the coarser description.

Meanwhile communication with British Columbia under the projects contemplated by the new Hudson's Bay Company will rapidly progress, and also with Canada *viâ* Lake Superior, and the United States *viâ* Red River and St. Paul.

Apprehensions may arise that the present easy access which the navigation of Red River offers to immigrants from the States will, in view of various circumstances gradually developing themselves, introduce a population to the fertile valley of the Saskatchewan, hostile to British Institutions and British connection.

The grounds for these apprehensions are as follow:

First: The limit which the American Desert establishes to the westward progress of settlement in the States. This limit is about one degree of longitude west of Fort Garry* and beyond it, south of the boundary line, large agricultural settlements cannot extend in Minnesota or Nebraska, or further south than these states; nor north, even in Central British America, until the limits of the "Fertile Belt" are reached.

Second: The necessity for a new line of Pacific Railway other than that near the 32nd parallel, adopted by the United States Government, which lies within the country claimed by the Southern States.

Third: The incomparable superiority of the country in Central British America for a railroad or postal route to the Pacific to any part of the United States north of the 32nd parallel. This superiority consists in the line of route passing through rich arable land to the foot of the Rocky Mountains, in contradistinction to an uninhabitable desert through which a railroad or common road would have to pass in any part of the United States; and also to the low altitude of the Pass in the Rocky Mountains.

Fourth: The existence of gold widely distributed, and in quantities, according to the latest intelligence, amply sufficient to prove remunerative to the industrious miner, not only on the east flank of the Rocky Mountains but also in the Drift, near the western shores of

* The longitude of Fort Garry is 95°, 52' 27", latitude 49° 52' 6". Pembina Mountain which marks the limit of the good land in the State of Minnesota, west of Red River, is on an average about thirty miles distant from the River. Beyond the 101st degree of longitude in the United States, agricultural settlements on a large scale are not possible on account of aridity.

Lake Winnipeg, with the probability of its matrix being found both in the Rocky Mountains and also near the western flanks of the Laurentian Range.

As opposed to these apprehensions we have,—

First: The comprehensive scheme of settlement proposed by the new Hudson's Bay Company, which will tend to people the valley of Red River and the Saskatchewan with settlers possessing British sympathies, and the strongest attachment to British rule.

Second: The fact that the best lands in Canada are now sold, and immigrants will prefer to go farther west in search of cheap available *prairie* land of the best description in Central British America, to settling on the comparatively poor *timbered* lands which yet remain in Canada at the disposal of the government.

Third: The manifest eagerness with which the people of Canada look forward to the opening of an easy and rapid communication between Lake Superior and Red River, and the unanimous determination which exists amongst all classes to uphold British rule on British soil.

Fourth: The material assistance ($50,000 per annum) which the Canadian Government, and the Government of British Columbia ($50,000 per annum), propose to render the Hudson's Bay Company in providing a rapid and easy means of communication across the continent through British territory, and in the construction of a telegraph, already commenced, to connect the Pacific with the Atlantic Ocean, also through British America. The electric telegraph annihilates distance, and will, when completed, unite all parts of this vast dominion and, in effect, bring it within reach of the central or governing power.

Fifth: The prospect of not only regaining, on a vastly enlarged scale, extending to China and Japan, the lucrative transit trade which in the time of "The Nor'-West Company" enriched so many of our merchants, but also that prospective trade which must necessarily spring up with a country abounding in all things suitable for the maintenance of a large population, and whose course towards the ocean lies naturally through the St. Lawrence, and in its most direct line seaward, exclusively through British America.

Sixth: The consciousness that the physical difficulties which oppose the direction of that trade in the desired channel, are of such a character as the means now at the disposal of those who have

already taken the matter in hand can successfully and easily overcome.

And lastly: The growing conviction among the people of British America, and of many in England, that the maintenance of British rule over that portion of the American continent is in a great measure dependent upon united action on the part of the different Colonial Governments, which must ultimately, and perhaps soon, lead to a closer union between them, in the form of a Federation and Vice-Royalty, under the protection of, and in intimate alliance with, the British Crown.

A necessary preliminary step in the establishment of a Federation of the British American Provinces, would probably be the legislative union of Nova Scotia, New Brunswick, Prince Edward Island, and Newfoundland. These Provinces have an aggregate population of 822,000 souls,* and an area of 84,353 square miles. The value of

* The population of Newfoundland, in 1851, was 101,600; in 1857, it was 122,638; at the present time it is probably 140,000. Of New Brunswick, the population, in 1840, was 154,000; in 1851, 193,800. Its present population is estimated at 234,000 souls. The population of Nova Scotia, in 1851, was 276,000; in 1861, 330,857—its rate of increase being in the last ten years within a fraction of 20 per cent.; and at the commencement of 1864, its population may, at the same rate of increase, be estimated at 352,000. The population of Prince Edward Island, in 1851, was 55,000; in 1861, it was 80,856; and it now probably exceed 95,000 souls.

	Area in sq. miles.	Estimated pop. Jan. 1864.
New Brunswick	27,620	235,000
Nova Scotia and the Island of Cape Breton	18,600	352,000
Newfoundland	36,000	140,000
Prince Edward Island	2,133	95,000
Total area	84,353	822,000
Estimated area available for agricultural purposes 52,000	—	—
Upper Canada	140,000	1,520,000
Lower Canada	200,000	1,200,000
Estimated area of the Province available for agricultural settlement	90,000	—
Basin of Lake Winnipeg and Valley of the River Athabaska [Exclusive of Indian population (40,000)]	400,000	15,000
Estimated area available for agricultural settlement	95,000	—
British Columbia and Vancouver's Island [Exclusive of Indian population (60,000)]	210,000	50,000
Assumed area suitable for agricultural purposes	30,000	—
Total area	1,034,353	3,607,800
Estimated area available for agricultural purposes	267,000	—

Or about nine times the area of Great Britain and Ireland. But throwing out what may be called the inferior and desert portion of this immense territory, we find the area of the agricultural portion to be approximately 267,000 square miles, or as large as France, Holland, and Denmark put together, with an aggregate population approaching four millions.

their fisheries alone is $15,000,000 per annum; and they have immense available supplies of timber, iron, and coal, together with more than one thousand miles of sea coast, provided with excellent harbours. The total population of British America at the present moment approaches four millions, and the quantity of land *available for agricultural purposes*, is approximately 267,000 square miles—or more than twice the area of the United Kingdom of Great Britain and Ireland; and equal to France (including Corsica), Belgium, Holland, and Portugal combined.

This portion of the British empire contains within itself all those elements of material wealth which assist in creating populous and powerful nations; and besides these advantages, it possesses unsurpassed facilities for becoming the great commercial highway between the Pacific and the Atlantic. With such resources and possible future, it is neither vain nor premature to consider the expediency of consolidating the interests of the different and virtually independent Governments into which it is now divided, and of securing the speedy occupation and future allegiance of the key-stone of the arch, CENTRAL BRITISH AMERICA, upon which their prospective political and commercial position, as a great Federation, will be mainly dependent.

TESSERÆ CONSULARES.*

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THE relics of antiquity, which are known by the designation *tesseræ consulares*, are small oblong pieces of ivory or bone, with four faces,† bearing an inscription, a part of which is cut on each of the

* Mommsen, *Corpus Inscriptionum Latinarum*, vol. i. p. 195. Berlin, 1863.
Cardinali, *Diplomi Imperiali*, p. 121. Velletri, 1838.
Morcelli, *Delle tessere degli spettacoli Rom.*, ed. Labus, Milan, 1827.

† There is one which has six faces. See Marini, *Atti*, p. 822. It bears the inscription—

PINITVS
ALLEI
SP·K·FEB
TI·CL·CAES·II
C·CAEC
COS

faces, so that it is doubtful with which we should begin. These four parts of the inscription are generally—a name in the nominative, always of a man; a name in the genitive, generally of a man; the letters SP. with the day of the month, and the names of the consuls whereby the year is indicated. On some *tesseræ* the month is stated, but not the day; and on some both names are in the nominative. There are also other peculiarities, which may be noticed in the following varieties:

(1)
DIOCLES
LONGIDI
SP·K·SEP
CN·OCT·C·CVR

(2)
AESCINVS
AXSI
SP·A·D·VII·K·A
Q·HOR·Q·MET

(3)
PELOPS
PETILI
SP·ME·QVI
CN·LE·L·PHIL·COS

(4)
MYRTILVS
ATTIAE
SP·III·N·IVN
L·SVLL·L·SVLP

(5)
FLORONIVS
ROMANVS
SP·K·DEC
L·CAN·Q·FABR·COS

(6)
C·NVMITORIVS
NORBANVS
SP·III·K·FEB
A·LIC·Q·CRET·COS

(7)
REPENTINVS
CANINI
SP·N·IAN
SER·COR·L·VIS

(8)
CELER
CLODI
SP·ID·IVL
L·ASPR·A·PLAVT

(9)
PAMPHILVS
SERVILI·M·S
SPE·K·FEB
C·CAES·M·LEP

At first sight it is plain that the names in such inscriptions as (1), (2), (3), (4), (7), (8), and (9), are those of a slave and his master or mistress: in (9) the S, standing for SERVUS, is expressed. It is also plain that the names in (5) and (6) are those of

freemen. In (1), (2), (4), (5), (6), (7), (8), and (9), the day of the month is stated, but in (3) only the month. In (1), (5), (7), (8), and (9), the leading divisions of the Roman month—*scil.* Calends, Nones, and Ides—are mentioned; but in (2), (4), and (6) intermediate days. In (2) A.D. (*ante diem*) are given; but in (4) and (6) they are omitted. In (3), (5), and (6), but in none of the others, COS follows the names of the consuls. On further enquiry relative to these peculiarities, we find that of the sixty-two *tesseræ*, which are admitted by the best authorities to be genuine,* only five bear the names of freemen. Three give the month alone, and they differ from the others in this particular, that they were not found in or near Rome, but in other localities.

The letters A.D. are found on the most ancient: the oldest of those on which they are omitted is of the date A.D. (*Anno Domini*) **5**. Of the fifty-eight, which state the day of the month, twenty-four give the Calends, twelve the Ides, four the Nones, and eighteen intermediate days. COS does not appear on any, which were found at or near Rome, of a date before 52 B.C., but is common on those that were found there of dates after 8 B.C. The earliest date which is inscribed on any of the *tesseræ* is = 85 B.C., and the latest = 74 A.D.

From these preliminary observations it is evident that no part of these inscriptions presents any difficulty,† so far as the reading of

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* No fewer than twenty-eight, of which four or five are in the British Museum, are regarded as "suspected or false" by Mommsen, either on his own authority or in conjunction with that of Borghesi, Henzen, Hefner, Cardinali, or Olivieri. Borghesi remarks that Ligorius did not forge any *tesseræ*, and that counterfeits were not known before the commencement of the 18th century. Mommsen accepts this statement as generally but not universally true.

† As some of my readers may require aid, I subjoin the readings and translations of the examples, which I have given in p. 428:—

(1)

Diocles	Diocles
Longidii	of Longidius
(servus)	(the slave)
Sp——Kalendis Septembribus	—— the 1st of September,
Cneio Octavio Caio Curione	in the consulship of Cneius Octavius and Caius (Scribonius) Curio *i.e.* A.U.C. 678 or B.C. 76.

(2)

Æscinus	Æscinus
Axsii	of Axsius
(servus)	(the slave)
Sp——ante diem septimum Kalendas Apriles	—— the 26th of March,
Quinto Hortensio Quinto Metello	in the consulship of Quintus Hortensius and Quintus (Cæcilius) Metellus *i.e.* A.U.C. 685, or B.C. 69.

them is concerned, except the letters SP, or, as it is given in n. (9), SPE.

(3)

Pelops	Pelops
Petilii	of Petilius
(servus)	(the slave)
Sp——mense Quintili	—— the month of July
Cneio Lentulo Lucio Philippo consulibus	in the consulship of Cneius (Cornelius) Lentulus and Lucius (Marcius) Philippus *i.e.* A. U. C. 698, or B.C. 56.

(4)

Myrtilus	Myrtilus
Attiæ	of Attia
(servus)	(the slave)
Sp——tertio Nonas Junias,	—— the 3rd of June
Lucio Sulla Lucio Sulpicio	in the consulship of Lucius (Cornelius) Sulla (Felix) and Lucius (Servius) Sulpicius (Galba) *i.e.* A. U. C. 786, or A.D. 33.

(5)

Floronius	Floronius
Romanus	Romanus
Sp——Kalendis Decembribus	—— the 1st of December,
Lucio Caninio Quinto Fabricio consulibus	in the consulship of Lucius Caninius and Quintus Fabricius *i.e.* A. U. C. 752, or B.C. 2.

These consuls were *suffecti*: the *ordinarii* were Augustus and M. Plautius Sylvanus.

(6)

Caius Numitorius	Caius Numitorius
Norbanus	Norbanus
Sp——tertio Kalendas Februarias	—— the 30th of January,
Aulo Licinio Quinto Cretico consulibus	in the consulship of Aulus Licinius (Nerva Silanus) and Quintus (Cæcilius Metellus) Creticus *i.e.* A. U. C. 760, or A.D. 7.

(7)

Repentinus	Repentinus
Caninii	of Caninius
(servus)	(the slave)
Sp——Nonis Januariis	—— the 5th of January,
Servio Cornelio Lucio Visellio	in the consulship of Servius Cornelius (Cethegus) and Lucius Visellius (Varro) *i.e.* A. U. C. 777, or A.D. 24.

(8)

Celer	Celer
Clodii	of Clodius
(servus)	(the slave)
Sp——Idibus Juliis	—— the 15th of July
Lucio Asprenate Aulo Plautio	in the consulship of Lucius (Nonius) Asprenas and Aulus Plautius *i.e.* A. U. C. 782, or A.D. 29.

These consuls were *suffecti*: the *ordinarii* were L. Rubellius Geminus and C. Fufius Geminus.

(9)

Pamphilus	Pamphilus
Servilii Marci Servus	of Marcus Servilius the slave
Spe——Kalendis Februariis	—— the 1st of February
Caio Cæsare Marco Lepido	in the consulship of Caius (Julius) Cæsar and Marcus (Æmilius) Lepidus *i.e.* A. U. C. 708, or B.C. 46.

The expansion of these letters, which has been generally adopted by Epigraphists from the 16th century, is SPECTATVS, with reference to gladiators, whence the objects are also called *tesseræ gladiatoriæ*. This view is supported by the consideration that the great majority of the persons mentioned are slaves, but few are freemen, and there are no names of women in the nominative.

The sense, in which this expansion was generally* understood, was that the gladiator, to whom the *tessera* was given, was "tried," "approved," and allowed to retire on the specified day of the month in the year indicated by the specified consuls. In support of this interpretation the well-known verses were cited:

> "Spectatum *satis, et donatum jam rude quæris,*
> *Mæcenas, iterum antiquo me includere ludo.*"

Morcelli, *de Stilo*, i. p. 412, suggested, instead of *spectatus, spectavit*,† on the authority of an inscription given by Tomasini and Fabretti, in which that word appeared on a *tessera, in extenso, scil.* PILOMVSVS·PERELI·SPECTAVIT. The sense in which he understood the word, was—"was a spectator," "took his seat amongst the citizens and looked on." He believed that these *tesseræ* were given to gladiators, who had received not only the *rudis*, but liberty, and that they entitled those who had received them to sit amongst the citizens. The inscriptions would thus be regarded as stating the date of the first occasion on which such gladiators availed themselves of the privilege conferred by the presentation of the *tesseræ*. Another expansion, *spectaculum*, has been proposed by Gori, *Inscrip.* i. 74, but I am unable to conjec-

* Thus Reinesius, *Syntag.* p. 372, remarks: "*Fulvius Ursinus putabat significari videri, quo anno seu consulatu, mense ac die gladiator spectatus, diu multumque in arte versatus, rude sit ac tessera eburnea donatus, quibus solutum se palæstræ atque arenæ legibus athletam ostenderet.*" Amati, *Giornale Arcad.* 1826, explains *spectatus* thus: "*Le picciole taglie quadrilatere di avorio or di osso erano visibili documenti di morte per essi gladiatori ad altri recata, e almeno di sanguinosa vittoria ottenuta con atterrar l'avversario.*" Tomasini, *de tesseris*, makes the astonishing statement: "*Erat autem rudis tessera quædam eburnea, cui nomen gladiatoris ætate emeriti inscribebatur quam qui accipiebat, is ab omni pugnandi necessitate eximebatur.*" It is scarcely necessary to remark relative to this view, that there is no authority for the notion that the *rudis* was a *tessera*.

† Ursatus, *de Notis Romanorum*, remarks: SP. Spectatus. *Pignorius, q'ui*, de Servis, *scribit, hanc notam quæ doctos viros hucusque torsit, nihil aliud* "*Significare, quam, spectavit, ut detur intelligere, conductos fuisse aliquos, veluti ab editore, gladiatores insignes, rude olim donatos, spectandi gratia, non pugnandi.*" Pitiscus, *Lexicon*, in *tessera*, Facciolati, *Lexicon*, in *Specto*, and Orelli, n. 2561, adopt the view of Morcelli. Henzen, n. 6162, seems to prefer *spectatus*. Zell, *Delectus*, p. 60, reads *spectandus*.

ture in what sense* he understood it. Morcelli, who notices this expansion, dismisses the reading with the expressive phrase—*quod miror*. His own expansion, however,—*spectavit*,—cannot be received, even though a second† inscription, in addition to that given in p. 431, may be cited in its favour, for there can be but little doubt that both these inscriptions are forgeries. Besides, we may now assume that the first two syllables of the word are SPECTAT, on the authority of the following inscription, on an unquestionably genuine *tessera*, published for the first time by Mommsen,‡ p. 201:

MENSE·FEBR·M·TVL·C·ANT·COS·ANCHIAL·SIRTI·L·S·
SPECTAT·NVM.

From this it appears that of the two expansions *spectatus* is the more probable; but even it is not satisfactory, and Mommsen with good reason calls it in question. He objects that the words of Horace by no means prove that *spectatus* was the proper or ordinary term for expressing the fact that a gladiator had fought.‖ *Pugnavit*, he believes, would be much more clear and suitable than *spectatus est*. He also notices the inconsistency of the days named on the *tesseræ* with the days, which we know were fixed for the *ludi gladiatorii* at Rome, *viz.* a.d. xiii. xii. xi. x. k. Apr. To these objections I would add, that there is no notice, so far as I am aware, in any ancient author, of *tesseræ gladiatoriæ*.§ The designation is

* Muratori, *Nov. Thes.* p. MCXI. n. 2, explains SP. as meaning that the person named informed the people that he had given or intended giving a *spectaculum*.

† See Mommsen, *c.* p. 200.

‡ The account of this is so interesting that I give the words: "*Sero reperi in libro ms. Lanthelmi Romieu Arelatensis scripto a.* 1574, *servatoque hodie Lugduni Bat. inter Voss Germ. Gall. Q*, 1. *Legitur ibi f.* 88 *sic:* Ores ie commence icy à fere mention des Epitaphes d'Arles —— ——et en premier lieu ie veux reciter l'escrit memorable, qui se list clairement en une piece d'ivoire ou plustot de corne de cerf, que i'ay, qui a esté nouvellement trouvée icy a la poincte au bord du Rosne, la quelle est si menue et estroicte, qu'elle n' est pas plus longue, ne plus large, que la moytie du petit doigt de ma main, etant percée à l'un des bouts: ou est faite mention de Ciceron, et de Caius Antonius."

‖ The sense, in which the word was understood by the greater number of those who received it, conveyed more than this, as I have stated in p. 431. Mommsen's objection, however, as to the application of *spectatus* to gladiators is valid in whatever sense the term was taken. Indeed I do not recollect any passage in a Latin author, besides that cited from Horace, in which *spectatus* is used with a reference, direct or indirect, to gladiators.

§ This designation is used by Maffei, Fabretti, Orsato, Marini, &c. And yet the phrase is, as I have remarked, unsanctioned by ancient authority. There is no passage, with which I am acquainted, that mentions any such object as a *tessera* given as a reward, unless the words *tabulam illico misit* in Suetonius, *Claudius*, c. 21, be taken in this sense, as Morcelli interprets them. His explanation, however, is, in my judgment, very unsatisfactory. He seems to have forgotten the statement in Dio Cassius, lx. 13, relative to the usage of Claudius at these shows:—κήρυξι μὲν ἐλαχίστα ἐχρῆτο, τὰ δὲ δ. πλείω ἐς σανίδας γράφων διεδήλου. *i.e. Præconibus rarissime usus est ac pleraque* tabulis inscripta *significavit*.

a modern invention, accepted and used by those archæologists who read SP as *spectatus*, with reference to gladiators. As the explanation, which has been commonly received, is open to objections and cannot be satisfactorily sustained, I venture to offer a suggestion, which seems to me to give a more probable solution of the difficulty. Previously to stating my own view, I must briefly notice the conjecture, which I have seen somewhere, that these objects were *tesseræ frumentariæ*. On this it seems sufficient to remark, that the forms and inscriptions of those *tesseræ* were not similar, and that such tickets were not given to slaves, as appears from Persius, *Sat.* v. 74: *Libertate opus est: non hac qua quisque Velina Publius emeruit, scabiosum tesserula far Possidet.*

Nor does a reference to any usage amongst the Greeks throw any light on the subject. They had, certainly, in use small pieces of ivory, known as *tesseræ theatrales*, but they are entirely different from those objects called *tesseræ gladiatoriæ* or *consulares*. They generally have on one side the name of a deity or man, with a number in both Greek and Latin, and on the other a head or other design, and were most probably* used as tickets of admission to the theatre, the row being designated by the number, and the block (*cuneus*) being known by the name of the deity or man. Thus:

VII
ΑΡΗC
Ζ

in which the seventh row of the *cuneus*, called Mars, is indicated. When I first examined the inscriptions on the *tesseræ consulares*, I had seen only those containing the names of slaves, and was inclined to conjecture that they might have been given to persons of that class as testimonials of approved character. Thus Terence, *Adelphi*, v. 6, 5, *is mihi profecto est servos* spectatus *satis*. On re-examination of the subject two or three years ago, I found the names of freemen also; and observing the frequent mention of the Calends, Nones, and Ides, I was led to think that the *tesseræ* were in some way connected with money. Hence I conjectured that the word was SPECTATOR, in the sense "examiner of money;" and now, perceiving that this conjecture derives support from SPECTAT·

* See Morcelli, ed. Labus, *De alle tessere*, &c.; Rochette, *Mem. de L'Inst. de France*, xiv. 265; Henzen, *Annal. Inst. arch. Rom.* xx. 273; and Curtius, *Corp. Inscrip. Græc.* iv. 273.

NVM· (*i.e.*, as I read it, *spectator numorum* or *numularius*)* in the recently published Arles inscription, I submit this reading as more probable than any of which I am aware.

Of the use of *specto* and its derivatives in this sense, the following passages afford sufficient evidence: *Ex omni pecunia certis nominibus deductiones fieri solebant, primum pro* spectatione, &c. Cicero, *Verr.* v. 78; *Cape hoc, sis. Quin das? Numi sexcenti heic erunt Probi, numerati; fac sit mulier libera, Atque huc continuo adduce. Jam faxo heic erit. Non, hercle, quoi nunc hoc dem* spectandum, *scio.* Plautus, *Persæ*, iii. 3; *Quum me ipsum noris, quam elegans formarum* spectator *siem.* Terence, *Eunuch*, iii. 6, on which Donatus remarks: "*Spectator, probator, ut pecuniæ* spectatores *dicuntur;*" *Adcipe: heic sunt quinque argenti lectæ numeratæ minæ.* Plautus, *Pseudol*, iv. 7, 50; *Lectum'st: convenict numerus quantum debui.* Terence, *Phormio*, i. 2, 3, on which Donatus remarks: "Spectatione *lectum est;*" *Veri speciem calles, ne qua subærato mendosum tinniat auro?* Persius, v. 105, on which Kœnig remarks: *Sumptum hoc ab illo hominum genere, quorum erat* probare numos, *quique* spectatores *vel docimastæ vocabantur.* In later times, the provers of gold were called *spectatores*, as we know from Symmachus, *Epist.* iv. 56:—*Nullo jam provincialis auri incremento trutinam* Spectator *inclinat.* In none of our English works on Archæology is there any explanation of either of these terms—*spectatio* or *spectator*—but the necessity for employing persons skilled in distinguishing base from good coin, and the origin of this *spectatio*, are well pointed out in an article by Dr. Schmitz, on *Moneta*, in Smith's "Dictionary of Greek and Roman Antiquities":

"As long as the Republic herself used pure silver and gold, bad money does not seem to have been coined by any one; but when, in 90 B.C. the tribune Livius Drusus suggested the expediency of mixing the silver which was to be coined with one-eighth of copper, a temptation to forgery was given to the people, and it appears henceforth to have occurred frequently. As early as the year 86 B.C. forgery of money was carried on to such an extent, that no one was sure whether the money he possessed was genuine or false, and the prætor M. Marius Gratidianus saw the necessity of interfering. (Cic. *de off.* iii. 20.) He is said to have discovered a means of testing money and of distinguishing the good from the bad denarii. (Plin. H. N. xxxiii. 46.) In what this means consisted is not clear; but some method of examining silver coins must have been known to the Romans long before this time. (Liv. xxxii. 2.)"

* The *numularii* did more than tell whether coin was good or base. They seem to have been like our money brokers. Their occupation and position were below those of *argentarii*. In the Theodosian Code, xvi. 4, 5, *servi* and *numularii* are classed together.

Dr. Schmitz's interpretation of the passage in Pliny's Natural History seems to me very doubtful. The words are—"*Miscuit denario triumvir Antonius ferrum. Miscentur æra falsæ monetæ. Alii e pondere subtrahunt, qu a sit justum lxxxiv e libris signari. Igitur ars facta denarios probare, tam jucunda lege plebi, ut Mario Gratidiano vicatim totas statuas dicaverit. Ars facta denarios probare* do not appear to me to signify—"a means of testing money and of distinguishing the good from the bad denarii was discovered," for that cannot have been done *lege*, "by a law;" but rather "the testing of denarii was made an art, became a recognised occupation," *i.e.* the law of Gratidianus provided for the appointment or recognition of a certain class, whose business it was to distinguish good and base denarii. It seems probable that this law also had enactments relative to ascertaining the competency of those persons, who were to practise this art, and as to distinguishing them when approved. Thus the origin of *spectatores* may, perhaps, be traced to this law; and it is not unworthy of remark, that the oldest *tessera* of the whole series is of the date, 85 B.C.

It seems not improbable then that these *tesseræ* were carried, or, it may be, hung round the neck, by those who acted as *spectatores*, as badges indicative of their occupation, and that the inscription showed that they were authorized to act as such, having been approved on the stated days, or in the stated months. Thus the frequency of the occurrence of the Calends, Nones, and Ides seems to be satisfactorily accounted for; for these were, as is well known, the settling* days, the principal times for money transactions. But a question presents itself—which may also be asked if we accept the old reading *spectatus* with reference to gladiators—why the days are stated on those *tesseræ*, which were found at or near the city, whilst the three examples of the month alone are on those found in other places, *viz.*, Parma, Modena, and Arles? Mommsen is of opinion that perhaps we should take in these instances the month as used for the Calends of the month—"*fortasse intelligendæ sunt ipsæ kalendæ in tesseris his nescio quomodo præcipuæ.*" Another explanation of this distinction may be given by supposing that these badges or certificates were issued in Rome on any day of the month, on which they were applied for, especially the Calends, Nones, and Ides, being those on

* *Nemo Kalonio molestus est neque* Kalendis *Decembribus neque* Nonis *neque* Idibus. Cicero, *Verr.* ii. 1, 57; *Omnem redegit* Idibus *pecuniam, Quærit* Kalendis *ponere.* Horace, *Epodes*, ii. 69, on which see Orelli.

which the services of the *spectatores* would be most required ; whilst in the country parts they were issued only once in the month, the day for such issue not being fixed, but left to the discretion of the issuing officers.

Still another view may be taken, that these *tesseræ* indicated the time, not from which the persons holding them might act as *spectatores*, but for or during which they were empowered to discharge that duty —in the city for a specified day— in the country for* a specified month.

In addition to the inscriptions of this class which have been already noticed, there is an unique, which Mommsen believed that he he had found on one of the *ollæ ex Vinea S. Cæsarii*. The inscription stands thus :

FELIX·PETIC·SP K FEB
M·CAES·GALIVS

This so closely resembles those found on *tesseræ*, that that distinguished Epigraphist, although well aware that those *ollæ* bore funereal records, attempted to discover the names of the consuls in the second line, and proposed M·CAESO·GAB·COS. *i·e. Marco Cæsonino et Gabinio consulibus, scil.* the Piso and Gabinius of A. U. C. 696. He now, however, p. 212, justly abandons this reading. It is difficult to decide for what SP stands there : the most probable expansions are *Servus Publicus*, and S[E]P for *Sepultus*, the latter of which is preferable.

There is also a singular object, apparently of this class, in the Museum at Paris, as noticed by Chabouillet, *Catalogue des camées et pierres gravées de la Bib. Imp.*, n. 3171. It bears the following inscription :

D·IVNIVS
HERMETVS
SPECT K·MAR
M LEPID Q CAT

There is reason to suspect that this is a forgery, for the *tessera* is not of ivory or bone but of metal.

* There is no objection to the Latinity of *mense* in this sense, *viz.* "during."

A POPULAR EXPOSITION OF THE MINERALS AND GEOLOGY OF CANADA.

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(Continued from page 219.)

The Upper Silurian Series:—This subdivision in Canada—as separated from the Middle Silurian series—contains but two groups of strata: the Onondaga formation at the base of the series, and the succeeding Lower Helderberg division; but the latter, as regards the greater part of the Province, is but feebly represented.

The Onondaga Formation:—This division, more commonly known as the "Onondaga Salt, or Gypsiferous, Group," derives its name from the village of Onondaga, near Syracuse, in the State of New York. The abundant brine-wells of that locality belong to the group. In Canada, the Onondaga deposits average in thickness between two and three hundred feet, and consist essentially of thin-bedded dolomites, usually of a yellowish colour, with greenish shales (chiefly argillaceous dolomites), and some associated masses of gypsum. The latter substance, so largely employed as a mineral manure, and in the preparation of *Plaster of Paris* (see PART II.), does not occur in regular beds, but in large lenticular masses, as exhibited in the annexed figure. The dolomitic layers above the gypsum, are generally arched, and more or less fissured; whilst those on which the gypsum rests, retain their normal condition. The disturbance, consequently, by which the upper beds have been affected, was evidently produced by some after cause connected with the presence of the gypsum. The peculiarity was originally explained by assuming the gypsum to have been derived from the surrounding rocks by the gradual action, upon these, of springs containing a certain amount of free sulphuric acid: springs of this kind occurring, at present, at several localities in Western Canada and New York. But it is now regarded by Professor Sterry

Fig. 226

Hunt as more probably due to the contraction of the gypsum masses having been less than that of the overlying and contemporaneously deposited shale materials, in consequence of which, the latter would gradually settle down and fold themselves around the gypsum. Another view assumes the sulphate of lime to have been originally deposited in the form of *anhydrite*, a closely related mineral but without water of crystallization. The after absorption of water would then cause an increase in bulk, and so produce the bulging and fracturing of the overlying beds.

Fossils are scarcely known in this formation. A few obscure and rare traces of organic forms are all, indeed, that have been recognized in Canadian localities. The Onondaga deposits are in great part of chemical origin, and were evidently accumulated in strongly saline waters, principally by evaporation: facts which go far to explain the absence of organic remains. The only forms of probable occurrence would be certain cyproids or bivalve entomostracans, as species of these, at the present day, inhabit brine solutions in which an active evaporation is going on. Casts of prismatic crystalline masses, however, like that exhibited in figure 214, and others of a flat and square pyramidal or hopper-shaped form, the latter evidently derived from ordinary salt, are of not uncommon occurrence. This would follow naturally from the conditions under which the beds were deposited.

The Onondaga formation (No. 13 in the sketch-map, fig. 249) crosses the Niagara River above and below Grand Island, or a short distance above the Falls, and follows the general outcrop of the Niagara and Guelph formations up to the vicinity of the Saugeen River on Lake Huron. It thus passes through portions of the Counties of Welland, Haldimand, Brant, Oxford, (north-east corner), Waterloo, Perth, and Bruce, but throughout much of this area it is covered by Drift accumulations. On the American side of Lake Huron, the picturesque island of Mackinaw is chiefly made up of Onondaga rocks, and these occur also in places on the adjoining coast of Michigan. Canadian exposures are exhibited chiefly near the village of Waterloo, in Bertie township, on the Niagara River; along the Grand River between Cayuga and Paris, and higher up the stream near the Don Mills; at places near Ayton and Newstadt, in the township of Normanby, on the Upper Saugeen; around Walkerton, on the Saugeen River, in Brant township; and at various points down the river, more especially at the elbow in the south-west corner of Elderslie township,

and on the banks of the stream a little below Paisley. At the mouth of the Saugeen, and on the adjacent coast south of this, the formation is concealed by Drift sands and clay.

The gypsum or "plaster" deposits constitute the most valuable economic material of the Onondaga beds; but some of the dolomitic shales of the formation, as those at Walkerton, furnish also valuable materials for the manufacture of hydraulic cement. The gypsum is principally mined or quarried at Cayuga, Indiana, and York, in the township of Seneca; also at Mount Healy and elsewhere in the adjoining township of Oneida, on the opposite side of the Grand River; in Brantford township; and largely around Paris. The annual amount obtained at present from these localities, is between fourteen and fifteen thousand tons.*

The Lower Helderberg Group.—The group of rocks thus named, is developed somewhat extensively in the vicinity of the Helderberg Mountains and in the eastern part of New York generally, as well as in the more eastern part of Canada south of the St. Lawrence; but it thins out towards the west, and presents merely two or three outlying patches in the neighbourhood of Montreal, and a comparatively narrow strip of slight thickness in Western Canada, between the eastern end of Lake Erie and the township of Cayuga. It may probably extend beyond this latter point along the western limit of the Onondaga zone, up to Lake Huron, but no exposures of its strata have been seen west of that township. This strip, in no place exceeding fifty feet in thickness, consists of the lowest division of the group as subdivided by the New York geologists, or of the equivalents of their "Water-lime Group or Tentaculite Limestone." With us, in Western Canada, it might be called the "Bertie or Cayuga dolomite," as its only known exposures are in those townships; or a still better term would be the *Eurypterus* formation, so named from its principal and characteristic fossil: the *Eurypterus remipes*, a low form of the crustacean class, figured in woodcut 227. In the above townships its strata consist of thin-bedded greyish dolomites, interstratified towards the base with a few brownish shales, and with a brecciated bed composed chiefly of dolomite fragments.

At St. Helen's Island and Round Island, opposite Montreal, on Isle Bizard, and at one or two neighbouring localities, some outlying

* The gypsum, as quarried, sells at about $2 the ton. When ground for manure, the cost per ton is about $3.50; and when calcined for plaster, about fifteen or sixteen dollars.

or small isolated patches of conglomeritic rock, referred to the Lower Helderberg division, have been recognised of late years. Their existence was first pointed out by Dr. Dawson. They are made up of fragments of various rocks, gneiss, Trenton limestone, Utica shale, syenite, &c., cemented together by a paste of greyish dolomite. These conglomerates are regarded as patches of strata once continuous with the Lower Helderberg series of eastern New York, their removal in intervening areas having been effected by denudation. The limestones and shales which at Cape Gaspé, and elsewhere in that region, rest unconformably on the dark shales of the Calciferous or Quebec formation, are likewise referred by Sir William Logan to the Lower Helderberg group. These beds are, at present, known provisionally as the "Upper Gaspé Limestones"—the lower limestones of the Gaspé series, already alluded to as occurring on the Chatte, Rimouski, and other rivers of that district, being referred to the Middle Silurian period. See the remarks on this point, under the Niagara formation, above.

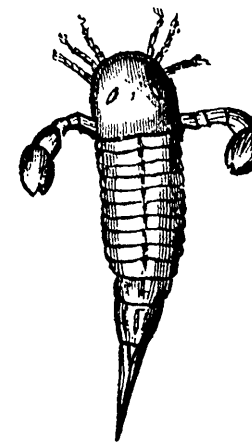


Fig. 227.
Eurypterus remipes (reduced).

Devonian Strata.—The rock formations of Devonian age, occurring in Canada, are restricted to the following subdivisions (here named in ascending order):—(1), The Oriskany Formation; (2), The Corniferous Formation; (3), The Hamilton Formation; and (4), The Portage and Chemung Group. Of these, however, Nos. 1 and 4 are but very slightly developed. It is in the Devonian strata, it will be remembered, (at least as regards this continent) that we find the first traces of vertebrated life and of land vegetation.

The Oriskany Formation.—In Canada the so-called Oriskany beds consist essentially of white or brownish sandstones of both fine and coarse grain, averaging about seven or eight feet in thickness. These rest on a layer of chert or hornstone. The latter contains much iron pyrites; and the bottom beds of the sandstone present here and there a brecciated structure, being chiefly made up of frag-

ments of this chert. Fossils are very abundant, but the greater number appear to be identical with those of the overlying Corniferous formation. This fact, combined with the cherty character of the beds, renders the separation of the two groups little more than a mere arbitrary distinction. Amongst other forms, the following may be enumerated as especially abundant:—*Favosites Gothlandica* (fig. 215), *Zaphrentis prolifica* (fig. 230), *Strophomena rhomboidalis* (fig. 232), *Atrypa reticularis* (fig. 240), *Stricklandia elongata* (fig. 236), *Pentamerus aratus* (fig. 235), and *Calymene Blumenbachii* (fig. 209).

This formation, which is somewhat extensively developed in the State of New York, enters Western Canada in Bertie township (about opposite to Buffalo) and appears to extend as a thin band along the southern edge of the Eurypterus or Onondaga deposits, at least as far as the County of Norfolk; but the only known exposures occur at places in the townships of Bertie, Dunn, North Cayuga, Oneida, and Windham. From the exposure in North Cayuga, a little north of the Talbot road, good millstones have been obtained.*

The Oriskany formation is probably represented in Eastern Canada, according to Sir William Logan, by some of the sandstones of Little Gaspé and that district. A small seam of coal, under two inches in thickness, occurs in these beds, together with numerous carbonized plants. The latter have been described and figured by Dr. Dawson in the *Canadian Naturalist*, vols. V. and VI.

The Corniferous Formation.—This group of strata includes the "Onondaga limestone" and the "Corniferous limestone" of the New York geologists. Its name is derived from the occurrence of nodular masses and layers of chert or hornstone in many of its beds. It is made up essentially of limestones, generally free from magnesia, but often highly bituminous, combined with layers of chert, and with a few beds of calcareous sandstone and an occasional band of bituminous shale. The total thickness of the formation, with us, is apparently under 200 feet, but this is somewhat doubtful. The limestones are exceedingly fossiliferous; and in places (more especially towards the base of the formation) they abound in fragments of crinoids and other organic remains in a silicified condition. The fossils, indeed, are mostly, though not entirely, in this condition throughout the group.

* These are manufactured by Mr. DeCew, Provincial Land Surveyor, of DeCewsville, near Cayuga, in Haldimand County: from whom, also, interesting suites of fossils, belonging to the formations of that district, may be procured.

They have formed the nuclei, to which, during the consolidation of the strata, much of the cherty matter has been attracted. In some of the silicified corals and brachiopods, petroleum is also found.

A few of the more important organic remains are shown in the annexed figures :—

Fig. 228.
Michelinea convexa
(D'Orbigny).

Fig. 229.
Syringopora Maclurei
(Billings).

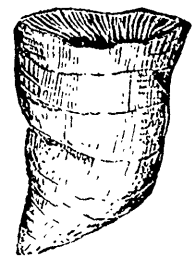


Fig. 230.
Zaphrentis prolifica
(Billings).

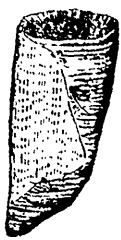


Fig. 231.
Cystiphyllum Senecaense
(Billings).

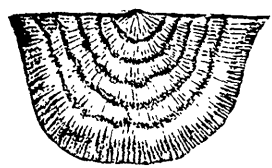


Fig. 232.
Strophomena rhomboidalis
(Wahlenberg).

Fig. 233.
Spirifer gregarius
(Hall).

Fig. 234.
Athyris Clara
(Billings).

Fig. 235.
Pentamerus aratus
(Conrad).

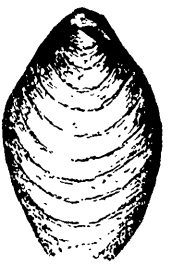


Fig. 236.
Stricklandia elongata
(Billings).

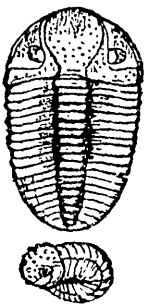


Fig. 237.
Phacops bufo
(Green).

In addition to these forms, *Spirifer mucronatus* (fig. 238), *Spirigera concentrica* (fig. 239), and *Atrypa reticularis* (fig. 240), may also be mentioned as being of common occurrence.

The Corniferous formation (No. 16 in the sketch-map, fig. 249) occupies two extensive areas in Western Canada, although covered and obscured in most places by Drift accumulations. These areas comprise portions of the counties of Welland, Haldimand, Norfolk, Brant, Oxford, Perth, Huron, and Bruce, on the one hand, and parts of Kent, Essex, and Lambton on the other. A comparatively broad tract, occupied by the Hamilton formation, intervenes between these two areas. The latter formation, as shewn some years ago by Sir William Logan, rests in a depression on the summit of a flat but important anticlinal which traverses this western peninsula in a general east and west direction. Exposures of Corniferous strata occur more particularly on or near to the shore of Lake Erie in the townships of Bertie, Humberstone (Rama's Farm, near Port Colborne), Dunn, Rainham, Walpole, Woodhouse, &c.; also in North and South Cayuga; near Woodstock village; largely at St. Mary's; in Carrick township, on a branch of the Maitland, and also in the adjoining township of Brant; at Point Douglas on Lake Huron, and elsewhere along the coast, in the townships of Bruce and Kincardine; further south, near Port Albert, and on the Maitland, near Goderich; and also at the extreme west of the peninsula, as near Amherstburg, on the River Detroit.

Many of these exposures, and more especially that of the last-named locality in Malden township on the Detroit, furnish excellent

building materials; but the Corniferous formation is chiefly of importance, in an economic point of view, as the supposed source of the great oil supply of this western region. As the oil-wells in successful operation, however, occur entirely within the central area, across which, as stated above, the Hamilton formation extends, their discussion will be entered into in connexion with the latter series of strata.

In Eastern Canada, the Corniferous formation is undoubtedly represented by a portion of the Gaspé deposits, and probably also by some of the altered strata of the Eastern Townships. The beautiful yellow-veined marbles of Dudswell are thought to be of this age. In Gaspé likewise, as near Douglastown and elsewhere in that district, petroleum springs occur in Devonian strata referrible either to this series, or to the somewhat lower horizon of the Oriskany Formation.

The Hamilton Formation.—The name of this formation must not be confounded with that of Hamilton in Canada: a city situated on strata (the Medina) of a much lower geological horizon. As a misconception of this kind often occurs, it is almost to be regretted that our Provincial Geologist did not in this instance depart from the usual and strictly legitimate plan, and propose for the group in question a Canadian or palæontological name. It might be called appropriately the Lambton or Goniatite formation, the latter type first appearing in the beds of this series. The term "Hamilton," as at present applied to the group, is from the village of that name in Madison County, New York. The American geologists usually subdivide the formation into three groups, distinguished chiefly by lithological characters. The lowest group consists of dark bituminous schists known as the Marcellus shales; the second group, or Hamilton group proper, is made up of argillaceous and other shales or flags, with an interstratified bed of encrinal limestone, and in some places an overlying limestone bed called the Tully limestone; finally, the third or uppermost group is composed of dark shales closely resembling those of the first division, and known as Genesee shales. Some observers separate these latter, however, from the Hamilton formation, and place them in the succeeding Portage group: a view adopted by the Canadian Survey. The Marcellus shales thin out greatly towards the west; and on entering Canada, the formation appears to consist only of the second group; but its junction with the underlying Corniferous strata has not yet been observed. It crosses the counties of Norfolk, Elgin, Kent, Middlesex, Lambton, and the south part of Huron; but is much obscured throughout by overlying Drift deposits.

The best and almost the only known exposures occur in the township of Bosanquet in the north-west corner of the county of Lambton. As there seen, its strata are composed of soft grey calcareous shales, with one or two beds of encrinal limestone. Sir William Logan estimates the total thickness of the formation, with us, at about 300 feet. The shales contain numerous fossils, the most abundant, perhaps, being the four species figured below.*

Fig. 238.
Spirifer mucronatus
(Conrad).

Fig. 239.
Spirigera concentrica
(Von Buch).

Fig. 240.
Atrypa reticularis
(Linnæus).

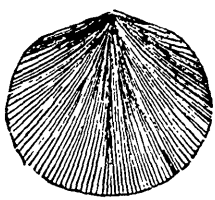


Fig. 241.
Orthis Vanuxemi
(Billings).

In addition to these, several corals and some other brachiopods are of common occurrence; and examples of the trilobite, *Phacops bufo*, fig. 237, are often met with.

Petroleum Springs and Wells.—As stated on a preceding page, the celebrated "oil-wells" of Western Canada are principally situated within the area occupied by the Hamilton shales, although the oil itself, more properly known as petroleum or fluid bitumen, is thought to arise from the underlying Corniferous formation. The existence

* These species occur also abundantly in the Corniferous formation; and *Atrypa reticularis* is found as low down as the Clinton group.

of natural springs of petroleum in the valley of the Thames, appears to have been known to the Indians long before the clearing of that district. Under the name of "Seneca oil," the petroleum from these sources was employed as a popular remedy for rheumatism, &c., by the early settlers, who are said to have learnt the use of it from the Indians of the locality. In the Geological Report of the Canadian Survey, for 1850, Mr. Murray pointed out the occurrence of several of these so-called "oil springs" in the townships of Mosa and Enniskillen; and in the Report of the succeeding year, attention was called to a deposit in that district of bitumen or mineral tar, arising from the thickening or drying up of petroleum overflows. One of these concreted petroleum deposits occurs in the southern part of Enniskillen, forming two detached portions of about an acre each, and varying in thickness from about a couple of inches to two feet. Another deposit of a similar character, three or four inches in thickness, has been since discovered in the northern part of the township, eight or ten feet beneath the surface of the ground. It occurs in Drift clay above a stratum of gravel. Subsequently to the announcement of the natural springs of this locality, others have been found in the townships of Zone and Orford; and some also near Tilsonburg, in the township of Dereham. These latter lie beyond the limits of the Hamilton formation, or over the Corniferous limestone; and petroleum has been obtained by wells from that rock.

In 1857, the idea occurred to Mr. Williams, of Hamilton, C.W., then engaged in the distillation of the solid bitumen of Enniskillen, to bore through the Drift clays of that district into the underlying rock beds, in the hope of striking subterranean reservoirs of the petroleum, such as had been shown to occur in Ohio and Pennsylvania—and his attempt was rewarded by an almost unexpected success. At the present time about one hundred wells or bore-holes have been put down in Enniskillen alone. Many of these were at first "flowing-wells," the petroleum rising above the surface of the ground; but after flowing for some time, the action in the greater number suddenly ceased. Some, however, still continue to flow. Altogether, an immense quantity of petroleum has been obtained from these sources.

The wells in Enniskillen are of two kinds, known respectively as *surface* and *rock* wells. The former pass through the soil and Drift clay to a depth of about 50 or 60 feet into a stratum of gravel imme-

diately above the rock ; whilst the latter are continued into the rock itself, to an average depth of from 50 to 150 feet. The discharge from the wells is accompanied, in many cases, by salt water, and by emissions of inflammable gas. In some of the wells which have ceased to yield petroleum, salt water has taken the place of the rock oil.

The fissures or reservoirs in which the petroleum occurs, are apparently of restricted size, and very irregular in their course. Whilst in some instances, neighbouring wells affect each other, and thus evidently draw their supply from the same immediate source, in other instances, borings put down close to wells in active operation, and carried even to a greater depth, have failed to strike the oil fissure.

The origin of the petroleum is involved in great obscurity. Two views have been suggested in explanation of its occurrence. One of these connects the presence of the rock oil with the great coal deposits of Michigan, or those of Ohio and Pennsylvania. The coal-bearing strata of these districts occupy a much higher geological position than the petroleum-containing beds of Western Canada. The Pennsylvania coal strata are geologically over 10,000 feet above these latter ; and a thickness of 860 feet intervenes between the top of the Hamilton formation and the coal deposits of Michigan. A long interval of time must therefore have elapsed between the deposition of the two series of strata. But the petroleum may have been generated in the Michigan beds at some subsequent epoch, and have been carried along a system of fissures into our Devonian rocks: the two formations, owing to the dip of the strata, occupying very nearly the same topographical elevations. Several facts are opposed, however, to this view. In the first place, no evidence of the occurrence of liquid petroleum amongst the Michigan coal seams has hitherto been obtained, neither are any reservoirs of petroleum known in coal rocks of other localities ; secondly, small quantities of petroleum and of solid bitumen, (a closely allied substance) occur in various strata far below, and topographically far removed from coal deposits ; and thirdly, the direct distance between the rim of the Michigan coal field and the oil district of Enniskillen is at least 80 miles, so that the existence of continuous fissures of communication between the two is not very probable.

The second view regards the rock oil as originating within the strata in which it occurs, by some peculiar decomposition of fucoids

or animal remains. Fucoids or sea-weeds, it must be remembered, are the only vegetable matters hitherto discovered amongst the fossilized bodies of our Silurian and Lower Devonian rocks. But if we adopt this view, we must adopt, also, certain other and apparently unwarrantable conclusions. The organic remains of these strata are not more numerous than those of other strata in which not the slightest traces even of petroleum have been found; neither do they present any characters peculiar to themselves and suggestive of oil-forming capabilities. Hence we have to infer the existence in the Devonian seas in which these deposits were laid down, of a vast abundance of soft-bodied animals, or sea-weeds, of a nature altogether unknown: a most gratuitous supposition. The enormous quantity of petroleum yielded by these sources, and by others in the American States and elsewhere, renders the formation of this substance from sea weeds or perishable animal remains in the highest degree improbable.

But are we absolutely driven to the adoption of either of the above views, in order to explain the occurrence of petroleum in our Devonian strata? The question mainly turns upon this: Are we forced to assume with certain chemico-geologists—who refuse all explanations of natural phenomena incapable of being rendered evident by laboratory experiments—that all forms of carbon, and all compounds into which carbon enters (with the sole exception of carbonic acid, and that only in part) are necessarily of organic derivation? With all respect for laboratory investigations, some of which have shed much light on obscure geological problems, it cannot be doubted that this view assumes too much. There are many facts, universally recognized as such, which chemistry is quite unable to explain. The allotropic conditions of certain simple bodies, for instance, carbon amongst the number; the existence of chlorine, oxygen, &c., in the solid state in the greater number of their compounds; the peculiar condition of water in hydrated substances, and so forth. We have the positive fact likewise that carbon exists, as such, in meteoric stones; that it separates often in crystalline scales from molten iron; and that it is present in steel, a fusion-product, also, as sometimes prepared. Why, then, are we debarred from assuming its existence amongst the primary or original components of the earth-mass? During volcanic outbreaks in many parts of the world, petroleum has frequently made its appearance, through fissures on the sea-bed, or around the volcanic vent, as one of the products of the eruption. This was memorably the case

in the eruption of Vesuvius in 1861.* The great petroleum springs of Central Asia, which have been flowing for ages also, with those of Zante (mentioned by Herodotus) and others of different localities, lie essentially in areas of volcanic action; and the so-called mud-volcanoes often pour out large quantities of bituminous matter, mixed with other products. It might be argued that in these cases the petroleum is derived from deeply-seated coal beds, but of this we have no proof. And when we consider the fact that small quantities of bitumen and petroleum occur in rocks geologically far older than those of the coal series, we have an equal right to assume that these matters may be generated, without the aid of organic bodies, by unknown chemical action within the crust of the earth, and may be poured out through fissures from time to time, both amongst deposits under process of accumulation, and amongst others already consolidated.† In this manner, I imagine, our petroleum springs of Western Canada have originated. And I would go beyond this, and refer to the same action a leading part in the formation of all bituminous shales, and of coal seams generally. In the latter case, the liquid bitumen or petroleum may be conceived to have flowed into broad marshes, or over low-lying districts, in which an abundant vegetation was under growth. The vegetable matters thus saturated and mixed up with the thickening petroleum, would add their substance to the formation of the coal, and would be chiefly instrumental perhaps in imparting to this its peculiar character. On this view, the formation of bituminous shales by the saturation of the finer kinds of sedimentary matter by petroleum overflows, becomes readily explained; and also the close agreement in character which exists between the shales of the coal measures and those of many Silurian strata. The old view does not explain these points in a satisfactory manner. The petroleum theory likewise obviates the necessity of assuming the growth of an enormous and unparalleled vegetation during the Carboniferous period; and it explains why the vegetation of after periods so rarely yielded coal—the outflows of petroleum having chiefly taken place during the Carboniferous epoch, and only locally at other times.

The Portage and Chemung Group.—The rocks of this group, so largely developed in the peninsula of Michigan and other districts of

* See *Canadian Journal*, vol. vii, p. 126.

† If the term "unknown chemical action" be here objected to, we may refer, amongst other cases, to that of the diamond: a substance certainly formed by chemical action, but of a kind altogether unknown to us.

the American States, occur with us in the form only of a few isolated and inconsiderable patches. These consist of black and highly bituminous shales—the probable equivalents of the "Genesee slates," referred by some observers, as already explained, to the Hamilton formation. The principal locality of these shales is Cape Ipperwash, or Kettle Point, in the township of Bosanquet on Lake Huron; but they occur also nearly twenty miles inland from this point, on a creek near Kingston Mills in the south part of the township of Warwick; and also, still further inland, in the township of Brooke. The shales weather dull-grey, and those of Cape Ipperwash are occasionally coated with a yellow crust of oxalate of iron (see PART II. under "Humboldtine"). They contain large spherical concretions (with radiated internal structure) of carbonate of lime; and also much iron pyrites. In the shales of Kettle Point, likewise, long flattened stems of vegetable forms (mostly referred to the *Calamites ornatus* of Dawson) are of common occurrence; and impressions of fish scales are met with in those of Warwick. The thickness of the exposure at Kettle Point is under fifteen feet; and it is still less than this at the other localities.

Carboniferous Strata.—The Bonaventure Formation.—The only locality at which Carboniferous strata occur in Canada is the south-eastern extremity of Gaspé. Exposures of great thickness range along the Bay of Chaleurs and the coast of Percé, and enter Gaspé Bay. These Carboniferous strata occur consequently, for the greater part, in the district of Bonaventure; and as they make up the entire portion of the island of that name, off Percé, Sir William Logan has bestowed upon them the name of the *Bonaventure Formation*. They consist essentially of conglomerates, associated with red and brown sandstones and some reddish shales. The conglomerates are made up of pebbles of limestone, sandstone, syenite, agate, quartz, and other rock-matters, held together by an arenaceous or partly calcareous cement. Many impressions and casts of vegetable remains occur throughout this formation, but its beds are apparently destitute of coal. They belong to the base of the coal series, proper; and evidently form a portion of the northern rim of the New Brunswick coal field.

The Bonaventure Formation rests unconformably on the Gaspé sandstones and limestones, and dips generally towards the south-east. According to Sir William Logan, it presents a total thickness of about 300 feet.

SKETCH-MAP OF THE GEOLOGICAL FORMATIONS OF WESTERN CANADA.

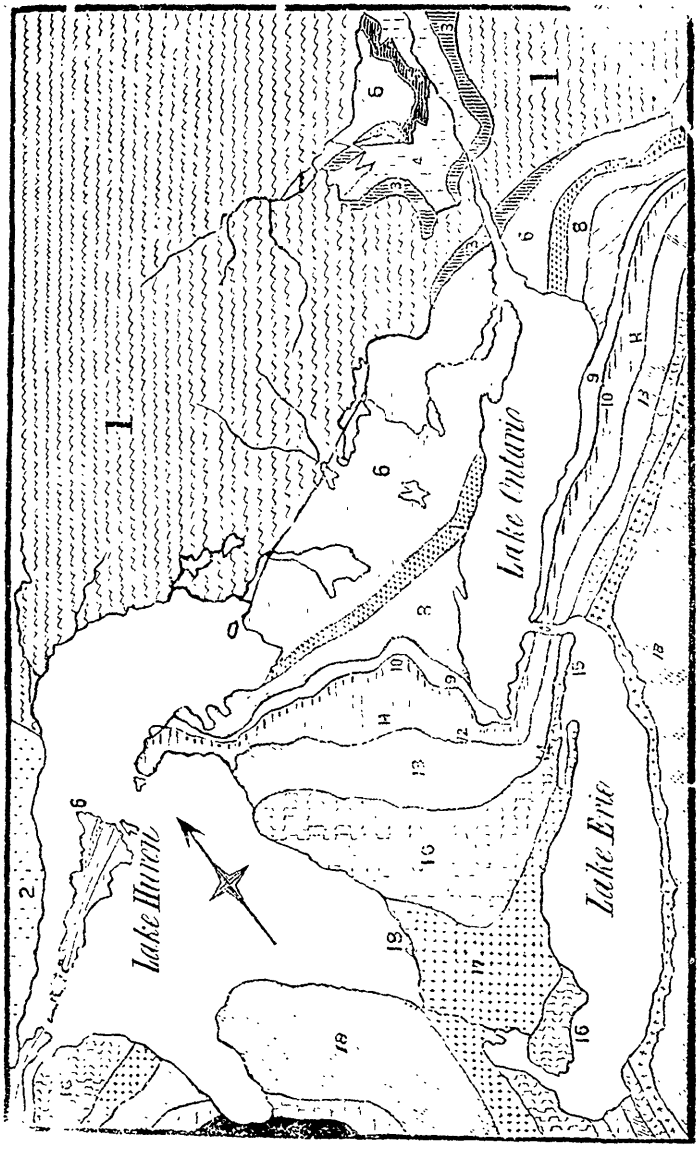


Fig. 249.

References to Map on preceding page.

DEVONIAN SERIES:

Erie Group.	No. 18.	Portage and Chemung Group, (Kettle Point Form.)
	17.	Hamilton (or Lambton) Formation.
	16.	Corniferous Formation.
	15.	Oriskany Formation.

UPPER SILURIAN SERIES:

Grand River Group	14.	Eurypterus Formation, or Lower Helderberg Group.
	13.	Onondaga or Gypsiferous Formation.

MIDDLE SILURIAN SERIES:

Niagara or Anticosti Group.	12.	Guelph Formation.
	11.	Niagara Formation.
	10.	Clinton Formation.
	9.	Medina Formation.

LOWER SILURIAN SERIES:

Ontario Group.	8.	Hudson River Formation.
	7.	Utica Formation.
	6.	Trenton (including Bird's Eye and Black River) Fm.
Quebec Group.	5.	Chazy Formation.
	4.	Calciferous Formation.
Potsdam G.(in part.)	3.	Potsdam Formation.

AZOIC SERIES:

Azoic Group.	2.	Huronian Formation.
	1.	Laurentian Formation.

THE POST-TERTIARY DEPOSITS OF CANADA.

Under this term, we include three series of deposits: the Drift or Glacial series, the Post-glacial series, and certain still more recent accumulations. These, though properly distinct, merge so gradually into each other, that no actual lines of demarcation can be drawn between them.

The Drift, or *Glacial Formation* proper, consists of thick beds of clay, sand, and gravel, with *boulders* or transported stones of various kinds and sizes, spread generally over the surface of the country, and extending on this continent to about 40° N. latitude. It does not appear to contain any fossils. Those cited as belonging to it, come properly from Post-glacial deposits. When these Drift materials are removed from the underlying rocks, the surface of the latter (where not in a partial state of disintegration) is generally found to be worn down, so as to present a smooth or even polished condition, and is traversed also by numerous thin lines or grooves, running in a general north and south direction—that is to say from some point between N. W. and N. E., towards the opposite direction in the south. The boulders vary in size from mere pebbles to masses of many tons' weight, and consist of all kinds of rock. In some places they belong to rock-masses of the immediate locality, but far more generally they have been transported by some powerful agency from other and distant sites. With the exception of certain mountainous localities, in which the boulder-courses radiate around central points, these travelled stones have been derived (as regards the northern hemisphere) invariably from northward-lying regions. In Canada, the greater number of boulders consist of gneiss or other varieties of rock belonging to the great Laurentian area described in a preceding part of this Essay; but where limestone or other strata occur in the immediate neighbourhood to the north, these gneissoid boulders are often mixed with pebbles and transported masses derived from the latter beds. Like the surface of the underlying rock, many boulders are smoothed down upon one side, and exhibit, upon this, delicate parallel furrows. Polished and striated rock-surfaces occur, in Canada, on the north shores of Lakes Superior and Huron; on the Blue Mountains, Collingwood township, at an elevation of about 1,500 feet above the sea; in the vicinity of Niagara Falls; the neighbourhoods of Belleville, Kingston, Marmora, Brockville, Ottawa, Montreal, Quebec; and

at other localities.* These drift-beds vary in thickness from a mere coating in some spots, to over 100 feet in others. In all places they rest upon denuded surfaces. As a general rule, the lower beds consist of calcareous clays, frequently, if not usually, free from boulders; whilst sand, gravels, and boulders, mixed here and there with seams of clay (mostly free from lime), make up the higher portions of the mass. The conditions under which these various matters appear to have been accumulated, will be referred to presently.

The Post-glacial deposits consist, like those of the true Drift epoch, of beds of clay, sand, and gravel, with here and there a few boulders; and they appear to have been derived in most instances from re-distributed Drift materials. Hence they are often designated by the term of *Modified Drift*. In Canada, east of the gneissoid belt of the upper St. Lawrence, and throughout the New England States of the Northern Union, these Post-glacial deposits contain marine and estuary shells, referrible for the greater part, if not wholly, to species of mollusca now existing in the Gulf of the St. Lawrence, or along the coast from Labrador to Cape Cod. Shells of this kind, mixed with a few other marine types (*Balani*, &c., see PART IV), occur at various heights above the sea-level, extending, as regards Canada, up to about 500 feet. Some of the principal localities of their occurrence, comprise: Kemptville in Oxford Township, Grenville Co. (about 250 ft.); Winchester Township, Dundas Co. (about 300 ft.); Kennyon and Lochiel Townships, Glengarry Co. (270–300 ft.); Fitzroy Township on the Upper Ottawa, Carleton Co. (360 ft.); Green's Creek on the Ottawa, (about 120 ft.); Montreal Mountain (various heights up to nearly 500 feet), and environs of Montreal generally; Upton, Eastern Townships (about 270 ft.); Beauport near Quebec (about 120 ft.); Mouth of the River Gouffre (130–360 ft.); Shore of the River Matanne in Gaspé (about 50 ft.); Banks of the River Métis (130–245 ft.); and terraces of the River Ste. Anne and Rivière du Loup. At Green's Creek on the Ottawa, the shell beds contain, also, examples of the capelin (*Mallotus villosus*) and the lump-sucker (*Cyclostomus lumpus*); and the remains of the northern seal (*Phoca Grœnlandica*), with detached vertebræ of a whale, have been discovered in the Montreal deposits.

Professor Dawson divides the Eastern Post-glacial beds into two

* As regards localities in Western Canada, see papers by the author, in *Canadian Journal*: vol. V. p. 41; and vol. VI. p. 221.

series: a comparatively deep-sea deposit, the "Leda clay;" and a shallow-sea or shore-line deposit, the "Saxicava Sand." Some of the more characteristic fossils of the Leda clay, comprise: *Leda Portlandica*, and *Rhynconella psittacea*; and those of the upper group: *Saxicava rugosa, Mya truncata, Tellina grœnlandica, and Buccinum undatum.**

Fig. 242.
Leda Portlandica.

Fig. 243.
Rhynconella psittacea

Fig. 244.
Saxicava rugosa.

Fig. 245.
Mya truncata

Fig. 246.
Tellina grœnlandica.

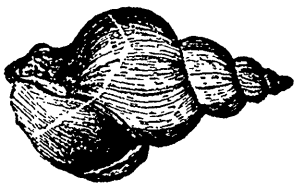


Fig. 247.
Buccinum undatum.

* The reader is referred for figures of the other fossils of these Post-glacial deposits, to valuable papers, by Dr. Dawson, in the *Canadian Naturalist*, vols. II. and IV. Also to an earlier paper on the same subject, by Mr. Billings, in the first volume of that journal.

In Western Canada, or rather in that portion of the Province west of the gneissoid belt that crosses the St. Lawrence at the Thousand Isles, the Post-glacial deposits consist principally of beds of sand, often exhibiting an oblique stratification (see fig. 54 in PART III.) No marine remains of any kind have been detected in these beds. The shells of fresh-water mollusca, on the other hand, occur in them at many localities. These belong to species which still inhabit our lakes and streams, and comprise, more especially, the following genera: *Unio, Cyclas, Amnicola, Valvata, Melania, Planorbis, Limnea,* and *Physa.* Several species of *Helix* accompany these at some localities. Examples of fresh-water deposits of this kind, formed by causes no longer in action where such deposits now occur, have been recognized in the vicinities of Collingwood and Owen Sound; Angus station on the Northern Railway; Barrie, Orillia, Paris, Brantford, Toronto, Belleville, and other places, at various elevations from 30 or 40 to over 500 feet above Lake Ontario—the present surface of the latter being 232 feet above the sea. Fresh-water shells occur also in Post-glacial deposits around Niagara Falls, where, as pointed out by Sir Charles Lyell, many years ago, they evidently indicate the former bed of the Niagara River It is only, however, within the last two or three years, that the occurrence of these shells throughout the lake area generally, has been definitely ascertained, and the true character of the beds in which they occur correctly shewn.* As the shells in question occur all over this region, and at various heights above the existing levels of the lakes—and as they could not have been drifted into their present positions by freshets, or left there, viewed collectively, by the drying up of ponds, lowering of streams, or other causes—they appear to indicate incontestibly the former union of our great lake-waters, and the consequent extension of these into a vast, inland, fresh-water sea. The barrier that kept up these waters on the east —perhaps a glacier or ice-stream, see below—was undoubtedly situated

* The first publication on this subject was by Robert Bell, of the Geological Survey of Canada, in the *Canadian Naturalist* for February, 1861. This was followed by a more extended article by the author of this work (who had previously communicated some of his observations to Mr. Bell), read before the *Canadian Institute* in March, 1861, and published in the *Canadian Journal*, vol. vi., p. 221, and in the *Philosophical Magazine* for July of that year. In this paper, the former union of our lake waters, and the lacustrine origin of the terraces north of Toronto, &c, was first maintained. A succeeding paper by the author (*Canadian Journal*, November, 1861, vol. vi., p. 497), described a remarkable locality—first made known to him by one of his students, Mr. A. E. Williamson, of Toronto—in which unios and other fresh-water types occur in great abundance, near the Nottawasaga River, between Lake Simcoe and Georgian Bay.

along the gneissoid belt of the Upper St. Lawrence: the line, it will be remembered, which separates the eastern or marine deposits of this period from those of lacustrine origin. In this connexion, it is interesting to observe that in the township of Pakenham (as discovered by Andrew Dickson, Esq.,) and also in that of Augusta, both immediately adjacent to this gneissoid belt, a few fresh-water types have been found in conjunction with shells of *Tellina Grœnlandica*, (fig. 246), a marine or brackish-water species. The destruction of this barrier—whether of ice or rock—accompanied probably, and perhaps occasioned, by a gradual and periodically-interrupted depression of the eastern country, eventually lowered the waters to their present levels, and caused the formation, by denuding action, of the various ridges and terraces which occur so prominently throughout the lake districts. Those north of Toronto, described as *ridges* by Sir Charles Lyell, and thought by him to be of marine origin, are really a succession of *terraces* rising one above another up to a height of about 760 feet above the present surface of Lake Ontario, and then successively descending towards Lake Simcoe and Georgian Bay—their abrupt or escarped faces being always in the direction of the nearest lake.

The mollusca of this region during the Post-glacial period, appear to have been throughout identical with those of our present lakes and rivers; and most of the mammalia were of the same genera and species as those which now inhabit Canada. Of this latter class, the more common remains comprise the jaws and other parts of the common beaver (*Castor* fiber); the horns and bones of the Wapiti (*Elaphus Canadensis**); and the teeth and skull of the black bear (*Ursus Americanus*). Two at least, however, of the mammals that roamed over the shores of the great lake region during the period in question, are extinct. These are the Mammoth, an extinct species of Elephant, (*Elephus primigenius*); and the Mastodon (*M. Ohioticus?*). Their remains, hitherto found with us, mostly of detached molar teeth (fig. 248); but examples, more or less entire, of the skull and tusks have also been discovered. The sediments in which these occur,

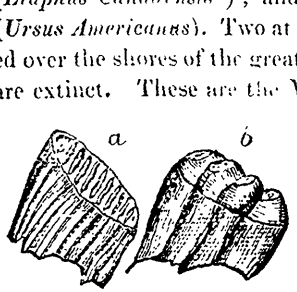


Fig. 248.
a—Molar tooth of *Elephas primigenius*.
b—Molar tooth of *Mastodon Ohioticus*.

* The Wapiti, although at one time common throughout Canada, is now only to be found in the extreme northern and north-western regions, and will probably become extinct at no distant day.

appear to be of the same age and character as those which at Amiens, Abbeville, Creil, Suffolk, Bedford, and elsewhere, contain flint implements of rude manufacture, mixed with the remains of the mammoth and other types, both living and extinct. The arrow-heads and other stone implements so constantly found in our Canadian superficial deposits, are of a much less primitive character, however, and belong in all probability to a comparatively recent date.

Conditions under which the Drift and Post-glacial deposits were accumulated.—It is now universally admitted that the various deposits of the Drift, and immediately succeeding period, were accumulated under conditions more or less resembling those which at present prevail in Arctic latitudes. This conclusion is based chiefly on the following facts:—(1). The resemblance of the polished, rounded, and striated surface of the rocks beneath the Drift, to the surface-rocks of Alpine regions in which glaciers prevail, or to those which in higher latitudes have been subjected to glacial action generally. (2.) The greater development and extension of glaciers in these regions, during the interval between the close of the Cainozoic period and the commencement of the existing epoch, properly so-called. (3.) The evident signs of the occurrence of ancient glaciers in lower and more southern districts during the same period. (4.) The apparent impossibility of any other agency than that of ice to have effected the transportation of the numerous boulders scattered throughout Drift-covered regions: many of these boulders, including some of large size, having been carried across lakes, seas, ravines, and other obstacles, to far distant localities. And (5), the general arctic or northern character of the mollusca, &c., found in the modified drift or Post-glacial deposits of various countries.

The fossils which occur in Cainozoic strata, prove clearly the prevalence of a warm, if not of a tropical climate, throughout the period during which these strata were deposited. Towards the close of the Cainozoic Age, however, the relative levels of land and water, throughout all the more northern and extreme southern portions of the globe, appear to have undergone great though gradual changes, during which, a period of increasing cold came slowly on, covering all the more elevated districts with enormous glaciers, filling the sea with floating icebergs, and compelling a general southerly migration of such life-forms as were able, by this or other means, to resist its destructive influence. The greater part of Canada must certainly have been

submerged beneath the sea, during a portion at least of this period. The polishing and striation of the rocks may have been occasioned in part by glaciers, and in part by stranded icebergs; but the transportation of the boulders from the northern districts, southwards, must have been chiefly effected by the agency of the latter: just as at the present day, large masses of granitic and other rocks are dropped over the bed of the Atlantic by the melting of the icebergs on which they travel from the north. It should be mentioned that, as a general rule, these icebergs are nothing more than fragments detached from the extremities of arctic glaciers, where the latter reach the level of the sea. The stones brought down by these enormous ice-rivers, or broken off their rocky shores, collect in large heaps at their lower extremities, and many are thus floated off by the detached bergs, and conveyed over broad oceanic spaces to distant and more southern spots. That the country east of the gneissoid belt of the Upper St. Lawrence was beneath the sea to a depth of at least 500 feet at one period of this glacial epoch, is shown by the numerous deposits containing marine and estuary fossils, which occur, as explained above, throughout that area and the adjoining New England States. The same thing is proved also for both portions of the province, by the thick masses of drift clay, &c., which could only have been accumulated under water. As regards Western Canada—and this may probably apply to eastern districts likewise—a gradual submersion of the Palæozoic or more southern portion must first have taken place, since the lower clays are highly calcareous, and are evidently derived from the Silurian and Devonian strata immediately beneath or closely adjacent to their areas of deposition. The depression still continuing, the higher lands and gneissoid strata of the north would be brought within the influence of the waves, and thus the sands, gravels, and boulders of the Upper Drift deposits, would be gradually accumulated. A re-sorting of these materials must have occurred to some extent during the subsequent elevation of the country, producing, in part, the various post-glacial deposits; although in the western region, most of these latter must have been formed by the great lake-waters whic extended over this area, as described on a preceding page, after the final elevation of the land. The cold of the Drift period, with its accompanying phenomena, came on gradually, and as gradually diminished in intensity; or, in other words, these glacial manifestations shrunk back slowly, after a certain lapse of time, to within the

higher latitudes and Alpine elevations in which they still prevail. No strong or abrupt lines of demarcation can thus be drawn between the close of the Cainozoic Age and the dawn of the existing state of things. The one period merged slowly into the other; and certain life-forms, indeed, appear to have existed throughout all the changes which occasioned and accompanied the general deposition of the Drift.

Recent Deposits:—These comprise various formations, of limited thickness and extent, produced by causes now, or recently, in action at the localities in which these deposits occur. The principal consist of: Shell marl, calcareous tufa, bog iron ore, ochres, and peat. *Shell marl* is a soft calcareous deposit made up largely of the minute shells of certain species of planorbis, cyclas, and other fresh-water mollusks. It occurs at the bottom of almost all our lakes, ponds, and swamps; and sometimes forms near the margin of these, a bed of several feet in thickness. This lies usually at a short depth beneath the surface of the ground. It shows the former extension of the pond or swamp near which it is met with. Several specimens, examined by the writer, contained nothing but carbonate of lime mixed with a little sand; but some are said to contain phosphate of lime. The substance on exposure to the atmosphere becomes about as hard as ordinary chalk.

Calcareous tufa is a deposit of carbonate of lime on moss, twigs stones, &c., and is of very common occurrence in many of our smaller streams. Good specimens of a solid structure, capable of receiving a fine polish, are produced by some of the springs which issue from crevices in the Niagara escarpment, as at places near Hamilton, Rockwood, Falls of Noisy River, and other localities along the line of country through which the escarpment runs. A large deposit occurs also on the Beaver River, in the townships of Euphrasia and Artemisia. See under the "Niagara Formation," above.

Bog Iron Ore (see PART II.) is a hydrated sesquioxide of iron, a variety of Brown Iron Ore or Limonite. It arises from the decomposition of iron pyrites and other ferruginous substances in rocks and soils, and the after solution of the oxide of iron, thus formed, by water containing free carbonic acid or organic acids. The iron compounds dissolved by this agency, and carried into swamps and other low-lying places, are there deposited, and are subsequently converted into hydrated sesquioxide. Patches of this kind are also occasionally found on hill tops and sides, by deposition from springs containing ferruginous matter. This bog ore occurs in small quantities in numerous lo-

calities throughout the Province; but largely in Norfolk County, C. W., and along the north side of the St. Lawrence, especially in the Three Rivers District, and in the counties of Vaudreuil and Bellechasse, Canada East. The iron ochres, generally associated with the bog ore, have a similar origin (see descriptions of these, in PART II.) The red ochre is anhydrous, but the brown and yellow varieties contain a certain amount of water, usually about 20 per cent.

Economic Materials of the Post-Tertiary Deposits:—These comprise, *Gold, Bog Iron Ore, Ochres, Brick Clay, Shell Marl, Moulding Sand*, and *Peat*.

Gold:—Native gold in fine grains, including here and there a small nugget, occurs in the Post-Tertiary sands of the metamorphic region south of the St. Lawrence: or throughout the area lying between the River Richelieu and the Gaspé peninsula; and more especially along the valleys of the St. Francis, Chaudière, Rivière des Plantes, Etchemin, and Rivière des Loups. (See under "Native Gold," in PART II., *B*. 1.)

Bog Iron Ore:—The principal localities of this substance are given above. The ore, at present, is only melted at the Radnor Furnaces, Batiscan, C. E. The neighbouring furnaces of St. Maurice, after continuing in operation for over a century, went out of blast a few years ago.

Ochres:—These are capable of extensive use as paint materials. A yellow variety, becoming brown and red on ignition, occurs abundantly in the county of Middlesex, and also at Sydenham and in the township of Nottawasaga, in Canada West. Red, brown, yellow, purple, and greenish-black ochres occur likewise in workable quantities near the mouth of the Ste. Anne River, and in the seigniories of the Cap de la Madelaine and Pointe du Lac, in Canada East. Also in the Eastern Townships. The black ochres contain a considerable quantity of peroxide of manganese.

Brick Clay:—Clays suitable for bricks and tiles, occur very generally throughout the Province. White or yellow bricks are largely manufactured in the neighbourhoods of London, Hanover, Toronto, Cobourg, Peterborough, &c. Red bricks at Walkerton, Sydenham, Toronto, Montreal, St. Jean (Lobinière), and many other places. Manufactories of drain tiles are in extensive operation at Treadwell village, on the Ottawa, and in the vicinity of Quebec.

Shell Marl:—This substance, described above, is much employed as a manure, and occasionally also as a whiting or wash-material. It occurs, more or less, all over the Province, but has been worked more especially, in the townships of Bentinck, Carrick, Brantford, King, W. Gwillimbury, Scarborough, Thurlow, Sheffield, Olden, Nepean, and W. Hawkesbury, in Canada West; and near Montreal, &c., in Canada East.

Sand for Moulding:—Good sand for this purpose, has been obtained from the neighbourhood of Dundas, and also at Sydenham (Owen Sound.)

Peat:—Large deposits of this useful substance are known to occur in many parts of the Province, but hitherto, on account of the abundance of wood, they have been generally neglected. Some of the more important localities comprise: Longueuil, opposite Montreal, and many places along the south shore of the St. Lawrence, between that point and the Rivière du Loup (Sir W. Logan). Also La Valtrie, and the seigniory of Cap de la Madelaine, on the north shore. The explorations of the Geological Survey have made known, likewise, a large peat area on the south side of the Island of Anticosti. In Western Canada, peat occurs chiefly in the townships of Plantaganet, Clarence, Cumberland, Gloster, Goulbourne, and Westmeeath, in the Ottawa region. Also in the townships of Humberstone and Wainfleet, on Lake Erie.

*** The conclusion of this Essay, embracing a general summary of Canadian Geology, will appear in the next number of the Journal

THE STRUTHIONIDAE: THE EXTENT AND DIVISIONS OF THE FAMILY WITH ITS SYSTEMATIC POSITION AND RELATIONS

BY REV. WILLIAM HINCKS, F.L.S., ETC.,
PROFESSOR OF NATURAL HISTORY IN UNIVERSITY COLLEGE, TORONTO.

Having on a former occasion laid before the Institute a scheme for an improved arrangement of Birds founded on principles which I believe to be applicable to the whole animal kingdom, and having afterwards, on occasion of the exhibition of an interesting specimen, at-

tempted to illustrate the application of my principles to one family throughout its details, I now propose in a few occasional papers to examine the true position and relations of some other families, especially where there exist acknowledged difficulties or where my judgment, after giving all the consideration I could to the subject, differs from that of the writers upon whom I usually most rely, and whose opinions seem to me deserving of the highest respect. This evening I have to offer a note on the family Struthionidae—the Ostrich tribe—which some have referred to the RASORES (poultry and game birds), others to the GRALLATORES (stilted or wading birds), whilst many have considered them as entitled to form an Order of themselves, which has been called STRUTHIONES by some, by others CURSORES (or running birds). I would endeavour to arrive at a rational and satisfactory settlement of this controversy, marking how the system I adopt removes the chief difficulty; and I would also examine the extent of the family *Struthionidae* and the sub-families of which it is made up, suggesting some affinities not hitherto noted which seem to me not a little interesting, and which harmonize beautifully with the system of a set of different developments of a common type, each of which is analogous with one of the co-ordinate types forming the larger groups, of which the whole family is one of the members.

The beak, the general habits and the nidification of the Ostrich and its allies remind us so strongly of the Rasorial birds, that we see at once that the reference of them to the Grallatores depends entirely on the length of their legs, the great strength of which is, however, somewhat unlike the Waders generally. I am disposed to conclude that those who have arranged the Struthionidae among the Rasores have been guided by real and important analogies; that those who have placed them among the Grallatores have attached undue importance to a single character which really only indicates the position of this in reference to the other families of Rasores; and those who have elevated this group to the rank of one of their great orders of Birds have chiefly manifested their hesitation between the other two views, by taking a sort of intermediate position. A slight view of the limits and genuine members of the Rasorial order may, perhaps, set the subject in a clearer light.

It is well known that by many high authorities the pigeons (*Columbidae*) are counted amongst Rasorial birds, and, without doubt, they have very striking Rasorial characters in the figure of the beak, the

cere, and the kind of food, as well as the general mode of feeding; but on the other hand the powers of flight, the feet with the hind toe on the same level as the others, and above all the monogamous character, and the helpless condition of the few young ones, so strongly mark them as belonging to the Insessorial order that the just conclusion is that they represent the specially Rasorial tendency among the hard-billed or *Conirostral* Insessores. There remain among the Rasores the families of *Tetraonidae*, the Grouse; *Cracidae* the Curasows; *Phasianidae* the pheasants and Poultry; *Struthionidae* according to the opinion I have maintained, and *Megapodidae* a singular and little-known Australian family, without mentioning the *Sheathbills*, which I regard as, probably, (at least if they are at all Rasorial birds) a special form of Tetraonidae, or the Tinamous a very interesting South American group which seem to me to be a semi-arboreal form of Struthionidae, and which I therefore reject from among the leading families of the order. It is probable that *Tetraonidae* stand first among the Rasorial birds, as the most complete development of the type; *Cracidae*, with their arboreal habits, may be placed next; *Phasianidae* naturally follow, as the peculiarly typical or specially Rasorial group; *Struthionidae* I consider as occupying the position analogous with that of the order Grallatores in the larger circle; and I have no hesitation in regarding *Megapodidae* as the lowest family in the order. In the accompanying tabular view I give the sub-families in the three best known and most numerous groups, leaving the others for the present, as either being such small families, or our knowledge of them so imperfect, that nothing satisfactory could be accomplished in respect to them.

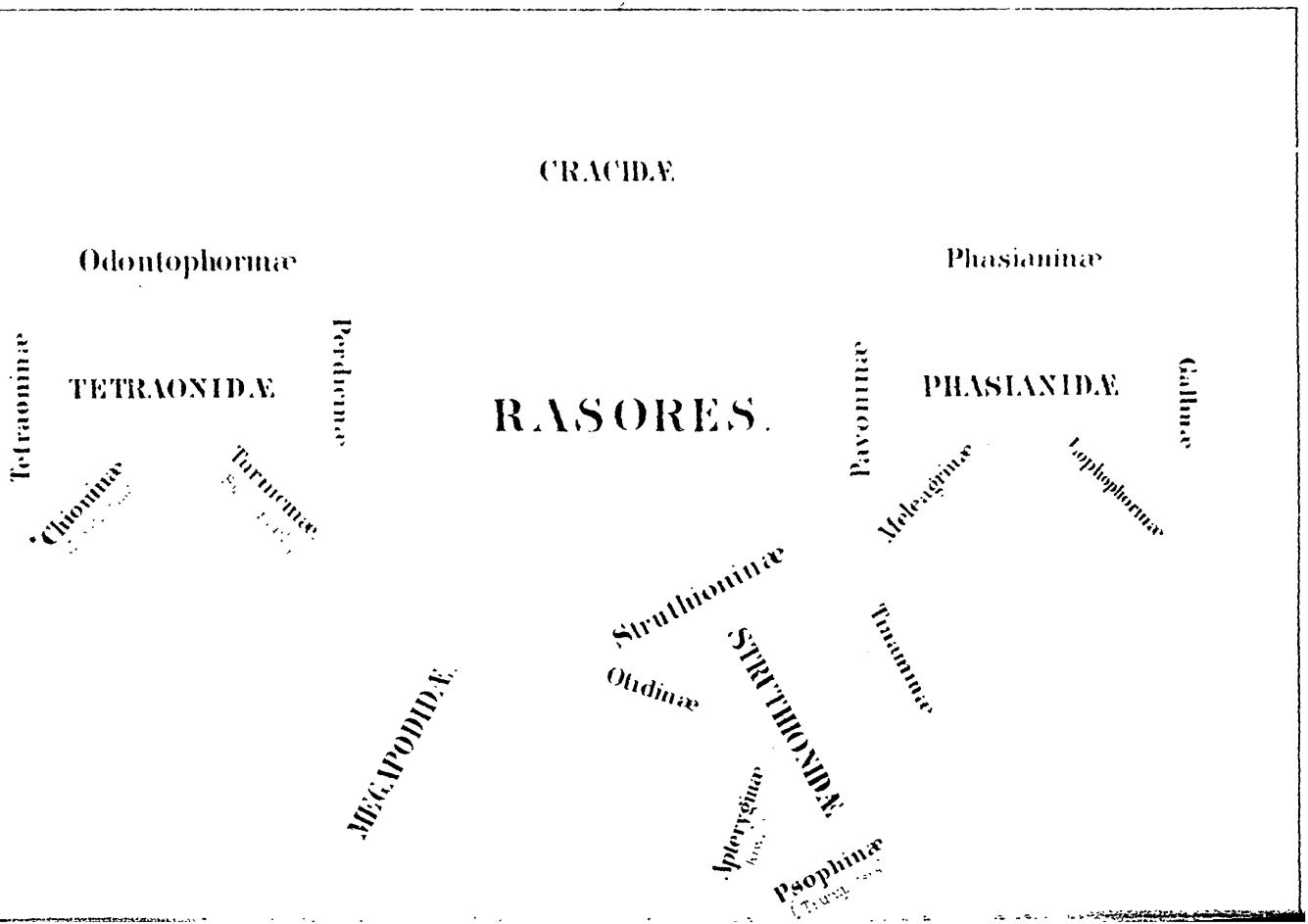
The family Struthionidae is distinguished by a more or less complete mixture of the long legs and neck of the Grallatores, with the usual Rasorial characters, the birds being generally above the medium size and deficient in power of flight, which in some cases is entirely wanting. We could not precisely define Struthionidae by any one or two characters, (those generally given, as the extremely short wings and rounded sternum, being peculiar to the typical sub-family STRUTHIONINAE), but birds coming near the boundary, between Rasores and Grallatores, in which notwithstanding usual marks of the latter division, the characteristics of the former seem, on the whole, to predominate, may be safely referred to this family. Dr. Geo. Gray, making the single family a distinct order

of birds under the name STRUTHIONES, assigns to it three sub-families *Struthioninae*, *Apterygiuae* and *Otidinae*, the bustards. The latter indeed are not destitute of power of flight, but they possess it in a moderate degree with a generally Rasorial structure, and considerable length of neck and legs. Their greater length and power of wing than any others in the tribe with the depressed and feeble beak of the most typical species will mark their position as the Fissirostral type of the family. If we inquire what other families of birds may be suspected of near affinity with these, that we may mark the limits of the famil satisfactorily, a slight acquaintance with descriptive Ornithology will suggest two as proper subjects for examination,—first, the Tinamous; secondly, the Trumpeters. The Tinamous consist of a group of three or four genera, with but few species inhabiting the woods and plains of South America, considered as decidedly Rasorial, yet so distinct as to have been treated as a separate family, though in numbers so few that they would more naturally form a sub-family. They are remarkable for short rounded wings, very moderate powers of flight and great strength in running. Some have the hallux, or hind toe, entirely wanting, others remarkably small; some of them are known to roost in the low branches of trees, near the roots of which they lay their eggs. From their characters and habits Dr. G. Gray places them as *the last* family of Rasores immediately adjoining Struthiones. Considering the latter also as a Rasorial family, and expecting its sub-families to display varying analogies, I rank the *Tinaminae* as the lighter and more arboreal form of STRUTHIONIDAE, the peculiar port of which they strikingly manifest, their sternum, though not rounded or deprived of its ridge, as in Struthioninae, is very peculiar, and quite inconsistent with powers of flight. Their comparatively small size might seem an objection to their introduction into this family, but only indicates their representation of the arboreal or most active type, the special character of the class Birds, whose prevailing tendency is to small size; and I cannot but think their relation quite as obvious as that of *Otidinae*, which, nevertheless, I am so far from questioning, that I believe it to be established on the soundest principles. Latham, like Buffon, placed the Trumpeters (*Psophinae*) among the Rasores. More recent naturalists have combined them with Grallatores, and according to Dr. G. Gray, they form (as being nearest to the Rasorial structure) the first sub-family of *Ardeidae*, the Herons. Their beaks and plumage resemble Rasores, as well as their food and habits. They are easily dome-

ticated, and their flesh is excellent food. Their power of flight is very small, but they run swiftly. The editor (we believe Mr. Blythe) of that part of Orr & Co.'s edition of Cuvier's Animal Kingdom, thus comments on the station at the head of the Cranes which his author had assigned to the Agami (*Psophia*) :—"The location of this very singular species among the Cranes is by no means satisfactory ; but we do not know that it can be placed to greater advantage elsewhere. Its port resembles that of the Struthious birds ; and the configuration of the sternum is unique, not even approaching any other group. Upon the whole, we conceive that it is as nearly allied to the Tinamous which inhabit the same region, as to any other known genus, and would prefer to detach it in a more marked manner from the Cranes." This is important independent testimony, and we need only add that the peculiar figure of the sternum, is, like that of the Tinamou, inconsistent with power of flight. The position of Apteryx, a most extraordinary New Zealand bird, as the type of a sub-family of Struthionidae, seems to be conceded, and its long narrow beak, with the nostrils at its extremity, is so especially Tenuirostral that there can be little doubt about its fittest place, though its entirely suppressed wings and hair like feathers might seem to mark it as last in the circle, because lowest in development—a conclusion, however, to which the consideration of the Emeu and Cassowary, which belong to the first sub-family, is opposed. We have now, therefore, every one of the tendencies of development duly represented in this family, and together forming a complete natural group of very distinct aspect connecting the Rasores with the Grallatores, and representing the latter amongst the former, to which as an order this natural group seems to me manifestly to belong.

NOTE TO DIAGRAM OPPOSITE.

*We have mentioned a reasonable doubt whether the Sheath-bills are truly Rasorial: should this doubt be confirmed, we suggest *Pteroclinae* the sand-grouse, remarkable for their long pointed wings and power of flight, but which, in the above scheme, are incorporated with *Perdicinae*, as occupying this station. Some doubt also attends *Odontophorinae* which can scarcely be well separated from *Tetraoninae*. Perhaps the true combination for this position is formed from the smallest birds of the tribe, popularly called Quails, and including the Genera Ortyx, Cryptonyx, and Coturnix. We need a more intimate acquaintance with some of these birds, before the family can be satisfactorily arranged.


CRACIDÆ
Odontophorinæ
Phasianinæ
Tetraoninæ
TETRAONIDÆ
Perdicinæ
RASORES.
Pavoninæ
PHASIANIDÆ
Gallinæ
Meleagrinæ
Lophophorinæ
Struthioninæ
Otidinæ
STRUTHIONIDÆ
Tinamininæ
MEGAPODIDÆ
Apterygina
Psophinæ

EDITORIAL.

Prehistoric Man: Researches into the Origin of Civilization in the Old and the New World. By Daniel Wilson, LL.D., Professor of History and English Literature in University College, Toronto; Author of the "Archæology and Prehistoric Annals of Scotland," etc. In two volumes. Cambridge and London: Macmillan and Co.

Britanno-Roman Inscriptions, with Critical Notes. By the Rev. John McCaul, LL.D., President of University College, Toronto, &c. Toronto: Henry Rowsell. London: Longmans.

Explorations in Labrador. By Henry Y. Hind, M.A., Professor of Chemistry in Trinity College, Toronto. Two volumes. 8vo. London: Longmans.

Air-Breathers of the Coal Period: A Descriptive Account of the Remains of Land Animals found in the Coal Formation of Nova Scotia, with Remarks on their bearing on Theories of the Formation of Coal, and of the Origin of Species. By J. W. Dawson, LL.D., F.R.S., F.G.S, etc., Principal of McGill University. Montreal: Dawson Bros.

Abstracts of Magnetical Observations made at the Magnetical Observatory, Toronto, Canada West, during the Years 1856 *to* 1862, *inclusive, and during parts of the Years* 1853, 1854, *and* 1855. Toronto: Printed by Lovell and Gibson.

Prehistoric Annals of Scotland. By Daniel Wilson, LL.D., Professor of History and English Literature in University College, Toronto; Author of "Prehistoric Man," etc. Second edition, revised, and nearly re-written. With numerous illustrations. 2 vols. 8vo. London and Cambridge: Macmillan and Co.

The evidence of literary and scientific activity afforded by the above list of works cannot fail to be gratifying to Canadians, and, in particular, to the members of the Canadian Institute, to which Society

the authors without exception belong, and at whose meetings not a few of the investigations now embodied in these works were originally communicated. The peculiar connection in which these authors mostly stand with this *Journal*, either in being on its editorial staff or being members of Council in the Society, renders it inexpedient to give any detailed criticism or general review of their productions; that task must be delegated to other pens less liable to be influenced by partial feelings than those of the writers of this *Journal*. Nor have such in abundance been wanting among the influential critics of the Old World; and to them, whether for praise or blame, our readers must perforce be referred. We may, however, with propriety notice one small fact, namely, that the volume of Observations made at our Provincial Observatory since the date of its transfer, has been published *before* the completion of the issue of the Observations, made previously to that date, which has been for ten years preparing under the care of the Imperial authorities.

Neither should we omit to notice in further evidence of Canadian enterprise, the publication of a Literary Monthly Journal* under the editorship (it is understood) of a member of the Council of the Institute, to which we offer our best wishes for a prosperous career.

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* *The British American; A Monthly Magazine devoted to Literature, Science, and Art.* Toronto: Rollo and Adam.

CANADIAN INSTITUTE.

PROCEEDINGS AT THE GENERAL MEETINGS.

ANNUAL GENERAL MEETING.—*20th December*, 1862.

Hon G. W. ALLAN, M.L.C., in the Chair.

I. The report of the Council for the year 1861-62 was read and adopted, on motion of S. B Harman Esq., seconded by Doctor Ogden.

II. A ballot having been taken for officers of the Institute, for the ensuing year, the following gentlemen were declared duly elected.

President . . . REV J McCAUL, LL.D., President University College.

First Vice-President ...	T. C. KEEFER Esq., C.E.
2nd do ...	SANDFORD FLEMING Esq., C.E.
3rd do ...	Rev. Prof. G. P. YOUNG, M.A
Recording Secretary	P. FREELAND, Esq
Corresponding do ...	P. R MORRIS Esq., M.D
Treasurer	D CRAWFORD, Esq
Curator	Prof H. Y. HIND, M.A., F.R.G.S.
Librarian	Rev H. SCADDING, D.D.
Council	Prof. D WILSON, LL.D
do	Prof. H H. CROFT, D.C.L
do	Prof. Rev W HINCKS, F.L.S.
do	Prof Rev. G. C. IRVING, M.A
do	U. OGDEN, Esq., M.D.
do	T Moss, Esq., M.A.

III. *The following Paper was read:*

By Prof H. Y. Hind, M.A. "On Vegetable Parchment, its uses and preparation."

IV. Prof. Chapman repeated the notice given at the last meeting in reference to alteration of By-Laws

V. Messrs. Harman, Kingsford and the Secretary were appointed a committee to endeavour to find some more convenient accommodation for the Institute than the rooms at present occupied.

THIRD ORDINARY MEETING.—*10th January*, 1863.

The Rev. J. McCAUL, LL.D., President, in the Chair.

The following donations for the Library were announced, and the thanks of the Institute were voted to the donors.

From Prof. J. Hall, Albany, New York:

Fifteenth Annual Report of the University of the State of New York on the Cabinet of Natural History, &c., 1862.

Contributions to Palæontology.

From Hon. J. M Brodhead, Washington:
Patent Office Reports, 1861, Agriculture. Vol. I.
Preliminary Report, Census, United States, 1860. Vol. I.
Regents' Annual Report Smithsonian Institution, 1861. Vol. I.

From Association for Promotion of Social Science, per Hon. G. W. Allan, M.L.C.
The Transactions of the Association for 1860 and 1861. 2 vols.

From Hon. Sir J. B. Robinson, Bart.
Prof. L. Agassiz Contributions to the Natural History of the United States. Vol. IV.

II. *The following Gentleman was elected a Member:*

W. MORTIMER CLARK, Esq., Toronto.

III. The notice for the alteration of By-Laws given by Prof. Chapman on 13th and 20th December, 1863, was submitted to the meeting and carried.

IV. The President, the Rev. J. McCaul, LL.D, read the Annual Address.

On motion of Mr. Harman, seconded by Mr. Kingsford, the cordial thanks of the Institute were given to the President for his able and interesting address.

V. *The following Papers were then read:*

By the Rev. C. J. S. Bethune, M.A.
"On the nocturnal Lepidoptera found in Canada.
By Prof. J. B. Cherriman, M.A.
"Note on Guldin's Properties of the centre of gravity.

FOURTH ORDINARY MEETING.—*17th January*, 1863.

The Rev. J. McCAUL, LL.D., President, in the Chair.

I. *The following Gentlemen were elected Members:*

L. McFADEN, Esq., Toronto.
JOHN WISE MARTIN, Esq., LL.D., T.C.D., Toronto.
JAMES HUBBARD, Esq., Toronto.
CHARLES A. MORSE, Esq., Toronto.
B. F. FITCH, Esq., M.A., Toronto.

II. Moved by Mr. Kingsford, seconded by Doctor Campbell. That the Institute sympathizing with the loss of Professor Chapman at the fire at the Rossin House of his books, and recognizing the literary assistance which for past years he has extended to the Institute, request Prof. Chapman to receive bound vols. of the Journal published to this date, as some slight acknowledgment of the services he has rendered.—Carried.

III. *The following Papers were then read:*

By Prof. D. Wilson, LL.D.
"On the characteristics of the flint implements of the drift as compared with those of a later stone period."

By John Martin, Esq., LL.D.
"On some General Properties of Curves."

FIFTH ORDINARY MEETING.—*24th January*, 1863.

The Rev. J. McCaul, LL.D., President, in the Chair.

I. *The following Papers were read:*

By Mr. A. E. Williamson

"A proposed classification of the Genus Helix."

By Professor J. B. Cherriman, M.A.

"On Poinsot's memoir on Rotation."

"Remarks on Comets."

SIXTH ORDINARY MEETING.—*31st January*, 1863.

I. *The following donation for the Library was announced, and the thanks of the Institute voted to the donor.*

From W. Kingsford Esq. "Impressions of the West and South during a six weeks holiday."

II. The following resolution recommended by the Council was submitted to the meeting:

The Council and members of the Canadian Institute desire to record their profound sentiments of regret at the lamented death of Sir John Beverly Robinson, Bart.: and to give expression to their grateful recollections of the services rendered by him to this Institute, while he filled the office of President, and of the substantial evidences of his interest in its progress furnished by his valuable gifts to the Library, and to the building fund. The association with this Institute of the name of one so justly esteemed among those who have been foremost in advancing the highest interests of the Province, will ever be felt to add a lustre to its early annals, and confer an additional honor on those who may hereafter fill the chair which he occupied as its president; and the members desire now to record their deep sympathy with the relatives of the deceased on whom the loss of one characterized by virtues so calculated to endear him to all who knew him must be felt as so irreparable a bereavement.

That this resolution be entered on the minutes, that a copy of it be communicated to Lady Robinson; and that the Institute do now adjourn without proceeding to any other business.

SEVENTH ORDINARY MEETING.—*7th February*, 1863.

The President, the Rev. J. McCaul, LL.D., in the Chair.

I. *The following Papers were read:*

By Prof. G. T. Kingston, M.A.

"The Meteorological Report of 1861."

By James Hubbard, Esq.

"On the Fungi."

By B. R. Morris, M.D.

"On the natural checks to the destruction of our crops by insects."

EIGHTH ORDINARY MEETING.—*14th February*, 1863.

Doctor DANIEL WILSON in the Chair.

I. Mr Harman on behalf of the Committee appointed at the Annual Meeting to endeavour to find some more convenient accommodation for the Institute than those now occupied, reported that the committee had examined the new building in course of erection for the Bank of Toronto, and found that rooms there at present in an unfinished state could be secured on reasonable terms, for the use of the Institute, and recommended that steps be taken to secure them. The report was adopted and the committee discharged

II. *The following Papers were then read:*

By Prof. G. T. Kingston, M A.

"On the disturbance of Magnetical Declination at Toronto, during the years 1855–62 inclusive."

Doctor Wilson made a communication relative to a new Kind of Cannon which was described to him on his recent visit to Washington.

NINTH ORDINARY MEETING.—*21st February*, 1863.

The President, the Rev. J. McCAUL, LL.D., in the Chair.

I. *The following Papers were read:*

By Doctor W. Ogden.

"On Chloroform and its effects"

A Paper by T. J. Cottle, Esq.,

"On a new species of Astacus," was laid on the table.

TENTH ORDINARY MEETING.—*28th February*, 1863.

The President, the Rev. J. McCAUL, LL.D., in the Chair.

I. *The following donations were announced, and the thanks of the Institute voted to the donors.*

For the Library, from the Societies:

1. Proceedings of the Literary and Philosophical Society of Liverpool, 51st Session, 1861–62.
2. Transactions of the Royal Irish Academy, Vol. XXIV. Part II. Science.

For the Museum from SANDFORD FLEMING, Esq., C.E.

1. Large Salmon Trout from Lake Huron.

II. *The following Paper was read:*

By S. Fleming, Esq., C.E.

"On the present condition of the oil springs of Enniskillen."

The Rev. Prof. Hincks' Paper—

"Notes on the position and relations of certain families of Birds," was laid on the table.

Mr. Saunders' Paper—

"Catalogue of plants found near London, C. W.," was also laid on the table.

ELEVENTH ORDINARY MEETING.—*7th March*, 1863.

In the absence of the President and Vice Presidents, Professor J. B. CHERRIMAN, M.A., was called to the Chair.

I. *The following Gentlemen were elected Members.*

JOHN L. LIZARS, M.R.C.S., Edinburgh, Toronto.
WILLIAM CLARKE, M.D., Toronto.
JAMES J. O'DEA, M.D., Toronto.
ROBERT EMERY, M.D., Toronto.
JAMES ROWELL, M.D., Toronto.
WILLIAM WINSLOW OGDEN, M.B., Toronto.

II. The Secretary on behalf of the Council gave notice that a special general meeting of the members of the Institute would take place on Saturday the 14th day of March inst., for the purpose of taking into consideration the following resolutions which were recommended for adoption by the Council, viz:

1. That the Canadian Institute sanction the formation of a section, limited to members of the Institute, for the cultivation of Medical Science.

2. That the medical section shall have the management of its own affairs, the election of its officers, &c., and shall report the same to the council, but that its action shall be subject to such regulations and bye laws of the Institute as now exist or may hereafter be enacted.

3. That the Institute shall furnish the Medical Section with the necessary minute books and stationery.

4. That the medical section shall have the privilege of meeting in the rooms of the Institute at any time that may be approved of by the Council.

III. *The following Papers were read:*

By Doctor Daniel Wilson.

"Notes of a recent visit to the Mortonian Collection of the Academy of Natural Sciences of Philadelphia."

By Professor G. T. Kingston, M.A.

"Note on the temperature co-efficients of magnets."

TWELFTH ORDINARY MEETING.—14*th March*, 1863.

SESSION—1862-63.

The President the REV. J. McCAUL, LL.D., in the Chair.

I. *The following Gentlemen were elected Members:*

MICHAEL LAWLOR, M.D., Toronto.
WM. THOS. AIKEN, M.D., Toronto.
DOCTOR JOSEPH HOWSON, Toronto.

II. *The following donation for the Library was announced.*

Britanno-Roman Inscriptions, by Doctor McCaul, presented by the author.

III. *The following Paper was read:*

By Professor Hind, M.A.
"On the Masquapees."

IV. The President having read the resolutions respecting the proposed medical section, proceeded to put the resolutions clause by clause.

The first clause was put and carried.

The second clause having been read and Doctor Campbell having given notice of his intention to introduce an amendment, the President declared the discussion adjourned to another evening.

The President gave notice that a special general meeting of the Institute would be held on Saturday the 21st inst., at 8 o'clock for the purpose of considering the propriety of erecting a building for the purposes of the Institute.

THIRTEENTH ORDINARY MEETING.—21*st March*, 1863.

SESSION—1862-63.

REV. J. McCAUL, LL.D., President in the Chair.

I. *The following Gentleman was elected a Member:*

MICHAEL BARRETT, M.A., M.D.

II. The President mentioned to the meeting that the Council had purchased a site for a Building at the corner of Richmond and Clare streets 88 feet in front by 103 feet in depth and that a plan for a building had been prepared and was now submitted. The President also explained the views of the council upon the subject.

Mr. Spreull moved, seconded by Mr. English, that the action of the Council in purchasing the building site be approved and confirmed, which was carried.

Mr. Kingsford moved, seconded by Prof. Chapman, that the council be and are hereby empowered to enter into contracts for the building according to such plans as they may deem expedient. Carried.

The President announced that the plans and estimates for the erection of the building would remain on the table for one week from this date for the inspec-

tion of members that suggestions may be made to the council in reference to them.

III. The discussion in reference to the establishment of a medical section in connection with the Institute was resumed.

The second resolution was brought forward.

Mr. Kingsford moved in amendment, seconded by Prof. Chapman,—That the words "that the medical section shall have the management of its own affairs, the election of officers, &c., and shall report the same to the council, but that its action," be omitted Lost.

The second resolution was put and lost.

The third and fourth resolutions were put and carried.

Adjourned on motion of Mr. Freeland, seconded by Professor Cherriman.

FOURTEENTH ORDINARY MEETING —28*th March*, 1863.

REV. J. McCAUL, LL.D., President in the Chair.

I. *The following donation for the Library was announced.*

FROM SAMUEL SPREULL ESQ, TORONTO.

On ribs and transverse processes with special relation to the theory of vertebrate skeleton.

On the Relations of the vomer, ethnoid and intermaxillary bones.

II. *The Auditors for the year were appointed.*

GEORGE WILSON ESQ, by the President

SAMUEL SPREULL, ESQ., by the Meeting.

III. *The following Papers were read :*

By P. Freeland Esq

"On the measurement of microscopic objects"

By the President.

"On the derivation of ancient Roman dates"

By Doctor Bovell.

"On growth and repair"

The President announced that the session would be continued for two more meetings.

FIFTEENTH ORDINARY MEETING.—11*th April*, 1863.

REV J. McCAUL, LL.D, President, in the Chair.

I. *The following Gentleman was elected as Junior Member.*

SAMUEL RIDOUT ESQ. Toronto.

II. *The following donation was presented by S. Fleming on behalf of T. Devine, Esq., Crown Land Department, U. C.*

Thirteen electrotype casts of Fossils—the thanks of the Institute were unanimously voted to the donor on motion of Dr. Scadding seconded by P. Freeland Esq.

III. *The following Paper was read:*

By Prof. Chapman Ph. Dr.

"On a specimen of Carbonaceous matter from Lake Superior, with remarks on the origin of the Petroleum, as applied more particularly to the oil district of Western Canada, and some new views on the general formation of Coal."

SIXTEENTH ORDINARY MEETING.—18*th April*, 1863.

REV. J. McCAUL, LL.D., President, in the Chair.

I. *The following Papers were read:*

By Rev. H. Scadding, D.D.

"On Phonetic Anomalies observed in some modern forms of ancient proper names."

By Rev. Prof. G. P. Young:

"Formulæ for the cosines and sines of multiple arcs."

By W. Saunders, Esq, London C. W.

"On Canadian Arctiadæ."

SEVENTEENTH ORDINARY MEETING.—25*th April*, 1863.

T. C. KEEFER, ESQ., C.E., Vice-President, in the Chair.

I. *The following Gentleman was elected a Member of the Institute.*

HENRY J. CLARKE, ESQ., of Toronto.

II. *The following Paper was read:*

By Sandford Fleming Esq., C.E.:

"Notes on projected Canadian canals to connect the upper Lakes with the St. Lawrence.

Moved by Dr. Thorburn and seconded by Dr. Hall. That the Secretary be requested to transmit a copy of Mr. Fleming's paper of this evening to T. C. Street Esq, M.P.P., for the County of Welland, and to John Simpson Esq, M.P.P., for Town and Township of Niagara.

MONTHLY METEOROLOGICAL REGISTER, AT THE PROVINCIAL MAGNETICAL OBSERVATORY, TORONTO, CANADA WEST,—AUGUST, 1863.

Latitude—43 deg. 39.4 min. North. Longitude—5 h. 17 m. 33 s. West. Elevation above Lake Ontario, 108 feet.

Day.	Barom. at temp. of 32°.				Temp. of the Air.				Excess of mean above Normal.	Tens. of Vapour.				Humidity of Air.				Direction of Wind.			Resul't. Direction.	Velocity of Wind.					Rain in inches.	Snow in inches.
	6 A.M.	2 P.M.	10 P.M.	Mean.	6 A.M	2 P.M	10 P.M	M'E'N		6 A.M.	2 P.M.	10 P.M.	M'N	6 A.M	2 P.M.	10 P.M.	M'N	6 A. M.	2 P. M.	10 P. M.		6 A.M.	2 P.M.	10 P.M.	Result.	M'E'N		
					°	°	°	°	°												°							
1	29.505	29.505	29.630	29.5128	69.5	78.9	72.4	74.55	+ 7.58	.617	.773	.682	.716	.86	.78	.86	.83	w b s	s w b s	s w b w	s 32 W	1.2	12.6	0.5	5.14	5.20	...	...
2	.581	.583	—	—	71 7	85.0	—	—	—	.691	.828	—	—	.89	.69	—	—	Calm.	s w b s	s w b w	s 62 W	0.0	10.5	1.5	5.27	8.41	...	...
3	.787	.786	.807	.7995	65.9	77.1	66.3	69.58	+ 2.73	.411	.529	.379	.431	.64	.57	.59	.59	N N W	s b E	N	N 16 W	10.5	5.2	8.0	2.68	4.27	...	...
4	.851	.763	.654	.7460	60.1	76.4	68.8	69.17	+ 2.37	.366	.568	.501	.487	.70	.62	.72	.67	N	s E b s	E b N	s 78 E	0.5	5.5	1.0	2.21	2.36	...	...
5	.613	.514	.516	.5485	67.7	83.2	71.7	74.93	+ 8.13	.585	.750	.710	.687	.87	.66	.91	.80	E b N	s s w	N W b N	s 63 W	0.5	11.6	6.0	3.70	6.58	0.075	...
6	.627	.663	.707	.6650	67.0	81.1	65.9	71.30	+ 4.73	.566	.421	.425	.468	.85	.39	.66	.63	N W	N W b W	N N W	N 33 W	0.5	10.0	3.0	4.86	5.16	...	...
7	.688	.608	.557	.6000	61.9	73.5	65.2	68.20	+ 1.52	.451	.550	.550	.536	.82	.66	.88	.78	N N W	s E b E	N	N 78 E	0.5	0.5	2.0	1.23	1.53	0.700	...
8	.463	.420	.411	.4277	67.4	76 0	73.1	73.67	+ 7.00	.632	.731	.738	.688	.94	.81	.90	.83	N E b E	s w b s	s w b s	s 83 w	2.2	6 0	2.5	2.67	4.18	...	...
9	.446	.445	—	—	68.1	78.9	—	—	—	.579	.740	—	—	.85	.75	—	—	Calm.	s W	Calm.	s 31 W	0.0	5.5	0.0	1.62	1.81	0.055	...
10	.592	.604	.566	.6827	69.5	80.3	72.4	74.70	+ 8.18	.661	.737	.666	.693	.92	.71	.84	.81	Calm.	s	E S E	s 21 E	0.0	2.0	1.5	1.12	1.46	0.023	...
11	.490	.352	.556	.4698	73.5	82 9	67.0	74.38	+ 7.95	.733	.770	.512	.655	.89	.68	.77	.76	s s w	s w b s	w s w	s 51 W	5.5	19.0	0.8	7 32	9.09	...	...
12	.751	.780	.809	.7882	56.9	70.2	60.5	62.78	— 3.55	.374	.443	.432	.412	.80	.60	.81	.72	N w b w	s w b s	Calm.	N 88 W	0.5	10.0	0.0	2.03	3.75	...	...
13	.830	.785	.659	.7603	53.3	72.8	67.4	65.92	— 0.32	.366	.435	.531	.467	.90	.51	.80	.74	Calm.	s E b E	E b N	N 71 E	0.0	3 5	1.2	0.76	2.21	...	...
14	.853	.604	.663	.6380	61.1	82.5	71.7	73.18	+ 6.95	.524	.566	.661	.590	.87	.51	.86	.74	Calm.	w b N	N w	s 84 W	0.0	10.8	1.5	2.17	4.45	...	...
15	.742	.744	.723	.7342	63.7	72.0	66.6	67.42	+ 1.27	.554	.584	.586	.572	.93	.75	.90	.85	N N W	E b N	Calm.	N 77 E	4.6	2.5	0.0	1.59	2.06	Inp.	...
16	.655	.610	—	—	67.4	72.8	—	—	—	.534	.680	—	—	.80	.85	—	—	E	s b E	N E	N 43 E	2.6	1.8	6.0	4.11	4.85	0.080	...
17	.857	.893	.922	.8930	55.1	67.0	54.7	59.53	— 6.43	.353	.355	.358	.354	.82	.53	.84	.71	N	s	Calm.	s 74 E	5.8	4.2	0.0	1.49	3.14	...	...
18	.935	.891	.784	.8667	53.3	68.4	58.7	61.05	— 4.78	.341	.455	.396	.405	.84	.65	.80	.75	Calm.	s s E	Calm.	s 13 W	0.0	4.5	0.0	0.88	1.39	...	...
19	.761	.604	.604	.6165	55.4	86.1	68.1	71.92	+ 6.15	.360	.728	.608	.580	.82	.58	.88	.74	N W b N	w	Calm.	N 88 W	1.2	12.5	0.0	2.79	4.70	0.050	...
20	.606	.569	.557	.5757	68.4	65.5	63.0	65.22	— 0.33	.618	.586	.539	.575	.89	.93	.93	.92	N	E b N	N E b N	N 54 E	6.8	6.5	1.5	1.95	2.25	0.805	...
21	.013	.591	.517	.5623	63.4	73.5	67.3	68.73	+ 3.28	.541	.594	.619	.571	.92	.72	.92	.82	Calm.	s b w	s w b s	s 24 W	0.0	1.5	4.2	2.16	2.46	...	...
22	.438	.410	.553	.4708	67.4	77.8	60.1	67.87	+ 2.53	.617	.573	.439	.531	.92	.60	.84	.78	s w b s	w b s	N N W	N 63 W	4.5	11.2	7.2	5.01	7.04	0.030	...
23	.658	.673	—	—	53.1	64.8	—	—	—	.315	.338	—	—	.77	.55	—	—	N	E S E	S E	S 54 E	5.7	4.4	12.0	3.85	4.37	0.005	...
24	.402	.340	.677	.4865	67 0	78.2	56.9	67.72	+ 2.77	.623	.636	.319	.593	.93	.71	.68	.79	s E b s	s w b w	N W N	s 87 W	2.0	16.8	5.0	7.64	11.54	0.005	...
25	.777	.767	.779	.7803	51.5	65.9	55.1	57.08	— 7.65	.314	.347	.283	.309	.83	.54	.64	.67	N b w	s w b s	N	N 32 W	4.5	6.5	8.0	1.65	5.66	...	...
26	.828	.782	.766	.7913	46.1	65.2	57.2	56.90	— 7.63	.243	.333	.358	.311	.78	.53	.76	.67	N N W	s b w	w b s	s 43 W	1.5	11.6	4.5	3.21	5.38	...	...
27	.719	.620	.546	.6188	53.6	72.0	58.0	62.72	— 1.60	.373	.500	.435	.449	.91	.63	.90	.79	w b s	s s w	Calm.	s 24 W	1.0	13.0	0.0	7.80	7.96	...	...
28	.422	.350	.350	.3663	61.9	71.0	60.5	64.53	+ 0.40	.489	.500	.496	.492	.88	.66	.94	.82	s s w	s b w	s w b s	s 21 W	9.5	15.4	9.0	7.85	8.56	0.380	...
29	.351	.465	.689	.5188	58.0	57.2	46.8	54.12	— 9.70	.441	.250	.253	.304	.92	.53	.79	.72	s w bw	w	w b s	s 78 W	1.7	13.0	6.6	9.65	9.73	...	...
30	.845	.943	—	—	43.9	59.8	—	—	—	.235	.290	—	—	.82	.56	—	—	w b N	s b w	s b w	N 87 W	7.8	9.2	0.5	3.39	5.48	...	...
31	.989	.927	.883	.9252	44.6	60.9	51.8	53.75	— 9.57	.264	.320	.363	.316	.90	.59	.94	.77	s b w	s E b s	E N E	S 79 E	2.5	5.8	4.5	2.69	4.51	...	...
M	29.6650	29.6292	29.6467	29.6453	61.01	73.68	63.35	66.58	+ 0.82	.478	.542	.494	.506	.86	.63	.82	.76										2.70	8.16	3.18		4.89	2.208	

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR AUGUST, 1863.

Highest Barometer . . . . . 29.969 at 6 a.m. on 31st. } Monthly range=
Lowest Barometer . . . . . 29.321 at 4 p.m. on 28th. } 0.668 inches.

Self-registering Thermometer: Maximum temperature . . . . 88°0 on p.m. of 19th } Monthly range=
Minimum temperature . . . . 42°4 on a.m. of 31st } 45°6

Mean maximum temperature . . 75°72 } Mean daily range=17°74
Mean minimum temperature . . 57°98 }

Greatest daily range . . . . . 35°5 from a. m. to p. m. of 19th.
Least daily range . . . . . 4°5 from a. m. to p. m. of 20th.

Warmest day . . . 5th...Mean Temperature . . . 74°93 } Difference=21°18.
Coldest day . . . . 31st...Mean Temperature . . . 53°75 }

Maximum Solar . . . . . .101°0 on p.m of 19th } Monthly range=
Radiation Terrestrial . . . . . 34°4 on a. m. of 26th } 69°.6

Aurora observed on 5 nights, viz., 5th, 6th, 13th, 15th, and 17th. Possible to see Aurora on 19 nights; impossible on 12 nights.

Raining on 12 days; depth, 2.208 inches; duration of fall, 41.2 hours.

Mean of cloudiness=0.45. Most cloudy hour observed, 4 p.m; mean=0.54; least cloudy hour observed, 8 a.m.; mean=0.35.

Sums of the components of the Atmospheric Current, expressed in Miles.

North.	South.	East.	West.
940.71	1589.94	482.53	1652.78

Resultant direction, S. 61° W.; Resultant Velocity, 1.80 miles per hour.

Mean velocity 4.89 miles per hour.

Maximum velocity 24.0 miles, from 5 to 6 p.m. on 11th and 24th.

Most windy day 24th—Mean velocity 11.54 miles per hour. } Difference 10.15.
Least windy day 18th—Mean velocity 1.39 miles per hour. }

Most windy hour, 1 to 2 p.m.—Mean velocity, 8.56 miles per hour. } Difference
Least windy hour, 4 to 5 a.m.—Mean velocity, 2.21 miles per hour. } 6.35 miles.

2nd. Thunder and lightning in N.W. 4 to 8 p.m.; rainbow at 6 p.m.—5th. Thunderstorm 4 to 6 p.m.; rainbow 6 to 7 p.m.—9th. Rainbow 3.30 to 4 p.m.—10th. Sheet lightning, accompanied by rain at 10 p.m.—15th. Distant thunder and light rain 9 to 10 a.m.—16th. Distant thunder at 6 a.m.—20th. Distant thunder in N.W. at 6 a.m.—22nd. Thunderstorm 9 to 10 a.m.—23rd. Thunderstorm 8 to 9 p.m.—24th. Distant thunder and slight rain 2 to 4 p.m.—26th. Hoar frost at 6 a.m., (first of season).—27th. Lunar halo at midnight.—29th. Thunderstorm 4.30 to 6.30 p.m.

Heavy dew recorded on 14 mornings during this month.
Sheet lightning, alone, observed on 7 evenings during the month.
Great change of temperature from a.m, to p.m. of 19th. Range=35°5 in 15 hours.

August, 1863, was comparatively mild, dry, and calm, and the amount of clouds equalled the average.

COMPARATIVE TABLE FOR AUGUST.

YEAR.	TEMPERATURE. Mean.	Excess above Average, (66°0).	Maximum observed.	Minimum observed.	Range.	RAIN. No. of days.	Inches.	SNOW. No. of days.	Inches.	WIND. Resultant. Direction.	Velocity.	Mean Force or Velocity
	°		°	°	°							
1840	64.7	— 1.3	80.1	47.4	32.7	12	2.905	...	...	...	...	...
1841	64.4	— 1.6	83.5	46.7	36.8	9	6.170	...	...	...	...	0.19 lbs
1842	65.7	— 0.3	80.7	45.3	35.4	6	2.500	...	...	...	...	0.30 "
1843	66.4	+ 0.4	85.5	44.4	41.1	4	4.850	...	...	...	...	0.12 "
1844	64.3	— 1.7	82.5	44.3	38.2	17	Imp.	...	...	...	...	0.16 "
1845	67.9	+ 1.9	82.5	44.4	38.1	9	1.725	...	...	...	...	0.19 "
1846	68.4	+ 2.4	86.3	50.4	35.9	9	1.770	...	...	...	...	0.17 "
1847	65.1	— 0.9	83.1	44.9	38.2	10	2.140	...	...	...	...	0.19 "
1848	69.2	+ 3.2	87.5	49.3	38.2	8	0.855	...	...	S 21 E	0.93	4.55 ms
1849	66.3	+ 0.3	79.5	51.4	28.1	10	4.970	...	...	N 71 W	0.60	3.76 "
1850	66.8	+ 0.8	84.2	43.0	41.2	13	4.355	...	...	N 15 E	0.35	4.46 "
1851	63.6	— 2.4	79.8	43.6	36.2	10	1.360	...	...	N 63 W	0.40	4.63 "
1852	65.9	— 0.1	81.2	46.7	34.5	9	2.695	...	...	N 70 E	0.56	3.30 "
1853	68.6	+ 2.6	91.6	47.6	44.0	11	2.575	...	...	S 36 E	0.30	4.26 "
1854	68.0	+ 2.0	98.1	47.0	51.1	5	0.455	...	...	N 64 W	1.76	4.60 "
1855	64.1	— 1.9	82.1	44.9	37.2	7	1.455	...	...	N 63 W	1.04	6.97 "
1856	63.6	— 2.4	81.3	44.0	37.3	12	1.680	...	...	N 50 W	2.88	7.03 "
1857	65.3	— 0.7	85.3	50.1	35.2	13	5.265	...	...	N 77 W	1.51	6.36 "
1858	67.6	+ 1.6	83.4	45.4	38.0	11	3.890	...	...	N 69 W	1.57	6.50 "
1859	66.6	+ 0.6	81.4	46.2	35.2	11	3.990	...	...	N 36 W	1.62	5.96 "
1860	64.5	— 1.5	81.8	47.1	34.7	14	3.405	...	...	N 70 W	1.83	5.80 "
1861	65.5	— 0.5	82.5	48.2	34.3	15	2.953	...	...	N 8 E	0.46	4.21 "
1862	67.6	+ 1.6	87.6	47.7	39.9	15	3.483	...	...	N 78 W	1.67	5.96 "
1863	66.6	+ 0.6	87.2	43.9	43.3	12	2.208	...	...	S 61 W	1.80	4.89 "
Results to 1861.	66.02	...	83.81	46.47	37.35	10.2	2.951	...	...	N 58 W	0.85	5.17
Exc. for 1863.	+0.58	...	+ 3.39	— 2.57	+ 5.95	+ 1.8	— 0.743	...	...	...	...	— 0.28

MONTHLY METEOROLOGICAL REGISTER, AT THE PROVINCIAL MAGNETICAL OBSERVATORY, TORONTO, CANADA WEST.—SEPTEMBER, 1863.

Latitude—43 *deg.* 39.4 *min. North. Longitude*—5 *h.* 17 *min.* 33 *sec. West. Elevation above Lake Ontario,* 108 *feet.*

Day.	Barom. at temp. of 32°.				Temp. of the Air.				Excess of mean above Normal.	Tens. of Vapour.				Humidity of Air.				Direction of Wind.			Resultant Direction.	Velocity of Wind.					Rain in Inches.	Snow in Inches.
	6 A.M.	2 P.M.	10 P.M.	MEAN.	6 A.M	2P.M.	10PM	MEAN		6 A.M	½ P.M.	10 P.M.	M'N	6 A.M	2 P.M.	10 P.M.	M'N	6 A.M	2 P.M.	10 P. M.		6 A.M	2 P.M	10PM	Resul't.	MEAN		
					°		°		°																			
1	29.874	29.795	29.749	29.8005	51.1	63.1	55.4	58.45	— 4.58	.352	.369	.394	.370	.94	.53	.89	.76	N N E	S S W	S E b E	S 16 E	2.8	4.5	2.5	1.34	2.38	...	...
2	.709	.678	.632	.6757	52.2	63.4	60.5	60.75	— 1.08	.369	.455	.419	.417	.91	.65	.80	.78	S E	S E	N	N 17 E	0.8	1.0	15.0	4.99	7.64	...	...
3	.736	.740	.813	.7647	51.8	61.2	50.8	54.53	— 7.88	.270	.239	.262	.252	.70	.44	.70	.60	N	N b W	N b W	N 1 W	13.8	12.8	13.5	10.97	11.12	...	...
4	.833	.804	.739	.7900	45.0	59.1	43.6	51.60	—10.53	.221	.256	.241	.237	.74	.51	.69	.62	N	S b E	N E b N	S 85 E	8.0	8.4	6.4	2.56	5.97	...	...
5	.700	.585	.573	.6143	46.1	64.5	59.4	58.05	— 3.78	.234	.442	.434	.375	.75	.73	.86	.76	N N E	E b N	N b W	N 78 E	4.2	7.8	1.5	2.88	3.72	...	...
6	.633	.671	—	—	58.0	69.2	—	—	—	.428	.443	—	—	.89	.62	—	—	N b W	N b W	N N W	N 11 W	0.5	2.0	8·0	5.48	5.60	Inp.	...
7	.826	.785	.741	.7822	54.4	62.1	59.4	59.40	— 1.75	.373	.449	.375	.410	.88	.81	.74	.81	N N E	E b S	E b S	N 86 E	5.6	5.2	2.0	3.39	3.99	...	...
8	.651	.638	.809	.7093	57.6	70.6	55.8	61.98	+ 1.25	.458	.603	.322	.463	.96	.81	.72	.81	S E b E	W N W	N N W	N 38 W	1.5	14.2	5.3	7.39	9.97	Inp.	...
9	.954	.945	.972	.9573	45.4	58.0	48.6	51.25	— 9.10	.225	.228	.241	.238	.74	.47	.69	.64	N N E	S b E	N	N 57 E	7.0	5.8	8.5	3.29	6.21	...	...
10	30.013	.939	.811	.9087	44.3	60.5	55.1	54.92	— 5.13	.221	.292	.386	.309	.76	.54	.89	.72	N b E	E	E b N	S 84 E	6.0	8.2	2.3	4.30	4.73	...	...
11	29.731	.611	.599	.6335	57.6	67.4	63.0	63.45	+ 3.80	.434	.561	.487	.508	.92	.83	.85	.87	E N E	S W b S	S W b W	S 55 W	0.6	5.0	1.8	3.28	4.96	0.215	...
12	.584	.636	.677	.6397	59.8	63.4	55.4	60.13	+ 0.90	.465	.417	.349	.406	.90	.71	.80	.78	N W b N	N	N b E	N	1.2	10.0	7.2	6.47	7.30	Inp.	...
13	.713	.701	—	—	49.7	60.9	—	—	—	.208	.321	—	—	.83	.59	—	—	N E b N	S E	S E b E	S 85 E	6.2	3.0	4.5	3.94	4.40	...	...
14	.743	.728	.735	.7392	51.3	71.3	61.9	62.07	+ 3.73	.353	.509	.428	.433	.92	.66	.77	.78	S E b E	S b W	S W b S	S 24 W	0.8	9.8	3.0	5.08	5.22	...	...
15	.773	.708	.723	.7333	60.9	78.2	63.0	67.55	+ 9.03	.503	.559	.450	.503	.94	.58	.78	.76	S W	S W b S	Calm.	S 35 W	7.5	15.2	0.0	6.39	6.42	...	...
16	.735	.663	.571	.6502	58.0	76.0	64.8	67.90	+10.38	.452	.604	.542	.562	.94	.67	.88	.83	S W b W	S E	S b E	S 20 E	1.0	8.5	0.8	3.43	3.71	...	...
17	.541	.390	.271	.3883	65.9	78.2	67.7	70.43	+13.43	.567	.604	.585	.590	.89	.63	.87	.80	S b W	S b W	W b S	S 19 W	4.2	13.0	8.2	6.98	9.04	0.770	...
18	.261	.319	.490	.3627	54.7	50.4	44.6	48.75	— 7.87	.370	.227	.217	.268	.80	.61	.74	.76	N N W	N W	W b N	N 44 W	17.2	24.5	7.0	12.82	13.25	.195	...
19	.571	.600	.657	.6140	36.5	50.4	41.4	43.82	—12.30	.199	.255	.214	.219	.92	.69	.81	.76	W N W	S b W	N W b W	S 83 W	3.5	8.0	3.0	4.39	6.08	...	...
20	.712	.678	—	—	38.9	54.7	—	—	—	.176	.242	—	—	.76	.56	—	—	W b N	S W	S W b W	S 60 W	1.8	7.0	5.0	4.76	4.98	0.055	...
21	.595	.643	.900	.7298	51.8	56.9	42.1	49.87	— 5.25	.333	.286	.178	.260	.80	.62	.66	.71	S W b W	N W b N	N W b N	N 48 W	4.8	21.0	6.8	9.51	10.37	...	...
22	30.062	30.114	30.111	30.0937	37.8	51.8	45.7	45.82	— 8.82	.165	.186	.231	.196	.72	.48	.75	.64	N N W	S S E	S b W	S 5 W	3.0	9.7	3.8	3.23	7.08	...	...
23	30.040	29.899	29.823	29.9082	48.6	61.2	54.0	55.08	+ 0.87	.282	.339	.325	.315	.82	.63	.78	.73	S b E	S	S	S 1 E	7.5	10.0	1.2	6.04	6.12	...	...
24	29.664	.655	.779	.7078	55.8	58.3	44.6	52.90	— 1.75	.401	.391	.226	.325	.90	.80	.77	.81	S by W	N b W	N	N 16 W	4.2	12.2	10.4	9.40	10.17	Inp.	...
25	.844	.849	.887	.8630	41.4	47.1	38.5	42.58	—10.65	.214	.184	.173	.196	.81	.56	.74	.71	N b W	N	N N W	N 9 W	10.5	10.8	9.0	10.26	10.55	...	...
26	.872	.799	.771	.8122	34.5	50.4	39.2	41.80	—10.93	.148	.197	.180	.173	.75	.53	.75	.65	N	S	S S W	N 55 W	8.0	9.0	5.0	6.67	5.30	...	...
27	.785	.720	—	—	31.6	56.9	—	—	—	.156	.286	—	—	.87	.61	—	—	N	S	Calm.	S 9 E	2.8	3.8	0.0	1.86	2.38	...	...
28	.702	.676	.684	.6878	47.5	61.2	52.9	54.18	+ 2.35	.316	.308	.327	.344	.96	.73	.82	.82	S E	E b S	N E	N 75 E	2.0	7.8	5.0	3.60	4.62	...	...
29	.733	.745	.766	.7470	52.2	63.0	56.5	57.55	+ 6.23	.327	.450	.335	.373	.83	.78	.73	.78	N E b N	E S E	N E b E	N 63 E	4.5	5.3	1.2	3.51	4.29	...	...
30	.758	.737	.695	.7273	52.2	65.2	58.7	58.93	+ 8.12	.327	.393	.361	.367	.83	.63	.73	.74	N N E	E S E	N E b E	N 66 E	4.3	5.0	8.0	5.86	6.22	...	...
31	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
M	29.7504	29.7185	29.7269	29.7324	50.57	62.42	53.37	55.88	— 1.61	.330	.381	.334	.350	.85	.64	.78	.75	.....	.....	.....	.....	4.86	8.95	5.20	.....	6.46	1.235	.....

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR SEPTEMBER, 1863.

Highest Barometer.....30.140 at 10 a.m. on 22nd } Monthly range =
Lowest Barometer .....29.259 at 8 a. m. on 18th } 0.881 inches.

Self-registering Thermom.
- Maximum Temperature ..... 80°0 on p.m. of 17th } Monthly range=
- Minimum Temperature ..... 31°4 on a.m. of 27th } 48°6
- Mean maximum Temperature ..... 64°49 } Mean daily range=
- Mean minimum Temperature ..... 46°99 } 17°50
- Greatest daily range ..... 27°1 from a.m. to p.m. of 27th.
- Least daily range..... 7°0 from a.m. to p.m. of 18th.

Warmest day ..... 17th... Mean temperature..... 70°43 }
Coldest day ..... 26th... Mean temperature..... 41°80 } Difference = 28°63.

Maximum { Solar..... 94°0 on p.m. of 16th } Monthly range =
Radiation. { Terrestrial..... 22°6 on a.m. of 27th } 71°4

Aurora observed on 8 nights, viz.,—8th, 9th, 10th, 16th, 18th, 19th, 22nd and 23rd.
Possible to see Aurora on 21 nights; impossible on 9 nights.
Snowing on . days, depth ... inches; duration of fall, ... hours.
Raining on 8 days, depth 1.235 inches; duration of fall 19.0 hours.
Mean of cloudiness = 0.42.
Most cloudy hour observed, 8 a.m: mean = 0.55; least cloudy hour observed, 10 p.m.; mean, = 0.32.

Sums of the components of the Atmospheric Current, expressed in miles.

North.	South.	East.	West.
2255.81	1343.11	974.65	1238.64

Resultant direction N. 16° W.; Resultant velocity 0.92 miles per hour.
Mean velocity .....6.46 miles per hour.
Maximum velocity ..... 24.5 miles, from 1.30 to 2.30 p.m. on 18th.
Most windy day .....18th.....Mean velocity, 13.25 miles per hour. } Difference=
Least windy days ...1st & 27th....Mean velocity, 2.38 ditto. } 10.87 miles.
Most windy hour ....2 to 3 p.m.....Mean velocity, 9.40 ditto. } Difference=
Least windy hour ...6 a.m. to 7 a.m.....Mean velocity 4.71 ditto. } 4.69 miles.

1st. Fog at 6 a.m.; and again at 10 p.m., and midnight.—2nd. Ground Fog 6 a.m.; Sheet lightning in W & S W at midnight.—5th. Sheet lightning in S W at 10 p.m. —7th. Dense fog at 10 p.m. and midnight.—10th. Hoar frost at 6 a.m.—11th. Ground fog at 6 a.m., and sheet lightning in W at 10 p.m. and midnight.—14th. Sheet lightning in N E from 8 p.m.—16th. Dense ground fog at 6 a.m.—17th. Thunderstorm from 7 p.m. to midnight.—19th. Sharp hoar frost 6 a.m.—20th. Sharp hoar frost 6 a,m.—22nd. Slight hoar frost 6 a.m.; Slight fog from 6 p.m.; Lunar Halo at 10 p.m. and midnight.—24th. Distant Thunder in S & S W 10 to 11.30 a.m.—26th. Sharp frost and thin ice at 6 a.m., Lunar Corona at midnight.—27th. Thin ice at 6 a.m.—30th. Fog 7.30 to 8 a.m.; Lunar Corona at 10 p.m. and midnight.

September, 1863, was comparatively cold, dry, windy, and clear.

COMPARATIVE TABLE FOR SEPTEMBER.

Year.	Temperature. Mean.	Excess above aver'ge (57.6)	Max. observed.	Min. observed.	Range.	Rain. No. of days.	Rain. Inches	Snow. No. of days.	Snow. Inches	Wind. Resultant. Direction.	Wind. Resultant. V'y.	Wind. Mean Force or Velocity.
	°		°	°	°							
1840	54.0	— 3.9	70.2	29.4	40.8	4	1.380	...	...	...	...	.....
1841	61.3	+ 3.4	79.9	37.5	42.4	9	3.340	...	...	...	...	0.23 lbs.
1842	55.7	— 2.2	83.5	28.3	55.2	12	6.160	...	...	...	...	0.45
1843	59.1	+ 1.2	87.8	33.1	54.7	10	9.760	...	...	...	...	0.57
1844	58.6	+ 0.7	81.5	29.6	51.9	4	Imp.	...	...	...	...	0.26
1845	56.0	— 1.9	78.8	35.3	43.5	16	6.245	...	...	...	...	0.34
1846	63.6	+ 5.7	84.0	39.0	45.0	11	4.595	...	...	...	...	0.33
1847	55.6	— 2.3	74.8	38.1	36.7	15	6.665	...	...	...	...	0.33
1848	54.2	— 3.7	80.9	29.5	51.4	11	3.115	...	...	N 71° W	2.38	5.81mls.
1849	58.2	+ 0.3	80.4	33.5	47.1	9	1.480	...	...	N 75° W	0.69	4.23
1850	56.5	— 1.4	76.0	31.7	44.3	11	1.735	...	...	S 65° W	1.02	4.78
1851	60.0	+ 2.1	86.3	33.4	52.9	9	2.665	...	...	N 14° E	1.03	5.45
1852	57.5	— 0.4	81.8	36.1	45.7	10	3.630	...	...	N 77° W	0.53	4.60
1853	58.8	+ 0.9	85.4	36.1	49.3	12	5.140	...	...	N	1.06	4.33
1854	61.0	+ 3.1	93.1	36.3	56.8	14	5.375	...	...	N 22° W	1.33	4.04
1855	59.5	+ 1.6	81.7	36.1	45.6	12	5.585	...	...	N 20° E	1.29	7.61
1856	57.1	— 0.8	77.3	37.4	39.9	13	4.105	...	...	S 79° W	1.98	6.53
1857	58.6	+ 0.7	81.4	34.1	47.3	11	2.640	...	...	N 68° W	1.61	5.55
1858	59.1	+ 1.2	80.1	36.8	43.3	8	0.735	...	...	S 74° W	1.53	5.69
1859	55.2	— 2.7	73.8	35.7	38.1	15	3.525	...	...	N 44° W	1.60	6.36
1860	55.3	— 2.6	74.2	28.7	45.5	14	1.950	...	...	N 71° W	2.63	5.79
1861	59.1	+ 1.2	78.2	37.1	41.1	17	3.607	...	...	N 71° W	1.39	4.81
1862	59.6	+ 1.7	78.9	41 0	37.9	9	2.344	...	...	N 59° W	1.07	5.11
1863	55.9	— 2.0	78.2	31.6	46.6	8	1.235	...	...	N 16° W	0.92	6.46
Results to 1861.	57.91	...	89.51	34.22	46.30	11.2	3.973	...	...	N 62° W	1.13	5.40
Exc. for 1863.	2.03	...	2.31	2.62	0.30	3.2	2.738	...	...	.....	.....	1.06

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