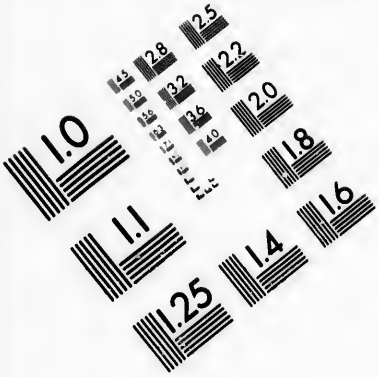

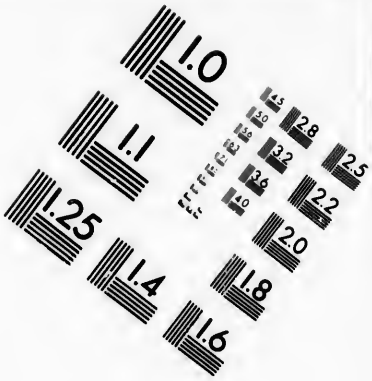

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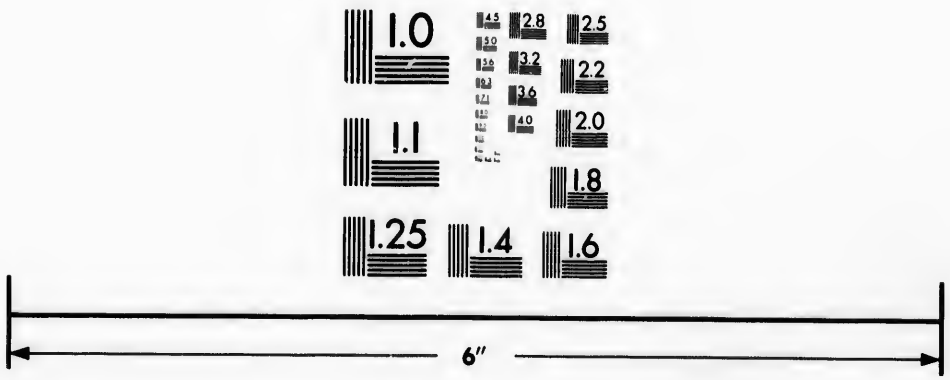

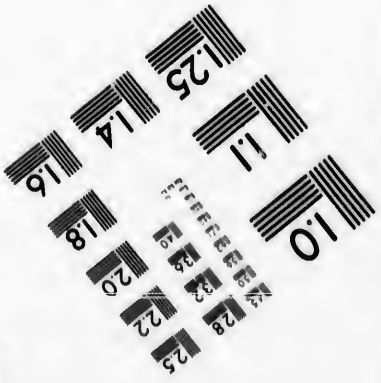

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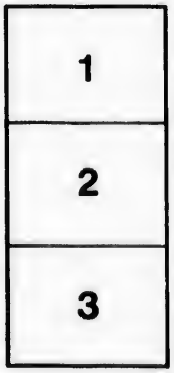

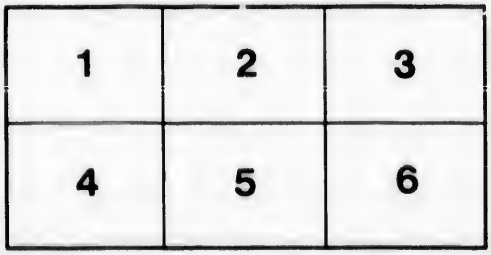

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ON THE

NEWER PLIOCENE

AND

POST PLIOCENE DEPOSITS

OF THE

VICINITY OF MONTREAL,

WITH

NOTICES OF FOSSILS RECENTLY DISCOVERED IN THEM.

BY J. W. DAWSON, LL.D., F.G.S.,
Principal of McGill College.

(Read before the Natural History Society of Montreal, Nov. 30, 1857.)

From the "Canadian Naturalist and Geologist."

Montreal:
PRINTED BY JOHN LOVELL, AT THE CANADA DIRECTORY OFFICE,
ST. NICHOLAS STREET.
1858.

PLATE VII.

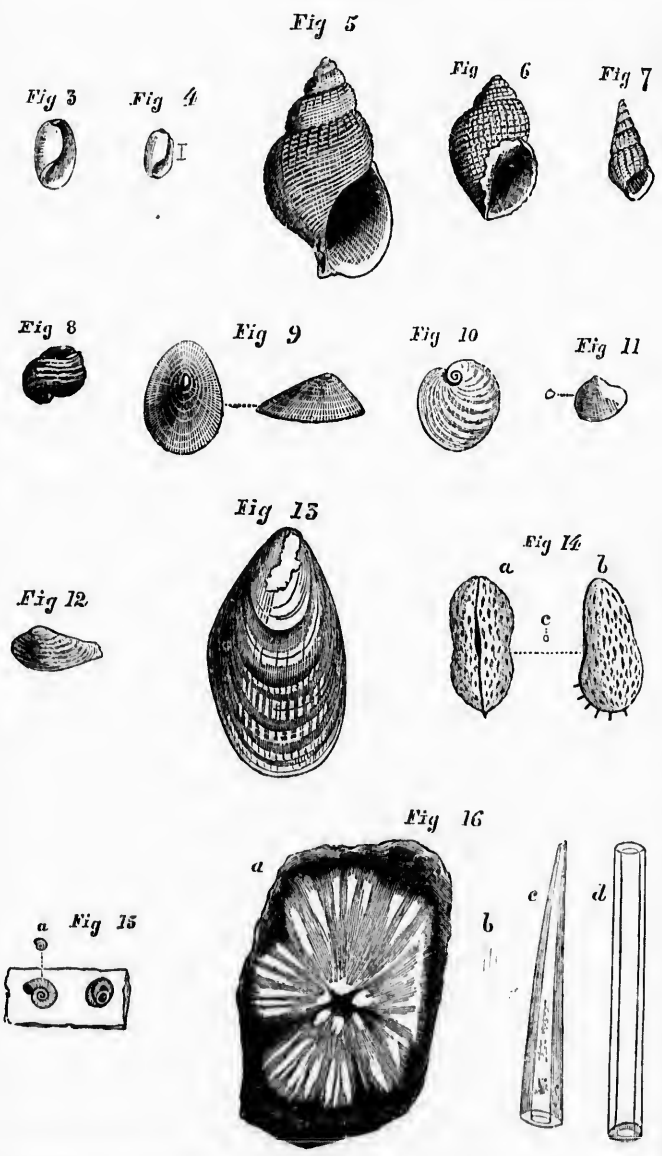
Fig 5
Fig 3
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Fig 15

Fig 7

Fig 11

b

d

Fig 17

Fig 18

Fig 19

Fig 20

Fig 21

Fig 22

Fig 23

Fig 24

Fig 25

Fig 26

Fig 27

Fig 28

Fig 29

Fig 30

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ON THE

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The deposits to which this paper relates, belong to that widely spread sheet of superficial detritus, by which the greater part of the northern hemisphere was covered at the close of the tertiary and commencement of the recent period. This formation, as it occurs in the lower part of the valley of the St. Lawrence, has been described by Dr. Bigsby, Rear Admiral Bayfield, Sir C. Lyell, Sir W. E. Logan, and Professor Emmons. More recently an excellent summary of the previous publications, with many new facts, was given by Mr. Billings in this Journal; and a paper by the writer on additional fossils recently discovered, was read before the American Association at its late meeting in Montreal.*

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* Annals of New York Lyceum, 1st series. Transactions Geological Society, 1839; Proceedings Geological Society, 1851; Lyell's Travels in North America; Reports of Canadian Survey; Emmons' Report on Geology of New York; Canadian Naturalist, vol. 1. The few pages devoted to Montreal in Lyell's Travels, contain a remarkably graphic and accurate view of these deposits as they occur here, and will enable any one not familiar with the subject, much more readily to comprehend the additional details given in this paper.

In the present paper I propose to notice the arrangement of the beds in the vicinity of Montreal, and the assemblage of fossils which they contain, in connection with the distribution of the species as inhabitants of the modern seas, and the inferences as to climate and other conditions deducible from them.

The isolated eminence of trap which rises in the mountain of Montreal to a height of about 700 feet, forms up to that elevation, a tide-guage of the Post Pliocene sea, marked on its sides by a series of sea cliffs and elevated beaches, indicating the stages of gradual or intermittent elevation of the land as it rose to its present level. The most strongly marked of these sea margins are at heights of 470, 440, 386 and 220 feet above Lake St. Peter on the St. Lawrence;* or 450, 420, 366, and 200 above the river at Montreal.

The highest of these beaches contains sea shells of existing species. Below the lowest, and at an elevation of about 100 feet above the river, spreads the great tertiary plain of Lower Canada, everywhere containing marine shells, and presenting a series of deposits partly unstratified and partly assorted by water. In this vicinity the regular sequence is as follows:

1. Fine uniformly grained sand, in some places underlaid or re-placed by stratified gravel. Marine shells in the lower part.
2. Unctuous calcareous clay, of gray and occasionally of brown and reddish tints. A few marine shells.
3. Compact boulder clay filled with fragments of various rocks, usually partially rounded and often scratched and polished.

Fig. 1.

SECTIONAL VIEW OF TERRACES AND POST PLIOCENE BEDS—MONTREAL.

a Trap, *b* Limestone with trap dykes, *c* Elevated Beach, *d d* Terraces on front of Mountain, *e* Saxicava Sand, *f* Leda Clay, *g* Boulder Clay, *h* Fluviatile Gravel.

* The first of these measurements is given on the authority of the Geological Survey. The others were ascertained for me by Professor Hamilton of McGill College, by levelling. The terraces are not quite level nor their limits always very distinct.

The thickness of these beds is at least 100 feet, of which the lower or boulder clay constitutes the greater part, but the sand often attains the thickness of 10 feet, and the fine clay that of 20 feet.

The boulders are not confined to the boulder clay, properly so-called. The stratified clays and sands often contain large rounded stones, partly of the mountain trap and partly of the older metamorphic rocks of the Laurentian formation, lying to the northward of the St. Lawrence valley. Dr. Bigsby long ago remarked that the boulders derived from the mountain have been drifted principally to the S. W.; in which direction they have been traced as far as the South Shore of Lake Ontario, 270 miles distant from their original position. On the other hand, the successive terraces are best seen on the North East side of the mountain, which is bare and abrupt.

Wherever I have observed the rock surfaces under the boulder clay, they present the striated and polished appearance usual in such positions. On the North East side of Montreal mountain the directions observed were from S. 70° W. to S. 50° W., corresponding to the direction of the drift mentioned above.

In some places the surface of the boulder clay has been deeply cut into furrows by the currents which deposited sand and gravel upon it. In like manner the surface of the stratified clay is sometimes cut into trenches filled by the overlying sand. On the other hand, in places which have been more sheltered, the boulder clay passes into the finer clay or into gravel, and the latter into sand. It is in these last localities, where evidences of denudation are absent, that marine fossils most abound.

The City of Montreal is built on the deposits just described. In the upper part of the city, at the base of the mountain, and at the height of about 100 feet above the river, we see in many places a fine yellowish sand, and about the same level, a little further East, at the mile-end quarries, are stratified gravel and sand. Below this sand we find the fine unctuous clay, forming a thick bed in the upper part of the city, and at the brick yard on the St. Lawrence Road, as well as at the village of the Tanneries. Under this is the thick bed of boulder clay and clay gravel seen in excavations on Dorchester and Lagauchetiere Streets; and at the gravel pits on the Lachine Railway. The steep descent at Beaver Hall Hill, at St. Patrick's Hospital, and along the Lachine road is the true margin of the river bottom, and marks the limit of the cut made by the St. Lawrence in these tertiary deposits

In this bottom we have in Craig Street, and toward the Tanneries, river gravel, occasionally with fresh-water shells. In some places the river has probably cut through the boulder clay quite to the underlying rock, but in other places this is not the case. In the bottom of one of the most advanced coffer-dams of the Victoria Bridge, I observed a great depth of the original boulder clay, on which the river had made no impression. The mud brought up by the dredging machines from the current immediately below Montreal, and from some parts of Lake St. Peter, is evidently the undisturbed marine clay. In the former place I found in it one of its characteristic fossil shells, Tellina grœnlandica.

All the beds above referred to belong to the close of the tertiary period, and they are all marine; but they may have been deposited at distant intervals of time, and in waters of very various depth and area. The climates and other physical conditions appertaining to the times of their deposition, may have been different from each other and from that which now prevails. On these subjects the best evidence that we can obtain is that of fossil remains. We may therefore proceed to consider these, as they exist in different localities and at different levels; and first with reference to the lower level referred to, that of the plain or terrace at the height of 100 to 120 feet above the river.

At and near the Tanneries, shells are found in superficial sand, and also in tenacious gray and reddish clay underlying it. In the former and at the surface of the latter, the prevailing shell is Saxicava rugosa, along with which Sir C. Lyell mentions Mytilus edulis, which I have not yet seen at this place. These may be regarded as in this latitude littoral or shallow water shells. In the clay the only abundant shell is Nucula (Leda) Portlandica. This, judging from the habits of its modern congeners, must be a deep sea shell, inhabiting quiet muddy bottoms at from 10 to 50 fathoms in depth, or perhaps still lower.*

At this place then there appears to have been a shallow water or littoral deposit, superimposed on one that must have been deposited in deeper water. Under both is the boulder clay.

In the grounds of McGill College, the excavations for the main pipe of the water work, have exposed an interesting section of

---

* Living specimens of Nucula tenuis and Yoldia lucida have been dredged from a depth of 200 fathoms on the coast of Norway by M'Andrew & Barrett.

these deposits. The overlying sand is here of a light yellow color; the clay below very fine and unctuous, and of a grey colour. Both contain a few large boulders, and are underlaid by boulder clay, which toward the base of the mountain, comes up to the surface. In some places the top of the clay is cut into deep furrows filled by the sand, but in others the latter rests on an unbroken surface, and a layer of greyish sandy clay forms a transition between them. The sand contains no shells. The thin transition bed of sandy clay abounds in the following species, arranged as nearly as possible in the order of their relative abundance:—

Tellina Groenlandica.
Saxicava rugosa.
Mya arenaria.
Mytilus edulis.
Astarte Laurentiana.
Tellina calcarea.
Trichotropis borealis.
Fusus tornatus.
Bulla oryza.
Leda Portlandica.

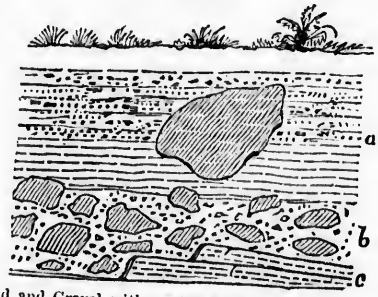
In the clay below, very few shells occur; and these exclusively Leda Portlandica and Astarte Laurentiana; which are found principally in its upper layers, and have their valves attached. Here again we have evidence of a deep sea bed overlaid by one that is littoral; and it is also worthy of notice that the two species found in the former are not now known as American shells, at least in this latitude; while in the upper bed there are common American species. For convenience we may name the upper bed the *Saxicava Sand*, and the lower the *Leda Clay*. (See Fig. 1.)

At the cutting of the Montreal and Ottawa railway near St. Denis street, and at the brick yards, the Leda clay and Saxicava sand occur as before. From the latter of these places Sir W. E. Logan has obtained a number of caudal vertebrae of a cetacean and part of the pelvis of a seal, as well as fragments of wood of the common American cedar (Thuja occidentalis). These remains were apparently contained in the Leda Clay.

At the Mile End quarries, the limestone has in places a thin coating of boulder clay, over which are stratified sand and gravel, with layers of shells in the lower part. This place is on the summit of a slight ridge, and the thick fine clay of the brick-yard

and Sherbrooke Street, has apparently not been deposited on it, or has been swept away, so that the littoral sand and gravel rest immediately on the boulder clay, and in some places on the rock. (*See Fig.* 2.)

Fig. 2.



a Stratified Sand and Gravel with marine shells, and a large boulder. *b* Hard Boulder Clay. *c* Silurian Limestone.

The following is the assemblage of shells at this place :

Saxicava rugosa, (by far more abundant than any other.)
Mya truncata.
Tellina Groenlandica.
Astarte Laurentiana.
Mytilus edulis.
Mya arenaria.
Tellina calcarea.
Balanus crenatus. (Bal. miser of some lists. It is usually attached to the mussel shells.)
Trichotropis borealis.
Bulla oryza.
Natica clausa.
Spirorbis sinistrorsa, (attached to stones and loose valves of Mya Truncata.

All these may be regarded as littoral, or circum-littoral shells, the deep sea deposit being here absent.

Between the slight ridge at the quarries, and another near the house of James Logan, Esq., produced by a thick dyke of trap, is a slight depression, in which excavations for drains have exposed the richest collection of Post Pliocene shells that I have anywhere seen. In this flat, there occur sands with purely littoral shells, as Mytilus edulis, Mya arenaria, &c., and sandy clay with

a variety of other species, inhabitants, at least in part, of deeper water; but I could not certainly ascertain the superposition of these beds. I presume that it is, in descending order; littoral sand, sandy clay deposited in deeper water, a thin layer of deep sea clay, and boulder clay.

At this place, in addition to all the species already noticed, I have found:

Buccinum ciliatum.
Buccinum undatum.
Admete viridula.
Acmæa cæca.
Nucula minuta.
Lacuna neritoides.
Natica helicoides?
Fusus scalariformis.
Serpula vermicularis.
Margarita arctica.
Modiolaria discors.
Rissoa minuta.
Trichotropis arctica.
Cytheridea Mulleri?

All these mollusks and articulates are known as inhabitants of modern seas, and most of them are boreal or arctic species.

In addition to these, there are at this place several species of Foraminifera, very abundantly distributed in the clay, and masses of silicious spicula of a sponge (Tethea). These sponges have evidently abounded in this quiet depression, and being covered by clay, their spicula have, on the decay of the animal matter, been imbedded in situ, so that at first sight they look little masses of asbestus, for which, indeed, they have been mistaken.

The large number of additional species collected at this place, shows that much may be done in adding to the fauna of the period. The circumstance which has favoured the accumulation here of so many species, is apparently the sheltered situation of this little hollow, and the deeper water in its bottom, as compared with that on the neighbouring ridges; on which, however, many of the shells may have lived, and may have been drifted into the intervening trough, so that we have here the inhabitants of different depths, or perhaps, more properly, a very rich spot of the sea bottom representing the laminarian zone intermediate between the purely littoral and coralline belts, but in its upper bed tend-

ing to the former, and in its lower part to the latter. The more fossiliferous part of the clay at this place, may thus represent a depth intermediate between that of our Saxicava sand and that of our Leda clay.

In many parts of Lower Canada, sea shells occur at the same level as those above described, and in similar beds, but not having examined them, I am not prepared to say much as to their bathymetrical conditions.

The celebrated locality of the capelin and lump-sucker, at Green's Creek on the Ottawa, appears to belong to this level, its elevation being 118 feet above Lake St. Peter.* The shells that I have seen from this place are chiefly littoral, as Mytilus edulis and Saxicava rugosa, but I have been favoured by Sir W. E. Logan with the inspection of a collection of the nodules found in the clay at this place, among which is one containing Leda Portlandica, and the young of a species resembling Leda pygmaea, in a tuft of delicate seaweed, in which they may have been drifted to the shore. In another of these nodules are the remains of an organism which appears to have been a star fish of the family Ophiuridae. Other nodules contain seaweeds of several species, and leaves of land plants, which will be noticed in the sequel.

The locality at Beauport, near Quebec, rendered classic by Captain Bayfield and Sir C. Lyell, belongs to this same level, and has afforded the following species not hitherto found at Montreal, beside many of those above enumerated.

Natica Groenlandica.
Natica heros.
Turritella erosa.
Scalaria Groenlandica.
Littorina palliata.
Cardium Groenlandicum.
Cardium Islandicum.
Pecten Islandicus.
Rhynconella psittacea.
Echinus granulatus.

I infer from the sections given by Lyell, Bayfield, and Emmons, that there may be at Beauport, as at Montreal, a distinction between the beds containing oceanic and deep sea shells,

* Mr. Murray, Reports of Geological Survey.

as Rhynconella psittacea and Pecten Islandicus, and those containing Saxicava rugosa and other littoral shells. It is also observable that the shells occurring at Beauport and not at Montreal, are more of an oceanic character than those of the latter locality; and this may, perhaps, be connected with the vicinity of the open sea at Quebec. Sir W. E. Logan informs me that the Beauport locality seems to be at the entrance of an ancient inlet. This would account for a mixture of shore and sea shells.

We may next direct our attention to the shore limits of the waters in which the shells of our one hundred feet level lived. It is evident that if in a given locality a bed occurs containing deep sea shells, say indicating depths of 20 to 50 fathoms, and another containing littoral shells, we must suppose that the shores appertaining to these two beds must have been very different, if, as we have every reason to suppose, the country was elevated and depressed en masse. In the Saxicava Sand, strictly littoral shells, as Mya arenaria and Mytilus edulis, are found with both valves attached, and apparently in situ, at a height of about 100 feet above the river, and at the base of the mountain. A sea level of this elevation would reach in a long bay up the Ottawa as far as Ottawa City. On the St. Lawrence it would not extend above the rapids, and south of the river it would reach but a short distance from the bank, except along the vallies of tributary streams. It would open into the Gulf of St. Lawrence by a strait of no great width. The sea area so characterized would be but a limited upward extension of the Gulf of St. Lawrence, not communicating directly with the ocean, receiving much fresh water, and subject to no ice drift, except that originating on its own shores. In such a basin the Mya arenaria and truncata, Mytilus edulis, Tellina groenlandica, and Saxicava rugosa, would find sufficiently congenial haunts, though their size might, as we find in some of the localities, be dwarfed by access of fresh water, or the extreme changes of temperature. In such a basin also, there might be deep channels affording passage to the tides, and containing shells of more oceanic character, and these might be expected to abound most toward the open sea on the north east. Locally there would be gravelly beaches, muddy inlets, sand banks, and deep oosy hollows, in each of which different species might predominate.*

* All these conditions may be observed in the bottom of the present Gulf of St. Lawrence, and in its quieter depths there are beds of clay closely resembling the Leda clay of this paper, and inhabited by two species of that genus of shell-fish.

If the land were slowly rising, so as to narrow the basin and limit the supply of sea water, species previously abundant might be diminishing in size and numbers; and in places storms and inundations might shut up shoaling bays, and inclose and destroy marine fishes frequenting such spots, entombing their remains along with those of sea weeds and of leaves of land plants drifted or blown from the shore. During such elevation, also, the positions of beaches, sand banks, and muddy bottoms, would be continually changing, so that similar alternations of argillaceous and coarse beds might be found at very different levels.

Such I suppose to have been the condition of the latest of the newer Pliocene, or post Pliocene sea areas of this part of the St. Lawrence valley, represented by the littoral sand and gravel of the lowest terrace or plain.

The clay which underlies this plain is of greater age, and is characterized by one deep sea shell which may represent a depth of from 100 to 300 feet or more, or a shore level of 200 to 400 feet above the river. We should, of course, expect to find the littoral shells belonging to this sea bottom at a higher level on the mountain, and at a greater distance from the river on the surrounding high lands.

Two of the most strongly marked terraces on the mountain occur at heights of 220 and 386 feet above Lake St. Peter. On these no shells have been found. If they existed, they have perhaps been swept away by land floods, or by the recession of the waters. Westward of Montreal, Sir W. E. Logan reports that gravel, sand and littoral shells occur near Kemptville on the Prescott Road, at an elevation of 250 feet above Lake St. Peter. Another locality in Winchester is 300 feet high, another in Kenyon 270 feet, and two others in Lochiel 264 and 290 feet. Sand and shore shells occur at Hobbes Falls, Fitzroy, at a height of 350 feet. At Dulham Mills on the De L'Isle, according to Mr. Murray, shells occur at a height of 289 feet above the St. Lawrence. Eastward of Montreal, Mr. Barnard, C. E., informs me that shells occur in gravel, near Upton Station, on the Portland and St. Lawrence railroad, 257 above the St. Lawrence, and in circumstances indicating shallow water. Still further to the east and north, on the River Gouffre, near Murray Bay, Sir W. E. Logan found two terraces with littoral shells at heights of 130 and 360 feet above high water level. The first probably corresponds to our 100 feet level at Montreal, the latter to one of the higher shores above mentioned.

These facts, to which many others might probably be added, from the Reports of the Geological Survey and other sources, rudely mark out parts of the shores of a larger and older gulf probably contemporaneous with the newer portion of the Leda clay of the lower plateau. In this condition of the St. Lawrence Valley, it would still be a land locked gulf; and while we might expect shore ice and breakers to mix many boulders with the gravel at its margin, only a few large stones would be dropped into the clay in its deeper parts by drifted ice cakes. The Leda clay, for this reason, contains few boulders.

There are, however, still higher terraces on the mountain: and one of these 479 feet above Lake St. Peter, contains shells, and is the highest fossiliferous deposit of this period known in Canada. This beach is best seen on the property of D. Davidson, Esq., above Cote des Neiges. It has been well described by Sir C. Lyell, who recognized at once its littoral character. An excavation kindly made for me by the proprietor, shows the following succession, in descending order:

1. Angular stones and sand 8 feet.
2. Fine gravel, with inclined layers of shells, principally Saxicava rugosa, 5½ feet.
3. Stratified Sand, few shells, 6 feet.

These beds are of very limited breadth, and rest against the steep side of the mountain, fronting the mouth of the Ottawa. They are evidently the remains of a beach thrown up at the mouth of a little cove or perhaps strait, intervening between the greater and lesser summits of the mountain, which must then have been rocky islets of very small size.

The sea that washed up this beach may have reached the escarpment of Niagara, and communicated with the ocean over the whole of the lower lands of Lower Canada and New England. It was, however, limited on the North by the high lands extending along that side of the St. Lawrence Valley; and on the Ottawa, in the 4th concession of Nepean, Sir W. E. Logan has observed a similar beach at a height of 410 feet. On the west, the highest terrace observed by the U. S. Geologists on the south side of Lake Ontario, appears to correspond with this sea level; and the gravel and sands containing elephantine remains near Hamilton, may have been washed into its western extremity from the neighbouring land. It does not appear, however, that marine shells have yet been found west of Kingston.

I know little of the fauna of this older sea area. The locality above referred to affords only Saxicava rugosa, Mya (fragments) Mytilus edulis, Tellina Greenlandica; and we do not certainly know that even the Leda inhabited the deep sea bottom around Montreal at this time, since the lower part of the Leda clay appears destitute of fossils. It was then over 60 fathoms under water, and probably not tenanted by many animals. The waters of this sea must have been traversed by the arctic currents, ice laden in the spring, and its northern shores probably had a climate of as low mean temperature as that of Labrador, though perhaps less extreme.

At a still earlier period than that indicated by the beaches last described, the waters had been far higher; for large boulders of laurentian rocks are found on the summit of the mountain, and much higher than this on the sides of the mountains of the Eastern Townships and of New England. The limited seas therefore in which the marine fossils above named lived, were preceded by a state of things in which an extensive oceanic surface was spread over North America, and probably only a few isolated peaks and ridges projected above the waters. Of the shores of this ocean and the animals that may have lived near them, I know nothing; and the sea deposit corresponding to this period is the lower part of the Leda clay and the surface of the great bed of boulder clay below it, neither of which have afforded fossils.

I have not as yet referred to this lower member of the formation, and I have nothing new to offer in relation to it. All my observations, whether in Nova Scotia or Canada, incline me to adhere to the view long advocated by Sir C. Lyell, and recently very ably illustrated by Professor Hitchcock,* that the true boulder clay has resulted from the gradual subsidence of the land under the influence of a cold climate, producing a deposit along the shores, resulting from the joint action of ice and water; and this, as the land sunk, spreading itself over the whole surface. As an additional fact confirmatory of this view, I may mention the appearance of successive ridges presented by the surface of the drift, and the linear distribution of stones in it, where it approaches elevated land. These appearances are often observable in cuts made in the drift in the vicinity of Montreal. This explanation of course implies that the land whose elevation we have

* Smithsonian Publications, 1856.

been considering, had previously to the beginning of the Post Pliocene period sunk below the waves. Its subsidence must have been very slow, to give time for the accumulation of so thick a bed of travelled stones and clay; and that its re-elevation was also slow is evidenced by the cliffs cut by the waves, the beds of clay and sand deposited, and the multitudes of shellfish which lived and died during the process.

These stupendous changes of level, however slow, must have caused great vicissitudes of climate, and must seriously have affected animal and vegetable life, both on the land and in the sea. If, as seems probable, before the great boulder period subsidence, the land had attained its present extent and elevation, the climate might have resembled that which now prevails. As the land sunk, its climate would become less extreme, but of lower mean temperature, and the opening up of easier access to the arctic currents might greatly reduce the temperature of the sea. This would be especially the case, if the loss of land was greater in the south, and extensive tracts remained above water in the north, producing quantities of drift ice.

The fossils correspond with such views. All the species, so far as determined, except one or two, are still living, and most of them in this latitude, though there is a prevalence of the more northern forms, and an absence of many species now extending as far north on the American coast. This conclusion was announced by Sir C. Lyell as far back as 1839, and it is confirmed by the species since found, which are stated by Dr. Gould of Boston, to form on the whole, a sub-arctic assemblage. Sir C. Lyell says, (Geol. Trans., 1839) "It is very probable that in the period immediately antecedent to the present, the climate of Canada was even more excessive than it is now, and that the shells resembled still more closely that small assemblage now found in high northern latitudes." Dr. Gould, in a letter to the author, says in reference to the group of additional species lately discovered: "Its character is sub-arctic, like that of Behring's Straits, Kamtschatka and Greenland." This character of the fauna corresponds with the indications of ice afforded by the presence of boulders, with the low mean temperature likely to result from a great depression of the land, and with the southward extension of the Arctic Ocean, and the great facilities thus afforded for the migrations of Arctic species both in longitude and latitude. On the other hand the resemblance of this fossil fauna to that of the American seas in modern

times, is increased by the direction of the present arctic currents, which give a boreal character to the marine fauna of Eastern America, as far south as Cape Cod.

In conclusion of this part of my subject, I may state that the precise limitation of the sea basins that occupied the St. Lawrence valley is of very great geological interest, when taken in connection with the conditions of life indicated by the fossils. The extension of observations on the fossils and the beds in which they are contained, is therefore very desirable; and I beg to invite to it the attention of observers. All the localities of the marine fossils should be noted, with the elevation and nature of the beds containing them. Any remains of land animals or plants imbedded with the shells would be of especial interest. Facts and specimens bearing on these points will always meet with attention if sent to the Geological Survey, to the author, or to the editors of this journal for communication to the Natural History Society.

I now proceed to give a list of the fossils found in these deposits; and as an aid to other inquirers, and a basis for future additions which I hope to make, I have thought it desirable to include not only the species recently obtained or identified by myself, (amounting to about 30, and indicated in the list by asterisks), but those previously known, with references to published figures and descriptions, synonymy, and new facts as to distribution in recent seas. Figures are also given of a few species not previously figured from this formation, or presenting peculiarities of interest.

I have to acknowledge the aid received from Dr. A. A. Gould, of Boston, who has kindly employed his extensive knowledge of American shells, in determining several species which I had not the means of identifying. Bathymetrical facts are given chiefly on the authority of Stimpson, ("Marine mollusks of New England"). Littoral extends to low water mark; Laminarian to 15 fathoms; Coralline to 50 fathoms; Deep Sea Coralline to 100 fathoms.

List of Canadian Tertiary Fossils.

(Species marked thus* have not been previously published as Canadian Fossils. (Lit.) denotes littoral, (Lam.) Laminarian; (Cor.) Coralline; (D. S. Cor.) Deep Sea Coralline; (C. G. S.) Collection of the Geological Survey of Canada.)

VERTEBRATA.

Phoca—Species not determined. Bones of posterior extremities, discovered by Mr. Billings, at Green's Creek, Ottawa, and

described by Prof. Leidy, Proc. Ac. Sci., Phila., April, 1856. Figured in Canadian Naturalist, Vol. 1. Also portion of a pelvis in C. G. S.

Cetacean—Species not determined; obtained by Sir W. E. Logan from clay near Montreal. Vertebræ in C. G. S.

Mallotus Villosus.—Capelin: Nodules from Green's Creek, in C. G. S., &c.

Cyclopterus Lumpus (Lumpus Anglorum)—Lump sucker. Nodules from Green's Creek, in C. G. S.

**Cottus*—A small fish from Green's Creek, found by Sheriff Dickson, of Kingston; imperfect, but probably of this genus.

MOLLUSCA.

(*Gasteropoda.*)

**Bulla Oryza*, Totten, (Fig. 3) Montreal, base of Saxicava Sand; rare, but of larger size than recent specimens. Recent on American coast, Maine and southward (Lit).

**Bulla Debilis*, Gould, (Fig. 4) Montreal, Logan's Farm. A single small specimen, with a visible spire, apparently referable to this species. It may be the young of the species figured by Emmons in the New York reports, and it much resembles B. Regulbiensis of Wood's crag Mollusca.

Buccinum Undatum, Lin. The specimens found at Montreal, St Nicholas and Beauport, and referred to this species, differ very much from recent specimens whether British or American. The body is much smaller in proportion to the spire, which is more elongated. The shell is much thinner, its revolving striæ finer and more uniform, and its transverse folds less distinct or absent. It always has one or more strong revolving ridges, giving in some specimens an angular appearance to the whorls. It resembles in form but not in markings, the variety figured by Sowerby (Min Con. Tab., C X.) as B. elongatum, and also, though less closely, the variety læviusculum of Wood's crag Mollusca. It corresponds more nearly with the description of B. Donovani, Gould, If not as I suspect, a distinct species from B. Undatum, this shell must be a delicate variety produced by a muddy bottom and sheltered inland situation, a kind of habitat in which I have not seen the living B. Undatum. I trust to obtain a more complete suite of specimens to determine this question (Lit to Cor.)

**Buccinum ciliatum*, O. Fabr., (Fig. Logan's Farm, Montreal. This species now lives on the American banks, also in

Greenland. Fossil in British pleistocene. Specimens found in Montreal are of small size (Cor.)

**Fusus tornatus*, Gould. Montreal, between Saxicava sand and Leda clay. This shell I suppose to be the F. Carinatus of the lists; but Dr. Gould assures me that it cannot be referred to that species, nor to the F. despectus of Linnæus, nor does it correspond precisely with any of the varieties of the Trophon antiquum of Wood's crag Mollusca, but it is evidently closely allied to that species. It corresponds exactly with Dr. Gould's description and figure*, and with recent specimens collected in Gaspé by Sir W. E. Logan. I have about 50 specimens, and they present no well marked variety of form. Recent on American banks (Cor).

**Fusus scalariformis*, Gould, (Trophon Scalariforme, Wood); very rare in Montreal, with F. tornatus. Recent Massachusetts Bay and northward; also in Spitzbergen, Behring's Straits and North Sea. Fossil in British crag. (Cor. and D. S. Cor.) (Fig.30.)

**Fusus* (Trophon) *harpularius*, Couthouy. Two specimens in the collection of the Geological Survey, correspond with this species. Recent in Massachusetts Bay. It closely resembles Clavatula castanea of Wood's crag Mollusca.

Trichotropis borealis, Brod. and Sow. Abundant at Montreal in Saxicava sand. Recent Cape Cod and northward, also in British crag. (Cor).

**Trichotropis arctica*, Middendorff. (Fig. 27) A single specimen found at Logan's farm, Montreal, is referred by Dr. Gould to this species, figured as Cancellaria arctica in the Malac, Rossica, and found recent at Behring's Straits.

**Admete* (*Cancellaria*) *viridula*, Stimpson (Fig. 6) (C. Costellifera, Wood's crag Mol). Montreal, with Fusus tornatus, &c. Larger than recent specimens, but resembles, according to Dr. Gould, large specimens figured by Middendorff. Recent Cape Cod and northward. Fossil in British crag. (Cor.)

Velutina zonata, Gould, (Fig. 10,) (V. Undata? Wood's crag Mol.) A single specimen from Logan's farm Montreal, given to me by Arthur Ross, Esq., appears to belong to this species. It is probably the same with that mentioned by Sir C. Lyell without specific name. Recent Massachusetts Bay and northward (Cor.)

Natica clausa, Brod. and Sow (Fig. Can. Nat., Vol. 1.) Plen-

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*The figures given by Sir C. Lyell, Prof. Emmons, and in Can. Nat. Vol. 1, represent small specimens with the lip broken.

tiful at Montreal and Beauport in Saxicava sand; of very large size at Logan's farm. There are two distinct varieties, one corresponding to the typical N. clausa (see Fig. in Can. Nat., Vol. 1), the other possibly identical with N. Occlusa of Wood's crag Mol., which it resembles in its more elevated spire and thinner lips. Recent from Cape Cod and northward; Fossil in British crag (Cor.)

**Natica helicoides*, (?) Johnston, (Fig. 24,) The specimens represented by Fig. 24 correspond so closely with N. helicoides, as described and figured by Wood, that I had ventured to give them that name; but Dr. Gould, though he considers the shell distinct from N. clausa, thinks it cannot be identified with the recent N. helicoides as described by Forbes, &c., unless indeed a larger number of specimens should connect it with that species as a very decided variety. These specimens differ from N. clausa in their deeply channeled suture, open though small umbilicus, prominent inner lip and distinct revolving lines. The shell has evidently been of a more dense texture and less easily weathered than that of N. clausa.

**Natica Grænlandica*, Beck, This shell occurs in some specimens collected by Rev. Mr. Kemp at Beauport. Recent Cape Cod and northward (Lam. to Cor.)

**Natica Heros*, Say. A shell collected by Rev. Mr. Kemp, at Beauport appears to belong to this species. Recent American coast (Lit.)

**Menestho* (Chemnitzia) *albula*, Moller, (Fig. 7.) Some shells in the Col. of the Geological Survey are referable to this species, though much larger than recent American specimens. They resemble the shell figured by Emmons as Turritella. Recent Cape Cod and northward (Lam. to Cor.)

Scalaria Groenlandica, Gould, (Fig. in Can. Nat., Vol 1,) Beauport, but not yet found at Montreal. Recent Massachusetts and northward. Fossil in British crag (Cor. to D S. Cor.)

**Turritella erosa*, Couth, (Fig. 8.) Fragments from Beaup ort larger than recent specimens. Recent coast of N. England (Cor to D. S. Cor.)

**Rissoa minuta*, Stimp.—Found in interior of larger univalves at Montreal. It is difficult to secure such small and fragile shells in a perfect state, and I am therefore not quite confident of the species. Recent on American coast, (Lit.)

Littorina palliata, Say. In Lyell's list of Beauport shells

I have received a specimen from Chicoutimi, Gaspé, from a littoral deposit a few feet above the level of the high tide, containing Saxicava rugosa, Balanus hameri, and Natica clausa. Recent American coast, (Lit.)

**Margarita Arctica*, Gould, (M. helecina, Moll,) Montreal with Fusus, &c. Some of the specimens are of large size and may be detected even when in fragments by their pearly appearance Recent Cape Cod and Northward, (Lit. Lam.)

**Lacuna neritoidea*, Gould. A single specimen with Fusus, &c., Montreal. Recent on New England coast.(Lit. Lam.) (Fig. 29.)

**Acmaea*, (Propilidium,) *Caeca*, Mon. (Fig. 9.,) (P. Candida, Couthony,) Montreal, with Fusus, &c. The specimens are of larger size than recent. This is probably the shell figured in N. Y. Reports as Patella. Recent Cape Cod and northward, also Greenland, Finmark, Spitzbergen. (Coral., D. S. Cor.)

**Amicula vestita*, Gray. (Fig. 24.) (Chiton Emersonii, Gould.) With Fusus, &c., at Montreal. Recent Cape Cod and northward. (Cor.)

Acephala.

Saxicava rugosa, Lam. (Fig. Can. Nat. vol. 1.) This is the most abundant shell in the littoral deposits at Montreal, Beauport, &c. Though not strictly a littoral shell, it was probably driven to the beach by breakers acting on the stony bottom of drift, or on the ledges of shale and limestone, in which it sheltered itself. At Beauport the size is small, and this is also the case at Green's Creek, and the higher levels at Montreal; but at Logan's Farm and at St. Nicholas, these shells are as large as any modern specimens that I have seen. On the surfaces of drift and Leda clay, this species seems, as on the American coast at present, to have sheltered itself among stones and in patches of sea weed and mussels; but from the abundance of perforated pieces of limestone, I suspect that it also burrowed in the softer submerged ledges, and that this may account in part for its great abundance. At present this shell is generally distributed over the North Atlantic. It ranges from low water to great depths, and is of larger size in the Arctic Seas and in deep water.

Mya arenaria, Linn. Abundant at Montreal,; but always of small size, rarely more than half the size of recent shells from the gulf of St. Lawrence; but there are in C. G. S. very large and thick specimens from a raised beach at Riviére du Loup. (Lit.)

Mya truncata, Linn. (Fig. Can. Nat. vol. 1.) More abundant and larger at Montreal than M. arenaria. Recent American Banks. (Lit. to Cor.)

Tellina Grœnlandica, Beck. (Fig. Can. Nat. vol. 1.) Very abundant in Saxicava sand, Montreal, &c. Recent in Arctic Seas, &c. Fossil in British Pleistocene. I suppose it identical with the T. fusca, recent in gulf of St. Lawrence. (Lit. Lam.)

Tellina calcarea, Lyell. (Fig. Can. Nat. vol. 1.) Probably T. proxima and sordida of American authors. Less abundant than the preceding species at Montreal, very plentiful at St. Nicholas. Recent Cape Cod and northward. (Cor.)

Astarte Laurentiana, Lyell. (Fig. Lyell's Elements and Can. Nat. vol. 1.) Common at Montreal in Saxicava sand and less so in Leda clay, supposed to be extinct, but closely allied to A. Sulcata, recent.

Cardium Islandicum, Lin. Beauport. (Lyell.) Cape Cod and northward. (Cor.)

Cardium Grœnlandicum, Gould, Beauport. (Lyell.) Cape Cod, &c. (Cor.)

Leda Portlandica, (L. truncata Wood's Crag. Mol.) Characteristic of the Leda clay, Montreal. Rare in Saxicava sand. Fossil in British crag, and recent in Arctic Seas, if identical with L. truncata; but Dr. Gould, after examining a suite of very perfect specimens from Montreal, thinks it distinct from any recent species known to him.

**Leda pygmæa*, Wood, (Fig. 11.) A few small specimens entangled in a delicate sea-weed, in a nodule from Green's Creek in C. G. S., have the form of this or some closely allied species.

**Leda minuta*, Gould, (Fig. 12.) Rare at Montreal. Dr. Gould says: "I think our L. tenuisulcata, Couthouy, a different species; but I have a specimen from our northern seas corresponding with this fossil, and with one sent by Dr. Loven, from Scandinavia as L. minuta." I suppose this to be the L. caudata of Wood's Crag. Mol. (Cor.)

Mytilus edulis, Lin. (Fig. 13.) Common at Montreal in Saxicava sand. It differs from the common recent varieties in its obtuse beaks, short rounded hinge line, oval outline, strongly marked and coloured lines of growth, and small size. Fig. 13 is the common form at Montreal. It resembles the var. elegans of Wood's Crag. Mol. Recent north Atlantic. (Lit.)

**Modiolaria discors*, Lin. (M. discrepans, Montagu.) A single

specimen found with Fusus, &c., at Montreal. Being a pearly shell it crumbles and can scarcely be preserved entire. Dr. Gould remarks:—"The synonymy is not quite clear; a very different shell has usually been held for M. discors. Neither M. discors nor discrepans of Gould is this shell; but M. nexa is the young. It is figured by Beck in Gaimard Voy. en Iceland et au Greenland, as M. striatula. A northern shell."

Pecten Islandicus, Mull. (Fig. Can. Nat. vol. 1.) Beauport. Recent Connecticut and northward. Fossil British Crag, (Lam. and Cor.)

Rhynconella psittacea, Chemnitz, (Fig. Can. Nat. vol. 1.) Beauport. Recent Gulf St. Lawrence. Fossil in British Crag, (D. S. Cor.)

ARTICULATA.

Balanus Hameri, Ascanius, (Fig. Can. Nat. vol. 1.) Beauport and St. Nicholas, not as yet at Montreal. This is the B. uddevallensis of Lyell's list, and appears to be the B. miser of the New York Reports. Fossil in European and British pleistocene; recent in British and American seas. I have a fine specimen with the animal from the coast of Nova Scotia. (Cor.) A deep water shell according to Darwin. Fig. 25 represents the opercular valves from St. Nicholas.

Balanus crenatus, Brug. Abundant at Montreal, &c. The variety elongatus is very plentiful, also the depressed variety. It is often attached to mussel shells and to pebbles in the stratified gravel. (Deep water,—Darwin.) As I am not aware that the opercular valves of this species have been previously found in Canada, I have represented a pair in Fig. 26.

Balanus porcatus, Da Costa. Darwin, in the Palaeontographical Society's publications, gives this as one of the Beauport species in Sir C. Lyell's collection.

**Cytheridea*, (Fig. 14.) At Logan's farm Montreal, with sponge spicula, &c. It resembles C. Mülleri (Münster), recent in the Zuyder Zee, fossil in the Pliocene of the Netherlands and in the Eocene of England, so closely that I have not much hesitation in referring it to that species: (see Jones in London Geological Journal, vol. x. 160.)

**Spirorbis sinistrorsa*, Montagne. (Fig. 15.) At Mile end quarries, Montreal, attached to shells of Mya truncata and to pebbles in stratified gravel. Recent George's Bank, (Cor.)

**Serpula vermicularis*, Lin. (Fig. 28.) A small specimen, Montreal, supposed by Dr. Gould to be this species.

RADIATA.

Echinus granulatus, Say. Found at Beauport by Sir C. Lyell. (Lamin.)

**Ophiura.*—In a nodule from Green's Creek in C. G. S., are the remains of an organism which appears to have been a star fish of the family Ophiuridae.

**Tethea*, Lamarck, (Fig. 16.) Silicious spicula, referable to sponges of this genus, abound at Logan's farm, Montreal, and as I am informed at other places in the tertiary clays, though they have hitherto been supposed to be of mineral origin. They occur in radiating flattened masses, just as they have existed in the living sponges, some of which must have attained a diameter of nearly three inches. They have either grown on the clay or attached to dead shells. The long cuticular spicula are $\frac{3}{10}$ths of an inch in length, slightly curved, pointed at both ends, and with a large internal cavity, which appears in the large as well as in the small specimens. Under a high power the points appear slightly truncated and open. The shorter internal spicula are about $\frac{1}{10}$th of an inch in length. Mr. Bowerbank of London, who has kindly examined these curious fossils, has no doubt that they belong to the genus Tethea; but does not refer them to any species. The spicula resemble the simple ones of T. Cranium, as figured by Johnston; but our fossils do not afford any that are tricuspidate. In the mean time, therefore, until this species can be identified with any previously described, I may claim for it, as one of the most curious fossils of these deposits, the name of T. Logani, in honour of the head of the Canadian Geological Survey, who has kindly placed at my disposal for this paper many of the materials he had collected for the description of these tertiary deposits, to which the pressure of more important departments of his work has hitherto prevented him from devoting much of his attention.

Mr. Bowerbank informs me that the recent species of Tethea range from low water mark to 200 fathoms.

**Foraminifera.*—The calcareous shells of several species of these minute creatures, occur with the sponges above mentioned. My means of reference do not permit me to refer them with any cer-

tainty to their species, though I presume they are all living forms; nor have I yet had time to examine all the specimens collected. Figs. 19 to 22 represent some of the forms observed. Fig 17 appears to be a Rosalina. Fig. 18 is probably the Quinqueloculina occidentalis of Bailey, obtained from the Atlantic soundings from a depth of 20 fathoms. Fig. 21 may be the widely diffused Orbulina universa, also found in the Atlantic soundings. Figs. 19 and 20 appear to be species of Polymorphina.

I might add to this list of animal remains, a Lymnea, apparently elodes, and a Cyclas, but I suspect them to be recent and accidental. The same remark applies to shells of Ostrea borealis occasionally found in the surface soil over the marine beds.

Plantae.

**Populus balsamifera*—Balsam poplar.—In a nodule found by Sheriff Dickson of Kingston, at Green's Creek, is a leaf of this species. Another, less perfect, is in C. G. S. This is a northern species widely diffused.

**Potentilla Norvegica*.—In a nodule from Green's Creek in C. G. S., is a leaf which, according to Prof. Barnston, cannot be distinguished from a cauline one of this species. This also is a widely diffused northern plant.

**Thuja occidentalis*—the common Cedar of Canada.—Branches in C. G. S., from brick clay pits near Montreal, show the structure of this species.

**Algae*.—In nodules in the C. G. S. are at least three species. These sea-weeds have been examined by Rev. A. Kemp, who states that one of them is apparently a stem of Laminaria, and that others are probably referable to the genera Fucus, Polysiphonia, and Porphyra, but that their state of preservation does not admit of accurate specific determination.

Nearly all the fossils in the above list have been obtained in beds belonging to the plateau, elevated about 100 feet above the St. Lawrence. Two of them, Leda Portlandica and Astarte Laurentiana, are characteristic of the stratified clay, and these are the only species which we have any reason to believe extinct. A number of recent species belong to the littoral sand and gravel, and several of these occur at all heights up to 470 feet. A very large number of species have been obtained from what I regard as the intermediate deposit of Logan's farm near Montreal.

At Montreal, then, we have a littoral group of shells, a group belonging to the Laminarian and Coralline zones, and a group probably belonging to the Coralline and deep sea Coralline zones. Perhaps the reason why the two shells characteristic of these last zones have not been recognised as recent, is that the deep sea muddy bottoms on the American coast, have not yet been well explored. It must be observed, however, that as the land was rising at the time when these beds were deposited, in the lower levels these three belts are stratigraphically superimposed on each other, and mark not only difference of depth but lapse of time. To what extent the precise order of these deposits, as observed at Montreal, may hold in other parts of the St. Lawrence valley is not yet known, but I hope to extend my observations with relation to this point; and from facts published by other observers, I have reason to believe that this arrangement will be found somewhat generally prevalent.

With respect to the divisions into which these deposits may be separable, the presence of recent shells alone in the upper beds, would refer them to the Post-Pliocene period, while on similar grounds the Leda clay and boulder clay might be regarded as Newer Pliocene. Strictly speaking, however, the whole formation belongs to the period of transition from the Pliocene to the modern epochs. The great boulder clay indicates a subsidence at the close of the former, and the overlying beds the conditions of deposit and of life during the re-emergence of the land; so that if we regard physical change as our guide, I should with several previous writers on the subject, consider the whole of the stratified beds overlying the boulder clay as one group of "modified" as distinguished from "unmodified" drift, a division which I long ago adopted for the non fossiliferous drift of Nova Scotia. This view would be farther strengthened by the probability that the high beaches containing recent shells may be contemporary with the low lying clays having species supposed to be extinct, and the farther probability that these last may yet be found living. In the meantime, therefore, I prefer to consider these deposits as extending through portions of the Newer Pliocene and Post Pliocene periods, without establishing any lines of division other than those stamped on the deposits in the locality to which this paper principally relates.

By the kindness of Arthur Ross, Esq. of Montreal, I have been favoured with a collection of fossil shells, from St. Nicholas, 15

miles above Quebec," on the south side of the St. Lawrence, at the head of a rocky ravine, 400 yards from the river, and 180 feet above its level." These shells belong to a level much higher than that which has afforded the greater number of the species at Montreal and Quebec. The assemblage is considerably different from that at other localities. Tellina calcarea predominates, and is of very large size, some specimens being $1\frac{1}{2}$ inch in length. Balanus Hameri is very abundant, and sometimes has its opercular valves: also Mya truncata, the latter of small size. The only other shells are Saxicava rugosa, Astarte Laurentiana, Trichotropis borealis and Buccinum undatum. The matrix is stony clay. This deposit though at a considerable elevation, was probably formed in deep water.

As I observe in a note in the Edinburgh New Philosophical Journal for October, that Professor H. J. Rogers is still disposed to consider the shells found at a height of 470 feet on the Montreal Mountain, as having been "swept thither from a much lower level," I presume by earthquake waves; I think it necessary to add to the statements above given, that the shells occur only in stratified sand and fine gravel, alternating in thin layers exactly in the manner of a modern beach. The shells are of course not precisely in situ, being arranged in layers among the sand, but their arrangement indicates merely the ordinary action of the waves on the shores of a bay. The error of Professor Rogers may have been caused by his confounding the stratified fossiliferous sand with the unstratified debris which overlies it, and which may perhaps indicate subsidence and ice drift subsequent to the formation of this beach. I think it more probable, however, that the overlying confused mass has resulted from the subaerial waste of the steep slope above the beach. The existence of this incoherent terrace of sand and shells perched on a steep and exposed hill side, is one of the most convincing proofs that could be desired that no cataclysmal waves have swept over the Montreal Mountain since the sea stood at this level. It is proper to add that Sir C. Lyell, writing in 1845,* clearly distinguishes the stratified shell bearing beds from the unstratified mass above.

A very interesting collection of recent shells from the mouth of the St. Lawrence, has just been brought to Montreal by Mr. Bell, a young gentleman employed on the Geological Survey. It

* Travels in North America, vol. 2.

includes numerous specimens of Buccinum undatum, but none of them present the peculiarities of the fossil variety. Fusus tornatus is represented by a single specimen, quite similar to the fossil individuals. Natica heros is abundant, as are Mytilus edulis, Mya arenaria, Tellina groenlandica, Littorina palliata, and Pecten Islandicus. There is a single specimen of Tellina calcarea, said to have been found in brackish water at Bay St. Paul. Scalaria groenlandica, Mya truncata, Astarte sulcata, and Cardium Islandicum are represented by single specimens. Balanus crenatus and a Spirorbis, apparently nautiloides, are attached to mussels and to Pecten Islandicus. Saxicava rugosa does not appear in the collection. Purpura lapillus, Mactra ovalis, Littorina tenebrosa, Solen ensis and Mesodesma arctata, are numerous, though they have not yet been found in the tertiary clays.

The specimens of Mya arenaria are large and coarse in comparison with those found at Montreal. The mussels have not the antique form. Tellina groenlandica has precisely the character of the fossils; and the more common variety, (Sanguinolaria fusca) is also represented by specimens said to have been found in brackish water.

The collection may be regarded as showing the prevalent shells, in that part of the gulf of St. Lawrence nearest to those ancient extensions of the same gulf described in this paper.

Other materials have been accumulating since the above paper was written; and I hope in some future number of the *Naturalist* to follow up the subject.

REFERENCE TO FIGURES.

Fig. 3. Bulla oryza, ... Montreal.
4. Bulla debilis, ... Do.
5. Buccinum ciliatum, ... Do.
6. Admete viridula, ... Do.
7. Menestho albula, ... Do.
8. Turritella erosa (fragment), ... Do.
9. Acmaea cacca, ... Do.
10. Velutina Zonata, ... Do.
11. Leda pygmaea? nat. size and magnified, . Green's Creek.
12. Leda minuta, ... Montreal.
13. Mytilus edulis (var. Laurentiana), . . Do.
14. Cytheridea (nat. size and magnified), . Do.
15. Spirorbis sinistrorsa (nat. size and magnified), Do.
16. Sponge (Tethea Logani), (*a*) nat. size in situ, (*b*) spicules, (*cd* large spicules magnified.

17 to 22. Foraminifera (magnified), ... Montreal.
23. Natica helicoides? . . . . . Do.
24, Amicula vestita, two anterior valves, . Do.
25. Opercular Valves of Balanus Hameri.
26. Opercular Valves of Balanus crenatus, three times natural size.
27. Trichotropis arctica.
28. Serpula vermicularis.
29. Lacuna neritoidea.
30. Fusus scalariformis.