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THE

CANADIAN NATURALIST.

SECOND SERIES.

ON THE ROCKS AND CUPRIFEROUS BEDS OF PORTAGE LAKE, MICHIGAN.

By THOMAS MACFARLANE.

During the summer of 1865 I was employed on the Geological Survey of Canada in making certain explorations on the north and east shores of Lake Superior. I had instructions to visit also the mines of the south shore, in order to acquire some idea of the experience there gained in mining the deposits of native copper, it being anticipated that such might be advantageously applied in explorations on the Canadian side of the lake. The observations which I made on the south shore, although sufficiently interesting, could not well find a place in a report having reference to Canadian territory, and, Sir William Logan having kindly consented, I have made them the subject of the following paper.

One of the most conspicuous geographical features of the south shore of Lake Superior, is Keweenaw Point. Like the rocks constituting it, it strikes out into the lake in a north-easterly direction for a distance of fifty miles. Portage Lake is situated near its base, and together with Sturgeon River, which flows into Keweenaw Bay, almost severs the point from the main land. The north-western part of Portage Lake intersects the various strata of trap and other rocks which run along the whole length of Keweenaw Point. While to the north-eastward, at Eagle River and elsewhere, the mines of greatest note are generally situated upon veins crossing the strike of the trap, those in the neighbourhood of

Portage Lake are worked almost exclusively upon beds, the strike and dip of which are parallel with that of the enclosing rocks. Such beds are not, however, altogether absent in other districts of the copper region, where they have been called 'ash beds,' but it is in the Portage Lake district that they occur most frequently, and are mined most successfully. The rocks with which they are interstratified are principally what are called traps and greenstones, together with conglomerates and sandstones. They maintain a general strike of N. 20° to N. 40° E., and have a dip of 50° to 60° north-westward.

In attempting to describe these rocks more minutely, I shall begin with those lying immediately west of the great cupriferous bed on which the Quincy, Pewabic and Franklin mines are situated, and proceed then to notice those lying to the eastward, which are, geologically, lower lying rocks.

The rock which is observed at the side of the road leading past the Quincy mine to the Pewabic, and which lies several hundred feet west of the cupriferous bed, is distinctly of a compound nature, but all its constituent minerals are not large enough to be accurately determined. Conspicuous among them is a dark green chloritic mineral, the grains of which vary from the smallest size to one fourth of an inch in diameter. In the latter case they are irregularly shaped, with rounded angles, but they are never quite round or amygdaloidal. They frequently consist in the centre of dark green laminæ. The mineral is very soft and has a light greenish-grey streak. It fuses readily before the blow-pipe to a black magnetic glass, and it would seem to be the preponderating mineral in the rock. The other constituents are in very fine grains, and consist of a reddish-grey feldspathic mineral, with distinct cleavage planes, and closely resembling it, light greenish-grey particles but whether of a feldspathic, pyroxenic or hornblendic nature could not be determined. The prevailing colour of the rock is dark greyish-green. Hydrochloric acid produces no effervescense with it, even when in a state of fine powder. Its specific gravity is 2.83, and the magnet attracts a very small quantity of magnetite from its powder. The colour of the powder when very fine is light greenish-grey. When ignited it loses 3.09 per cent. of its weight and changes to a light brown colour. When digested with nitric acid, and then afterwards with a weak solution of caustic potash (to remove free silica) it experiences, including the loss by ignition, a loss of 46.36 per cent. This consists of

Silica	14.73
Alumina	7.17
Peroxide of iron	14.87
Lime	4.47
Magnesia	2.03
Water	3.09
	46.36

In the undecomposed residue light red and dark coloured particles are discernible. On digesting it with hydrochloric acid and subsequently with a weak solution of potash, it sustains a further loss of 10.6 per cent., which consists of

Silica	3.48
Alumina	3.03
Peroxide of iron	1.98
Lime	1.76
Magnesia	.35

The undecomposed residue was still found to consist of a light red and a dark coloured constituent. The latter was the heavier, and an approximate separation was accomplished by washing. The dark coloured particles. which could not however be freed wholly from the light coloured felspathic constituent, fused readily to a dark brown glass. To judge from its gravity and fusibility it would not appear unreasonable to regard it as either pyroxene or hornblende. In quantity, however, it did not exceed one-eighth of the felspar. The latter fused easily before the blow-pipe to a colourless glass, tinging the flame strongly yellow. It would therefore seem to be of the nature of labradorite, although it is only slightly decomposed by hydrochloric acid. Since, according to Girard, neither labradorite, nor pyroxene nor magnetite are decomposable by nitric acid, it may reasonably be concluded that the constituents removed by the nitric acid are those of the chloritic mineral. On treating the rock, previous to ignition, with hydrochloric acid, much of the iron is removed as protoxide. Although some peroxide is also possibly present, I have calculated the whole of the iron as protoxide, and have moreover added the difference of weight between it and the iron as peroxide, to the loss sustained by ignition, and put it down as water. In this way the composition of the chloritic mineral calculated to 100 parts, would be

Silica	31.78
Alumina	15.47
Protoxide of iron	28.87
Lime	9.64
Magnesia	4.37
Water	9.87
	100.00

In these figures the quantity of iron is much greater, and that of magnesia much less than in ordinary chlorite. In its composition, and in being easily decomposed by acids, the mineral most closely resembles the ferruginous chlorite of Delesse,* (the delessite of Naumann), but differs from it in containing a considerable amount of lime, and in being readily fused before the blow-pipe. Assuming, nevertheless, that the chloritic constituent is delessite, and that one half of the iron removed by hydrochloric acid belongs to the magnetite, then the rock would be composed mineralogically of

Delessite	46.36
Labradorite	47.43
Pyroxene or hornblende	5.26
Magnetite	0.95
	100.00

The next rock to the eastward, to which I paid some attention, is that which constitutes the hanging wall of the Quincy Mine. It is a fine-grained mixture of reddish-grey feldspar, and dark green delessite, the former predominating. In this mixture larger crystals of feldspar and larger rounded grains of the ferruginous chlorite are occasionally discernible. Its sp. gr. is 2.83. The powder is of a reddish-grey tint, and the magnet shews the presence in it of a trace of magnetite. On ignition it changes to light brown,

* The following is the composition of ferruginous chlorite according to Delesse's analysis :

Silica	31.07
Alumina	15.47
Peroxide of iron	22.21
Protoxide of manganese	traces
Lime	0.46
Magnesia	19.14
Water	11.55

Bischof: Chemical and Physical Geology, III, 228.

sustaining at the same time a loss of 1.32 p. c. No effervescence is produced by hydrochloric acid, which dissolves out from the rock 32.44 per cent. of bases, consisting of

Alumina	7.52
Peroxide of iron	15.04
Lime	4.34
Magnesia	5.54

which, doubtless, principally belong to the chloritic mineral. The residue contains a very small quantity of the heavier and darker constituent which was found in the rock first described. The residue is not decomposed by concentrated sulphuric acid.

Next, in downward succession, comes the cupriferous bed generally known as the 'Pewabic Lode,' although it possesses none of the characters of a vein. It has a thickness of about 12 feet, and in places resembles the rock which constitutes the foot-wall of the mine, into which it seems to graduate. In its characteristic varieties it differs, however, completely from that rock. It is a reddish-brown or chocolate coloured uncrystalline rock with amygdaloidal structure and uneven, almost earthy fracture. The matrix sometimes contains some small amygdules, which are not always completely filled, and thus render the rock porous. The matrix is fusible to a black, slightly magnetic glass. It is in places impregnated with grains of metallic copper, from the minutest size to those having a diameter of a tenth of an inch. Those of a still larger size very generally project from the matrix into the amygdules, or form rounded particles lying entirely within these cavities, and filling them. The copper is here accompanied by a mineral of a light green colour, very soft, and separable from the rock as a green powder. It fuses before the blowpipe to a black slightly magnetic glass. On ignition it changes to a light yellow colour losing 0.4 p. c. of its weight. It is decomposed by hydrochloric acid and the resulting solution contains protoxide as well as peroxide of iron. On analysis, it gave the following results, in which all the iron is calculated as protoxide, and the difference between it and peroxide put down as water

Silica	46.48
Alumina	17.71
Protoxide of iron	21.17
Lime	9.89
Magnesia	trace

Alkalies........................	1.97 by difference.
Water...........................	2.78
	100

It is probably a variety of green-earth. Some of the amygdules are altogether filled with it, in which case it frequently contains small isolated grains of metallic copper. Sometimes calcspar is found along with the green-earth, the two minerals generally occupying separate parts of the cavity. Very frequently the green mineral merely lines the cavities, and the rest is filled up with calcspar. The foregoing description is of a specimen of the bed exceedingly rich in copper. At other places the matrix is more compact and darker coloured, and the amygdules are exclusively filled with calcspar, without any enclosing film of green-earth. Sometimes quartz, delessite, laumontite and prehnite occur filling the cavities. In many parts of the bed, large irregular patches and veins of calcspar are seen, through which and through the adjoining rock, run huge irregular masses of copper frequently weighing several tons, with which small quantities of native silver are associated. Epidote is also often met with in the bed, generally unconnected with the amygdules, and forming small irregular masses in the chocolate-coloured rock. The foregoing description applies equally to the cupriferous bed as developed in the Pewabic and Franklin mines. These are situated on the north side of Portage Lake. The continuation of the bed to the south-east was sought for a long time fruitlessly, until at last it was discovered accidentally at a distance of about four miles south-west of Portage Lake. At this point, on the property of the South Pewabic Mining Company, it is being opened and presents the following characters. The rock is of the same colour as on the Quincy Mine, but it is finer grained, and in places a conchoidal fracture is even observable. The amygdules are smaller, and the metallic copper seems altogether confined to them, forming solid rounded pellets. It is accompanied by delessite, calcspar, laumontite and prehnite, which minerals also occur in the cavities alone. The matrix of this bed is also fusible to a black magnetic glass.

The rock which underlies the copper-bearing bed of the Quincy Mine is distinctly amygdaloidal. The matrix is fine grained, but it is crystalline and is seen to consist of different constituents. Its colour is dark reddish-grey, and it is fusible to a black glass. The cavities, which seldom exceed the size of a pea, are filled with what appears to be the same chloritic mineral which occurs as a constituent in the first two rocks above described. It is very soft and may be cut into small, slightly coherent slices. These fuse readily to a black glass, which is slightly magnetic. In fine powder its colour is light greenish grey, and by ignition it turns dark brown, losing 5.85 p. c. of its weight. Hydrochloric acid decomposes it readily. On analysis, and calculation as above described, it gave.

Silica	30.59
Alumina	26.07
Protoxide of iron	22.01
Lime	1.92
Magnesia	12.36
Water	7.23
	100.18

It will be observed that these results correspond much more closely with the composition of delessite than that calculated from the constituents dissolved by nitric acid from the rock first described. The specific gravity of the rock, including the amygdules, is 2.78. The colour of the fine powder is dark reddish-grey. On ignition it turns brown and loses 2.33. Nitric acid dissolves 25.67, and hydrochloric acid 34.12 of its weight. In the residue from treatment with the latter acid, no heavy dark coloured constituent could be detected. From the above particulars the following mineralogical composition is deducible.

Delessite in amygdules and grains	38.
Labradorite	62.
	100

An occasional crystal of feldspar is met with in the rock, which seems to be identical with that occurring in the matrix, and is only partially decomposed by hydrochloric acid.

The various bands of rock which underlie the Pewabic lode have been intersected by a cross-cut, more than five hundred feet in length, from the seventy fathoms level of the Pewabic mine. This working has passed through the following rocks, the local names and thicknesses (horizontally) of which are as follows :

Trap	137 feet.
Old Pewabic lode	34 "
Trap	85 "

Green amygdaloid vein..........	19	feet.
Trap................................	98	"
Albany and Boston vein.........	7	"
Trap................................	45	"
Epidote or Mesnard vein.......	23	"
Trap................................	20	"
Fluckan............................	1	"
Conglomerate.....................	31	"
Sandstone.........................	6	"
	506	feet.

The general strike of these strata is N. 38° E. and the dip 55° northwestward. The two beds above denominated as the Green amygdaloid vein and the Mesnard vein are also found on the Quincy property, where the first named bears a general resemblance to the rock of the Pewabic lode. The matrix is perhaps darker coloured, and contains grains and crystals of feldspar as well as amygdules of green-earth and calespar, the latter containing copper in fine grains. The rock of the Mesnard vein is dark brown, with a bluish tint. The minerals of the amygdules are principally green-earth, quartz and metallic copper. This bed is also called the Epidote vein but the green-earth has probably been mistaken for epidote.

The trap which overlies the conglomerate in the Albany and Boston Mine is a fine grained mixture of dark green delessite, (in grains less distinctly isolated than in the rocks already described) greenish-grey feldspar, and reddish-brown mica, some of the laminæ of the latter shewing ruby-red reflections. Its sp. gr. is 2.81, and the smallest trace only of its powder is attracted by the magnet. The colour of the powder is greenish-grey, which changes on ignition to brown, a loss of 4.19 being sustained. Nitric acid dissolves from it 24.52 p. c., which consist of

Alumina............................	5.96
Peroxide of iron..................	14.78
Lime.................................	3.41
Magnesia...........................	0.37

These figures agree pretty closely with the quantities of bases dissolved from the rocks already described, but the quantities of lime and magnesia are a little smaller. The residue consists of a dark coloured, heavier, and a reddish-white coloured lighter part, the latter about twice as large in quantity as the former. The dark coloured portion consisted probably in greater part of mica, and to judge from the comparatively low specific gravity of the rock, little or no pyroxene or hornblende could be present. The mineralogical composition of this trap is therefore probably as follows :

Delessite	40
Mica	20
Labradorite	40
	100

The 'Fluckan' which underlies the trap last described is separated from it by a small seam of clay. The fluckan itself is a fine grained, dark-red shaly rock in which pieces of a greenish blue colour are sometimes seen. Both substances are fusible before the blow-pipe and contain occasionally small grains and flakes of copper. It resembles the old *Thonstein* (claystone) of the Germans, now more properly named Felsite tuff.

The conglomerate upon which the foregoing rock rests, has acquired some celebrity on account of its being mined for copper on the property of the Albany and Boston Mining Company. The boulders and pebbles consist of various species of porphyry. One of them has a dark brown matrix with small white crystals of feldspar ; another has a matrix of the same colour but with larger crystals of orthoclase, while a third variety consists principally of a fine grained mass of orthoclase with which a small quantity of a dark coloured mineral occurs in particles too small for determination. The matrix consists of a coarse grained sand of porphyritic material, impregnated with calcareous matter. In many places the interstices are not at all filled up, in others calcspar is the matrix, and very often in the lower part of the bed the matrix is almost pure metallic copper. Sometimes the metal completely fills the whole space between the pebbles, sometimes it is accompanied by calcspar, but much more frequently it is disseminated in fine particles through the coarse grained matrix. Sometimes a pebble is found quite saturated with copper, but it seems to have been of a more porous nature than the others and an amygdaloidal structure may be detected in it.

As above mentioned, a bed of sandstone underlies the conglomerate. It shews traces of stratification, is of a dark-red colour, and evidently consists of the same material as the conglomerate pebbles but in finer particles.

The trap which underlies this sandstone is amygdaloidal, but becomes more compact at a distance from the sandstone. In the adit which is being driven across the strata on the Quincy property, and which, so far as it has yet gone, is in the trap underlying the conglomerate, the rock much resembles the one first described as occurring on the road passing the Quincy mine. The grains of delessite are however smaller, seldom exceeding one tenth of an inch in diameter. An occasional crystal of feldspar is also observable in the fine grained mass of the rock. This mineral is in places reddish-grey, and in others greenish-grey, fuses readily to a colourless blebby glass and colours the blow-pipe flame strongly yellow. The sp. gr. of the rock is 2.89, and the colour of the powder light greenish-grey, but somewhat darker than that of the rock first described. It changes like that to a light brown on ignition, losing at the same time 2.77 p. c. On being treated with nitric acid and caustic potash the following substances are removed from it :

Silica	12.41	per cent.
Alumina	5.96	"
Peroxide of iron	15.85	"
Lime	3.77	"
Magnesia	1.84	"
	39.83	per cent.

These substances, together with the water lost on ignition, calculated in the same manner as in the case of the rock first described, for 100 parts give

Silica	29.52
Alumina	14.00
Protoxide of iron	33.47
Lime	8.80
Magnesia	4.29
Water	9.92
	100.00

The residue from this treatment, which amounts to 57.17 per cent. of the original rock, on being digested in hydrochloric acid lost 6.7 p. c. additional, consisting of

Alumina	2.38
Peroxide of iron	2.45

Lime	1.57
Magnesia	.30

The residue consisted of the same dark and light coloured parts as in the case of the rock first described. Calculated in the same manner as it, the mineralogical composition of this rock frem the Quincy adit would be

Delessite	42.60
Labradorite	50.69
Pyroxene or hornblende	5.62
Magnetite	1.09
	100.00

From the particulars above given, it would seem that the constituents of the traps of the Portage Lake district are principally feldspar of the labradorite species, and chlorite of a species allied to delessite, with which are found occasionally mica, small quantities of magnetite and perhaps of augite or hornblende. Similar results are given in Foster and Whitney's Lake Superior Report II, 87; but the relative proportions of the constituents are not given, nor is the peculiar nature of the chlorite referred to. The name of greenstone would seem altogether inapplicable to these rocks, because augite or hornblende only occurs in them occasionally if at all, and then in comparatively small quantity. As to the name of trap, the rocks previously so called have been by the best lithological authorities subdivided into two families, Melaphyre and Basalt.* The latter family which includes dolerite, anamesite and common basalt is distinguished by the dark, mostly black or greyish-black colour, the high specific gravity, and the richness in augite and magnetite of its rocks, and by the frequent occurrence in them of olivine and zeolites. The melaphyres on the other hand are characterised by their apparent want of augite, by their comparatively low specific gravity, by their colour of reddish-grey mixed with green and black, and their frequent development as amygdaloidal varieties; in which case quartz, calcspar and delessite fill the cavities more frequently than zeolites. The traps above described would seem to belong to the class of melaphyres, and to resemble especially those of Mansfeld described by Freiesleben, of Saxony,† and that of Faucogney described by Delesse.

* Naumann; Lehrbuchder Geognosie i, 599; Senft. Classification und Beschreibung der Felsarten, pp. 262 & 272.

† Geognostische Beschreibung des Konigreiches Sachsen ii, 447.

It is in the latter locality that the ferruginous chlorite, of which the analysis is quoted above, is found. It not only occurs in the amygdaloidal varieties of other localities, but, according to Naumann, it is also a constituent of many compact melaphyres. The following translation is from Naumann's Lehrbuch (I, 600) and is descriptive of the peculiarities of the melaphyres. It will be seen at once that it in every particular applies to the melaphyres of Portage Lake. "The principal characteristic of these rocks is "founded, on the one hand, on the decided nature of the felspa- "thic constituent, which when distinctly developed, has always "been recognized as labradorite, and on the other hand on the cir- "cumstance that pyroxene is very seldom present in recognizable "crystals, or grains, and usually cannot be determined mineralogi- "cally. The melaphyres generally appear as micro- or crypto- "crystalline rocks and only sometimes have arrived at a distinctly "granular developement. A third peculiarity is recognizable in "the tendency which these rocks have to the formation of air- "cavities and amygdaloidal structure, on which account the mela- "phyres are very frequently developed as amygdaloids or spilites. "In the amygdules, which sometimes reach a considerable size, "and then appear as geodes of varied constitution, the following "minerals are mostly found:—calcspar or brown-spar, and many "varieties of the species quartz (chalcedony, carnelian, jasper, "quartz, amethyst, agate) as also a mineral resembling chlorite or "green-earth which usually forms the periphery of the amygdules "like a shell or rind. *A similar, soft and green-coloured mineral* "is also often disseminated in the rock in grains and indistinct "crystals. The zeolites which are so frequent in the amygdaloidal "basalts, belong to the more rare occurrences in melaphyres pro- "perly so called. If we now add to these characters the com- "plete absence of quartz in the form of a rock constituent, the "predominating reddish-brown to reddish-grey colour of the mass "of the rock, which sometimes runs into greenish-grey, dark- "green and black, and the frequent occurrence of rubellan or "mica, we shall have tolerably exhausted the general petrographical "peculiarities of the melaphyres." Dr. T. Sterry Hunt, in his valuable paper on lithology, refers to this class of rocks as requiring a distinctive name, but he seems unwilling to adopt that of melaphyre. Since, however, Von Buch, Naumann and Senft*

*My objection to retaining the name of melaphyre is based upon the fact that these authors apply the name to different rocks. Brongnart, who invented it, favor its adoption, and the science of lithology is already well stocked with terms of by no means general adoption, it would seem advisable to retain the word melaphyre to denote such rocks as those above described. With regard to the copper-bearing beds, the fusibility of the rock, and its transition in places into the neighbouring rock connects it distinctly with the melaphyres. This, together with the total absence of crystalline structure, and its apparently detrital character in places, would lead one to suppose that these beds are melaphyre tuffs, bearing the same relation to melaphyre, which volcanic tuffs bear to trachytes and basalts. The trap of the Portage Lake District might therefore be properly termed granular melaphyre when it is small-grained and crystalline; amygdaloidal melaphyre when cavities are present in a crystalline matrix; compact melaphyre when the rock is fine-grained and crystalline; and tufaceous melaphyre when the matrix is destitute of crystalline structure.

The rocks which occur to the eastward of the trap last described, I had no opportunity of examining minutely. They consist probably however of the same rocks as those above mentioned, alternating with each other for about one and a quarter miles, which is the distance across the strata from the conglomerate bed of the Albany and Boston property to the so called vein explored by the Isle Royale, and other mines.

About 260 feet west of the 'Isle Royale Vein,' the bed occurs upon which the Grand Portage mine is situated. The colour of the matrix is light-green, thus differing greatly from the beds hitherto described. It has an uneven earthy fracture, is non-crystalline, with small white spots here and there through it. It is fusible and gives water when heated in a glass tube. The amygdules are all of a dark-green colour, and frequently consists exclusively of delessite. Quite as frequently, however, they consist of that mineral, with a kernel of quartz, or much more seldom of calcspar. The copper is found oftener in the amygdules than in the matrix. As in the other beds larger aggregations of crystal-

gave it to black porphyries holding hornblende; Von Buch and d'Halloy use the name as synonymous with an augite-porphyry, while finally Naumann and Senft restrict the term to rocks which contain neither hornblende nor augite, and are not black in color, as the name melaphyre would imply. Hence I agree with Bernhard Cotta in rejecting the name, while admitting at the same time that some term is requisite to designate the important class of anothosite rocks in which a hydrous mineral (ferruginous chlorite) takes the place of hornblende or augite.—T. S. H.—(EDITOR'S NOTE.)

line minerals occur, in which quartz generally preponderates, associated with calcspar, prehnite and native copper. Some specks of native silver sometimes occur in this veinstone. The strike of the bed is N. 30° E., and the dip about 52° north-westward.

Between the Grand Portage and Isle Royale Veins the trap is of the usual character, reddish-grey coloured, with dark-green grains and spots of delessite impregnating it.

The cupriferous bed of the Isle Royale mine is often of a dark-chocolate colour similar to that of the Pewabic lode. In other places it has the character of the Portage lode, being light-green coloured, non-crystalline and with an uneven fracture, but it is comparatively free from amygdules.

Trap, as usual, underlies the Isle Royale Vein, and, with other rocks, fills up the space between it and Mabb's vein which lies about a mile to the south-eastward. One of these is a conglomerate resembling that of the Albany and Boston mine, so far as the nature of the pebbles is concerned. The matrix is very porous, and in coarse grains, which are in places cemented together by quartz as well as calcspar.

Mabb's Vein, upon which mining has also been commenced by the Isle Royale Co., has a matrix of a much more crystalline character than any of the cupriferous beds already described. It is of a dark-green colour, and is impregnated with grains and irregular spots (but not amygdules) of quartz, which is accompanied by epidote and metallic copper. Sometimes, however, an approach to the light-green earthy rock of the Isle Royale vein is noticeable.

A short distance to the east of Mabb's vein another conglomerate bed is found. The pebbles are porphyritic here also, but contain crystals of quartz as well as of felspar, and the paste is difficultly fusible before the blow-pipe, fine splinters of it only becoming glazed. The pebbles do not seem to be so well rounded as in the other beds.

I had no opportunity of examining any of the rocks further eastward, which form the base of the trap formation, but since those already described form part of a series of strata having a vertical thickness of about 10,000 feet, it may be supposed that they afford good average specimens of the whole.

There is probably no one point, even in Europe, where within a limited area, there are to be found such a number of mines, many of them rich, well appointed and well managed; such a display of beautiful mining machinery; or such magnificent stamp-works as are to be found within say five miles of the towns of Hancock and Houghton on Portage Lake. Even the professional visitor, who has given previous attention to the subject, cannot but be astonished as he rounds the point beneath these towns, and sails up to them, at the scene of life and activity which suddenly opens up before him. Having only spent ten days in the district, it would be impossible for me to attempt to describe with a moderate degree of minuteness even its principal mines. There are at least twelve mines in operation within a short distance of the lake, and of these the majority are producing copper in quantity varying from 20 to 120 tons of the pure metal monthly. The mines which have the largest production are those of the Pewabic lode, and it will be sufficient to refer briefly to their mining and dressing operations.

In exploring the cupriferous bed in the Quincy mine, as in following the other beds in the district, the miner has only its lithological character to guide him, there being no distinct joints or walls on either side. The shafts, levels and winzes of the mine are all opened within the bed so that the amount of *dead work* done is the very least possible. At the 100-fathom level the strike is N. 30° E., and the dip 70° north-westward. The shafts on the Quincy mine are from 200 to 300 feet apart, and the levels from 72 to 75 feet beneath each other on the incline of the bed, and 60 feet perpendicularly. The width of the bed is from 6 to 30 feet and the average thickness ten feet. According to the general experience at the mine, the thicker the bed the richer is the rock in copper. About two-thirds of the area of the bed is removed as remunerative; the other third, although it may contain some copper, is left standing, as unworthy of excavation. The amount of ingot copper yielded by the ground actually removed in 1864 was 562 lbs. per cubic fathom. Assuming the sp. gr. of the rock of the lode to be 2.7, it thus yielded 1.4 per cent. Of course the copper was unequally distributed through the bed rock, and the true per centage would be at many places above, and at others below that just mentioned. The bed is excavated by a very judicious combination of over-hand and under-hand stopping. The rock is removed to the shafts in waggons containing about one ton each, and hoisted in *skips* or waggons of a peculiar shape, running on tracks in the inclined shafts. The contrivance whereby these skips are emptied on their reaching the surface is without doubt the simplest and most beautiful anywhere in use. There are six shafts; the deepest, No. 4, is 660 feet vertically, and about 800 feet on the incline of the bed, below the surface. The pumps have a six-inch bore with a seven-inch column, but they only work three hours in twenty-four, so little is the mine troubled with water. On reaching the surface the bed-rock undergoes a sorting and about one-third is set aside as worthless. The other two-thirds are roasted in huge heaps much in the same manner as iron-stone. The object of this operation is to render the rock more easily pulverized. After roasting, the larger masses of copper are sorted out and sent directly to the furnace, where they yield about 60 per cent. The remainder is forwarded in waggons, on an inclined tram-way (where the full waggons in descending pull up the empty ones) to the stamp-work situated close to the lake, below the village of Hancock. Here Wayne's stamps, Shiermann's jiggers and ordinary Cornish buddles are employed in concentrating the ore. Each stamp weighs 900 lbs., and has 16 inches lift. The stamped rock passes through a sieve made of boiler plate, $\frac{1}{4}$ inch thick. The holes are $\frac{1}{4}$ inch in diameter, and have a slight diminishing taper towards the stamps. The latter are stopped every eleven hours in order that the larger pieces of copper may be removed from the stamp-box. The stamped ore is discharged into a shallow run which has an inclination of a half inch in a foot. From this it comes on to a sieve which is constantly in motion, has $\frac{1}{8}$ inch holes, and separates it into coarse and fine work for the jigger. The fine work in passing down into the jigging sieve meets an upward current of water which carries away the slimes from it. The jigging machine, in which the sieve is stationary, apparently cleans the ore very effectually. A sample of the coarse ragging from it was given me which assayed 98.6 per cent., while the *skimpings* or refuse contained only 0.6 per cent. The fine *ragging* from the same machine assayed 89.3 per cent. and the refuse 0.73 p. c. The product from washing the finer stuff on the buddles assayed 78.6 per cent. while the *tailings* from the same operation gave 0.46 per cent. The whole of the refuse products of the stamp-work are, however, passed through an adjoining building, and some part of them worked over. The yield of the rock treated in the stamp-work was, during 1864, 2.96 per cent. I make no attempt to describe the magnificent machinery of the Pewabic and Franklin stamp-works where Ball's patent stamps and washers are employed. To judge, however, from the percentage of copper in the refuse products, the work is not so well done here as in the Quincy stamp-works. With the permission of the superintendent of the Franklin stamp-work, I took several samples from various parts of the run-house, and from the waste heap outside, which assayed as follows:

From head of run	4.93	per cent.
" middle of do	3.	"
" end of do	3.13	"
" a heap immediately outside of run house	0.66	"
" sand bank	1.00	"

When it is recollected that the yield of the rock treated in the Franklin stamp-work is only 1.69 per cent. the loss in the refuse products would appear to be very large. At the stamp-works of the Albany and Boston Mining Co., Gates's revolving stamps and Collom's jiggers are employed. This is also the case at the Huron stamp-work. (The Huron mine is on the Isle Royale bed.) It appears to be as yet uncertain as to which system of dressing is the most advantageous, but in view of the experience which is being acquired in the district almost daily, this cannot long remain a matter of doubt. It is, however, singular that in a district where such an enormous amount of capital is invested in mines and stamp-works, there should be no provision made for testing accurately, by the wet process, the various refuse and other products of the ore-dressing operations. It would seem difficult without such means, to come to a reliable result as to which method of concentration is the best.

The system of dividing the lands into small sections seems to have contributed not a little to the rapid developement of the mines of the Portage Lake district. The sections contain one square mile of 640 acres, and each of these is subdivided into four quarters. Some of the best of the mines have no more length of lode to work upon than may be contained in a quarter section. As a consequence, the attention and energies of the mining companies, and their managers, are, on the discovery of a cupriferous bed, at once turned to exploring and mining in depth. The opposite system, which prevails on the north shore of the lake, of having very large mining locations is as detrimental to the progress of the country as it is to the interests of the owners. The explorations are carried on over too great an area, they are desultory, are not easily superintended, and seldom yield any definite result.

In concluding this paper, I venture to hope that some of the facts which it relates concerning the mines of Portage Lake will be found useful in detecting the presence of remunerative cupriferous beds on the Canadian shore of the lake. The existence of such there can scarcely be doubted, and it is equally certain that if the same energy, intelligence and capital were employed in their developement as on those of Portage Lake, the north shore, now a wilderness, would soon become studded with towns as flourishing and populous as those which now ornament the south shore.

Acton Vale, C. E., January 3, 1866.

NATURAL HISTORY SOCIETY.

MONTHLY MEETINGS.

At the first monthly meeting convened at the rooms of the Society on Monday evening September 25, and at the second held Monday evening October 30, only routine business was done. The following donations were announced :—

TO THE LIBRARY.

The Statutes of Canada, for 1865 : from the Provincial Government.

Journal of Education, L. C. ; from the Superintendent.

United States Coast Survey Report; from the Superintendent.

Report of the Smithsonian Institute ; from the Director.

Statistics of U. S. Commerce ; from Secretary Chase.

Notes on *Selandria Cerasi* ; from Prof. Winchell.

Report on the Geological Survey of the Province of Canterbury, by Julius Haast, F. G. S. ; from the author.

Animals of N. A., by H. B. Small, (2 copies) ; from the author.

Journal of Prison Discipline, Philadelphia.

Diagnosis of new Gasteropods, by Dr. Stimpson ; from the author.

Report of the Northern Home for friendless children, Philadelphia.

Calendar of the University of St. Andrews, Scotland.

Pre-Historic Man, by Dr. Wilson ; from the author.

Descriptions of new fossils, by Prof. Winchell ; from the author.

Pennsylvania School Report for 1865.

Report on the Geology of New Brunswick; from Prof. Hind.
Défenses des Colonies, par Joachim Barrande; from the author.

And in exchange for the Canadian Naturalist.

Journal of the Society of Arts, London.
Geological Magazine, London.
Quarterly Journal of Science, London.
Journal of the Geological Society, London.
Technologist, London.
Popular Science Review, London.
Journal of the Board of Arts for U. C.
Transactions of the Lit. and Hist. Society of Quebec.
Journal of the Franklin Institute, Philadelphia, Pa.
Proceedings of the Academy of Sciences, Philadelphia, Pa.
Proceedings of the Essex Institute, Salem, Mass.
Silliman's Journal, New Haven, Conn.
Annals of the Lyceum of Nat. Hist., New York.
Proceedings of the Society of Nat. History, Boston, Mass.

The third monthly meeting was held Monday evening November 27; the President Dr. Smallwood in the chair.

The following donations were announced, and the Society's thanks voted to the donors:—

TO THE MUSEUM.

A young specimen of the white variety of the Canadian Deer (*Cervus Virginianus*) from Mr. W. S. Macfarlane; Sword, Powder-horn and Pouch, made by the Mandingoes, from Sierra Leone, from Commissary General Winter; Stone Hatchet, &c., found in New Jersey, from Mr. J. M. Brown; White-footed Mouse, (*Mus leucopus*, Raff.), from the Cabinet Keeper.

NEW MEMBERS.

Dr. Daniel Wilson, Toronto, and Mr. Westwood, Professor of Zoology, University of Oxford, were elected honorary members; Mr. G. F. Angas, of London, a corresponding member; and Messrs. Thomas Watson and Thomas Robinson, ordinary members.

PROCEEDINGS.

Mr. Alfred Rimmer read a paper on certain proposed alterations of the Game Laws. A discussion ensuing, the subject was referred to a Committee consisting of Messrs. Drummond, Rimmer and Watt, when the meeting adjourned.

The fourth monthly meeting was held at the society's rooms on Monday evening, December 18; the President, Dr. Smallwood, in the chair.

The following donations were announced and thanks voted to the donors:—

TO THE MUSEUM.

A fine specimen of the American deer (*Cervus Virginianus*), from Mr. W. S. Macfarlane; seven specimens of Central American birds from Mr. Haig, through Mr. Leeming; specimen of a South American turtle-dove from Mr. Struthers; nine specimens of Devonian fossil fishes from Orkney, Scotland, from Mr. Barnston.

PROCEEDINGS.

A paper on the natural history of *Sanguinaria Canadensis* or Canada blood-root, by Dr. Gibb, of London, was read by the Secretary.

Principal Dawson afterwards exhibited a number of specimens of flint implements and fossils from St. Acheul, near Amiens, and made some observations on the mode of their occurrence in the 'high level gravel,' in the valley of the Somme. He referred to the investigations of Boucher-de-Perthese, Lyell, and Prestwich, and quoted a portion of the description of the locality by the latter geologist. He stated that he had come to the following conclusions, derived from an examination of the locality and of the specimens, more especially those in the collection of Mr. Prestwich:

1. The implements cannot be considered so much as characteristic of a particular age as of particular work. They are not spears, or arrows, or hatchets, but picks and diggers, adapted for digging in the earth, or hollowing wooden canoes. A consideration of the implements of the American stone age renders it in the highest degree improbable that the makers of these tools did not possess also stone arrows, spears, knives, and other implements. The application of the idea of an older and ruder stone age to such implements is gratuitous, and contradicted by the evidence afforded by American antiquities.

2. There are some reasons which induce the belief that these implements have been used in burrowing small horizontal adits into the gravel beds of St. Acheul, in search of flints. In this case they may not be of great antiquity, though certainly older than the Roman occupation of Gaul.

3. They may have been deposited with the gravel. In this case they belong historically to a very ancient period, though geologically modern; and at the time when they were so deposited the climate of France must have been more severe than at present, its level different, its surface covered with dense forests, inhabited by several great quadrupeds now extinct, and the River Somme must have been much larger than at present, and must have spread its waters over a wide plain, in which the St. Acheul gravel constituted a bank or point, inundated in times of flood, and perhaps resorted to by the aborigines as a place for making canoes.

4. Before either of the two theories above stated can be finally accepted, much more thorough investigations must be made, and also careful topographical surveys of the whole district. In event of the view last mentioned being sustained, the question of the absolute time required will still be difficult to determine, since the causes of erosion and deposition in operation at the period in question must have been very dissimilar from those now in action; and other unknown causes, whether sudden or gradual in their operation, must have intervened to produce the present state of the country. In this case, however, there would be a strong probability that the *Rhinoceros tichorhinus* and the Mammoth had continued to exist in Europe down to the period of the implement making.

It is much to be desired that a series of systematic excavations in these gravels, and a geological and topographical survey of the whole basin of the Somme should be undertaken by some scientific body in France or England, as it may require many years to enable individual explorers to obtain the data required to settle the questions that have been raised in connection with these deposits.

The society's thanks were voted to Dr. Gibb and to Dr. Dawson, and the meeting thereafter adjourned.

The fifth monthly meeting of the Society was held Monday evening, January 29; The President in the chair.

NEW MEMBER.

Mr. Alexander Agassiz, of Cambridge, U. S., was elected a corresponding member.

PROCEEDINGS.

It was resolved to hold the Annual Conversazione on Thursday evening, March 1, and a committee was appointed to make the necessary arrangements.

Dr. Dawson moved the adoption of the following new by-law (of which he had given due notice) which was unanimously carried :—

"That ordinary members not resident in Montreal shall be required to pay an annual subscription of $3, and shall be entitled to received the *Canadian Naturalist* for each year; the said contribution to be paid in advance, and such members to be designated non-resident ordinary members."

Mr. Rimmer made some remarks on the proposed amendments to the Game Laws and read the draft of a report. His views had not the support of the committee and the discussion was therefore adjourned till next meeting.

Mr. H. G. Vennor presented a catalogue of the birds noted on the Great Manitoulin Islands, and accompanied it with a few observations on its physical features. Having given a brief topographical description of the Island and a sketch of its geology, some of the silicified fossils of the Clinton group from the neighborhood of Lake Manitou were exhibited; also photographs of glacial groovings and scratchings on rocks on the south shore of the island. The following are extracts from the notes then read:

"From the village of Manitouaning, a fair portage road or trail leads off to the first and largest lake on the Island, Lake Manitou, or the Lake of the Great Spirit. The portage is about three miles in length and runs through fine open woods, comparatively free from under-brush. For the information of any who may hereafter visit the Great Manitoulin, I may state that no canoes are to be had on any of the interior lakes of the island, and that it is not unusual to paddle for days on these, without even meeting with an Indian family. Consequently all canoes and Indians required have to be procured either at Little Current or Manitouaning. * * * * * Manitouaning Bay is ten miles long, and reaches to within two and one-half miles of South Bay, on the South side of the Island, thus nearly cutting off the unceded portion of the Island.

"The waters of Lake Manitou are beautifully clear, and abound in fine fish—such as Black-bass, Salmon and Brook-trout, White-fish, and Perch.

"At the extreme Western end of this lake the Indians cross by a portage to another large lake called 'Mindemooya' or 'Old Woman's Lake'; here canoes have also to be portaged.

"The whole of this portage is strewn over with very fine Clinton fossils. The cliffs around this lake lie at some distance from the shores, so that we were not much surprised at f ding a belt of good and well timbered land, between these cliffs and the shores. On such land we noticed large crops of corn and potatoes. From the middle of the lake rises Mindemooya Island, which is said to be much infested by snakes. Farther westward we have another large lake called Kagaweng, and numerous smaller ones generally distributed over the island.

" Oil wells were being successfully worked at Wequemakong by the Great Manitoulin Oil Company. The oil from this locality is of the finest description. An office has been opened in Montreal in connection with this Company.

" On the interior lakes the bald-eagle and fish-hawk were very numerous; the former bird apparently living by the toiling of the latter species. Ruffed-grouse, Spruce-partridge and Wild-pigeons were very numerous all through the interior of the island. The islands in the lakes swarmed with the Silvery and Black-backed gulls, while the waters resounded with the cries of the Loon. The Whip-poor-will might always be heard along the rocky shores and particularly near the mouth of rivers."

On the whole, the reader remarked that the Great Manitoulin presented many advantages to the settler; for although perhaps one third of the island was of a rocky and consequently barren character, the remaining two-thirds contained land of the finest description, covered at present either by Indian crops, or splendid hard-wood forests, which last yielded large quantities of maple sugar—generally at the rate of 1,000 lbs per acre. Mr. Vennor concluded by expressing a hope that ere long we might be able to hear of this great Manitoulin Island as being the home of the white settler, where he might be seen surrounded by waving fields of grain, and possessing not only the comforts, but also the luxuries of life.

The sixth monthly meeting of the Society was held at the rooms of the Society, on Monday evening, February 26; the President, Dr. Smallwood, in the chair.

PROCEEDINGS.

" The Committee on the Game Laws submitted the following Report:—

The Committee on the Game Laws has the honour to report the following recommendations:

1. That all game legislation be consolidated into one general act.

2. That the following be the close-terms for the whole Province.

Woodcock and Snipe;—March 1, to August 1.

Ptarmigan and all kinds of Duck;—March 1, to September 1.

Deer of all kinds;—February 1, to September 1.

Turkey, Pheasant, Partridge, and Grouse of all kinds;—February 1, to September 1.

Quail;—February 1, to October 1.

Fur bearing animals;—April 1, to November 1.

Your Committee does not consider these dates to be absolutely the best, but rather as compromise close-terms such as would probably unite different interests.

3. That egging and bird-nesting be prohibited, save on the North-shore east of the Saguenay, and on the Islands of the Gulf, where it shall be legal up to June 1 as at present.

4. That there should be no close-term for birds within these limits. [Except for Eider-ducks.]

5. That this Report be sent to the Fish and Game Club with a view to a joint effort being made to procure the necessary legislation.

The Committee is of opinion that no action is needed in the matter of fish, inasmuch as the administration of the Fisheries Department has been judicious, and the operation of the new Fishery Act (in itself greatly in advance of similar enactments in the mother country) promises to be on the whole satisfactory.

Respectfully submitted.

GEORGE A. DRUMMOND.
DAVID A. P. WATT.

The Report having been received was thereafter unanimously adopted, excepting the last clause relating to fish, which was reserved for discussion.

Mr. A. RIMMER believed that fishing by means of fixed-engines should be made illegal; and contended that all such were destructive of fish and ruinous to salmon grounds. Since they had been suppressed in England, the yield of salmon had been increased immensely. He remarked on the demoralizing effects of such nets, killing and maiming the fish by night and by day; and asserted that the destruction of salmon in Upper Canada was owing to these nets, as the fish were thereby driven off their proper breeding grounds. Formerly salmon abounded in the rivers to the west of Montreal, and formed a staple article of food for the inhabitants; but they had long since ceased to exist, and for many years none had been seen. One solitary fish found its way to the St. Regis river last season, but the Indians who killed it were unable to tell its name and looked on it as a sort of *lusus naturæ.* He objected to any fixed obstacles being placed in the way of fish going to their spawning grounds, and said that since these had been abolished in England, salmon could there be purchased cheaper than in Canada. As to using seines for catching fish, they were used in England, and our Canadian rivers were much better adaptéd to their use. One river that he knew, the Jacques Cartier, in which salmon had been exterminated, now abounded with these fish, the result of care and of allowing a free passage to the spawning ground; the Murray river too formerly abounded with salmon, but they had been exterminated by brush-weirs, and now a single fish was the season's catch. The owners of brush-weirs at Murray Bay had told him that formerly they took herrings by means of them in such abundance that they had to use them for manure; while now they got very few herrings or fish of any kind, a result not to be wondered at as he had found these weirs full of herring-fry and other small fish; in one brush-weir upwards of five thousand smolts had been killed in one tide.

Mr. Drummond maintained that the only question at issue was how to catch for the market, at the smallest expense, the greatest weight of salmon, making sure to leave in the rivers, as well an ample supply for keeping up the breed as all the immature fish. He argued that these ends could most easily be attained by means of fixed-engines in the salt-water (where seining was practically out of the question), and had in fact, to a considerable extent, been already attained by the Canadian nets hitherto used, inasmuch as the numbers of fish in our salmon-rivers had of late years vastly increased. He asserted that the British modes of fishing were much more destructive than the Canadian, and quoted statements to prove that salmon had not increased in the United Kingdom under recent legislation and that they were very much dearer there than here.

Dr. Dawson said that the chief objection which he saw could be urged against brush-weirs was their inefficiency; they captured too few fish, and were rude clumsy implements which fish soon learned to avoid. He thought a good deal of misapprehension existed as to the kinds of fish caught in them, his observations led him to believe that no salmon- or herring-fry nor other immature fish were taken by them; at least he had never seen such though he had examined several weirs.

Mr. Watt stated that the Fisheries Act left the Commissioner of Crown Lands free to allow or to disallow any sort of net or combination of nets, and that he and his subordinates might be supposed to understand their own business better than amateurs and to have the interests of the fisheries as much at heart. He said that so far from fixed-engines being abolished in Britain it was perfectly lawful to use them even in fresh-water and for salmon, and quoted official advertisements approved at the Home Office in January last, containing regulations for the guidance of salmon fishermen using stake-nets, bag-nets, stake-weirs and fly-nets, authorizing meshes much smaller than ours, and netting five weeks later; he averred that the modes of salmon fishing pursued in Britain were much more destructive than that pursued here, and would, owing (among other causes) to the different physical conformation of Lower Canada, empty our rivers in a few years if practised by us. He denied that the salmon nets now in use were in any way responsible for the evils complained of. His observations on brush-weirs coincided with those of Dr. Dawson. Having examined many such he had found neither smolts nor immature fish of any kind ; their contents consisted chiefly of tomcods, sand-launce, caplin, sardines, and smelts—some of which fish had often been confounded with salmon-fry. As regulated by the Act, Mr. Watt considered these weirs should be harmless enough modes of fishing.

Mr. A. Murray (President of the Game Protection Club) said that as this matter had been taken up by the Society, it was important that its decision should be a correct one and based on a sufficient knowledge of the subject. In the Game Protection Societies of Montreal and Quebec the opinion was almost unanimous against fishing by means of fixed-engines. He had with him a number of authorities on the subject and was prepared to enter upon it, but as the discussion was not likely to be a short one, he preferred to adopt the suggestion already thrown out and allow the matter to lie over until next meeting. The report of the Montreal Fish and Game Club would be issued in course of a week or two; it would discuss the subject at some length and he would see that a copy of it was placed in the hands of each member of the Society.

Further discussion was accordingly adjourned.

Mr. J. F. Whiteaves then made a communication " On certain new additions to the Society's museum."

He remarked that the few statements which he had been requested to make would refer only to the collection he had brought from England during the summer of 1865, and that he did not wish that any remarks he might offer concerning the specimens should be looked upon as the result of original investigation, or that they had any claim to novelty.

The following is a list of the donations in question, which have not previously been recorded :—

Prof. ROLLESTON, Oxford University.

Skin of the grey headed kalong or flying-fox (*Pteropus poliocephalus*, Temminck).

Cast of the head of the dodo, from the specimen in the Oxford University Museum.

Two cuttle-fishes, (*Loligo vulgaris*), in spirits.

From the late Rev. F. W. HOPE, through Professor WESTWOOD, Oxford University.

Three cases of crustaceans from the Mediterranean (mostly brachyurous decapods) consisting of forty-five specimens, of twenty-six species.

Two cases of exotic insects, mostly coleoptera, some of them from Central Africa, as follows:

Coleoptera,	84	species.
Hymenoptera,	1	"
Orthoptera,	4	"
Hemiptera,	15	"

MR. G. F. ANGAS, London.

Seven species of shells, two of bryozoa, three of annelida, three of echinodermata, four of corals, and four of sponges; all from Southern Australia.

One lepas from California.

Prof. TENNANT, King's College, London.

Six species of fossils from the Upper Chalk of Gravesend, Kent.

MR. JAS. PARKER, JR., Oxford.	Six species of fossils from the English Upper Silurian, and five from the Purbeck beds of Dorsetshire.
MR. W. E. JAMESON, London.	Fossils from the Oxfordshire oolites, the greensand of Farringdon (Berkshire) and from the Norfolk Crag; in all eight species.
MR. R. S. STANDEN, London.	Fossils from the Great Oolite of Minchinhampton, Gloucestershire; and from the Inferior Oolite of the neighbourhood of Cheltenham. Altogether ten species.
MR. J. F. WHITEAVES.	Two specimens of the Sagouin, (*Jacchus vulgaris* Geoffroy St. Hilaire, *Hapales jacchus* Illiger,) from Brazil.

One skin of the Malabar squirrel; (*Sciurus maximus*).

Six species of exotic shells.

Five species of Echinodermata.

One coral.

A fine specimen of the *Balanus tulipa*, from Australia.

A number of European fossils, including a series of fishes from the Old Red Sandstone of Scotland: the Carboniferous deposits of Staffordshire, &c.: the Permian of Durham: the Lias at Lyme Regis: the Oolites of Oxfordshire: the Chalk of Kent: the Eocene of Monte Bolca, near Verona: and the Crag of Norfolk.

Estimate of this collection.

Upper Silurian,	11	species.
Devonian,	1	"
Carboniferous,	14	"
Permian,	1	"
Lias,	12	"
Oolites,	59	"
Chalk,	27	"
Tertiary,	40	"
Post-tertiary,	1	"
Altogether	166	species.

From Principal DAWSON, (in exchange for duplicate specimens , brought from England).	Fourteen species of Echinodermata from Norway.
	A series of Tertiary fossils, consisting of forty-one species from the Eocene and Miocene of Paris; of eight species from the Eocene, Miocene, and Pliocene of the United States; and five from the English Pliocene.
	Specimen of *Dictyonema Websteri*, from the Upper Silurian shales of Nova Scotia.

Mr. Whiteaves said :— In the few remarks which I propose making on these specimens, I shall adopt the ordinary zoological classification.

A pair of specimens of the Sagouin, *Jacchus vulgaris* of Geoffroy St. Hilaire, *Hapales jacchus* of Illiger, were exhibited. They were stated to belong to the order Quadrumana, a group which includes the Baboons, the Apes, the Monkeys generally, and the Lemurs. The Sagouin is one of the American or Platyrhine monkeys, a group peculiar to the New World, and one which is characterized by the flatness and broadness of the nose, and the width of its septum, which makes the nostrils appear far apart from each other on each side of the nose. The species in question has received several popular names. It is the Sagouin or Sanglin of Edwards and of other authors; the Ouistiti of Buffon and of French naturalists; the striated monkey of Pennant; while by some it is called loosely the Marmoset. It is a small species, not much larger than some squirrels, and is very squirrel like in its habits. It inhabits the forests of Guiana and Brazil, to some extent is omnivorous in its habits, but its favourite food, in a wild state, is said to be the banana. It has two tufts of hair round the ears, its tail is long but not prehensile.

The grey-headed flying-fox, (*Pteropus poliocephalus*) belongs to the order Cheiroptera, which includes the Bats, the Vampyres, &c. The ordinary bats are for the most part insectivorous in their habits, while the flying-foxes, from the blunt tubercular crowns of their molars, were supposed to be essentially frugivorous. All the members of the order, however, are more or less omnivorous, and it was found that the Pteropus in confinement fed readily on the flesh of birds. They derive their name of flying-foxes from the resemblance of the head to that of a fox. Their jaws are more elongated than are those of the bats and vampyres. Probably the idea of the harpy was derived from animals of this order, and it has been thought likely by some writers that the bat of the Bible was a species of Pteropus.

The Malabar squirrel (*Sciurus Maximus*) is a true squirrel and belongs to the genus Sciurus as restricted by modern zoological writers. It inhabits the Malabar coast, and is chiefly remarkable for the peculiar colouring of its fur. It is said to prefer living among palm trees, and to be very fond of the milky juice of the cocoa-nut, as well as of the more solid part of the fruit.

A cast of the skull of the Dodo was exhibited, taken from the specimen in the Oxford University Museum. The species, of which only a few fragments of the skeleton, &c., are preserved, formerly inhabited the Mauritius, and is supposed to have been extinct for about 200 years. Considerable discussion has taken place amongst naturalists as to its supposed affinities; some have thought that it should be classed in the order Raptores, and placed near the Vultures; others again have regarded it as belonging to the group Cursores, on account of the rudimentary character of its wings Messrs. Strickland and Melville, in a comparatively recent treatise on this bird, have placed it among the pigeons, and consider that its nearest living ally is the Didunculus of the Navigator's Islands, a bird which, however, can fly tolerably well. Bones of three other species of large wingless birds from the Island of Rodriguez, an island east of those of Bourbon and of the Mauritius, are in the possession of the Zoological Society of London. As these last three birds, and the Dodo, could hardly pass from one island to another, being provided with rudimentary wings only, it has been supposed by some naturalists, that the islands of Bourbon, of the Mauritius, and of Rodriguez, at one time formed part of a great continent, which is now submerged beneath the waves of the Indian Ocean.

Two letters were read from Mr. G. A. Rowell, the Assistant Curator of the Oxford University Museum, in which a contribution of skins of mammals and birds was promised by the professors of geology and zoology, in the spring of 1866.

Several species of South Australian Mollusca have been presented by Mr. G. F. Angas, and some miscellaneous exotic species by Mr. Whiteaves. One of the S. Australian shells is a Solemya (*S. Australis*) interesting as closely resembling a species (*S. velum*, Say,) found on the Atlantic coast of the United States.

Two species (four specimens) of Bryozoa have also been received from Mr. Angas, who collected them in S. Australia, two of them belonging to the genus Retepora. The difference between the hardparts of a bryozoon and those of a true coral was explained; and it was shewn that the stony cells of bryozoa are destitute of the radiating calcareous partitions usually seen in the cells of corals.

An interesting named series of crustaceans from the Mediterranean, has been received from Mr. Westwood, the Professor of Zoology in the University of Oxford. They formed a part of the fine collection presented by the late Rev. F. W. Hope to that University. All of them belong to the order Decapoda, in which order all the stalk-eyed crustacea of which it is composed have the whole of the thoracic segments united, with the head, into a single mass, "incased in a common shell, with no traces of segmentary division." Their branchial organs are inclosed within a cavity on each side of the cephalo-thorax, and their true thoracic legs are nearly always ten in number, whence the name of the order. One of the species, *Scyllarus Arctus*, belongs to the macrurous or long-tailed division of the Decapods, a division to which Shrimps, Prawns and Lobsters belong. The remainder of the twenty-six species are brachyurous or short-tailed decapods, and are mostly peculiar kinds of crab.

A beautiful series of exotic insects has been presented by Prof. Westwood. Among the most noticeable of the beetles are seven species from Tropical Africa, collected by some of the members of Dr. Livingstone's expedition. Of these, *Texius Megerlei* is a fine large carnivorous ground beetle, belonging to the family Carabidæ. A fine pair of the rare *Dynastes taurus* has been received, a genus which is allied to the well known Hercules beetle of Brazil, and belongs to the family Dynastidæ of the lamellicornes. Other examples of the lamellicorn beetles from Tropical Africa are a pair of the large Rhinoceros beetle, *Oryctes boas*, and of *Copris gigas*, an insect not very dissimilar to the sacred beetle (*Ateuchus sacer*) of the Egyptians. The *Gnathocera Iris*, a brilliant green cockchafer, and the *G. suturalis*, another cockchafer with black longitudinal stripes on a light olive green ground, are also representatives of the lamellicornes of Tropical Africa. There remain two specimens of a Calandra, a large and curious weevil, also *Tetrognatha gigas*, from the same country, which is a large longicorn species. Attention was called to a series of Buprestidæ, from India, New Holland, Brazil, &c. These beetles surpass all others of their class in the beauty of their metallic colouring, and are used at the present day as jewelry. Other curious forms are the Goliath beetles, *Goliathus* (*Ceratorrhina*) *guttata* and *G. aurata*; a pair of each of which, from Cape Palmas, have been received from Prof. Westwood. The two species indicated are not however among the larger forms of the group, but are remarkable for beauty of colour. These insects, like the crustaceans, were part of the Rev. F. W. Hope's collection, presented by him to the University of Oxford. Mr. Angas has kindly presented a series of annelida, echinodermata, corals and sponges, from S. Australia; Mr. Whiteaves, several interesting exotic echinodermata and corals; and Principal Dawson a collection of Norwegian echinodermata. The Society's collection of fossils previously consisted of a little more than 300 species, and was very deficient in fossil fishes. Pains have been taken to supply this deficiency, and with some success, twenty-six species, from rocks of various ages, having been added to the collection. The latest classification of recent fishes was briefly explained, and specimens of fossil fishes, from Palæozoic, Mesozoic and tertiary rocks, were exhibited, and their affinities described. It was shewn that the Palæozoic fishes in point of organization, belong to a very high order among fishes, a fact which by Hugh Miller and others has been thought to militate against Mr. Darwin's views as to the origin of species. Some of the Palæozoic fishes have many reptilian characteristics. Throughout the Palæozoic and in the older mesozoic age, ganoids, and sharks (selachians with placoid scales) were the dominant race of fishes, and true bony fishes (teleosts), which are the prevalent forms now in existence, do not date farther back than the cretaceous period. A number of miscellaneous European fossils were exhibited, and some of the more interesting were explained verbally somewhat in detail. It was stated that about 250 species had been added to the Society's collection of fossils, the result of last summer's collecting in England.

A special vote of thanks was unanimously voted by the Society to each of the donors of the specimens referred to, also a vote of thanks to Mr. Whiteaves for his zeal in collecting.

COMPARISONS OF THE ICEBERGS OF BELLE-ISLE WITH THE GLACIERS OF MONT BLANC, WITH REFERENCE TO THE BOULDER-CLAY OF CANADA.

By J. W. Dawson, LL.D., F.R.S., F.G.S., Principal of McGill College.

The snow-clad hills of Greenland send down to the sea great glaciers, which in the bays and fiords of that inhospitable region, form at their extremities huge cliffs of everlasting ice, and annually 'calve,' as the seamen say, or give off a great progeny of ice islands which, slowly drifted to the southward by the Arctic current, pass along the American coast, diffusing a cold and bleak atmosphere, until they melt in the warm waters of the Gulf stream. Many of these bergs enter the Straits of Belle-Isle, for the Arctic current clings closely to the coast, and a part of it seems to be deflected into the Gulf of St. Lawrence through this passage, carrying with it many large bergs.

Mr. Vaughan, late superintendent of the Light-house at Belle-Isle, has kept a register of icebergs for several years. He states that for ten which enter the straits, fifty drift to the southward, and that most of those which enter pass inward on the north side of the island, drift toward the western end of the straits, and then pass out on the south of the island, so that the straits seem to be merely a sort of eddy in the course of the bergs. The number in the straits varies much in different seasons of the year. The greatest number are seen in spring, especially in May and June; and toward autumn and in the winter very few remain. Those which remain until autumn, are reduced to mere skeletons; but if they survive until winter, they again grow in dimensions, owing to the accumulations upon them of snow and new ice. Those that we saw early in July were large and massive in their proportions. The few that remained when we returned in September, were smaller in size and cut into fantastic and toppling pinnacles. Vaughan records that on the 30th of May, 1858, he counted in the Straits of Belle-Isle 496 bergs, the least of them sixty feet in height, some of them half a mile long and two hundred feet high. Only one-eighth of the volume of floating ice appears above water, and many of these great bergs may thus touch the ground in a depth of thirty fathoms or more, so that if we imagine four hundred of them moving up and down under the influence of the current, oscillating slowly with the motion of the sea, and grinding on the rocks and stone-covered bottom at all depths from the centre of the channel, we may form some conception of the effects of these huge polishers of the sea-floor.

Of the bergs which pass outside of the straits, many ground on the banks off Belle-Isle. Vaughan has seen a hundred large bergs aground at one time on the banks, and they ground on various parts of the banks of Newfoundland, and all along the coast of that island. As they are borne by the deep-seated cold current, and are scarcely at all affected by the wind, they move somewhat uniformly in a direction from N. E. to S. W., and when they touch the bottom the striation or grooving which they produce must be in that direction.

In passing through the straits in July, we saw a great number of bergs, some were low and flat-topped with perpendicular sides, others were concave or roof-shaped like great tents pitched on the sea; others were rounded in outline or rose into towers and pinnacles. Most of them were of a pure dead white like loaf sugar, shaded with pale bluish green in the great rents and recent fractures. One of them seemed as if it had grounded and then overturned, presenting a flat and scored surface covered with sand and earthy matter.

At present we wish to regard the icebergs of Belle-Isle in their character of geological agents. Viewed in this aspect, they are in the first place parts of the cosmical arrangements for equalizing temperature, and for dispersing the great accumulations of ice in the Arctic regions, which might otherwise unsettle the climatic and even the static equilibrium of our globe, as they are believed by some imaginative physicists and geologists to have done in the so-called glacial period. If the ice islands in the Atlantic, like lumps of ice in a pitcher of water, chill our climate in spring, they are at the same time agents in preventing a still more serious secular chilling which might result from the growth without limit of the Arctic snow and ice. They are also constantly employed in wearing down the Arctic land, and aided by the great northern current from Davis's Straits, in scattering its debris of stones, boulders and sand over the banks along the American coast. Incidentally to this work, they smooth and level the higher parts of the sea bottom, and mark it with furrows and striæ indicative of the direction of their own motion.

When we examine a chart of the American coast, and observe the deep channel and hollow submarine valleys of the Arctic current, and the sand-banks which extend parallel to this channel from the great bank of Newfoundland to Cape Cod, we cannot avoid the conclusion that the Arctic current and its ice have great power both of excavation and deposition. On the one hand, deep hollows are cut out where the current flows over the bottom, and on the other, great banks are heaped up where the ice thaws and the force of the current is abated. I have been much struck with the worn and abraded appearance of stones and dead shells taken up from the banks off the American coast, and am convinced that an erosive power comparable to that of a river carrying sand over its bed, and materially aided by the grinding action of ice, is constantly in action under the waters of the Arctic current. The unequal pressure resulting from this deposition and abrasion, is not improbably connected with the slight earthquakes experienced in Eastern America, and also with the slow depression of the coast; and if we go back to that earliest of all geological periods when the Laurentian rocks of Sir Wm. Logan, constituting the Labrador Coast and the Laurentide Hills, were alone above water, we may even attribute in no small degree to the Arctic current of that old time the heaping up of those thousands of feet of deposits which now constitute the great range of the Alleghany and Appalachian mountains, and form the breast-bone of the American continent.

But such large speculations might soon carry us far from Belle-Isle, and to bring us back to the American coast and to the domain of common things, we may note that a vast variety of marine life exists in the cold waters of the Arctic current, and that this is one of the reasons of the great and valuable fisheries of Labrador, Newfoundland and Nova Scotia, regions in which the sea thus becomes the harvest field of much of the human population. On the Arctic current and its ice also floats to the southward the game of the sealers of St. John and the whalers of Gaspé. The distance that some of these creatures come, is shown by the fact that I once found upon the skin of a whale killed by the Gaspé fishermen, a species of acorn-shell (*Coronula reginæ*, Darwin,) supposed to be peculiar to the Pacific, an evidence that the creature had navigated the Arctic channels from Behring's Straits to be slain in the gulf of Saint Lawrence.

We may now proceed to connect these statements as to the distribution of icebergs, with the glaciated condition of our continents, with the remarkable fact that the same effects now produced by the ice and the Arctic current in the strait of Belle-Isle and the deep-current channel off the American coast, are visible all over the North American and European land north of forty degrees of latitude, and that there is evidence that the St. Lawrence valley itself was once a gigantic Belle-Isle, in which thousands of bergs worked perhaps for thousands of years, grinding and striating its rocks, cutting out its deeper parts and heaping up in it quantities of northern debris. Out of this fact of the so-called glaciated condition of the surface of our continents, has however arisen one of the great controversies of modern geology. While all admit the action of ice in distributing and arranging the materials which constitute the last coating which has been laid upon the surface of our continents, some maintain that land glaciers have done the work, others that sea-borne icebergs have been the agents employed. As in some other controversies, the truth seems to lie between the extremes. Glaciers are slow, inactive and limited in their sphere. Icebergs are locomotive and far-travelled, extending their action to great distances from their sources. So far, the advantages are in favor of the iceberg. But the work which the glacier does is done thoroughly, and time and facilities being given, it may be done over wide areas. Again, the iceberg is the child of the glacier, and therefore the agency of the one is indirectly that of the other. Thus, in any view we must plough with both of these geological oxen, and the controversy becomes like that old one of the Neptuunists and Plutonists, which has been settled by admitting both water and heat to have been instrumental in the formation of rocks.

Our country is one of those which have been most thoroughly glaciated, and in the midst of these controversies a geologist resident here should have some certain doctrine as to the question whether at that period, geologically recent, which we call the Post-pliocene period, Canada was raised to a great height above the sea, and covered like Greenland with a mantle of perpetual ice, or whether it was, like the strait of Belle-Isle and the banks of Newfoundland, under water, and annually ground over by icebergs. A great advocate of the glacier theory has said that we cannot properly appreciate his view without exploring thoroughly the present glaciers of Greenland and ascertaining their effects. This I have not had opportunity to do, but I have endeavoured to do the next best thing by passing as rapidly as possible from the icebergs of Belle-Isle to the glaciers of Mont Blanc, and by asking the question whether Canada was in the post-pliocene period like the present Belle-Isle or the present Mont Blanc, or whether it partook of the character of both?

Transporting ourselves then to the monarch of the Alps, let us suppose we stand upon the Flegere, a spur of the mountains fronting Mont Blanc, and commanding a view of the entire group. From this point the western end of the range presents the rounded summit of Mont Blanc proper, flanked by the lower eminences of the Dome and Aiguille de Gouté, which rise from a broad and uneven plateau of nevé or hard snow, sending down to the plain two great glaciers or streams of ice, the Bossons and Tacony glaciers. Eastward of Mont Blanc the nevé or snow plateau is penetrated by a series of sharp points of rock or aiguilles, which stretch along in a row of serried peaks, and then give place to a deep notch through which flows the greatest of all the glaciers of this side of Mont Blanc, the celebrated Mer de Glace, directly in front of our stand-point. To the left of this is another mass of aiguilles, culminating in the Aiguille Verte, only recently ascended by Mr. Whymper, of melancholy notoriety in connection with the fatal ascent of the Metterhorn. This second group of needles descends into the long and narrow Glacier of Argentiere, and beyond this we see in the distance the Glacier and Aiguille de Tour. As seen from this point it is evident that the whole system of the Mont Blanc glaciers originates in a vast mantle of snow capping the ridge of the chain, and extending about twenty miles in length with a breadth of about five miles. This mass of snow being above the limits of perpetual frost, would go on increasing from year to year, except so far as it might be diminished by the fall of avalanches from its sides, were it not that its plasticity is sufficient to enable the frozen mass to glide slowly down the valleys, changing in its progress into an icy stream, which descending to the plain melts at its base and discharges itself in a torrent of white muddy water. The Mont Blanc chain sends forth about a dozen of large glaciers of this kind, besides many smaller ones. Crossing the valley of Chamouni, and ascending the Montanvert to a height of about 6,000 feet, let us look more particularly at one of these glaciers, the Mer de Glace. It is a long valley with steep sides, about half a mile wide and filled with ice, which presents a general level or slightly inclined surface, traversed with innumerable transverse cracks or crevasses, penetrating apparently to the bottom of the glacier, and with slippery sloping edges of moist ice threatening at every step to plunge the traveller into the depths below. Still the treacherous surface is daily crossed by parties of travellers apparently without any accident. The whole of the ice is moving steadily along the slope on which it rests, at 8 to 16 inches the rate of eight to ten miles daily; the rate of motion is less in winter and greater in summer; and farther down, where the glacier goes by the name of the Glacier du Bois, and descends a steeper slope, its rapidity is greater; and at the same time by the opening of immense crevasses its surface projects in fantastic ridges and pinnacles. The movements and changes in the ice of these glaciers are in truth very remarkable, and show a mobility and plasticity which at first sight we should not have been prepared to expect in a solid like ice. The crevasses become open or closed, curved upwards or downwards, perpendicular or inclined, according to the surface upon which the glacier is moving, and the whole mass is crushed upward or flattens out, its particles evidently moving on each other with much the same result as would take place in a mass of thick mud similarly moving. On the surface of the ice there are a few boulders and many stones, and in places these accumulate in long irregular bands indicating the lines of junction of the minor ice streams coming in from above to join the main glacier. At the sides are two great mounds of rubbish, much higher than the present surface of the glacier. They are called the lateral moraines, and consist of boulders, stones, gravel and sand, confusely intermingled, and for the most part retaining their sharp angles. This mass of rubbish is moved downward by the glacier, and with the stones constituting the central moraine, is discharged at the lower end, accumulating there in the mass of detritus known as the terminal moraine.

Glaciers have been termed rivers of ice; but there is one respect in which they differ remarkably from rivers. They are broad above and narrow below, or rather their width above corresponds to the drainage area of a river. This is well seen in a map of the Mer de Glace. From its termination in the Glacier du Bois to the top of the Mer de Glace proper, a distance of about three and a half miles, its breadth does not exceed half a mile, but above this point it spreads out into three great glaciers, the Geant, the du Chaud and the Talefre, the aggregate width of which is six or seven miles. The snow and ice of a large interior table-land or series of wide valleys are thus emptied into one narrow ravine, and pour their whole accumulations through the Mer de Glace. Leaving however the many interesting phenomena connected with the motion of glaciers, and which have been so well interpreted by Saussure, Agassiz, Forbes, Hopkins, Tyndall and others, we may consider their effects on the mountain valleys in which they operate—.

1.—They carry quantities of debris from the hill-tops and mountain valleys downward into the plains. From every peak, cliff and ridge, the frost and thaw are constantly loosening stones and other matters which are swept by avalanches to the surface of the glacier, and constitute lateral moraines. When two or more glaciers unite into one, these become medial moraines, and at length are spread over and through the whole mass of the ice; eventually all this material, including stones of immense size, as well as fine sand and mud, is deposited in the terminal moraine or carried off by the streams.

2.—They are mills for grinding and triturating rock. The pieces of rock in the moraine are, in the course of their movement, crushed against one another and the sides of the valley, and are cracked and ground as if in a crushing-mill. Farther the stones on the surface of the glacier are ever falling into crevasses, and thus reach the bottom of the ice, where they are further ground against one another and the floor of rock. In the movement of the glacier these stones seem in some cases to come again to the surface, and their remains are finally discharged in the terminal moraine, which is the waste-heap of this great mill. The fine material which has been produced, the flour of the mill, so to speak, becomes diffused in the water which is constantly flowing from beneath the glacier, and for this reason all the streams flowing from glaciers are turbid with whitish sand and mud.

The Arve which drains the glaciers of the north side of Mont Blanc, carries its burden of mud into the Rhone, which sweeps it with the similar material of many other Alpine streams into the Mediterranean, to aid in filling up the bottom of that sea, whose blue waters it discolours for miles from the shore, and to increase its own ever enlarging delta which encroaches on the sea at the rate of about half a mile per century. The upper waters of the Rhone, laden with similar material, are filling up the Lake of Geneva; and the great deposit of 'loess' in the alluvial plain of the Rhine, about which Gaul and German have contended since the dawn of European history, is of similar origin. The mass of material which has thus been carried off from the Alps, would suffice to build up a great mountain chain. Thus by the action of ice and water—

> "The mountain falling cometh to naught
> And the rock is removed out of its place."

Many observers who have commented on these facts have taken it for granted that the mud thus sent off from glaciers, and which is so much greater in amount than the matter remaining in their moraines, must be ground from the bottom of the glacier valleys, and hence have attributed to these glaciers great power of cutting out and deepening their valleys. But this is evidently an error, just as it would be an error to suppose the flour of a grist-mill ground out of the mill stones. Glaciers it is true groove and striate and polish the rocks over which they move, and especially those of projecting points and slight elevations in their beds, but the material which they grind up is principally derived from the exposed frost-bitten rocks above them, and the rocky floor under the glacier is merely the nether mill-stone against which these loose stones are crushed. The glaciers in short can scarcely be regarded as cutting agents at all, in so far as the sides and bottoms of their beds are concerned, and in the valleys which the old glaciers have abandoned, it is evident that the torrents which have succeeded them have far greater cutting power.

The glaciers have their periods of advance and of recession. A series of wet and cool summers causes them to advance and encroach on the plains, pushing before them their moraines, and even forests and human habitations. In dry and warm summers they shrink and recede. Such changes seem to have occurred in by-gone times on a gigantic scale. All the valleys below the present glaciers, present traces of former glacier action. Even the Jura mountains seem at one time to have had glaciers. Large blocks from the Alps have been carried across the intervening valley and lodged at great heights on the slopes of the Jura, leading the majority of the Swiss and Italian geologists to believe that even this great valley and the basin of Lake Leman were once filled with glacier ice. But unless we can suppose that the Alps were then vastly higher than at present, this seems scarcely to be physically possible, and it seems more likely that the conditions were just the reverse of those supposed, namely, that the low land was submerged and that the valley of Lake Leman was a strait like Belle-Isle, traversed by powerful currents and receiving icebergs from both Jurassic and Alpine glaciers, and probably from further north. One or other supposition is required to account for the appearances, which may be explained on either view. The European hills may have been higher and colder, and changes of level elsewhere may have combined with this to give a cold climate; or on the other hand, a great submergence may have left the hills as islands, and may have so reduced the temperature by the influx of Arctic currents and ice, as to enable the Alpine glaciers to descend to the level of the sea. Now we have evidence of such submergence in the beds of sea-shells and travelled boulders scattered over Europe, while we also have evidence of contemporaneous glaciers in their traces on the hills of Wales and Scotland and elsewhere, where they do not now occur.

I have long maintained that in America all the observed facts imply a climate no colder than that which would have resulted from the subsidence which we know to have occurred in the temperate latitudes in the post-pliocene period, and though I would not desire to speak so positively about Europe, I confess to a strong impression that the same is the case there, and that the casing of glacier ice imagined by many geologists, as well as the various hypotheses which have been devised to account for it and to avoid the mechanical, meteorological and astronomical difficulties attending it, are alike gratuitous and chimerical, as not being at all required to account for observed facts and being contradictory, when carefully considered, to known physical laws as well as geological phenomena.*

Carrying with me a knowledge of the phenomena of the glacial drift as they exist in North America, and of the modern ice drift or its shores, I was continually asking myself the question—To what extent do the phenomena of glacier drift and erosion resemble these? and standing on the moraine of the Bosson glacier, which struck me as more like boulder clay than anything else I saw in the Alps, with the exception of some recent avalanches, I jotted down what appeared to me to be the most important points of difference. They stand thus:—

1.—Glaciers heap up their debris in abrupt ridges. Floating

* Canadian Naturalist, Vols. viii and ix. Geological Magazine, December, 1865.

ice sometimes does this, but more usually spreads its load in a more or less uniform sheet.

2.—The material of moraines is all local. Icebergs carry their deposits often to great distances from their sources.

3.—The stones carried by glaciers are mostly angular, except where they have been acted on by torrents. Those moved by floating ice are more often rounded, being acted on by the waves and by the abrading action of sand drifted by currents.

4.—In the marine glacial deposits mud is mixed with stones and boulders. In the case of land glaciers most of this mud is carried off by streams and deposited elsewhere.

5.—The deposits from floating ice may contain marine shells. Those of glaciers cannot, except where, as in Greenland and Spitzbergen, glaciers push their moraines out into the sea.

6.—It is of the nature of glaciers to flow in the deepest ravines they can find, and such ravines drain the ice of extensive areas of mountain land. Icebergs on the contrary act with greatest ease on flat surfaces or slight elevations in the sea bottom.

7.—Glaciers must descend slopes and must be backed by large supplies of perennial snow. Icebergs act independently, and being water-borne may work up slopes and on level sufaces.

8.—Glaciers striate the sides and bottoms of their ravines very unequally, acting with great force and effect only on those places where their weight impinges most heavily. Icebergs on the contrary being carried by constant currents and over comparatively flat surfaces, must striate and grind more regularly over large areas, and with less reference to local inequalities of surface.

9.—The direction of the striæ and grooves produced by glaciers depends on the direction of valleys. That of icebergs on the contrary depends upon the direction of marine currents, which is not determined by the outline of the surface, but is influenced by the large and wide depressions of the sea bottom.

10.—When subsidence of the land is in progress, floating ice may carry boulders from lower to higher levels. Glaciers cannot do this under any circumstances, though in their progress they may leave blocks perched on the tops of peaks and ridges.

I believe that in all these points of difference the boulder clay and drift of Canada and other parts of North America, correspond rather with the action of floating ice than of land ice. More especially is this the case in the character of the striated surfaces, the bedded distribution of the deposits, the transport of material up the natural slope, the presence of marine shells, and the mechanical and chemical character of the boulder clay. In short, those who regard the Canadian boulder clay as a glacier deposit, can only do so by overlooking essential points of difference between it and modern accumulations of this kind.

In conclusion, I would wish it to be distinctly understood, that I do not doubt that at the time of the greatest post-pliocene submergence of Eastern America, at which time I believe the greater part of the boulder clay was formed, and the more important striation effected, the higher hills then standing as islands would be capped with perpetual snow, and through a great part of the year surrounded with heavy field and barrier ice, and that in these hills there might be glaciers of greater or less extent. Further it should be understood that I regard the boulder clays of the St. Lawrence valley as of different ages, ranging from the early post-pliocene to that at present forming in the gulf of St. Lawrence. Further, that this boulder clay shows in every place where I have been able to examine it, evidence of sub-aquatic accumulation, in the presence of marine shells or in the unweathered state of the rocks and minerals enclosed in it, conditions which, in my view, preclude any reference of it to glacier action, except possibly in some cases to that of glaciers stretching from the land over the margin of the sea, and forming under water a deposit equivalent in character to the ' boue glaciare ' of the bottom of the Swiss glaciers. But such a deposit must have been local, and would not be easily distinguishable from the marine boulder clay. While writing these notes I have had the advantage of reading the interesting papers of Messrs. Jamieson, Bryce and Crosskey, on the boulder clay of Scotland,* which in character and relations so closely resembles that of Canada, but I confess several of the facts which they state lead me to infer that much of what they regard as of sub-aerial origin must really be marine, though whether deposited by ice-bergs or by the fronts of glaciers terminating in the sea, I do not pretend to determine. It must however be observed that the antecedent probability of a glaciated condition is much greater in the case of Scotland than in that of Canada, from the high northern latitude of the former, its more hilly character, and the circumstance that its present exemption from glaciers is due to what may be termed exceptional and acci-

* Journal of Geological Society for August, 1865.

dental geographical conditions; more especially to the distribution of the waters of the Gulf stream, which might be changed by a comparatively small subsidence in Central America. To assume the former existence of glaciers in a country in north latitude 56°, and with its highest hills, under the present exceptionally favourable conditions, snow-capped during most of the year, is a very different thing from assuming a covering of continental ice over wide plains more than ten degrees farther south, and in which, even under very unfavourable geographical accidents, no snow can endure the summer sun, even in mountains several thousand feet high. Were the plains of North America submerged and invaded by the cold Arctic currents, the Gulf stream being at the same time turned into the Pacific, the temperature of the remaining North American land would be greatly diminished; but under these circumstances the climate of Scotland would necessarily be reduced to the same condition with that of South Greenland or Northern Labrador. As we know such a submergence of America to have occurred in the Post-pliocene period, it does not seem necessary to have recourse to any other cause for either side of the Atlantic. It would, however, be a very interesting point to determine, whether in the Post-pliocene period the greatest submergence of America coincided with the greatest submergence of Europe, or otherwise. It is quite possible that more accurate information on this point might remove some present difficulties. I think it much to be desired that the many able observers now engaged on the Post-pliocene of Europe, would at least keep before their minds the probable effects of the geographical conditions above referred to, and enquire whether a due consideration of these would not allow them to dispense altogher with the somewhat extravagant theories of glaciation now agitated.*

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* While these sheets were in the press, I have seen with much gratification, that Jamieson has recognized in Caithness a truly marine boulder-clay, holding those elongated and striated stones heretofore regarded as characteristic of glacier action; but which are frequent in the marine boulder-clays of Canada, and in the bed of the present Arctic current.

THE MUSK-RATS AS BUILDERS AND MINERS.*

By J. K. Lord, F. Z. S.

The genus Fiber has hitherto been based on a solitary species, the well-known musk-rat, the *Fiber zibethicus* of zoologists, the musquash of Canadian trappers and fur traders, the ooklak of the inland Indians west of the Rocky Mountains. Strictly American mammals, musk-rats, true to their native proclivities, are habitual wanderers, regardless of even 'squatter's preemptive law,' unscrupulously seize on 'new locations' that best befit their tastes and requirements.

A summer travelling party of musk-rats, on discovering a desirable spot for a settlement, at once appropriate it. One species sets to work and erects neat little dwellings, that are always placed in the water; the building materials fringe the pool, fixed on as the village site. The other species, *diggers* by profession, scorn the builder's art, and *excavate* houses on the bank of some lazy stream or muddy pool.

The requisite establishments complete, the emigrants settle quietly to the 'struggle for existence,' and patiently bear as best they can, the ills that musquash, like all other flesh, is heir to.

A happy adaptability to extreme climatal changes, enables the musk-rat to endure the scorching heat of an inter-tropical sun, or the nipping cold of an Arctic winter, with trifling inconvenience either to its health or happiness. Throughout the length and breadth of Canada—tenanting the shoals of its countless lakes, the banks of its many rivers, its oozy swamps and muddy, stagnant pools—musk-rats are always to be found. Away into the trackless wastes of the Hudson Bay Company; by the lone, still ponds scattered over the sunny prairies, or hid neath the shadows of the

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* Fiber zibethicus, Musk-Rat.

Synonym.—*Castor zibethicus*, 'Lin. Syst. Nat.,' i., 1766.
Mus. zibethicus, 'Gmelin Syst. Nat.,' i., 1788.
Myocastor zibethicus, 'Kerr's Linnæus,' 1792.
Fiber zibethicus, Cuv., R. A. I., 1817, 192.
Lemmus zibethicus, 'Fischer Synop.,' 1829, 289.
Ondatra zibethicus, 'Waterhouse Mag. Nat. Hist.,' iii., 1839, 594.
Musk Beaver, 'Pennant's Arct. Zool.'
Musquash, Wach-usk of the Crees and Hurons (the animal that sits on the ice in a round form).

Nov. Sp.—*Fiber osoyoosensis* (Lord), 'Proc. Zool. Soc.,' London, 1863.

lofty pines; in dark, miry wastes, amid fungoid growths, sedge plants, and perpetual decay; along the banks of tortuous rivers, from their sources—mere mountain burns, trickling down the craggy sides of the Rocky Mountains—to their mingled exit into the Atlantic, as the great St. Lawrence;—musk-rats live, thrive, and multiply. Cross the snow-clad heights of the Rocky Mountains, and descend their western slopes, through hotter lands, to the shores of the Pacific; from the Rio-Grande to the desolate regions of Arctic America; through fertile California; grassy, flower-decked Oregon; Washington Territory, with its deserts and mountains; and the densely-timbered wilds of British Columbia, to its junction with Russian America; on rocky Vancouver Island, as well as on every island of any size in the Gulf of Georgia;—musk-rats have found their way, built and burrowed. It was once supposed, that the musk-rat had made its way to the Asiatic side of Behring's Straits, but there can be but little doubt the skins obtained from Kamschatka and Tschucktchis are traded, or bartered, from native tribes living on the American shores.

There are many structural points of similarity betwixt the musk-rats and *Arvicolus*, or 'field-mice;' still the peculiarly formed feet, flattened tail, much larger size, and singularities of habit in the former, distinctly separates the two genera. Indeed, the musk-rat seems to fill a gap, as it were, between the field-mice (*Arvicolinæ*) and the porcupines (*Hystricidæ*). The sub-family (*Casterinæ*) which the famed beaver represents, connects the squirrels and marmots (*Sciurissæ*), on the one hand, with the gophers (*Geomyinæ*) on the other. The teeth of the musk-rat are of arvicoline type. The first and third molars are longer than the second, the second being wider than either of the other two. The grinding surface of the first molar has two indentations or reëntrant angles on each side; the second, two outside and one inside; the third, three outside and two inside. The first and third grinders have five prisms or projections on their surfaces, the second four. The loops of enamel extending across the tooth, and joining the enamel that encases the surface, completely isolates the patches of dentine; thus a mill-stone is formed by this most simple contrivance, that improves in grinding power the more it is worked, and never needs roughing with the stone-cutter's hammer.

In the lower jaw the first molar is much larger than the second and third, which are about equal in length and width. The first having five indentations inside and four outside. The other grinders have each two on either side; the angles are alternate. The upper cutting, or incisor teeth, are broader than the lower, plane in front, but bevelled off at the outside edges, the lower being more rounded away than are the upper. Like the teeth of all the rodents, they are admirably constructed chisels, that by a simple arrangement of hard and softer material, sharpen themselves, the cutting edges becoming keener in proportion to the density of the material gnawed. The musk-rat's mouth is truly a marvellous mill, worked by machinery that needs neither steam or water-power to drive it. Its millstones—by the side of which man's best contrivance is but a bungle—never wear smooth, nor deteriorate in grinding capabilities, however hard the 'miller' works. To supply the mill are admirable nippers that never blunt, and always remain the same length, wear and growth being so admirably balanced.

A very marked peculiarity in the skull of the musk-rat is the curious shape of the temporal bone; so compressed is it betwixt the orbits as to narrow the skull into a mere isthmus, not at all wider than the extreme end of the muzzle. Parietals very small; occipital foramen nearly circular.

Fiber osoyoosensis Lord. *Sp. char.*—In total length 3¼ inches shorter than *Fiber zibethicus* Cuv.; in general size much smaller. General hue of back jet-black; but, the hair being of two kinds, if viewed from tail to head, it looks grey—the under fur being fine, silky, and light grey in colour; concealing this on the upper surface are long coarse black hairs; the belly and sides somewhat lighter; head broad and depressed; neck indistinct; ear small, upper margin rounded; eye small and black; whiskers long, and composed of about an equal number of white and black hairs; incisors nearly straight, on the external surface orange-yellow. The thumb of the fore-foot is quite rudimentary; the third claw is considerably longer than the second and fourth. The hind feet are singularly twisted, the inner edges being posterior to the outer. This simple modification of position, gives the animal immense power in swimming. The feet are then bent towards each other; in the backward stroke, the full expanse of the flat soles pushes against the water, sending the swimmer forwards; in the forward stroke the feet are 'feathered,' like rowers feather an oar, passing through the water edge on, offers the least possible resistance. The claws on the hind feet are small, compressed, and but slightly curved. The skin covering the under surfaces of the feet is black, wrinkled, perfectly naked, and keenly sensitive to tactile impressions. A distinct web joins the digits for about half their length; the upper parts of the feet are clothed with short lustrous hairs, terminating at the sides in a fringe of stiff bristles, which increase the surface, and give additional force in swimming. Tail nearly as long as the body without the head, cylindrical at the base, then flattened to the point. The tail curves somewhat to a sickle shape; being readily bendable towards the belly, its point can be made to touch the inferior surface of its base; in this position it is almost circular, like a hoop. This is a highly important arrangement, indispensable to the musk-rat. A more perfect rudder was never designed than is this flexible tail. If swimming when freighted, and a stiff breeze curls the water into miniature waves, the musk-rat drops its tail, and bending it more or less according as it needs extra steering power, guides itself straight for the desired haven. In calm weather and smooth water the rudder is carried horizontally, and a slight lateral motion close to the surface, suffices to guide the living ship. It is worth while to note, *en passant*, how differently the beaver's rudder is built, as compared with that of the musk-rat's—a difference easily accounted for when we know their respective habits. The beaver never uses its tail as a trowel, and has no more idea of 'lath and plaster' than a hippopotamus has of a polka. This story is a myth, and the sooner the absurd fables of plastering, and "using the wondrous tail as a trowel," are sponged from out all books on natural history the better.

The beaver, with a heavy log of green timber (that would sink like a stone if free) clasped between its fore-legs, swims for its house. The counterpoise to this overweight at the bows is the downward pressure of the flat tail on the water, flattened more horizontally than the musk-rat's. Indeed, the tail of the beaver is much like an ox-tongue in shape. The musk-rat, conveying such materials through the water as are light, needs only powerful rudder-power, having no forward weight to counterbalance. The tail is covered by small hexagonal scales, with a few long, coarse hairs irregularly scattered over it. The skull differs from *Fiber zibethicus* in being much smaller, $2\frac{1}{8}$ inches in length, $1\frac{1}{6}$ inch in width, very much shorter from the anterior molar to incisors; nasal bones much more rounded at their posterior ends, the superior outline less curved; postorbital process not nearly so much developed; the cranial portion of the skull in its upper outline is much less concave and smoother; superior outline of occipital bone not so prominent or strong; incisors shorter and much straighter; molars much smaller, but in general outline similar.

And now I must ask my readers to accompany me, in imagination, to the Osoyoos Lakes, on the eastern side of the Cascade Mountains, where my attention was first directed to the rush-building rat, as being distinct in species from that which burrows in the mud banks. The specific name *osoyoosensis* was given in commemoration of the locality.

This magnificent piece of water is formed by the widening out of the Okanagen river as it passes through a deep valley, walled in by massive piles of rock. The Osoyoos Lake may be defined as one huge lake, or three smaller ones, with equal correctness; as a narrowing in at particular points, gives the appearance of an actual division into separate lakes. The 'boundary-line' runs through its centre, so that one half the lake belongs to Britain (its northern half), the southern to the United States. The shore is sandy, like a sea-beach, and strewn thickly with fresh-water shells along the ripple line, gives it quite a tidal aspect. On either side, a sandy, treeless waste stretches away to the base of the hills, so carpeted with cacti—which grow in small knobs covered with spines, like vegetable porcupines—that walking on it without being shod with the very thickest boots, is to endure indescribable torture; the prickles are so sharp and hard that they slip through ordinary leather like cobbler's awls. I had to tie up both dogs and horses, for the latter, getting the prickly knobs into their heels, kicked and plunged until exhausted. The dogs at once got three or four fast to their feet; when impatiently seizing the vegetable pests, the prickles stuck with like pertinacity to the tongue and cheeks. I have no hesitation in saying a dog must inevitably die from starvation if he ventured to cross this waste alone; once getting the cactus prickles in his mouth, unaided he could never free himself. A low 'divide' separates this valley from the Similkameen. The water from the lakes eventually finds its way into the Columbia river. If there is an Eden for water-birds, Osoyoos Lakes must surely be that favoured spot. At the upper end a perfect forest of tall rushes, six feet in height, affords ducks, grebes, bitterns, and a variety of waders, admirable breeding haunts; safe alike from the prying eyes of birds that prey on their kindred, and savages that devour anything.

The water, alive with fish of many species (permanent residents), becomes during 'the season' crowded with lordly salmon like a fashionable watering-place; thus affording a perpetual banquet to birds that devour fishes. The tempting, juicy mollusks, "like turtle," seem palateable to all, be the diners scale-clad or feathered. On one side of this lake is a swamp, in which are numerous pools, some of them deep in the middle, shoal at the sides to a few inches, all alike fringed with a tall growth of rushes. In these aquatic snuggeries, ducks, literally swarm thick as bees round thorn-blossoms. Here, too, musk-rat houses may be likened to cities rather than villages; the inhabitants—swimming idly about, just diving out of the way if I came too near, reappearing a short distance off—evidently deemed me an impudent intruder.

For years I have been in the habit of seeing these rush houses (which I shall presently describe), but took it for granted there existed but *one* species of musk-rat, whose winter quarters was the rush house; its summer residence a tunnel excavated in a mud bank. Sir John Richardson (Fa. Bo. Am.), after describing the 'winter huts,' goes on to say, "In summer the musquash burrows in the banks of the lakes, making branched canals many yards in extent, and forming its nest in a chamber at the extremity, in which the young are brought forth." Another author writes, "They live in curiously-constructed huts, in a social state during winter; in summer, these creatures wander about in pairs, feeding voraciously on herbs and roots." Charlevoix adds, "They build cabins, nearly in the form of those of the Beaver, but far from being so well executed; their place of abode is always by the waterside, so that they have no need to build causeways." Captain John Smith was in all probability the first who gave any account of the musquash, in a work published in the year 1624. He says, "The musascus is a beast of the form and nature of a water-rat, but many of them smell exceedingly strong of musk." "We are not, however, aware that these nests are made use of by the musk-rat in spring for the purpose of rearing its young; we believe these animals *always* for that purpose resort to holes in the sides of ponds, sluggish streams, or dykes."—Aud. and Bach.

Seated on a sandy knoll, I contemplated, measured, and began to skin my prize. It occurred to me that there were no mud banks near, into which these rats could burrow, and according to the statement of the authorities, at this very time, they ought to have been in their summer holes.

My first proceeding was to hunt carefully round the lake to discover, if possible, some evidence of a burrow—not a trace of such could I find; next the rush houses underwent a rigid scrutiny. In each musk-rats were living, and more than this, whole families had clearly resided in the several mansions for a very long time. I now felt convinced there must be two distinct species, one a miner, the other a builder; and further, that the two species had been classed together by observers, under the supposition that they changed quarters, in accordance with the seasons. The next thing was to prove my supposition based on correct data.

Tents were soon after struck, and the lake, with all its living treasures, abandoned to nature and the red man.

We must take up our story at Fort Colville, one of the earliest trading posts of the Hudson Bay Company, situated on a gravelly plateau, close to the Kettle Falls, on the Columbia river, about a thousand miles from the sea.

The two weary winters passed in this solitary spot were cold enough to satisfy an Esquimaux, the temperature often as low as thirty and thirty-two degrees below zero, with deep snow covering the ground for full six months of the twelve. Through the gravelly valley leading from the Fort to the hills, wound a sluggish muddy stream, with deep banks on either side, in which dwelt whole colonies of musquash. About a mile and a half from the stream, divided from it by a steep ridge of rocks, was a sedgy flat, surrounding a deep, quiet pool, so overshadowed and shut in by a brake of bulrushes, as to be hidden, until its margin, reached by wading and cutting a trail through the reedy fringe, revealed its water, and a city of musquash-houses scattered like hay-cocks over the entire surface.

In the bright, glowing sunshine of mid-summer, I carefully watched the stream and pool, fully satisfying myself that both localities were densely populated; and, further, that 'builders' and 'miners' were blessed with infant workers, born, some in the rush dwellings, others in the nurseries of the mud tunnels. So far so good, nothing more could be done until winter.. On carefully comparing several of the musk-rats shot in the pool, with those brought from Osoyoos Lake, I found them to be specifically alike, but differing most markedly from the rats inhabiting the Colville stream; others procured from very distant mud banks, east and west of the Cascade Mountains, tallied exactly with these and each other, as did a series of rush-building-rats from widely separated localities. Up to this point, I had proved that both holes and lodges were occupied in July, and the rats inhabiting them differed in several distinctive characters always constant, though extended over a series of specimens, from remote and proximate districts.

The fur clothing of the two species (as I now venture to call them) seemed to my mind designedly coloured to facilitate concealment. The mud-rat's reddish, rusty-brown suit, closely resembled the furruginous tint peculiar to the gravelly soils prevailing in the north-west, and its habit is, when frightened, to dive, or if under water, to at once descend to the bottom, there to stir up the mud with all its might. In a second, the course of the fugitive is traceable only by clouds of mud rolled up into the water, like smoke into the air. Thus hid, escape is easy.

In clear water, too, small roadways are distinctly visible in every direction, threading the bottom of the stream like the lines on a map of railways, trails through which they travel to the different landings and doorways.

The *rush-rat's* black jacket is equally in keeping with the still dark water in which it swims, builds, and enjoys life; or the sombre stalks amidst which it rambles and feeds. I know no prettier sight than that of watching a musk-rat village. As the shadows lengthen, and the mingled sounds of day die imperceptibly away, and—save the whisper of the breeze as it rattles the tall rushes, the muffled cry of the owl soaring over the marsh, the 'quack' and 'whistle' of the bald-pate (*Marcca amer*), sure herald of coming night, and the throb of invisible wings—no sounds are audible. In this quiet eventide, the entire rat population steal out to swim, flirt, quarrel, or feast, as the custom is in musquash society. So like are the swimmers to dark sticks floating on the surface, that save the tiny wake made as they paddle on, the keenest eye can hardly detect the difference. The slightest noise indicative of danger, plunging sounds over the pool as though a heap of stones hurled into the air, were falling into the water like rain-drops, warns one the revellers are gone. They soon, however, reappear, some to sit on the domes of their houses in the position of begging dogs, holding between their fore-feet a dainty on which to sup; others to swim ashore, and forage amidst the rushes and sedge-plants, perhaps to be pounced on by the mousing-owl; whilst the remainder seem to have no definite occupation, but swim or dive for sheer enjoyment. I can recal many long evenings spent by some lone pool, watching these industrious little animals; too earnest in my vigils to note passing time, as stars one by one gemmed the sky, and night with silence came down upon the earth.

Winter came all too soon in October, heavy snow, and biting blasts, sent the hybernators to their quarters, the lingering migrants to their southern retreats, the deer to the depths of the forests, the insects, some to their final home, others into torpidity, hid in cleft or cranny.

If previous statements be true, no musk-rats will be found tenanting the mud-holes, but all snugly ensconced in rush-mansions in the pool.

On a piercing cold December morning, I waded through the snow to the miner's quarter, my aid and guide, a red-skin, equipped with pick, shovel and spear, to do the digging and capturing; if the musquashes, as I felt convinced was the case, had not abandoned their dwellings. It was no easy job breaking through the frozen ground; but the Indian warmed to his work, then I took a spell, and so on, until the subterranean galleries were one after the other laid open. No rats; we were not far enough in. At length we, by digging on, came plump upon a large vestibule, and in it, coiled up semi-torpid and stupid, was a family of 'miners;' a goodly heap of dry grass and leaves formed an admirable bed. The sleepers were hardly alive to danger, too drowsy to make any attempt at escape. No food was stored, but they lay huddled together for mutual warmth, as pigs do in straw. There were no holes visible through the snow, but several had been dug through the ground, to give, I imagine, admittance to the air.

This was a grand discovery. If like success attend our assault on the builders, my theory will be proven.

The pool was frozen hard enough to have borne ten men, enabling us to walk easily to the rush-houses, which were built in from three to four feet water. I could discover no holes, though quite three feet of dome in each house was clear above the ice. On removing the snow, and tearing open the intertwined rushes, there, rolled together in a grassy nest, as we had found the miners, were many builders, doing their quasi-hybernation. This clearly proved there were two kinds of musk-rats, that differed in habit, size and colour. The skulls also showing structural variations, left no further doubt. Two species for the future must characterize the genus Fiber, the second being *Fiber osoyoosensis*.

The number of young produced at a birth varies from four to seven, and it is by no means uncommon for a female to have three litters in a year; and well for the musk-rats is it that nature has given them such powers of increase. Their enemies are legion. Birds of prey are ever watching for them; indeed, it is difficult to save a trapped rat from the feathered banditti, ready on the shortest notice to tear the prisoner from the iron teeth of the trapper's snare.

The robber gang of weasels are untiring foes, hunting the rats night and day on the land and in the water. Their greatest enemy, however, is the trapper, be he red or white man. Five hundred thousand musk-rat skins were at one time annually imported from the Hudson Bay Company's territories. At the last fur sale in Fenchurch Street, in August, 1865, 93,787 skins of musquash were sold—a small proportion only of the yearly supply. The fur is used for various purposes, the bulk finding its way to foreign markets. The musk glands furnish the powerful, pungent odour from whence the animal derives its name, not to my nose the least like commercial musk. In the spring musk-rats really scent the air, and at this time the tails are taken off the trapped skins, tied in bundles, dried, and eventually sold in the bazaars at Constantinople, for ladies wherewith to perfume their cloths. The two glands are situated close to the base of the tail. Indians, white traders, trappers and settlers alike devour the muk-rat's body. To cook it *secundem artem,* after skinning, the glands should be carefully removed; the body, split and gutted, is skewered on a long, peeled wand, and carefully grilled over a brisk camp-fire.

There are various modes of trapping musquash. If by steel trap, the trap is usually placed on a log, in the rat's water way, about four or five inches below the surface, with a bait suspended over it. In trying to reach this seductive morsel the hind feet are secured in the iron snare, which has a long string and cedar log float attached, to mark its whereabouts, as the prisoner drags it on the muddy bottom of a stream, or the deeper water of the pools. Others are caught in a kind of figure-of-4 trap, but by far the larger number are speared. The food of the musquash is of most varied character; in the summer, grass, roots of marsh plants, the green bark from the young cotton-wood trees, and the stalks of succulent vegetation, constitutes their general fare. Though rodents, and in a measure vegetarians, they never refuse flesh if it can be obtained, and rather enjoy at times doing the cannibal. It is no infrequent occurrence for a hungry band to set upon their relative when fast by the legs in a trap, tear it to pieces, then devour the fragments as hounds are wont to rend and eat a fox. Sir J. Richardson tells us they have been known to eat one another in their houses, if unusually hungry, a statement I can quite believe, although it has never been my good or ill fortune to witness a musquash famine. I have often shot a duck that has fallen into the centre of a musk-rat pond; waiting and wishing for a friendly breeze to waft the prize ashore, I observe it moves slowly, propelled by some unseen power, it nears a rush-house, bobs and bobs like a float as a fish tugs impatiently at the bait, then suddenly disappears. Musk-rats are the thieves that dine sumptuously at my expense. River mussels and craw-fish are also largely consumed by the musk-rats. They either crack the shells of the *Unios* with their strong teeth, or, taking them on the land, let them remain until, panting for air, the shells are opened, when the rat pounces in and devours the inmates. Not only are mussels eaten, but all fresh-water mollusks share a like fate, if discovered by prowling musk-rats.

It may be as well to say a few words, in conclusion, about their systems of building. The rush-houses are built in from three to four feet water. A solid pier, composed of sticks, rushes, grass, mud and small stones, is raised from the bottom to a height of some inches above the surface; over this the dome-shaped roof is thrown, made of intertwined rushes with mud and sticks worked in amongst them; the bed is placed on the centre or pier, and the entrance is invariably beneath the surface of the water. I do not believe this dome is in any degree impervious to water; whenever I have opened a house in summer, it has invariably been wet; and during blazing hot weather it must be a great advantage to the rush-rats, assisting to keep them cool—an advantage equally enjoyed by the 'miners,' whose houses are always wet in summer. In winter the water freezes and hence cannot wet the insides of the domes or mud galleries. The grass and other material carried in for the winter bed must manifestly get wet in the transport, but rapidly drains and dries when the water solidifies. I do not believe in the possibility of an animal formed as the musk-rat making a waterproof fabric out of rushes and mud. One thing has always puzzled me in their engineering: how they manage to keep down the materials forming the centre or pillar, preventing light substances from floating until the aggregated weight of stones, mud, wetted rushes, and sodden sticks becomes, *en mass*, specifically heavier than water, is a secret I was never able to discover. They always work at night, hence it is impossible to watch their operations.

The pleasure of describing the habits of these interesting animals must be my excuse for these lengthy notes. A new species, like gold, usually tempts its finder to wander beyond the limits of prudence; if such has been my failing, I crave forgiveness, and conclude with the sentiments of Wordsworth—

"To the solid ground
Of nature trusts the mind that builds for aye:
Convinced that there, there only, she can lay
Secure foundations."

From the Intellectual Observer.

A CATALOGUE OF THE CARICES COLLECTED

by John Macoun, Belleville, C. W.

The following list embraces ninety specie, many of which have not hitherto been published as Canadian and three of which are new. All the species have been critically examined and determined by Prof. Dewey, of Rochester, U. S., the eminent caricographer; his descriptions of the new species are cited from Silliman's Journal for March, 1866.

Nat. Ord. CYPERACEÆ—Genus Carex Linn.

C. gynocrates, Wormsk.: Cedar swamp North Hastings; Big swamp Murray; on a mound in a swamp near Belleville Railroad Station.

C. polytrichoides, Muhl.: Cedar swamps; common.

C. Backii, Boott: Rocky ground vicinity of Belleville and Shannonville; scarce.

C. bromoides, Schk.: Marshes and borders of ponds; scarce.

C. siccata, Dewey: Sandy plains; abundant around Castleton.

C. disticha, Hudson—var. Sartwellii, Dewey: Small marsh west of Belleville College; rare.

C. teretiuscula, Good.: Marshes along the Bay of Quinté; marshes and swamps; abundant.

C. prairea, Dewey : Marshy border of Round Lake, Peterboro County ; big swamp, Murray. Local ; abundant.

C. vulpinoidea, Michaux : Low meadows ; very common.

C. stipata, Muhl. : Along rivulets in wet meadows ; common.

C. sparganioides, Muhl. : Low thickets and along fences ; uncommon.

C. cephalophora, Muhl. : Woods and dry meadows, Belleville and Shannonville ; frequent.

C. Muhlenbergii, Schk. : Dry sand hill, Belmont, Peterboro County ; rare.

C. rosea, Schk. : Cedar swamps and wet woods ; common.

C. rosea—var. radiata, Dewey : Dry open woods and thickets ; frequent.

C. retroflexa, Muhl. : Wet woodlands, five miles south of Belleville ; rare.

C. tenella, Schk. : Abundant in all cedar and tamarack swamps.

C. trisperma, Dewey : Cedar swamps ; common.

C. tenuiflora, Wahl. : Cedar swamps four miles west of Belleville. Abundant in a cedar swamp one mile beyond the Jordan, Hastings Road.

C. canescens, Linn. : Abundant in a wet meadow near Belleville. Sphagnum swamps, North Hastings.

C. canescens, Linn.—var. vitilis, Carey : Borders of cedar swamps and low woods, Hastings County.

C. Deweyana, Schw. : Rich low woods in tufts ; abundant.

C. stellutata, Good. : Cedar and sphagnum swamps ; also low woods.

C. scirpoides, Schk. : Border of Hooper's Lake, Hastings Road ; rare.

C. sychnocephala, Carey : Border of the Millpond, Hastings Village, Madoc. Low meadow along the Moira, Marmora.

C. scoparia, Schk. : Boggy woods and wet meadows ; common.

C. lagopodioides, Schk. : Border of water holes in meadows and fields.

C. cristata, Schw. : Low woods and meadows ; abundant.

C. festucacea, Schk. : Wet meadows and borders of woods, abundant ; all the varieties common.

C. straminea, Schk. : Low meadows near Belleville ; depressions in rocky ridges at Shannonville.

C. aperta, Boott: Border of a small lake, Hastings Road, Tudor; rare.

C. stricta, Lam.: Wet meadows near Belleville; meadows, Brighton.

C. aquatilis, Wahl.: Marshes along the Bay of Quinté; wet meadows, Belleville.

C. lenticularis, Michx.: Crevices of rocks back of the old saw mill, Marmora Iron Works; growing almost in the waters of Crow River; abundant.

C. crinita, Lam.: Low banks of streams; common.

C. limosa, Linn.: Peat-bog five miles north of Colborne; rare.

C. irrigua, Smith: Big swamp Murray; Sphagnum swamps, North Hastings; frequent.

C. Buxbaumii, Wahl.: Border of Hooper's Lake, Hastings Road; rare.

C. aurea, Nutt.: Low boggy meadows and sphagnous swamps; common.

C. tetanica, Schk.: Woods east of Belleville; very rare.

C. vaginata, Tausch: In cedar swamps near Belleville and Trenton; abundant.

C. granularis, Muhl.: Wet meadows; abundant.

C. conoidea, Schk.: Wet meadows east of Belleville; scarce.

C. grisea, Wahl.: Meadow east of Belleville; very rare.

C. formosa, Dewey: Low meadows and moist woods; frequent.

C. gracillima, Schw.: Wet woods; common.

C. plantaginea, Lam.: Rocky slopes in woods; Brighton and Huntingdon.

C. platyphylla, Carey: Dry rocky woodlands near Belleville; frequent.

C. digitalis, Willd.: Hillside, North Hastings; dry meadow, Brighton; meadows near Belleville.

C. laxiflora, Lam.: Rich moist woods; many varieties.

C. oligocarpa, Schk.: Gibson's Mountain, Prince Edward Co.; hillside Port Hope; rare.

C. Hitchcockiana, Dewey: Dry sandy field, Seymour; very rare.

C. eburnea, Boott: Dry limestone rocks, banks of Moira and Trent.

C. pedunculata, Muhl.: Dryish cedar swamps near Belleville.

C. umbellata, Schk.: Border of the Oak-hill Pond, Sidney; rare.

C. Novæ-Angliæ, Schw.—var. Emmonsii, Carey; Rocky woods and banks near Belleville.

C. Pennsylvanica, Lam.: Woodlands and thickets; common.

C. varia, Muhl.: Dry rocky ledges near Shannonville and Belleville.

C. Richardsonii, R. Brown: Dry field and thickets near Belleville and Trenton.

C. pubescens, Muhl.: Moist woods and meadows; frequent.

C. miliacea, Muhl.: In a ravine on Simon Terrill's farm, Brighton; scarce.

C. scabrata, Schw.: Margins of springs and woodland brooks, Brighton; also near Port Hope.

C. arctata, Boott: Woods rear of Picton; wet meadows near Wooler, Brighton.

C. debilis, Michx.: Woods and meadows, Brighton; scarce.

C. flexilis, Rudge: In a cedar swamp near Trenton; rare.

C. flava, Linn.: Abundant in old beaver meadows, North Hastings.

C. Œderi, Ehrh.: Wet sand, Presqu'ile Point, Lake Ontario; also on Wellington Beach; abundant.

C. filiformis, Linn.: Peat bogs and beaver meadows; abundant.

C. lanuginosa, Michx.: Low wet meadows: common.

C. Houghtonii, Torrey: Dry rocky hills, Marmora, Tudor and Grimpsthorpe.

C. lacustris, Willd.: Marshes and swamps; common.

C. aristata, R. Brown: Low wet ground, three miles west of Belleville; scarce.

C. trichocarpa, Muhl.: Low marshy meadow rear of Picton; low meadow along Crow River at Marmora works.

C. comosa, Boott: Marsh near Weller's Bay, Lake Ontario; also Big Swamp Murray; scarce.

C. Pseudo-Cyperus, Linn.: Swamps and bogs; common.

C. mirata, Dewey—var. minor: Border of a small pond in a meadow east of Belleville; very rare.

C. hystricina, Willd.: Wet meadows; common.

C. tentaculata, Muhl.: Wet meadows near Belleville; also Presqu'ile Point.

C. intumescens, Rudge: Woods and new meadows; common.

C. Canadensis, Dewey: Border of a small pond in a meadow, lot No. 6, 10th range, Seymour; abundant.

C. lupulina, Muhl. : Wet meadows ; common.

C. Macounii, Dewey : Along a small stream on lot 7, 10th range of Seymour ; rare.

C. retrorsa, Schw. : Marshy meadows, and along small rivulets.

C. Schweinitzii, Dewey : In a wet swampy meadow, near Baltimore, Northumberland Co. ; abundant.

C. Hartii, Dewey : Border of a small stream in F. Macoun's farm, Seymour.

C. Bella-villa, Dewey : In a ditch about four miles north of Belleville, along the gravelled road leading to Stirling.

C. monile, Tuckerman : Low meadows along the Moira, North Hastings. Also, C. Vaseyi, Dewey—which proves to be a young state of this plant.

C. ampullacea, Good. : Ponds in meadows, also in swamps ; common.

C. cylindraca, Schw. : Swamps and wet meadows ; abundant.

C. longirostris, Torrey : Rocks, Gibson's Mountain ; 'Big Boulder' of the Trent valley ; rocks, Marmora.

DESCRIPTIONS OF THE NEW SPECIES.

Carex Hartii, Dewey : Spicis staminiferis 1–3, sæpe 2, interdum 1, vel raro nulla, cylindraceis gracilibus variis erectis, suprema longiore in medio vel supra vel infra fructifera, sessilibus squamas lanceolatus acutas subfuscas ferentibus ; spicis pistilliferis 2–7, vulgo 4, cylindraceis oblongis sublaxifloris et infra praæcipue subremotis plerumque erectis foliaceo-bracteatis, superioribus sessilibus sæpe ad apicem staminiferis, inferioribus exserto pedunculatis interdum supra staminiferis infimis duobus longo-exserto-pedunculatis interdum recurvis, cum bracteis culmum superantibus ; fructibus *tristigmaticis* ovatis inflatis vel conico-ellipticis longo-rostratis et teretibus bidentatis nervosis infra teretibus et stipitatis lævibus divergentibus et adultis prope retrorsis, squama lanceolata acuta margine albida latera fusca multum longioribus ; culmi foliis longis strictis modosis per-angustis margine scaberrimis et sæpe culmum lævem plusquam duplo præcedentibus.

Culm 15–25 inches high, erect, slender above, smooth except the highest part of the edges, with bracts and leaves surpassing the culm, and the leaves very narrow and long, often more than twice the length of the culm and very scabrous on the edges, knotted: spikes very variable; the wholly staminiferous 1–3, commonly 2, nearly half 1, very rarely 3 or none, cylindric, slender, sessile; some staminiferous have a few fruit in the middle or at the base or vertex; the terminal much the longest, and all clothed with lanceolate acute scales; pistilliferous spikes 2–7, usually 4, the highest with stamens at the summit or in the middle or both and sessile, the next higher exsert pedunculate and erect, the lowest one or two very long-exsert pedunculate sometimes recurved, and the lowest sometimes staminate at apex, all oblong-cylindric, ½ to 2½ inches long, mostly erect, rather distant, loose-flowered, especially below, bracteate and the lower with long-leafy bacts surpassing the culm and rough-edged; stigmas 3; fruit ovate-conic, inflated, long conic-rostrate, bidentate, nerved, tapering below, and stiped, diverging or nearly retrorse in maturity, much longer than the slender ovate lanceolate scale.

Wet grounds, Dundee, Yates Co., N. Y., discovered by Dr. S. Hart Wright. Ludlowville, Tompkins Co., H. B. Lord. Hastings Road, Canada West, J. Macoun.

The retrorse fruit brings up *C. retrorsa*, but the difference in the spikes and culm and fruit is too great, and the achenia are very dissimilar. *C. retrorsa* has achenia long and round sub-triquetrous; the other has shorter triquetrous achenia tapering from the middle toward each end, and not roundish.

Var. BRADLEYI, Dewey: Staminate spikes less various; pistillate spikes more loosely flowered; fruit smaller; and plant more slender.

Wet grounds, Greece, ten miles west of Rochester, Dr. S. B. Bradley. Here Dr. B. had discovered *C. mirata*, and was searching for its rediscovery, 1861. Also, at Belleville, Canada West, J. Macoun.

C. VAGINATA, Tausch, 1821: Spicis distinctis; staminifera unica oblonga culmo stricto fulta vel " sub-anthesi rectangulè refracta;" pistilliferis sub-binis oblongis laxifloris remotis erectis linearibus exserto-pedunculatis lato-vaginatis; fructibus *tristigmaticis* triquetro-ovatis basi attenuatis brevi-rostratis bidentatis, squama oblonga sub-obtusa longioribus; culmo lævi foliato, foliis longis lato-linearibus margine supra scabris, bracteæ vagina vix foliaceum cuspidem abruptam ferente; culmo perlævi.

This plant is widely spread over Germany and Scandinavia, but it is so variable that Kunze in 1840–50 gave twelve synonyms in the nineteen authors he quotes on this species, and omitted the name given by Fries, *C. sparsiflora*. In my specimens from Europe, and one of them from the hand of Fries (in my collection), there is too great a difference for identity of species; and if so, different plants may have been confounded by some authors. The one from Fries has a pair of too close-fruited spikes, scarcely sheathed, too nearly sessile, and bracts too leaf-like. The others correspond chiefly to the above description, authorized by those of Fries, Lang, Anderson, Kunze and Steudel. In Hooker's Flora Bor.-Amer., Dr. Boott gave *C. phæostachyæ*, Smith as synonymous with *C. vaginata* Tausch, as does Kunze also, and credited it to Greenland, Fort Norman on Mackenzie River, and Rocky Mts. It is doubtless the European plant. Dr. Gray informed Mr. Paine, who had found a variety in this vicinity, that *C. vaginata* had been found near Montreal by the late Mr. Macrae, and later at "Rivière-du-Loup by W. Boott." A recent examination of some of Dr. Macrae's plants by Prof. Brunet of Quebec, did not detect any plant of that name. I had hoped to ascertain whether the Montreal specimens agreed with the European or with the varities found by Mr. Paine. This differs however from the European in so many particulars that a more full account is given under the following name.

Var. ALTO-CAULIS, Dewey: Spica staminifera brevi cylindracea erecta vel infra "*rectangulè fracta*;" pistilliferis spicis 1–3, sæpe 1, vulgo 2, per-rarô 3, cylindraceis brevibus laxifloris vel alterno-fructiferis sub-vicinis vel remotis, suprema subsessili, infirma interdum subradicali exserto-pedunculata, bracteatis vaginantibus, fructibus *tristigmaticis* ovatis ovato-conicis ellipticis interdum obovatis infra teretibus substipitatis subtriquetris lævibus nervosis brevi-rostratis bidentatis, rostro recto vel refracto, squama subacuta duplo longioribus: culmo alto-cauli infra lævi inclinato longi- et arcti-foliaceo: vagina angusta cum folio.

Culm 12–30 inches high, very slender and nearly filiform above, stiff and inclined, with culm leaves about half as long, sometimes longer; staminate spike single, short-cylindric or oblong, often distant from upper pistillate, erect or with *stem bent rectangularly above* and near that pistillate, with scales oblong and obtuse, green on the back and reddish on the sides or wholly; pistillate spikes 1–3, often 1, commonly 2, very seldom 3, cylindric, short, erect, loose-flowered or alternate-fruited, near or often quite remote; lowest rarely subradical, long-pedunculate, upper sometimes nearly sessile, lower enclosed or exsertly pedunculate, bracteate with a narrow and longer foliate sheath ; stigmas three ; fruit ovate or ovate-conic-elliptic, sometimes obovate-triquetrous, tapering below, stiped, short-rostrate and the beak often turned one side or refracted, two-toothed, smooth, near twice longer or rarely little longer than the ovate or oblong obtuse or sub-acute scale.

Discovered in a marsh in Bergen, twenty miles west of Rochester, by Rev. J. A. Paine ; the first known locality in the United States ; fruit mature in June, 1865. On some of the Bergen specimens, the *refraction* of the *culm* below the staminate spike and of the *beak* of the fruit, especially of the early mature plants, is striking. Both of these curious particulars are found on many of the European specimens. The former is given in the description of Kunze and Steudel as a common fact, and in some popular remarks of Fries ; and the latter is alluded to, with the other, as of no consequence, by Andersson in his Cyperaceæ Scandinaviæ ; while Lang states of the former that he had examined it on the *C. vaginata* cultivated in a botanic garden, but had never found it on one of the numerous specimens he had collected, or growing in their indigenous state. Of course Dr. Lang did not introduce the *refraction* of the . tem into his description of this species.

The height of *C. vaginata* (5 to 12 inches by Steudel), the greater width of the leaves (foliis latis, Lang) ; the short cuspid-like leaf or termination of the broad sheath in Andersson, so clear on the specimens from Europe and on the figures of Kunze and Andersson, the more thick and coarse leaves and more stocky form, as well as differences in the fruit, distinguish the Bergen plant from the European.

C. Macounii, Dewey : Spicis variis *ordinatis* distinctis vel *inordinatis* cylindraceis erectis bracteatis ; ordinatorum staminiferis 2, inferiore breviore longo-bracteata, terminali longiore, squamas longas graciles lanceolatas infra sparsas ferentibus ; et pistilliferis 4, suprema subsessili, cæteris remotis longo-pedunculatis : ordinatorum terminali staminifera longa et fructifera pistillis paucis supra vel medio vel infra interpositis, vel interdum terminali apicem pistillifera et dimidio inferiore fructifera, tunc terminali pistillifera longa et in medio vel basi pauco-staminifera ; spicis pistilliferis subquinis cylindraceis erectis laxifloris, inferioribus longa exserto pedunculatis, infirma apice vel medio rarò staminifera : fructibus *tristigmaticis* ovatis longo-conico-subinflatis lævibus nervosis brevi-furcatis substipitatis longo-gracili-rostratis divergentibu / vel rectangule separatis, squamam ovato-lanceolatam ad basin aequantibus vel supra superantibus; bracteis foliisque margine vix scabris et culmo lævi longioribus; culmo foliis basin breviore.

Culm one to two feet high, erect, smooth; bracts and leaves long, narrow, linear-lanceolate, the lower much surpassing the culm, smooth but slightly scabrous on the edges, nodose; spikes six, cylindric, pedunculate; the pistillate 1–2½ inches long, sessile above and sheathed exsert-pedunculate below, very *variable*; as (1.) regular, staminate spikes 2, terminal, cylindric, long, the lower short with a long slender bract, both bearing long lanceolate scales very lax below, and the pistillate 4, uppermost subsessile and the others remote, long pedunculate, erect; (2.) irregular, staminate spike terminal long, with a few scattered fruit at the vertex or in the middle or below, and pistillate 5, with some stamens at the vertex of the upper, sometimes the terminal 2–3 inches long and upper half pistillate with the lower half staminate, sometimes the terminal pistilliferous long with few stamens in the middle or at the base, sometimes the lowest pistillate with some stamens at its apex and in the middle; all the pistillate loose-flowered, especially below; stigmas 3; fruit ovate long-conic, inflated at base, rostrate with beak slender and bidentate, diverging or nearly rectangular below, smooth, nerved, generally longer than the narrow oblong acute and awned or ovate-lanceolate scale, or at the base of the lower spikes the fruit is sometimes scarcely longer than the scale; plant straw-yellow.

At streams in Seymour, Northumberland Co., Canada West, J. Macoun, whose name the discovery honors. Though related to *C. folliculata* L., it seems quite different, and the achenia wholly unlike; future forms may show more clearly its relations.

C. Canadensis, Dewey: Spicis distinctis; staminifera unica perlongo-cylindracea erecta remota et bractea foliata e basi distante, squamas longas latas lanceolatas ferente: spicis pistilliferis 1–3, vulgo 2, sæpe 1, per-raró 3, oblongis cylindraceis erectis subensi-floris, inferiore interdum brevi-ovata et sæpe per-longo-pedunculata; fructibus *tristigmaticis* ovato-conicis inflatis conico-rostratis bifurcatis subtriquetris nervosis glabris, squama ovata brevi-acuta vel aristata plus duplo longioribus; bracteis foliisque margine supra scabris culmum lævem superantibus.

Culm 15–24 inches high, erect, rather slender, very smooth, leafy towards the base; leaves and bracts surpass the culm; spikes distinct; terminal staminate long-cylindric, remote from its bract and more from the pistillate, erect and slender, covered with long broad lanceolate scales; pistillate spikes 1–3, commonly 2, often 1, very rarely 3, cylindric, oblong, erect, the lowest sometimes short and ovate and long exsert-pedunculate, bracteate and sheathed, sub-close-fruited; stigmas 3; fruit ovate, inflated, conic-tapering into a 3-sided beak, which is rather deep bifurcate and sub-scabrous on the edges, nerved and smooth, more than twice longer than the ovate acute or awned scale; plants yellowish.

Small ponds at Seymour, Northumberland Co., Canada West, J. Macoun. I have seen nothing like it in the specimens obtained by me. It has been referred to *C. lupulina*, but the achenia much differ, as well as the spikes and fruit.

C. Bella-villa, Dewey: Spicis staminiferis 2–3, ferè 3, cylindraceis erectis vulgo approximatis sub-remotis, terminali longiore et omnibus bracteatis sessilibus longo-squamiferis; pistilliferis vulgo 2, interdum 1, cylindraceis erectis exserti-pedunculatis brevi- et lato-vaginatis per-laxifloris suprema apice staminifera; fructibus *tristigmaticis* longis gracilibus ovato-lanceolatis conicis basin inflatis nervosis lævibus per-divergentibus rectangule positis vel sub-retorsis rostro longi-bifurcato subtriquetro longo-stipitatis, squamam longam lanceolatam dorso viridem infra subæquantibus supra præstantibus bracteis foliisque margine scabris culmum foliatum superantibus. Achenium est triquetrum infra teres supra brevi-rotundum triquetrum.

Culm about 1½ foot high, erect, strong, leafy toward the base, rough a little on the upper part; bract-leaves rise from short broad sheaths, and with the leaves surpass the culm; staminate spikes 2–3, commonly 3, cylindric, erect, near or sub-remote, the terminal often longer, all sessile and bearing long lanceolate scales, rough to the eye but soft to the touch; pistillate spikes commonly 2 and rarely 1, cylindric, exsert-pedunculate, erect, very loose-flowered, short and broad sheathed, the highest staminate at the apex and nearly sessile, the lowest sub-remote; stigmas 3: fruit long, slender, ovate-lanceolate, conic, nerved, smooth, diverging and horizontal or sometimes retrorse, stipitate, with a back deeply bifid or bifurcate, quite equalling the scale at the base and exceeding the scale at the upper part of the spike. Plant yellowish.

Near Belleville, Canada West, J. Macoun: a fine species.

NOTES ON THE "SPECTRUM FEMORATUM."

By Alex. S. Ritchie.

The order of Orthoptera, to which this insect belongs, is remarkable for the singularity of developement which characterizes individuals of some of its families; especially, those exotic species as the *Mantis religiosa* from the south of France, the *Phillium siccifolium*, or walking-leaf; and in the *Ectatosoma tiaratum* monstrosity reaches its acme; the last named insect has dilated spined legs, a swollen body, and appendages also spined. I had the pleasure of seeing a specimen of this insect in a private collection in New York. The appearance of the *Spectrum femoratum* is no less wonderful, having a long cylindrical body, resembling a little broken twig and hence the popular name of Walking-stick. The only entomologist who has treated on the habits of the Phasmidæ is Stoll; Kirby quotes him when speaking of this family of insects; with a few exceptions the order of Orthoptera has been less studied than any of the others.

There are two localities near Montreal where I have found this insect, namely, on the bass-wood trees on the north-east side of the mountain and on Logan's farm; to one who is not in the habit of collecting insects it is very difficult to observe them, they are generally slow and quiet in their habits when undisturbed, and their resemblance in colour to the bark of the trees on which they feed makes it difficult to notice them, except to the prying eye of the entomologist; in fact the general question asked me is—are these insects found in Canada? and the enquirer generally says, 'tis strange I have never seen any of them before. A friend of mine told me that while he was sitting reading in the vicinity of Niagara Falls, something fell on his book, which he said resembled a dried twig, but he was more astonished when he perceived the twig (as he called it) was possessed with life, and immediately walked off.

I am not aware of any other species than the *Spectrum femoratum* being found in Canada; they are apterous in both sexes, the male (as is generally the case among insects) being the smallest. The *Diurna chronos* of Van Dieman's Land, has wings; there is a specimen of this insect in the University Museum; another winged species is found in Virginia.

Having studied the habits of this insect for some time, I shall mention a few facts from actual observation, illustrating the peculiar adaptation for its comfort and place in the animal economy, and having also dissected carefully, and examined its external and internal anatomy with the microscope, I may be able to mention some new facts hitherto unobserved.

We shall first look at the habits of this little creature; the only time they are to be seen in numbers, is during the latter part of August and the month of September, when the males are in search of the females; you find them in rows on the bark of trees, their anterior legs stretched out horizontally in a level with the body; at other times they are rarely met with, as they are peculiarly solitary in their habits; they are not easily disturbed by the approach of any one, as instinct teaches them that they are not easily observed; however, when touched, the anterior legs are dropped, and they make good their escape in rather an active manner; their motion is ambulatory, or a kind of trot. They are exclusively herbivorous, living on the leaves of trees.

We shall now look at their external anatomy; the body is long and cylindrical, head and eyes small, legs long, very perfect mouth, antennæ long and setaceous, the feet are armed with two claws, and have a pulvillus or cushion, colour varies in the sexes, the length of any of the males which have come under my notice, has been from 2¼ to 2¾ inches exclusive of antennæ, the antennæ measuring about 2¼ inches; the length of the female from 3 to 3½ inches, antennæ 2 inches; the body of the male is more slender, and the colour of the legs of a green shade. The number of joints in the antennæ of those I have examined, amount to fifty-eight in the female, and seventy-two in the male, the joints gradually shortening to the tips; the eyes are small. One thing I may observe here, that there are no ocelli or simple eyes on the head of these insects, a fact about which there has been some dispute. Latreille who has also examined them, bears me out in this, although Kirby says that three very visible ones are distinguished in the winged species.

The trophi or organs of the mouth are well developed, serving both for cutting and grinding their food. The mandibles are rounded and blunt, the maxillæ or lower jaws are obtuse, the labial palpi are four jointed, and the maxillary palpi three jointed. Another fact which I noticed, is the presence of a spur at the base of the femur, which evidently has been overlooked, as Kirby states that their legs are without spurs or spines. I find this spur on the second and posterior pair of legs in the male well developed, and smaller in the female; the tarsi are five jointed, with a rudimentary or psuedo joint. The body is divided into eleven dorsal, and seven ventral segments.

The internal anatomy of these insects is typical of the class, only there are fewer convolutions of the intestinal canal, respiration is effected in the same manner as in the class insecta, by means of trachea, having an outlet by spiracles placed two on each segment. This dissection was made on a female; the eggs are attached by a thin membrauce to the back of the insect, under the dorsal vessel or heart. I examined the ovaries and saw clusters of eggs in every stage of developement, from the simple cell with a nucleus, to the more advanced oval shape, with the germinal spot clearly visible, they taper from the size of a pin's head to appearance under the microscope to that of a three cent piece, in this state they are all attached by the end. I opened one of the eggs laid by the insect and saw the germinal spot more advanced.

I obtained this specimen on the morning of the 12th of September when she commenced laying, at noon on the 13th she had deposited twenty-eight perfectly formed eggs; but on looking at her a few hours afterward she was dead, the eggs look like a miniature French bean, they have a depression on the inner side like the eye spot in that seed, and have a capsule fastened by a hinge like ligament on one side, to aid the young spectrum in making a more easy entrance into the world.

The largest egg belonging to any known insect, is the egg of *Phasma dilatatum*, one of this family it is figured in the fourth volume of the Linnean transactions; it measures five lines in length and three lines in breadth or from a quarter to half an inch approaching the size of some of the humming birds eggs.

In this family are also some of the largest known insects; they are natives of South America, Australia and the more southern latitudes.

The *Phasma gigas* measures about seven inches long by about seven-eighths of an inch broad. The *P. titan* of Macleay, a winged species, measures eight and one-half inches long, and three-fourths of an inch broad, longitudinal expansion of its wings, seven and one-half inches, transverse expansion, two and three-fourth inches. *P. dilatatum* is another giant in the insect world.

Very little is known of the larval state of this insect, and very little difference of appearance is observed, the metamorphoses not being complete ; size appears to be the only distinction, a succession of moults or excuviations bringing the young spectrum to the imago or perfect state.

We shall now look at the adaptation of this little creature for its place in the animal economy. First we may wonder why wings were denied it, nature answers this question ; instead of being a rover like some other insects, whose food is more precarious or uncertain, and has to be hunted, to those wings are given, but to—our humble neighbour born near its food, which, while spring time and harvest remain, trees will grow and put forth their buds, it manages to live and move and have its being.

We see also that it is gifted with a long leg to enable it to walk over the rough bark (full of hills and hollows) of the basswood on which it is generally found, where a short leg would not be so well suited, it is able to surmount those diffiulties with its long steady step, with its long body we can easily see that a short leg would not be so serviceable ; then the cushioned feet enable it to hold with greater security.

We may ask why those eyes on the crown of most insects were denied ; the dragon-fly and other insects to hunt their prey on the wing require to be pretty sharp-sighted, require to see above, around, and I may say, behind them; but the Femoratum walks leisurely along, its food is there before it as it were, its residence is among the leaves, (except towards the close of its existence, when we find them on the bark looking for their mates,) where it manages to get at it without the quick visual organ of those insects that live by hawking.

The mouth is also well adapted ; we can see the use of the grinders in ruminating animals, as well as the incisors in carnivorous so even in the insect-world the divine mechanician has supplied the wants of the little spectrum.

THE EVIDENCE OF FOSSIL PLANTS AS TO THE CLIMATE OF THE POST-PLIOCENE PERIOD IN CANADA.

By J. W. Dawson, LL.D., F.R.S., F.G.S., Principal of McGill College.

The importance of all information bearing on the temperature of the Post-pliocene period, invests with much interest the study of the land plants preserved in deposits of this age. Unfortunately these are few in number, and often not well preserved. In Canada, though fragments of the woody parts of plants occasionally occur in the marine clays and sands, there is only one locality which has afforded any considerable quantity of remains of their more perishable parts. This is the well-known deposit of Leda clay at Green's Creek on the Ottawa, celebrated for the perfection in which the skeletons of the capelin and other fishes are preserved in the calcareous nodules imbedded in the clay. In similar nodules, contained apparently in a layer somewhat lower than that holding the ichthyolites, remains of land plants are somewhat abundant, and, from their association with shells of *Leda truncata*, seem to have been washed down from the land into deep water. The circumstances would seem to have been not dissimilar from those at present existing in the north-east arm of Gaspé Basin, where I have dredged from mud now being deposited in deep water, living specimens of *Leda limatula* mixed with remains of land plants.

In my examinations of these plants, I have been permitted to avail myself of a considerable collection in the museum of the geological survey of Canada, and also of the private collections of Mr. Billings, of Prof. Bell of Queen's College, and of Sheriff Dickson of Kingston. An imperfect list of these plants was published in my paper on the Post-pliocene of Canada in this Journal, and which was reproduced in 'Geology of Canada,' 1863. Since that time I have obtained some additional material, and have carefully re-examined all the specimens with the aid of collections of recent northern plants. I have also explored the locality in which the greater number of these remains were found. The principal points to which my attention has been directed are,—(1) The correct determination of the species of plants found; (2) The climate which they would indicate; and, (3) The portion of the Post-pliocene period to which they belong, with its probable geographical conditions.

I. Species of plants found.

Under this head I shall give in detail only those species which I am able, from the fragments found, to determine with tolerable certainty.

1. *Drosera rotundifolia* Linn. In a calcareous nodule from Green's Creek, the leaf only preserved. This plant is common in

bogs in Canada, Nova Scotia and Newfoundland, and thence, according to Hooker, to the Arctic circle. It is also European.

2. *Acer spicatum* Lamx. (*Acer montanum* Aiton.) Leaf in a nodule from Green's Creek. Found in Nova Scotia and Canada, also at Lake Winnepeg, according to Richardson.

3. *Potentilla Canadensis* Linn. In nodules from Green's Creek; leaves only preserved. I have had some difficulty in determining these, but believe they must be referred to the species above named or to *P. simplex* Michx., supposed by Hooker and Gray to be a variety. It occurs in Canada and New England, but I have no information as to its range northward.

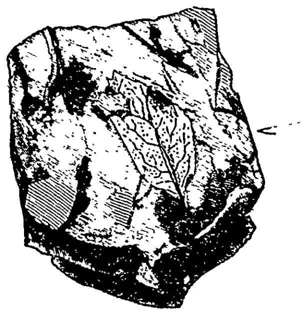
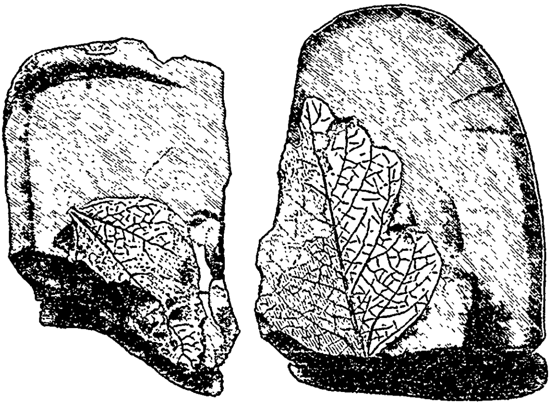


Fig. 1. Gaylussaccia resinosa.

4. *Gaylussaccia resinosa* Torrey and Gray. Leaf in nodule at Green's Creek. Abundant in New England and in Canada, also on Lake Huron and the Saskatchewan, according to Richardson.



Figs. 2 and 3. Populus balsamifera.

5. *Populus balsamifera* Linn. Leaves and branches in nodules at Green's Creek. This is by much the most common species, and its leaves are of small size, as if from trees growing in cold and exposed situations. The species is North American and Asiatic, and abounds in New England and Canada. It extends to the Arctic circle, and is abundant on the shores of the Great Slave Lake and on the McKenzie River, and according to Richardson constitutes much of the drift timber of the Arctic coast.

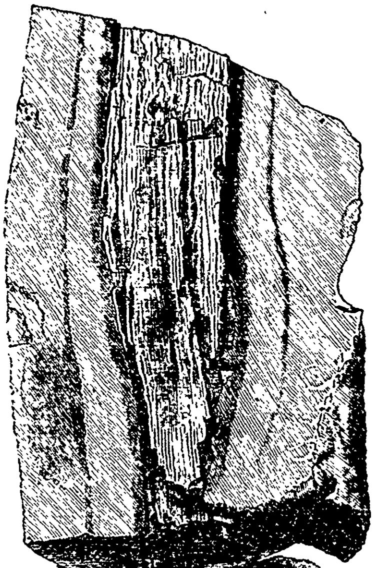


Fig. 4. Wood of Populus balsamifera.

6. *Thuja occidentalis* Linn. Trunks and branches in the Leda clay at Montreal. This tree occurs in New England and Canada, and extends northward into the Hudson Bay Territories, but I have not information as to its precise northern range. According to Lyell it occurs associated with the bones of Mastodon in New Jersey. From the great durability of its wood, it is one of the trees most likely to be preserved in aqueous deposits.

7. *Potamogeton perfoliatus* Linn. Leaves and seeds in nodules at Green's Creek. Inhabits streams of the Northern States and Canada, and according to Richardson extends to Great Slave Lake.

8. *Potamogeton pusillus.* Quantities of fragments which I refer to this species occur in nodules at Green's Creek. They may possibly belong to a variety of *P. hybridus* which, together with *P. natans*, now grows in the river Ottawa, where it flows over the beds containing these fossils.

9. *Caricea* and *Gramineæ.* Fragments in nodules from Green's Creek, appear to belong to plants of these groups, but I cannot venture to determine their species.

10. *Equisetum scirpoides* Michx. Fragments in nodules, Green's Creek. This is a widely distributed species, occurring in the Northern States and Canada.

11. *Fontinalis.* In nodules at Green's Creek there occurs, somewhat plentifully, branches of a moss apparently of the genus *Fontinalis.*

12. *Algæ.* With the plants above mentioned, both at Green's Creek and at Montreal, there occur remains of sea-weeds. They seem to belong to the genera *Fucus* and *Ulva*, but I cannot deter-

Fig. 5. Frond of Fucus.

mine the species. A thick stem in one of the nodules would seem to indicate a large *Laminaria.* With the above there are found at Green's Creek a number of fragments of leaves, stems and fruits, which I have not been able to refer to their species, principally on account of their defective state of preservation. Additional specimens may possibly in time resolve some of them.

II. Climate indicated.

None of the plants above mentioned is properly Arctic in its distribution, and the assemblage may be characterized as a selection from the present Canadian flora of some of the more hardy species having the most northern range. Green's Creek is in the central part of Canada, near to the parallel of 46°, and an accidental selection from its present flora, though it might contain the same species found in the nodules, would certainly include with these, or instead of some of them, more southern forms. More especially the balsam poplar, though that tree occurs plentifully on the Ottawa, would not be so predominant. But such an assemblage of drift plants might be furnished by any American stream flowing in the latitude of 50° to 55° north. If a stream flowing to the north it might deposit these plants in still more northern latitudes, as the McKenzie River does now. If flowing to the south it might deposit them to the south of 50°. In the case of the Ottawa, the plants could not have been derived from a more southern locality, nor probably from one very far to the north. We may therefore safely assume that the refrigeration indicated by these plants would place the region bordering the Ottawa in nearly the same position with that of the south coast of Labrador fronting on the Gulf of St. Lawrence, at present. The absence of all the more Arctic species occurring in Labrador, should perhaps induce us to infer a somewhat more mild climate than this.

The moderate amount of refrigeration thus required, would in my opinion accord very well with the probable conditions of climate deducible from the circumstances in which the fossil plants in question occur. At the time when they were deposited the sea flowed up the Ottawa valley to a height of 200 to 400 feet above its present level, and the valley of the St. Lawrence was a wide arm of the sea, open to the Arctic current. Under these conditions the immense quantities of drift ice from the northward, and the removal of the great heating surface now presented by the low lands of Canada and New England, must have given for the Ottawa coast of that period a summer temperature very similar to that at present experienced on the Labrador coast, and with this conclusion the marine remains of the Leda clay as well as the few land mollusks whose shells have been found in the beds containing the plants, and which are species still occurring in Canada, perfectly coincide.

The climate of that portion of Canada above water at the time when these plants were imbedded, may safely be assumed to have been colder in summer than at present, to an extent equal to about 5° of latitude, and this refrigeration may be assumed to correspond with the requirements of the actual geographical changes implied. In other words, if Canada was submerged until the Ottawa valley was converted into an estuary inhabited by species of *Leda*, and frequented by capelin, the diminution of the summer heat consequent on such depression, would be precisely suitable to the plants occurring in these deposits, without assuming any other cause of change of climate.

III. Age of the Deposits.

I have arranged elsewhere the Post-pliocene deposits of the central part of Canada, as consisting of, in ascending order; (1) The Boulder Clay; (2) A deep-water deposit, the Leda Clay; and, (3) A shallow-water deposit, the Saxicava Sand. But although I have placed the boulder clay in the lowest position, it must be observed that I do not regard this as a continuous layer of equal age in all places. On the contrary, though locally, as at Montreal, under the Leda clay, it is in other places and at other levels contemporaneous with or newer than that deposit, which itself also locally contains boulders.

At Green's Creek the plant-bearing nodules occur in the lower part of the Leda clay, which contains a few boulders, and is apparently in places overlaid by large boulders, while no distinct boulder clay underlies it. The circumstances which accumulated the thick bed of boulder clay near Montreal, were probably absent in the Ottawa valley. In any case we must regard the deposits of Green's Creek as coeval with the Leda clay of Montreal, and with the period of the greatest abundance of *Leda truncata*, the most exclusively Arctic shell of these deposits. In other words I regard the plants above mentioned as probably belonging to the period of greatest refrigeration of which we have any evidence of course not including that mythical period of universal incasement in ice, of which, as I have elsewhere endeavoured to show, in so far as Canada is concerned, there is no evidence whatever.

The facts above stated in reference to Post-pliocene plants, concur with all the other evidence I have been able to obtain, in the conclusion that the refrigeration of Canada in the Post-pliocene period consisted of a diminution of the summer heat, and was of no greater amount than that fairly attributable to the great depression of the land and the different distribution of the ice-bearing Arctic current.

In connection with the plants above noticed, it is interesting to observe that at Green's Creek, at Pakenham Mills, at Montreal, and at Clarenceville on Lake Champlain, species of Canadian *Pulmonata* have been found in deposits of the same age with those containing the plants. The species which have been noticed belong to the genera *Lymnea* and *Planorbis*.*

I may also state as a curious fact, that among the nodules containing leaves, I have found some containing impressions of *feathers*, apparently of some small grallatorial bird. The substance of the feather has disappeared even more completely than in the celebrated Solenhofen specimens, but the impression is perfect, and in these hard nodular concretions might endure for any length of time. In searching for the fossil plants, I have also found an interesting addition to the fauna of these deposits in a Stickleback of the genus *Gasterosteus*.

MISCELLANEOUS.

New Fluid for preserving Natural History specimens; by A. E. Verrill.—In consequence of the high price of alcohol, a series of experiments were undertaken by me last year, with the view of finding a substitute for it in preserving the soft parts of animals. Among the various solutions and liquids tested were nearly all that have ever been recommended, besides many new ones. Chlorid of zinc, carbolic acid, glycerine, chlorid of calcium, acetate of alumina, arsenious acid, Goadby's solutions, and various combinations of these and other preparations were carefully tried, and the results made comparative by placing the same kind of objects in each, at the same time. Although each of these, under certain circumstances, have more or less preservative qualities, none of them were found satisfactory, especially when the *color* and *form* of the specimen are required to be preserved as well as its structure.

* Canadian Naturalist, 1860, p. 195; 'Geology of Canada,' 1863, p. 928.

A- a test for the preservation of color, the larvæ of the tomato-worm (*Sphinx quadrimaculata*) was used. These larvæ are difficult of preservation with the natural form and color, nearly always turning dark brown and contracting badly in alcohol and most other preparations.

As a result of these experiments the following solutions were found highly satisfactory in all respects when properly used. By their use the larvæ and recent pupæ of the tomato-worm were preserved and still retain their delicate green colors, together with their natural form and translucent appearance, while the internal organs are fully preserved. Fishes, mollusks, various insects, worms, and leaves of plants have also been preserved with perfect success and far better than can be done with alcohol. In the case of mollusks, especially, the preparations are very beautiful, retaining the delicate semi-transparent appearance of the membrances nearly as in life, with but little contraction. Another great advantage is the extreme simplicity and cheapness of the solution.

To use this fluid I prepare first the following stock solution, which may be kept in wooden barrels or casks, and labeled :

SOLUTION A 1.

Rock salt............................	40 oz.
Nitre (nitrate of potassa)..........	4 oz.
Soft water...........................	1 gal.

This is the final solution in which all invertebrate animals must be preserved. A solution with double the amount of water may be kept if desirable, and called A 2. Another with three gallons of water will be A 3.

In the preliminary treatment of specimens the following solution is *temporarily* employed, and is designed to preserve the object while becoming gradually saturated with the saline matter, for in no case should the specimen be put into the full strength of solution A 1, for it would rapidly harden and contract the external parts and thus prevent access to the interior. Even with alcohol it is far better to place the object for a time in weak spirits and then tranfer successively to stronger, and for some objects, as Medusæ, no other treatment will succeed.

SOLUTION B 1.

Soft water......................	1 gal.
Solution A 1....................	1 qt.
Arseniate of potassa............	1 oz.

Another solution with double the amount of water may be made if desired, and called solution B 2.

To preserve animals with these solutions, they are, if insects or marine invertebrates, ordinarily placed first in solution B 1, but if the weather be cool it would be better in many cases to employ first B 2, and in the case of all marine animals washing first in fresh water is desirable, though not essential. If the specimens rise to the surface they should be kept under by mechanical means. After remaining for several hours, or a day, varying according to its size and the weather, in the B 1 solution it may be transferred to A 3, and then successively to A 2 and A 1, and when thus fully preserved it may be transferred to a fresh portion of the last solution, which has been filtered clear and bright, and put up in a cabinet, when no further change will be necessary if the bottle or other vessels be properly secured to prevent the escape of the fluid by crystallization around the opening. To prevent this, the stoppers, whether of cork or glass, together with the neck of the bottle or jar, may be covered with a solution of paraffine or wax in turpentine or benzole which should be applied only when the surfaces are quite dry and clean. The length of time that any specimen should remain in each of the solutions is usually indicated by their sinking to the bottom when saturated by it. In general the more gradually this saturation with the saline matter takes place the less the tissues contract or change in appearance. In many cases, however, fewer changes than indicated above will be effectual. I have in some cases succeeded well with but two solutions below A 1. For vertebrates, except fishes, the solution A 2, will usually be found strong enough for permanent preservation, especially when the object is small or dissected. If the entire animal be preserved, when larger than two pounds in weight, it should be injected with the fluids, especially B 1 or B 2, or an incision may be made in one side of the abdomen in vertebrates, or under the carapax of crabs, &c., to admit the fluids more freely. In preserving the animals of large univalve shells an opening should be made through the shell at or near the tip of the spire. Mammals, birds and reptiles, should be placed first in solution B 2 to obtain the best results. In cases where the use of the B. fluids would be objectionable, on account of their highly poisonous nature, a fourth dilution of solution A 1, corresponding in strength with B 1, but without the arseniate of potassa, may be substituted, and in many cases will do nearly as well, if the weather be not very hot, but the specimens in this case should be carefully watched and transferred to the stronger solutions as soon as possible, so as to avoid incipient decomposition while in the first fluids.—*Silliman's Journal.*

New Haven, Feb. 12, 1866.

ILLUMINATION UNDER THE MICROSCOPE.—At the late *soirée* at University College, two forms of Mr. Smith's (of the United States) illumination for opaque objects under high microscopic powers were exhibited. One was constructed by Messrs. Smith and Beck, Cornhill, and the other by Messrs. Powell and Lealand. The first form closely resembles the American contrivance—so closely, indeed, that it is difficult to know in what the difference between the two consists. A bass box intervenes between the end of the microscope tube and the objective. This is pierced at the side by an aperture opposite which a table lamp is placed; within the box is a small silvered mirror, which receives the light from the lamp, and throws it down through the objective upon the object. This contrivance, thought it works admirably with such a power as the one-fifth inch, is objectionable, from the fact that it cuts off half the pencil of rays proceeding to the eye of the observer. The second form—that exhibited by Messrs. Powell and Lealand—is superior to that of Smith and Beck, and differs from the American plan in having a reflector of plain glass. The result of this alteration of the original plan is that whilst sufficient light is thrown down to illuminate the object, the rays proceeding from the latter are not partially cut off. This modification applied to the one-twelfth inch gave splendid results, and the makers allege that it may be used with one-twenty-fifth or one-fiftieth inch glasses with equal advantage.—*Reader*, Dec. 23.

THE BIRDS OF NORTH AMERICA.—D. G. Elliot of New York (27, W. 23d st.) proposes to publish a work to contain all the new and unfigured birds of America, to be issued in Parts, 19 × 24 inches in size, containing each five plates colored by hand, with a concluding part of text; price for each part, ten dollars. Only 200 copies will be published. Mr. Elliot is author of a Monograph of the Pittidæ or Ant Trushes, in one volume imperial folio, with 31 plates, and a Monograph of the Tetraoninæ, Grouses, one vol. royal folio, with 25 plates; in each of which, the birds, with two exceptions only, are represented of life-size. Subscriptions are requested.—*Silliman's Journal.*

PUBLISHER'S NOTICE.

Owing to various unforeseen circumstances a very great delay has occurred in the issue of this number of the Canadian Naturalist. The remaining numbers of this volume will be issued during the present year, so that Vol. 3, *New Series, will be for* 1866–7.

Montreal,
January 12, 1867.

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ERRATUM.

On page 38, line 7, for "ten miles daily," read "ten *inches* daily."