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SOME NOTES ON THE DRIFT DEPOSITS OF WESTERN CANADA, AND ON THE ANCIENT EXTENSION OF THE LAKE AREA OF THAT REGION.

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(Read before the Canadian Institute, March 16th, 1861.)

The following notes and deductions are the result of a careful examination of the Drift deposits of Western Canada, undertaken during the last three or four summers in an unsuccessful search for marine post-tertiary fossils, such as occur so abundantly in many parts of Eastern Canada and throughout the New England States. The district more especially investigated, extends from the Bay of Quinté westward to the mouth of the Saugeen on Lake Huron, and includes the line of country lying along, and immediately within, the outcrop of the Laurentian rocks north of that region. Detached observations have been made, moreover, at various points on the islands and north shore of Lake Huron; and also beyond the limits of the Province, as in the district south of Lake Ontario, in Michigan, and along the southern shore of Lake Superior.

The notes recorded here, are arranged under two sections, of which the first comprises a collection of data, and the second a corresponding series of deductions.

§ 1. *Data.*

1. The first point observable, with regard to our drift deposits, is the very evident fact that the rock floor on which these accumula-

tions are spread, had been extensively denuded prior to their deposition upon it. They cover, thus, an undulating and more or less broken surface; and their thickness, consequently, apart from the denudation to which they have been themselves subjected, is exceedingly variable.

2. The lowest of these deposits appear to consist of dark blue or greyish clays, with thin layers of yellowish or light-coloured clay in places. This deposit is often laminated horizontally, and is generally very calcareous. It appears also to be free from northern or large crystalline boulders. Pebbles of limestone and other fossiliferous rock, mixed with some small pebbles of water-worn gneiss, occur abundantly in it in many localities; but northern boulders, properly so-called, are either absent or exceedingly rare. Amongst the localities in which these lower and boulder-free clay deposits are of marked occurrence, the district around Toronto, and many parts of the valley of the Saugeen and western shores of Lake Huron, may be especially mentioned; but wherever our drift deposits are found to consist of clay and other materials, the clay-beds are almost invariably seen to occupy the lower place. At the same time, as described more fully in the sequel, beds of yellow and other coloured clay, it should be observed, are occasionally found with northern boulders in a higher part of the series,—but these are quite distinct from the lower clays now referred to. They are, moreover, of no great thickness, but alternate with, and are subordinate to, thick deposits of gravel and sand; whereas, the lower clays attain in places to a thickness of over 100 feet, and present a general uniformity throughout. In these latter beds, no traces of contemporaneous fossils have, as yet, been found.

3. It is generally assumed, as an established fact, that the harder rocks beneath the Drift exhibit everywhere the marks of glacial action. Although we have numerous examples throughout this section of the Province, of polished and striated rock, I believe it to be still an open question as to whether the rocks which underlie these lower clays, have been thus affected. I have not been able to discover any instances of it, nor can I find any recorded cases in our Geological Reports, or in other trustworthy sources. The question, hitherto, does not seem to have been mooted,—the Drift accumulations, generally, being classed together by most observers under one

common term. As the point is of much interest, however, it should be kept in view.

4. Above the lower clay deposits, or resting immediately (where these are absent) on the foundation rock of the country, we meet with a series of sands and gravels of evidently northern origin, containing boulders of gneissoid and other rock, and alternating occasionally with beds of clay, in which northern boulders are also frequently found. This clay, with scarcely an exception, is remarkably free from calcareous matter,—the cause of which will be alluded to further on. In some places the clay and gravel are mixed up together, and present no signs of stratification; but more usually they are distinctly stratified, and the boulders are mostly accumulated towards the upper part of the series. As a general rule, indeed, the boulders occur in by far the greatest abundance, scattered, *per se*, over the surface of the gravels; or resting immediately on the underlying rocks where the clays and gravels are absent. This appears to have arisen, in some cases, from the subsequent removal, or washing away, of the looser materials in which the boulders were originally imbedded; but the greater number of these were evidently thrown down where they now lie, by melting or stranded icebergs, after the deposition of the other Drift materials. The boulders, whether of gneissoid or fossiliferous rock, belong always to northern localities, in relation to the spots on which they now occur. Here and there, the infiltration of water containing bi-carbonate of lime, has cemented some of these upper Drift deposits into conglomerates of considerable solidity. (Burlington Heights; vicinity of Niagara Falls; Georgetown, &c.)

5. Under the gravels and sands, or where the isolated boulders of this series are found, the rocks are always more or less marked by glacial action. The more common effects comprise: a smoothed and polished surface, and a fine striation—the striæ running in long straight lines in a general N.E. and S.W. direction, although following to a certain extent, in hilly and broken districts, the natural windings of the rock slopes on which they occur. These effects are seen in Western Canada, at various heights above the sea-level, up to an elevation of at least 1500 feet. They are well shown on the top of the Collingwood escarpment, at about 1000 feet above the level of Lake Huron; on the same line of escarpment near Niagara Falls; on many of the rock exposures on the north shore of Lake

Huron, and throughout the country at the junction of the Laurentian and Silurian formations, between the river Severn and the County of Frontenac. Also in the vicinity of Belleville, Trenton,* &c.

The isolated boulders scattered over the country, frequently exhibit in themselves a polished and striated surface; and the small boulders and pebbles imbedded in the gravel deposits, often present the same effects. (*e.g.* The pebbles found in the terraces north of Toronto; also those in Drift gravel in the environs of Belleville, Marmora, Guelph, Niagara Falls,† &c.)

6. The gravel and sand beds of this series occur, in places, in oblique stratification, or exhibit what is technically termed "false bedding." This occurs at or near the upper part of the series, and is evidently due to a re-arrangement of the materials by the action of currents. (*e.g.* Drift-bank seen in Great Western Railway cutting at Toronto, and extending westward several miles; beds at Orillia, on Lake Couchiching; also near Collingwood, &c. A remarkable example, alluded to more fully in the second part of this paper, Deduction 3, occurs near the village of Lewiston, on the south shore of Lake Ontario.) I think it will be rendered clear, by what follows, that the currents in question were not marine, but were produced in the lake waters, when these stood at higher levels. In places, moreover, secondary ridges, or ancient spits, have been formed by the same action out of these drift materials. (*e.g.* Ridge at Weston, near Toronto, described by Sandford Fleming, C.E., in the present number of the *Journal;* and a ridge in Nottawasaga Township, described by the same engineer, *Can. Jour.*, 1st series, vol. i. Also the ridge at Craigleith, in Collingwood Township, mentioned by the writer, in this *Journal*, vol. v. p. 305.) These secondary ridges, it should be observed, are altogether distinct from the terraces of the lake shores and intervening districts. A careful search would, no doubt, reveal their presence in very many localities.

7. We now come to a fact of great interest: the occurrence of shells of fresh-water mollusca in the sands and gravels of these Drift deposits, at various levels above the present surface of our lakes. These shells belong to existing species, inhabitants of the surround-

* See a paper, by the writer, "On the Geology of Belleville and its Environs," in the *Canadian Journal*, Vol. V. (New Series), pp. 41–48.

† The localities cited in this paper, are those which have come more immediately under the author's observation. In most instances, the lists given might be greatly added to.

ing waters. They must not be confounded with similar shells left in elevated spots by the drying up of streams and ponds, or by the cutting back and lowering of river-beds. As occurring in our modified drift deposits, they are imbedded in sand or gravel containing northern pebbles and small boulders; and in situations, moreover, in which it is evident that no merely local causes could have been concerned in their deposition. The fragility of most fresh-water shells, necessarily operates against the preservation of these in the coarser sediments, and explains their absence, probably, as regards the upper Drift beds of many localities.

In some of these re-sorted beds, the bones and teeth of both extinct and existing mammals are occasionally found. The extinct forms comprise: a species of Mastodon (*M. Ohioticus?* see *Can. Jour.* New Series, vol. iii. p. 356); the *Elephas primigenius;* and apparently an extinct species of the horse. The remains of existing species found in these deposits (always confining our remarks to Western Canada), include the Wapiti, the Moose, Beaver, Musk-rat, &c. These two classes of remains have been found together. In a railway cutting through Burlington Heights, near Hamilton, the tusk of a Mammoth (*Elephas primigenius*) and the horns of a Wapiti (*Elaphus Canadensis*) were met with at a depth of about forty feet below the present surface of the ground.* I have also seen the lower jaw of a Beaver (*Castor fiber*), obtained from the same locality. The flint arrow-heads, and other wrought implements of Amiens and Abbeville, which are now attracting so much attention in Europe, occur, apparently, in deposits of the same kind and age.

I have discovered fresh-water shells, under the conditions described above, in beds of stratified Drift consisting of coarse gravel filled with pebbles of gneiss and other northern rocks, on the Kingston road, about two miles east of Belleville, at an elevation, by rough measurement, of about 40 feet above the present level of Lake Ontario. These belong to *Planorbis trivolvis*, or to some closely related species. Other examples of the same shell were obtained from fine gravel in oblique stratification, near the village of Orillia, at a height of about 18 feet above the level of Lake Couchiching. This lake is about 120 feet higher than Lake Huron, and about 700 feet above

* See a paper on the Geology of this district, by Charles Robb. C.E., in this Journal, New Series, Vol. V. p. 510.

the sea. Pieces of nacreous shell (belonging to a species of unio?) were also found in gravel, in the vicinity of Barrie, at an estimated height of about thirty feet above Lake Simcoe. I have found lacustrine and terrestrial shells in many other places, but these I omit from mention, as the shells occurred on the sites of ancient swamps, in gullies, or in flat lands adjacent to running streams; or in other doubtful situations in which they may have been deposited by freshets and other agencies of comparatively recent date.

Mr. Robert Bell, of the Geological Survey of Canada, has added greatly to the above localities, in a valuable paper published in the *Canadian Naturalist* for February of this year (1861). Amongst other spots in which he has discovered fresh-water shells, the environs of Collingwood and Owen Sound may be cited. At the former, examples of *Planorbis trivolvis*, associated with several species of *helix*, were found by him at an elevation of seventy-eight feet above Lake Huron. Specimens of *Melania conica* have been obtained, according to Mr. Bell, from another spot in this locality. Dr. Benjamin Workman, of Toronto, has also communicated the discovery of examples of a *Melania* and *Unio ellipsis*, on the high banks of the Don, about thirty feet above the lake. These may have been deposited by the river, however, when flowing at a higher level; but they were covered, according to Dr. Workman, by a considerable deposit of sand.

The upper deposits of the Drift period are separable with difficulty in many places from those of more recent age. As the one period merged gradually into the other, this must necessarily be the case. Among the more recent deposits of Western Canada, however, our river "flats" may be more especially cited, as those of the Grand River, filled with the remains of land mollusca. Also, the closely-similar deposits of the ancient bed of the Niagara, so high above the present level of that river; together with the shell-marls and calcareous tufas of our lakes and streams; and our deposits of bog iron ore and iron ochres.

§ 2. *Deductions.*

The following deductions appear to flow naturally from the observations recorded above:

1. A general depression of the land, at the commencement of the Drift period, must have taken place to such an extent as to admit of

the deposition of the lower clays. These latter were evidently derived from the limestones and other Silurian and Devonian strata lying beneath and around them. Hence their generally calcareous nature. Their derivation from this source is proved, moreover, by the pebbles of Trenton limestone and other ossiliferous rocks which they frequently contain. Extensive denudation must thus have occurred both immediately prior to, and during, the deposition of these clays; but it may be questioned whether the bolder contours offered by the denuded rocks, such as the escarpment that sweeps from the Niagara river to Cabot's Head on Lake Huron, were not produced during the first uprise of the palæozoic strata from the earlier seas in which their materials were accumulated, ages before the period now under discussion. It appears, at least, to be a well-admitted point, that these rocks had been elevated into dry land before the deposition of the higher formations in the south and west.

2. After the deposition of the lower Drift clays, a sudden and abrupt change in the character of the sediments took place. A striking example of this may be seen in the natural sections about Hogg's Hollow, a few miles north of Toronto. The change in question must have been effected by a still further depression of the country, bringing the higher lands and gneissoid strata of the north within the influence of the waves, and yielding the sands, gravels, and boulders of the upper Drift accumulations. This depression permitted an invasion and broad extension southwards of the ice-covered Arctic seas, the true cause, in all probability, of the cold of this epoch. The depression must have exceeded 1,500 feet, since northern boulders are found at that height above the sea, on the Collingwood escarpment. The gneissoid boulders there met with, must at least have traversed the basin of Georgian Bay; but the glacial striæ which also occur there, may have been produced by the action of ice, originating at the spot itself. The three or four distinct sets of striæ observed at this locality, however, do not radiate from any fixed point, but run in the usual north and south direction, some being a little east and others a little west of north.*

3. At the close of this second series of phenomena, a gradual uprise of the land appears to have taken place, and a vast area, extending

* On a visit to this spot, since the publication of the "Note on the Geology of the Blue Mountain Escarpment," in the *Canadian Journal*, Vol. V. p. 304, some additional sets of striæ were observed.

over and around our present lake basins, then became converted into a fresh-water sea. This probably found its outlet to the ocean through what is now the broad valley of the Mississippi. Its waters stood at a great elevation above the waters of our present lakes, and were gradually lowered to these levels by physical changes in the surrounding country, and more especially by the depression of a higher region lying to the east. During this gradual fall and retrocession of the great lake waters, the upper layers of the Drift were re-sorted, mixed with newer sediments, and thrown up here and there into secondary ridges; and the remarkable terraces which form so salient a feature in the general aspect of our lake shores and intervening districts, were then in chief part produced. The escarped faces of these Drift terraces, it should be observed, *always front the present lake-basins*, and thus look in some places towards the north, and in others towards the south, &c., according to the direction of the nearest shores. This would necessarily arise if they were produced, as here imagined, by a gradual lowering of the waters, with intervening periods of repose. The shells of fresh-water mollusca, buried in the modified Drift, at various levels above the existing lake-waters, and in localities so far apart—for these shells have been found throughout the region south of the lakes, in addition to the localities mentioned in this paper—prove incontestibly the former expansion and union of our lakes, or, in other words, the presence in this part of Western America, of a widely-extended fresh-water sea, covering an enormous area. A curious circumstance, and one of great significance in its bearings on this question, is the fact that all the inclined layers of modified Drift (to the east, at least, of Lake Superior) appear to slope towards the west or south. A remarkable instance of this, hitherto, it is believed, unnoticed, may be seen near the mouth of the Niagara river, at Lewiston. At this spot, oblique layers of modified Drift, in beds made up of coarse gravel and pebbles, point nearly due south, and thus bear witness to the fact, that the current, which occasioned the inclined stratification, must have set directly up the gorge, *or against the direction of the present stream.*

The assumption of an immense fresh-water lake of this character, gradually falling from a high level, necessarily involves the additional assumption of an eastern barrier, extending at one period between the lake-waters and the Atlantic. This view was maintained by some

of the earlier investigators of our geology, and, notably, by Mr. Roy, in his much-discussed paper on the terraces of Lake Ontario, communicated to the Geological Society of London, in 1837.* The difficulty of finding a satisfactory location for a barrier of this kind, led Sir Charles Lyell, however, to reject the idea of an original lake extension, and to refer the formation of our terraces entirely to the action of the sea, during the slow uprise of the land at the commencement of the present epoch. In this, he has been followed by all geologists who have subsequently examined these terraces. The difficulty may perhaps be surmounted, by assuming the earlier and greater elevation of that portion of the country lying to the east of the gneissoid belt which connects our northern Laurentian district with the Adirondack Mountains of New York. The subsequent depression of this region would open an eastern outlet to the lake-waters, and gradually lower these to their present levels. But whatever the explanation, the undoubted fact remains, that, at the close of the Drift period, a vast fresh-water sea extended over the greater portion of Western Canada, and at a level of at least 500 feet above the present surface of Lake Ontario.

Whilst the mollusca of this ancient lake were identical with existing species, its shores were peopled by the mastodon and the mammoth, and probably by other extinct forms of life, together with various species that still survive. A great question remains to be solved. Our gravel beds may perhaps reply to this, and reveal to us, that here, as in Europe, man and the departed mammoth once trod the earth together. Could this be established, the discovery would be fraught with even deeper interest than that which attaches itself to exhumed human relics of the ancient plains of Picardy and the gravel-beds of Suffolk. Our Indian arrow-heads are disentombed by hundreds: the connecting link of the extinct tooth or bone may not be long forthcoming.†

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* See likewise the paper already referred to, by Sandford Fleming, C.E., on the physical characters of the Nottawasaga Valley.—*Can. Jour.* First Series, Vol. I. Mr. Roy's paper, I believe, was never printed.

† Since writing the above, Albert Koch's account of the discovery of the Missouri mastodon has come under the author's notice. In this account, published in 1841, it is stated that the mastodon bones were found in more or less immediate association with large arrow-heads. The same writer also attests to the discovery of wrought implements in connexion with Edentate remains in Gasconade county, Missouri.

NOTES ON LATIN INSCRIPTIONS FOUND IN BRITAIN.

PART VII.

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37. In Horsley's *Britannia Romana*, Durham, nn. xi. and xii., we have copies of two inscriptions on stones found at Lanchester :—

(XI.)

IMP · CÆS · M · ANT · GORDIA
NVS · P · F · AVG · BALNEVM · CVM
BASILICA A SOLO INSTRVXIT
PREGNLVCILIANVM; LEG AVG
PR · PR CVRANTE M · AVR
QVIRINO PRE COHILGOR

(XII.)

IMP · CÆSAR · M · ANTONIVS
GORDIANVS · P · F · AVG
PRINCIPIA ET ARMAMEN
TARIA CONLAPSA RESTITV
IT PER MAECILIVM FVSCVM · LEG
AVG · PR · PR · CVRANTE · M · AVR
QVIRINO PR · COH I · L · GOR.

Horsley reads and expands them thus :

(XI.)

"Imperator Caesar Marcus Antonius Gordianus pius felix Augustus balneum cum basilica a solo instruxit per Gneium Lucilianum legatum Augustalem propraetorem curante Marco Aurelio Quirino præfecto cohortis primæ legionis Gordianæ."

(XII.)

"Imperator Caesar Marcus Antonius Gordianus pius felix Augustus principia et armamentaria conlapsa restituit per Maecilium Fuscum legatum Augustalem propraetorem curante Marco Aurelio Quirino praefecto cohortis primæ legionis Gordianæ."

The points obviously open to objection, in these readings and expansions, are *Gneium Lucilianum*, in n. xi., and *Cohortis primæ legionis Gordianæ* in both. Instead of "*Gneium*," we should read *Egnatium*, as proposed by Mr. Ward, and established by an inscription on an altar found at High Rochester (*Bremenium*), (Bruce, *Roman Wall*, p. 457), in which the name of *Lucilianus* is given as EGNAT. In the rendering *cohortis primæ legionis Gordianæ*, the absence of the number of the legion at once suggests doubt, and this is strengthened by the consideration that there is no evidence that any legion, known to have been in Britain, bore the title *Gordiana*

As to Mr. Gale's conjecture, that the "legion here called *Gordiana* was the *legio sexta victrix*," there is no other ground for it than that "the stated quarters [of that legion] were at York whilst the other legions had theirs at a much greater distance." Mr. Smith (*Collect. Antiq.* iv. p. 142) with equally little reason, refers the inscriptions to "the twentieth legion, apparently the *legio Gordiana*."

An examination of the words preceding *legionis Gordianæ*, scil. *præfectus cohortis*, suggests fresh doubt, for there is no authority for a *præfect* of a legionary cohort, whilst the term is the usual designation of the commander of an auxiliary cohort. Moreover, the order of the words—*cohortis legionis*, and not *legionis cohortis*—is so unusual, if not unprecedented, as in itself to cause dissatisfaction. Influenced, probably, by these considerations, Henzen, n. 6626, rejects the expansion, *legionis Gordianæ*, although accepted by Orelli, n. 975, and suggests *Ligurum*, or *Ligurum Gordianæ*; but neither of these readings appears to me probable.

I interpret COH · I · L · GOR · as *cohortis primæ Lingonum** *Gordianæ*. We know that there were three, probably four, cohorts of the Lingones in Britain. Trajan's† *tabulæ* inform us that the fourth‡ was

* I do not recollect having seen a similar use of the first letter of the ethnic name of a cohort; but in this case no confusion could arise, for, so far as we have evidence, there was no other corps, that served in Britain, whose initial letter was L.

† Mr. Wright (*Celt, Roman, and Saxon*, pp. 362, 363), through some strange inadvertence remarks on these *tabulæ*—"They are all decrees of the Emperor Trajan;" and, again speaking of the inscription found at Malpas,—"The date of this record is fixed by its internal evidence to the 20th day of January, A.D. 103. The other similar monuments found in Britain are all of the same year."

‡ It appears that there is a difference in the number of the cohort between the outer and inner inscriptions of this diploma. The latter, it is stated, gives IIII and the former III. It is not easy to decide which is the correct number. Gazzera, Henzen, and Böcking prefer III.

serving in Britain in A.D. 104, and the first in A.D. 105–106; whilst Hadrian's diploma notices the second in A.D. 124. According to the *Notitia*, the second was stationed at *Congavata* (Burgh-upon-Sands?); and the fourth at *Segedunum* (Wallsend), near which an altar has been found (Bruce, *Roman Wall*, p. 85), erected by a Præfect of that corps.

Horsley (*Durham*, xv.) gives the following inscription (on a stone also found at Lanchester), which Dr. Bruce (*Roman Wall*, p. 461) regards as mentioning the first, not the second, cohort of the Lingones :—

GENIO PRAETORI
CL EPAPHRODITVS
CLAVDIANVS
TRIBVNVS CHO
I LING VLPM

i.e. Genio Prætorii* Claudius Epaphroditus Claudianus† Tribunus cohortis primæ Lingonum votum libens posuit merito.

Dr. Bruce (p. 460) figures a slab, found at High Rochester, which bears the inscription :—

IMP · CAES · T · AELIO
HAD · ANTONINO · AVG · PIO PP
SVB Q LOL VRBICO
LEG · AVG PRO PRAE
COH I LING
*E *Q F

Dr. Bruce gives *equitum* as the expansion of E Q; but the letters evidently stand for *equitata*—a contraction, of which there are many

* Horsley strangely interprets—Genius the prætor; and the Index to the inscriptions in *Monum. Hist. Brit.* gives "Genius prætor?" There can be no doubt that *prætorii* is correct.

† Camden and Horsley regarded the cohort, which is named here, as the *second*, but I prefer Dr. Bruce's opinion. An objection to my reading—*Præfectus cohortis primæ Lingonum Gordianæ*—may be drawn by some from the designation of the commanding officer being here *tribunus*, not *præfectus*: but there is no doubt that both terms are applied to the commanding officer of the same auxiliary cohort. In the *Notitia*, the second and fourth of the Lingones are each under a *tribunus*, whilst it appears, from inscriptions on stones found in Britain, that they were each under a *præfectus*.

examples,* and which, in this particular case, is established by the following inscription in Fabretti, p. 486:—

C · CAESIDIO
C · F · CRV · DEXTRO
EQ · COH · VIII · PRAET
COH · I · LINGONVM
EQVITAT · &c.

Camden gives an inscription, found at Moresby in Cumberland, which mentioned the second cohort—and it is believed that the same corps was noticed in two inscriptions (Horsley, nn. xiii. and xiv.) found at Ilkley in Yorkshire. One of these is so remarkable, that it deserves special notice, and I shall therefore consider it in a separate article. But to return to the Lanchester inscriptions—an obvious suggestion relative to L · GOR is, that it may be a misreading of LINGON; but we may not disregard the leaf-stops in n. xii, after COH, I, L and GOR.

There remains but one other point requiring notice—the use of the word *principia*, of which I have never seen any other example except on the stone found near Bath (*Vide* article, n. 6 of these Notes), on which the letters between PR and PIA are illegible. M. Gale regarded the *principia* as "either the quarters of the legionary soldiers called the *principes*, or the place where the ensigns were kept;" whilst Mr. Horsley "rather concludes it to be the General's pavilion." Dr. Bruce interprets the term as denoting "the chief military quarters," or "officers' barracks."

Mr. Smith (*Collect. Antiq.* iv. p. 142) observes:

"The *principia* mentioned in the inscription, it need scarcely be observed, means the quarters of the chief officers, and place of deposit of the standards. The word occurs in an inscription of the time of Elagabalus [?] lately dug up near Bath, and published in the *Journal* of the Archæological Institute."

Mr. Smith doubtless inferred the meaning of the word *principia*, as found in the Lanchester and Bath inscriptions, from its signification, when applied to a place in a camp. But there is no authority, so far as I am aware, either in ancient authors or in inscriptions, whereby

* In Horsley's *Britannia Romana* (*Cumberland*, lxi.) we have the same mistake. He reads I · HIS · EQ *primæ Hispanorum equitum;* it should be *primæ Hispanorum equitatæ.* In *Cumberland*, lii., and in *Northumberland*, lxxviii., the reading is *Gallorum equitum*, instead of *Gallorum equitata.*

this or any other interpretation of the term, as applied to a *building*, can be confirmed.

P. S.—Since the foregoing was in type, I have observed in Henzen's Index, "Coh. I. Lingonum Gordiana," with the reference to Orelli's n. 975=Horsley's *Durham*, n. xii., but it does not appear whether this statement was made through inadvertence or with the intention of correcting the opinion expressed in n. 6626.

38. The following is the inscription, found at Ilkley, to which I referred in the last article:—

RVM CAES
AVG*
ANTONINI
ET VERI
IOVI DILECTI
CAECILIVS
LVCAN * S
PRAEF COH

Horsley expands it thus: "*Pro salute* Imperatorum Caesarum Augustorum Antonini et Veri Jovi dilecti Cæcilius Lucanus praefectus cohortis."

The point, which at once attracts attention, is the use of the unique phrase—*Jovi dilecti*, especially as applied to but one of the Emperors named on the stone. Horsley compares the Homeric* διοτρεφέες βασιλῆες, but the illustration throws but little light on this remarkable compliment so strangely limited to one of the Emperors. For my part, I am persuaded that the reading is erroneous. Independently of the objection arising from the unprecedented epithet, there is a singular omission—according to Horsley's expansion—of the deity to whom the altar was erected. This should, in my judgment, be supplied from the fifth line; and I venture to suggest that the true reading is IOVI · DOLIC · TI · *i.e.* IOVI DOLIC[HENO] TI[BERIVS], *Tiberius* being the prænomen of *Cæcilius Lucanus*. The epithet appears in various forms, such as *Dolicenus*, *Dolcenus*, *Dolc*, and *D*.

39. In the *Gentleman's Magazine*, for November, 1860, an account is given of the proceedings of the *Yorkshire Philosophical Society*, at their

* Horsley might have cited διίφιλος, which more closely expresses the Latin *Jovi dilectus*.

monthly meeting in October. Mr. Kenrick, Curator of Antiquities, "called the attention of the members to the inscription on the monument of Flavia Augustina, discovered at the Mount, near York," and to the suggestion (which I offered in article 21) as to the letter I before LEG· being part of the abbreviation PRI., "This may have stood," the Report proceeds, "either for Princeps or Primipilaris, examples of both occurring in inscriptions. The latter is perhaps the more probable. * * * The monument in question, though coarse in execution, must have been costly, and we may conclude that Caeresius, who dedicated it to the memory of his wife and children, was a person of higher military rank than a common soldier." In articles 17 and 21 of my notes, I expressed a preference for *princeps* as the reading of PRI·; and on reconsideration of the subject, I see no reason for altering my opinion. It seems to me very improbable that the same contraction was used for the designations of two high officers of different rank; and the enquiry as to the meaning of PRI· appears to be no more than a search for a case in which the abbreviation certainly denotes either of them. If such be found, then it may, I think, be reasonably concluded that it was not used for the other. Now there is no example, so far as I am aware, which proves that PRI was ever used for *primipilus*; whilst PRI·PRI· in Orelli, n. 3451 (if that inscription be genuine) establishes the use of it for *princeps*. Moreover, in my notes on the subject, I had no reference to *princeps*, as "a common soldier," one of the *principes*, but to *princeps* as the designation of the chief centurion of the *principes*, and the second in rank of the centurions in a legion, for, as Vegetius, ii. 8, informs us, *Vetus autem consuetudo tenuit, ut ex primo principe legionis promoveretur centurio primi pili.* This use of *princeps*, as "the" *princeps*, not "a" *princeps*, is not uncommon. In Henzen, n. 6779, we have an example of an officer, who was—

PRIM·PIL
LEG·V·ET LEG·X·ET LEG·VI·ITA·VT·IN
LEG·X PRIMVM PIL·DVCERET EODEM
TEMPORE·PRINCEPS·ESSET LEG·VI

Vide also n. 6747.

In 6780 and 6781 we find the *princeps* of an auxiliary cohort in two inscriptions found in Britain:

(1.)

I O M
COH · II · TVNGR
M EQ · C · L · CVI
PRAEST · ALB
SEVERVS PR
AEF · TVNG · IN
ST VIC SEVRO
PRINCIPI

(2.)

* * * * * *
ET · NVM[INI · D ·]
N · COH · II · TVN
GROR · GOR · M · EQ
[C·] L · CVI · PRAE
EST * * * CLAV
D * * * * * PRA
EF · INSTANTE
AEL · MARTINO
PRINC · &c. &c.

Dr. Bruce (*Roman Wall*, p. 264) on the first of these inscriptions, and Mr. Hodgson (*Archæol. Æliana*, ii. p. 88) on the second, judiciously reject the interpretation of *princeps* as a proper name, or as the designation of the Emperor, and refer to Manutius as authority for "*primus princeps, secundus*," &c.

The opinion, which seems to have been held by both, would have been more clearly expressed, if they had distinctly stated that *princeps* alone (without *primus*) is used for the first centurion of the *principes*, just as *primipilus* is used for the first centurion of the *triarii*.

40. In the *Journal* of the Archæological Institute, n. 65, 1860, there is an interesting and carefully prepared paper by the Rev. Edward and Mr. Arthur Trollope, on "The Roman Inscriptions and Sepulchral Remains at Lincoln." As there are some points on which I differ in opinion from the learned authors, I purpose devoting two or three articles to the consideration of the doubtful readings or interpretations.

In p. 4 we have the inscription :

D · M
FL · HELIVS NATI
ONE GRECVS VI
XIT ANNOS XXXX
FL · INGENVA CO
NIVGI POSVIT

It is thus interpreted :—"To the divine shades,—Flavius Helius, a Greek by nation, lived forty years. The free-born Flavia erected this stone to her husband."

I cannot perceive any reason for rejecting the obvious interpretation of *Ingenua* as a *cognomen*. It is not rare: Mommsen (*Inscript. Neapol.*) furnishes several examples.

41. In p. 6 we have the inscription that formed the subject of article 20 of my notes :—

L · SEMPRONI · FLA
VINI · MILTIS · LEGVIIII
* ALAVDI SEVERI
AERVIIANORXXX
ISPANICA LERIA
CIVMA

The reading and interpretation of the third line, which seem to be most favourably received by the Messrs. Trollope, are the same as those which I suggested; but a preference is expressed for ISPANI · GALERIA, instead of ISPANICA · LERIA. It is remarkable that when I first saw the inscription, this reading suggested itself to me; but although recommended by the circumstance that the Galerian tribe was common amongst the Spaniards (Henzen, n. 5598), I rejected it on the ground, that there is no example, so far as I am aware, of such a position of the tribe, not only after the birth-place, but also after the years of age and of service. But the existence of *Leria*, as a town of *Hispania Tarraconensis*, seems to be questioned, apparently on the ground that it is "not found in Dr. Smith's Dictionary of Roman Geography." There can be no doubt, however, that it did exist: it is mentioned by Ptolemy, cited by Cellarius, i. p. 106.

The readings *civis* [or *civitate*] *maximi exempli* for CIVMA seem to me very improbable. I prefer my own suggestion—C · IVNIA

c[urante] Junia. In support of this it may be added that the *Junia gens* was common amongst the Spaniards, whence we may assume that IVNIA was an ordinary female name amongst them.—*Reinesius Syntag*, p. 137.

42. In p. 15, the stone is figured on which is the inscription given by Horsley, *Brit. Rom., Lincolnshire*, n. 1:—

DIS MNIBVS
NOMINI SACRI
BRVSCI · FNI CIVIS
SENONI · H CARSS
NAE CONIVGIS
* * * * * * * *

"The memorial has been thus read:—

DIS MANIBVS[1]
NOMINA (or NOMINII) SACRI
BRVSCI FILI CIVIS
SENONII ET CARISS
IMAE CONIVGIS
EIVS ET QVINTI F.

"The slab is broken off just below the last line [marked by asterisks], and the inscription may be imperfect."

Mr. Ward read the four middle lines: *Nominii Sacri Bruscifili civis Senonii et charissimæ Vaniæ conjugis.*

Horsley gives the expansion: "Dis Manibus Nominii Sacri Bruscifili civis Senonii et carissimæ Vaniæ conjugis ejus et Quintiæ."

Gough (*Camden's Britannia*, ii. p. 374) offers the astonishing note—that the first word in the fourth line "may as well be read LINCOLNI as SENONI."

I am inclined to suggest the reading: *Diis Manibus Nominii Sacri Brusci filii, civis Senonii, et carissimæ conjugis, Lucii Quinti filiæ.* This is favoured by the appearance of the remaining portions of the letters as given in the woodcut, but it may be LVCIE [scil. E for AE] QVINTI F[ILIAE], a reading which is recommended by having the name of the *conjux*.

43. In p. 17, the inscription on the grave-stone presented by Mr. Arthur Trollope to the British Museum, in 1853, is noticed:—

1·VALERIVS·1·F
CLA·PVDENS·SAV·
MIL·LEG·II·A·P·F·
>·DOSSENNI
PROCVLI·A·XXX
AERA * I D·SP
H·S·E

"The following reading of the inscription may be suggested—Julius (or Titus) Valerius, Julii (or Titi) filius, Claudia (*tribu*), Pudens, Savia, miles legionis II· Augustæ (or adjutricis) piæ, fidelis, centuriæ Dossenni Proculi, annorum xxx, ærum ii, de sua pecunia hoc sibi fecit (or hic situs est.)"

The appearance of the letters on the stone, as figured in the *Journal*, leads me to regard *Titus* as more probable than *Julius*. I also prefer *adjutricis* and *hic situs est*. For *de sua pecunia*, I would suggest *de suo peculio* (Orelli, n. 5553); and for *centuriæ, centuriâ*, as the usual construction seems to have been—the legion, cohort, or *ala* in the genitive, and the century or troop in the ablative. Thus in Renier nn. 3938, 3939, *centuria* and *turma* are given *in extenso*. On p. 17, the observation of Mr. Franks on this inscription is cited:

"It records Julius Valerius Pudens, son of Julius, of the Claudian tribe, and a native of Savia, a city in Spain; he appears to have been a soldier of the second legion, and of the century of Dossennus Proculus, and to have lived thirty years, two of them as a pensioner."

The tribe, being the Claudian, leads me to prefer (both here and in Gruter, 547, 10) *Savaria*, a town in Pannonia. *Vide* Reinesius, ch. viii. n. 5, and Orelli, n. 500. The interpretation, "two of them as a pensioner," is liable to the objections, that there is no number on the stone, which can be clearly read, and that there is no authority for "a pensioner." I am not sure that I correctly understand the use of the term by Mr. Franks, but if his meaning be, that Julius Valerius Pudens received pay for two years, as some of our discharged soldiers receive pensions, he has not at all expressed the sense of the Latin. The phrase AERA MERVIT means the same as STIPENDIA MERVIT, *i.e.* served [the stated number of] years.

But it is more important to notice the construction of the word in this inscription. Instead of AERVM we have AERA, for the last letter seems to be A. The number is so obliterated that it appears scarcely possible to propose a certain restoration; but per-

haps in this injured portion of the stone there was, besides the number, M standing for *meruit*.

I have pleasure in adding, that the Messrs. Trollope are the first, so far as I am aware, who have noticed the *ascia* in Britanno-Roman epigraphy.

44. In p. 19, we find the expansion,—Hic ex testamento positus (?)" for H · E · TEST · P. I prefer "Heres ex testamento posuit," the heir being the veteran named in the sixth line. This inscription is of much interest, as supplying another notice of the 14th legion. The only other stone found in Britain, which mentions this celebrated corps, is that dug up at Wroxeter, and now in the Library of the Grammar School at Shrewsbury, on which see *Notes*, p. iv. n. 14.

45. In p. 19, a stone is noticed which was found at Lincoln, during the early part of last year.

"The inscription, which is perfect, may be thus read:—

DIIS · MANIB
C · IVLI GAL
CALEN · F LVC
VET EX LEG · VI
VIC · PF NASEMF

"The person here commemorated may have been Caius Julius, of the Galerian tribe, son of Calenus, a native of Lucca (?), and a veteran of the sixth legion, styled *Victrix, pia, fidelis (?)*. The concluding letters are inaccurately formed, and their import is obscure. *Nepos a suo bene merenti fecit*, has been proposed, but we confess our inability to offer any satisfactory explanation. The sixth legion, however, it must be observed, was styled *firma* and *ferrata*, which may suggest the more correct reading. It is doubtful whether it was ever styled *pia, fidelis*.

The inscription, although apparently plain, and moreover accurately represented in a woodcut prepared with great care from a photograph, presents more than ordinary difficulty. The objections to the readings, proposed by Messrs. Trollope, for the first three lines, are: that *C. Julius* has no *cognomen*—that the normal arrangement of the name of the father and the tribe is inverted—and that the sixth letter in the third line seems clearly to be I, not F.

I am inclined to suggest the following expansion:—*Diis Manibus Caii Julii, Galeria tribu, Caleni, (or Galeni), Lugduno, i.e.* of Caius Julius Calenus, (or Galenus), of the Galerian tribe, a native of Lugdunum. The only objection, worth noticing, which I see to this, is, that in the woodcut there is a mark resembling a point between N

and I; but it seems probable to me that the mark is the result of injury or of age. It is remarkable that there is a similar mark between L and I, in the fifth line of the inscription noticed in the preceding article.

LVG is a common abbreviation for *Lugdunum*, and in that city the Galerian appears to have been the ordinary tribe. *Vide* Horsley, *Brit. Rom., Monmouthshire*, n. 111, and Orelli, n. 4020

But the principal difficulty remains for consideration. To the reading of the last line,

·VIC·PF NASEMF

the Messrs. Trollope suggest the serious objections, that PIA FIDELIS can scarcely be accepted as an expansion of P·F, as it is doubtful whether the sixth legion was ever styled *pia, fidelis;* and that the concluding letters are so inaccurately formed, and their import so obscure, that they are unable to offer any satisfactory explanation. Let us first consider the question as to the application of the epithets *pia fidelis* to the sixth legion. Henzen certainly seems to have been of the opinion that this legion was not styled *pia fidelis*, for, in his index, whilst giving other titles, he omits mentioning these, and corrects two inscriptions in which those letters are found in connexion with the sixth. In his emendations I concur, for the use of CLAVD· in each of these cases shows that LEG·VII was intended; but the opinion that P·F, standing for *pia fidelis* were never applied to LEG·VI, may be refuted by several examples. In Britain, omitting some instances which may be questioned, we find examples in Northumberland, n. xliv.; Cumberland, nn. xxiv. and xlii.; and Westmoreland, n. vi., of Horsley's Collection. In Stuart's *Caledonia Romana*, p. 349, we find an inscription in which the words *piæ fidelis*, applied to the sixth, are almost *in extenso*. Again, in Bruce's *Roman Wall*, pp. 270 and 274, we have other examples of the application of P·F. Nor is the usage limited to Britain. Steiner, n. 611; Lersch, *C. Mus.* i. p. 14; and Dureau de Lamalle, *Annal. dell' Inst. Arch.* iv. 1832, p. 151, supply examples found on the continent.

In Bruce's *Roman Wall*, p. 250, we have *fidelis* in extenso; and in Mommsen's *Inscrip. Neap.*, n. 2852, "*fidel.*," but in both cases without "*pia.*"

As it has now, I conceive, been established, that P·F in the last line of the inscription under consideration should be read *pia fideli*, we may proceed to the last letters, read by the Messrs. Trollope as NASEMF. The ligulate form, read by them as NA, seems to me to

be VM. It is not uncommon, and is noticed by Horsley in his table of abbreviations. Assuming, then, that these letters are VM, and adopting the reading of the others by Messrs. Trollope, I would suggest *vivus monumentum sibi et maritæ fecit.* But I am not satisfied that E, after S, is the correct reading. The letter, as it appears in the woodcut, looks very like P. If this be the fact, then I would suggest :—*Vivus mandavit sua pecunia monumentum fieri.* According to my view, the inscription may most probably be read thus:

DIIS MANIB[VS]
C[AII] IVLI[I] GAL[ERIA]
CALENI LVG[DVNO]
VET[ERANVS] EX LEG[IONE] VI
VIC[TRICE] P[IA] F[IDELI] V[IVVS] M[ANDAVIT]
S[VA] P[ECVNIA] M[ONUMENTVM] F[IERI].

46. Amongst the valuable results of the exploration of the Station of *Bremenium*, which was made through the liberality of the Duke of Northumberland, in 1852, was the discovery of several inscribed stones. On one of these, as figured in Bruce's *Roman Wall*, p. 458, is the following imperfect inscription:

IMP CAE * * * * * * * * * * * *
* * * * * * P·F * * * * * * * *
* * * * CH·I·F·VARD * * * *
* * * * * BALLIS A SOLO RES
SVB C·CLAP * LINI LEG AVG
INSTANTE AVR QVINTO TR

Dr. Bruce remarks:

"The inscription may be read:

IMP[ERATORI] CAE[SARI]
P[IO] F[ELICI]
C[O]H[ORS] I F[IDA] VARD[VLORVM]
BALLIS A SOLO REST[ITVIT]
SVB C[AIO] CL[AVDIO] APELLINI[O] LEG[ATO] AVG[VSTALI]
INSTANTE AVR[ELIO] QVINTO TRIB[VNO].

In honour of the Emperor Cæsar,
Pious, happy.
The first cohort of the Varduli, *styled* the faithful,
———— from the ground restored,
Under Caius Claudius Apellinius, imperial legate;
Aurelius Quintus, the Tribune, superintending the work.

† Another reading may be suggested: *Vidua marito sua pecunia monumentum fecit.* My objection to it is that I have never seen *vidua* in any ancient inscription not Christian.

"The word *ballis* being peculiar, it would be rash to hazard a hasty explanation of it. It does not occur in Gruter. Is it the termination of some word? Is it a contraction for *balneis?* or has *b* been substituted for *v*, and should it be *vallis?* These are the most plausible suggestions which have occurred to me, but I am not satisfied with any of them. I have written the cognomen of the legate, as I think the inscription requires; it is necessary, however, to state that this name does not occur in Gruter."

In the year 1855, excavations were carried on at the same place, and a slab was discovered bearing the following inscription, as given by Dr. Bruce, in the interesting account published in the *Archæologia Æliana* (*new series*), vol. i. p. 78:

IMP · CAES · M · AV * * *
* * * * * PIO F * * * *
TRIB · POT X COS * * *
P · P · BALLIST · A SO * *
VARDVL * * * * * * * *
TIB · CL · PAVL * * * *
PR · PR · FEC * * * * *
P · AEL * * * * * * * * *

This inscription, as Dr. Bruce observes, solves the question as to BALLIS in that found in 1852, for BALLIST suggests BALLISTARIVM, and we are also enabled to correct the reading of the name of the imperial legate, by substituting *Paulinus* for *Apellinius*. So far every thing seems satisfactory; but Dr. Bruce adds in a note:

"A comparison of the two inscriptions does not remove all the difficulties attending the reading of the name of the Proprætor on the slab found in 1852; but if the name of this dignitary be not (Tiberius) Claudius Paulinus, it is difficult to say what it is."

I am unable to understand the grounds of this remark. The name of the legate on the second slab seems to be, beyond doubt, *Tiberius Claudius Paulinus*, and from this we have to correct the reading on the first slab—*Caius Claudius Apellinius*. The substitution of *Paulinus* for *Apellinius* seems certain. *Claudius* remains in both, the only difference being that in the first we have the abbreviation CLA, in the second only CL—and all that remains to be done is to get rid of *Caius*, the prænomen in the first. Can there be any doubt that the C preceding CLA in that inscription stands not for *Caio* but for *cura*, *i.e.* that we should read *sub c*[*ura*]*? Paulini*, in the genitive, confirms the expansion.

Thus no difficulty regarding the names of this Proprætor remains. In one his *prænomen* is given; in the other it is omitted, as is frequently the case. In the Vieux inscription (Mr. C. R. Smith's *Collectanea Antiqua*, vol. iii. p. 95) the names of this same Proprætor also appear without the *prænomen*.—Compare the inscriptions 16*a*, 98, and 102*a* in *Monum. Hist. Brit.*

But another inquiry remains as to the age of the slabs. Dr. Bruce remarks on this point:

"The emperor here referred to is no doubt Heliogabalus. He assumed the same titles as Caracalla; but the character of the letters and the evidently intentional erasure of the distinctive part of his name, indicate the later rather than the earlier monarch. Fortunately the erasure in the second line has not been so effectually performed as to prevent the word ANTONINO being discernible."

Neither of the reasons given by Dr. Bruce seems to me conclusive evidence as to the emperor here referred to being Heliogabalus. Moreover, the examination of the date of the Vieux monument, by Mr. Roach Smith (*Collect. Antiq.*, iii. p. 98) does not favour this opinion. He observes:

"This monument was erected in the first year of the reign of the third Gordian. [In the inscription on the principal face the date is given—AN. PIO ET PROCVL·COS—which corresponds to A.D. 238.] The events mentioned in the inscriptions probably occurred a considerable time anterior to the setting up of the monument. M. Huet and the Abbé le Neuf believe that the Ædinius Julianus, præfect of the prætorium, whom Solennis went to Rome to see, and from whom he received this letter of recommendation [inscribed on the monument], is the Julianus mentioned by Herodian and Capitolinus, who held this high post in the time of Macrinus [*i.e.* before the commencement of the reign of Heliogabalus]. This was twenty years prior to the reign of Gordian, and as Julianus speaks of Paulinus as his predecessor in Gaul, Paulinus, in this case, must have been in Britain in the reign of Caracalla, possibly of Severus, when the sixth legion was in active service in the north of the island, repelling the Mæatæ and the Caledonians."

In the opinion of M. Huet and the Abbé le Neuf I concur. It seems very improbable that the *Julianus*, who was præfect of the prætorium under Commodus, was the individual named on the monument. I regard the *Ædinius Julianus* of the monument as most probably the same who is mentioned as *M. Ædinius Julianus* amongst the *patroni* of Canusium, in the well-known inscription (of the date A.D. 223) given by Mommsen, *Inscript. Neapol.*, n. 635.

47. In the *Journal of the Archæological Institute*, n. 67, 1860, p. 270, a tile from Caerwent is figured, which bears the name BELLICIANVS, four times written, in "what may be called the cursive hand [?] of the British Romans. The name Belicianus (with a single *l*) occurs on one of the tomb-stones from Bulmore, near Caerleon, and may possibly refer to the same individual."

To these observations of Mr. J. E. Lee, the following remarks are subjoined:

"The sepulchral stone found at Bulmore, to which Mr. Lee refers, is figured in his *Delineations of Roman Antiquities found at Caerleon*, pl. xxiv. p. 37. It bears an inscription in memory of Julia Veneria; it was erected by Alesander (*sic*) her husband and Julius Belicianus her son. The upper part of the stone forms a pediment, on which a dolphin is sculptured. The names Bellicius, Bellicinus, Beclicus, and also Bellianus, Bellienus, &c., occur in inscriptions given by Gruter. Bellienus was the name of a family of the *Annia gens;* Bellicianus may have been a name derived from that of the town in Gaul, of some note in Cæsar's campaign against the Allobroges, Bellicium, or Belica, now known as Belley. It is situated about forty miles E. of Lyons."

I am unable to consult Mr. Lee's work, as above referred to; but the inscription, which is cited, is the same as that given in Mr. Wright's *Celt, Roman, and Saxon*, p. 315:

"D. M.	To the gods of the shades.
IVLIA · VENERI	Julia Veneria,
A · AN · XXXII	aged thirty-three years,
I · ALESAN · CON	Alexander, her husband
PIENTISSIMA	most attached,
ET · I · BELICIANVS	and Julius Belicianus
F · MONIME	her son, this monument
F · C	caused to be made."

With this reading and translation I am by no means satisfied. The I at the beginning of the third line seems to me to be not a numeral, to be joined to XXXII in the preceding line, but the ordinary *nota* for *Julius*, scil. "*Julius Alexander*." "Her husband most attached" is evidently a casual slip, as a translation of CON[IVGI] PIENTISSIMA[E], which, of course, means "to his most attached wife." The name BELICIANVS may perhaps be nothing more than the ordinary cognomen FELICIANVS, the B being used for F. MONIME is so strange an abbreviation of MONIMENTUM, that it excites suspicion as to the correctness of the reading. I venture to suggest—M · OPTIME,—*i.e.* M[ATRI] OPTIM[A]E. According

to this view, the inscription denotes that "Julius Alexander to his most affectionate wife, and Julius Felicianus to his excellent mother, caused [this memorial] to be made."

48. In 1848, Lord Palmerston presented to the British Museum a pig of lead, found at Carthagena in Spain, which bears the following inscription :*

M · P · ROSCIEIS · M · F · MAIC.

This inscription is identical with that on the block in the Collection of Antiquities at the Bibliothèque Imperiale at Paris, which was also found in Spain. Mr. Way (in an excellent article on "The Relics of Roman Metallurgy," in the *Journal of the Archæological Institute*, n. 61) notices a reading *in extenso* suggested by Mr. Newton, scil. *Marcus Publius Roscius, Marci filius, Mœcia* [*tribu*]. This does not appear to me satisfactory. On comparing it with Henzen's n. 5733, beginning M · P · VERTVLEIEIS · C · F ·, I am inclined to regard ROSCIEIS as an archaic form of the nominative plural, M · P · as standing for *Marcus* and *Publius*, and M · F for *Marci filii*. MAEC · may be an abbreviation of MAECII, for we know that *Mœcius* was amongst the names borne by members of the Roscian *gens* e. gr. Orelli, n. 4952 :

L · ROSCIO · M · F · QVI
AELIANO · MAECIO
CELERI.

But I prefer Mr. Newton's MAEC[IA] *tribu*. Thus we have in Fabretti, p. 240.

L · RVSTICELLIVS · C · SCA [i. e. *Scaptia tribu*]
M · CVSINIVS · M · F · VEL [i.e. *Velina tribu*]

The omission of the cognomen is an evidence of rare antiquity in Latin Epigraphy and the same is indicated by the termination *eis*.

Henzen, (in a paper on the inscription n. 5733, published in *Bulletin dell' Institut. di Correspond. Arch. Rome*, 1845, and translated by Mr. Key, in *Proceedings of Philological Society*, vol. vi. p. 179) states that he has not met with this form of the nomina-

* The interesting character of this inscription will, I trust, be deemed a sufficient apology for my introducing some remarks on it, although not found in Britain. In a future Part I purpose taking up the inscriptions on the pigs of lead, of the Roman period, which have been found in Britain.

tive plural of the 2nd declension at a later date than about the middle of the seventh century of the City, *i.e.* about 100 years B.C.

It may be worth while to observe, that the omission of *et* between two names is not uncommon. We have an example in Henzen, n. 5733, —M · P · VERTVLEIEIS,—*i.e.* as we express it, *Marcus* and *Publius Vertuleius*. In Orelli, n. 3121, there is a similar form—Q · M · MINVCIEIS Q · F · RVF · i.e. *Quintus* et *Marcus Minucii, Quinti filii, Rufi*, or as we express it, *Quintus* and *Marcus Minucius Rufus, sons of Quintus*.

The inscription on the block I regard as showing that it was from the mines rented by the two Roscii. It is possible that they may have been public officers, but we should then probably have had their official designation.

NOTES ON THE DAVENPORT GRAVEL DRIFT.

BY SANDFORD FLEMING, C.E.

Read before the Canadian Institute, March 2nd, 1861.

The flat plain skirting Lake Ontario in the locality of Toronto, and on which the city is built, extends for many miles westerly, and is bounded on the east by the Scarborough Heights, and on the north by the terrace-shaped elevation known as the Davenport Ridge. This terrace crosses Yonge-street about half a mile north of Yorkville, immediately at the residence of the Hon. Mr. Morrison, and trends westerly and slightly north-westerly a little over three miles to the point where the Northern Railway crosses the Davenport road. At this point the terrace changes its direction, and a peculiar gravel deposit begins: the terrace, instead of continuing its uniform westerly direction, takes a sudden bend towards the north, and sweeps diagonally through the third and fourth concessions of the township of York, for a distance of nearly four miles, until it reaches the neighbourhood of Weston. Here it loses itself in the rising ground ascending easterly from the Humber, but is again developed on the western bank of that river, and, extending

southerly, becomes strongly marked near the village of Lambton, where it again makes a sudden detour and sweeps westerly along the line of Dundas-street and continues in a direction generally parallel to Lake Ontario through the neighbouring townships.

The gravel deposit already referred to, can likewise be traced over a considerable area, but, unlike the terrace in its windings into the interior, the gravel is found only in a uniformly straight direction, and that generally parallel to Lake Ontario. The gravel is found over a distance of two and a half miles in a well-defined, yet low, narrow ridge, averaging only about an eighth of a mile in width, in height from about fifteen to twenty feet in the centre, gently rounded, and sloping to the level ground on each side.

The terrace rises abruptly from the plain below to an elevation averaging from thirty to about fifty feet, and although generally known by the name of "The Davenport Ridge," it cannot properly be termed a ridge, as its summit either maintains its level as a table-land, or gently rises towards the interior in easy undulations.

Good sections of the gravel deposit are given in the ballast pits of the Northern and Grand Trunk Railways at points about half a mile apart, where these lines cross it at the Davenport and Carleton stations respectively. Both sections are so precisely similar in character that an illustration of one will suffice—(*See Plate*)—and it is not unreasonable to draw the inference that the same leading characteristics, similarly displayed at these points half a mile apart, obtain throughout the length of the deposit.

The terrace already referred to has frequently been noticed by geologists, especially where it crosses Yonge street, this point being easiest of access from Toronto. Sir Charles Lyell, in his "Travels in America," makes particular reference to it. He maintains that it marks the margin of the sea at some early period; others, again, consider it the former boundary of Lake Ontario. Following up the latter supposition we can scarcely avoid coming to the conclusion that the Davenport gravel ridge, from its peculiar outline and from its level, must have been washed by the ancient Lake Ontario in a manner precisely similar to that in which the singular and similar formation in front of Toronto harbour is washed by the present lake. We may even venture a step farther, and advance satisfactory reasons for attributing the origin and development of the Davenport gravel ridge to the action of the lake at its higher level. Many

gentlemen have submitted their views on the origin and progress of the formation which encloses Toronto harbour, as well as the adjoining sheet of water, Ashbridge's Bay. They nearly all agree that it is a deposit due to the continued action of the waves on the Scarborough Heights. Professor Hind very fully discussed the matter in an elaborate paper published in the *Canadian Journal* (first series); and the writer laid two papers on the subject before the Institute at an earlier period. It will not be necessary to go over the arguments given in the articles referred to. They seemed perfectly conclusive when applied to the ridge or shoal, island or peninsula, or whatever it may be called, in front of Toronto harbour. They are equally applicable to the Davenport gravel ridge, with Lake Ontario high enough to wash it, and if we are satisfied that the development of one formation is caused by the waves of the present lake, acting through a long course of years, in undermining the heights of Scarborough and in giving to the *débris* a progressive westward motion, we can have no difficulty in coming to a similar conclusion with regard to the formation of the Davenport gravel ridge, viz.: that it was gradually produced by the mechanical action of the waves of Lake Ontario when it stood at about 170 feet above its present level; that the materials of which the deposit is mainly composed are the insoluble portion of the *débris* formed by the destructive action of the waves on the terrace which stretches parallel to Lake Ontario and crosses Yonge street about half a mile north of Yorkville; that these materials have been transported westerly to their present resting-place by the singular progressive motion given to all beaches, under certain conditions, by the waves.

Admitting this to be the true history of the Davenport gravel deposit, and there can be little doubt of it unless it be assumed that the forces of nature have been entirely changed in their character as well as their mode of action, we are yet somewhat puzzled to account for some peculiarities in the stratification which are seen on a close inspection of the sections formed by the railway cuttings.

The gravel is not deposited in horizontal beds, as is generally the case with sub-aqueous formations, nor is it laid, as one would naturally expect to find it on accepting the foregoing theory as satisfactory, that is to say, in thin beds dipping southerly, or from the shore towards the water, as if they had been thrown up one over another on the inclined plane of the beach by the storms of the former lake.

On the contrary, we find the gravel invariably deposited in the opposite direction, that is to say, in beds dipping *away from* the lake, and, in some instances, nearly at right angles to what may have been the plane of the beach.

There seems only one way of accounting for this peculiarity, consistent with phenomena observed at the present day, and yet in harmony with the theory of formation already advanced.

We find on many similar drift deposits going on at the present time around Lake Ontario, as well as around all the great lakes, that the winds and waves under certain conditions produce results which will readily account for the peculiar stratifications at Davenport. It is, however, unnecessary to go farther than the formation already referred to in front of Toronto for an illustration. The long narrow spit which forms the eastern half of this formation, and which connects it with the main land, is perhaps under precisely the same conditions that the Davenport ridge was in with Lake Ontario at its supposed higher level. This modern spit is so low that it is not at all times above water; at the present moment a considerable extent of it is under water, at other times it is all or nearly all barely above the lake level; but, whether above or below water, it is exposed, when the wind blows *point blank* on the shore, to a destructive as well as an accumulative action, destructive on the outer or lake side and accumulative on the inner side.

These combined actions were observed by many a few years ago, when the special attention of the citizens of Toronto was drawn to the breach formed near Privât's hotel. Their effect on the deposit was chiefly to move it nearer the main shore, the materials being lifted by the waves from the outer slope and deposited on the inner side.

This action of the waves is not confined to a particular point. It may be witnessed to a greater or lesser degree along the whole extent of the spit, whether it be above or below the surface of the water, when the waves break on the beach at an angle not too acute. This difference, however, may be remarked: Where the summit of the ridge is above water, waves of greater force are required to wash the materials composing the beach over to the inner side.

The consequence of this action, continued year by year, must necessarily be a gradual recession of the formation and a stratification of its beds dipping towards the main land. The first agrees

with the ascertained facts, as careful surveys clearly show that the deposit is gradually approaching the main shore; and the second, although it has not to my knowledge been confirmed by actual excavations, cannot be called in question.

In this manner, it is thought, the peculiar dip of the strata at the Davenport gravel pits may be accounted for; but to perfect the analogy we must assume that the whole deposit was at one time considerably farther to the south.

Nor does this appear to be assuming too much when we reflect that the Davenport terrace, before being exposed to the long-continued destructive action of the waves, must have extended considerably farther southward, and hence the gravel spit, also, would be in a corresponding position. As the terrace gradually receded, or in other words, as the waves undermined the clay banks and the lake thus encroached upon the land, supplying fresh material for the extension of the spit, so also would the spit recede simultaneously with its extension westward, and, in this manner, produce the peculiarly inclined stratification, which at first sight appears not a little puzzling. Whether this theory be correct or not, it has at least the recommendation of being consistent with observed phenomena.

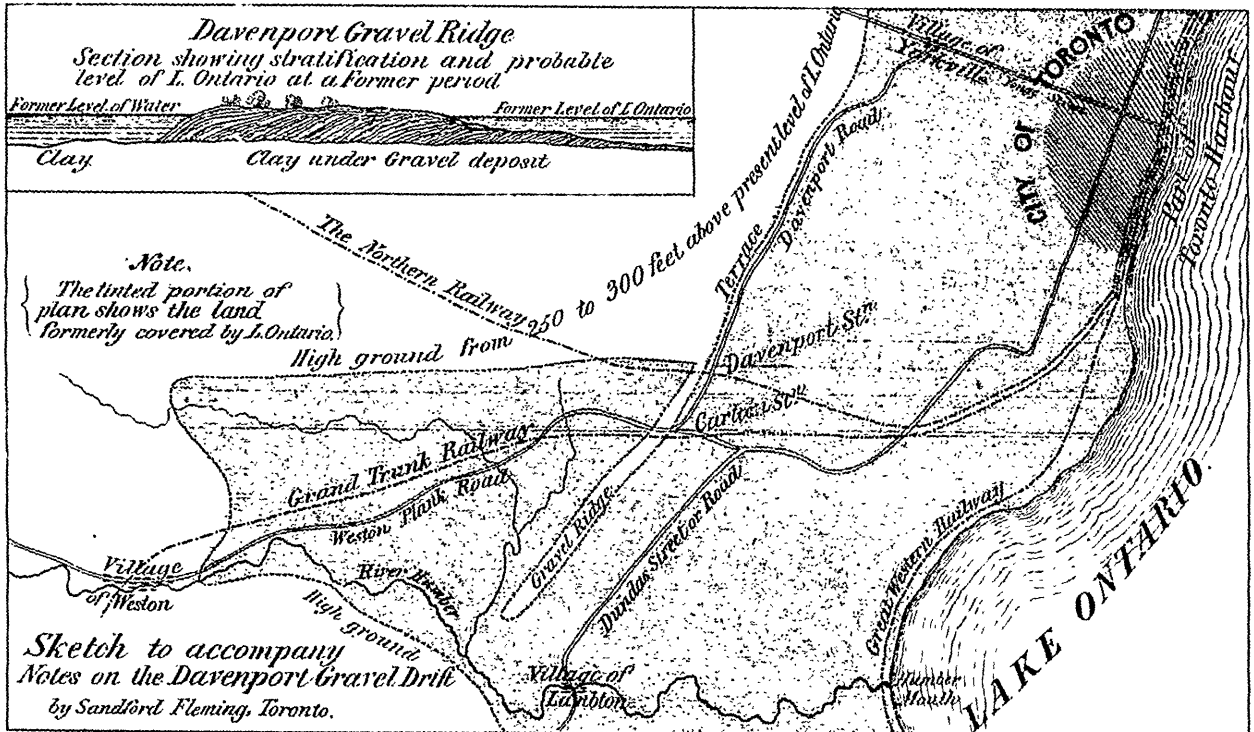
With regard to the character of the gravel found in the Davenport and Carleton pits, it varies in size from coarse sand up to pebbles one and two inches in diameter; the largest proportion of the deposit, however, consists of gravel under half an inch in diameter. There is nothing in the character of the materials composing the deposit inconsistent with the supposition that they at one time occupied a position in the drift clays of which the terrace is formed, or that they have travelled along its base (the former beach of Lake Ontario) impelled by the mechanical action of wind and waves. Indeed there is every argument to show that such has actually been the case. The particles of gravel are similar in character to rocky fragments found imbedded in the terrace, and they are rounded, which implies that they have been subjected to a rolling action in the water. The deposit is entirely free from clay (except in nodules hereafter referred to) which shows that the materials have not been deposited like ordinary sediment on the bottom of a lake. The entire absence of all large stones, or boulders, would likewise indicate that the materials have been brought by forces insufficient for the removal of these

substances; and the occurrence of boulders in very considerable quantities strewn along the flat land under the base of the terrace is a sufficient proof that they have been left behind.

The occurrence of nodules of clay, from an inch to two or three inches diameter, in some of the beds of gravel, is not a little remarkable, seeing that they are so soft as to be easily crumbled up in the hand. These clay nodules are not found in every bed, but only in beds here and there. Their presence may be accounted for by supposing that the waves had undermined a portion of the half frozen clay cliff in winter, and that some of the fragments had been rolled along the beach by the waves and ultimately washed up in their frozen condition and deposited where we find them. These fragments of clay are identical in character with the clay found in digging into the face of the terrace. Their rounded and water-rolled appearance would certainly go far to strengthen the above supposition, but in order to support it we are obliged to bring in the agency of frost. This may not only be quite justifiable, but the presence of these pieces of clay of the peculiar shape and in the singular position which we find them, may be some slender proof that the climate in those days long gone by was not unlike the climate at the present time.

The plate shows a section of the gravel deposit, as well as a sketch of its position in relation to the adjoining country. The tinted part is intended to represent the land which would be under water, with Lake Ontario 170 feet above its present level

We have had occasion in these observations to draw a comparison between the gravel deposit at Davenport and the formation now going on in front of Toronto; but perhaps the most remarkable resemblance in the character of both is that they denote the boundaries of two capacious natural harbours. The present one, the harbour of Toronto, is well known; and the ancient one must have occupied the whole of that flat expanse lying between the Davenport gravel ridge and the village of Weston, and must have embraced over seven square miles of sheltered water, or nearly double the area of Toronto Harbour. It is not a little strange that the same natural forces should be at work to-day in forming almost a duplicate of what they completed in the same neighbourhood before the commencement of history on this continent; for if the natural harbour of Toronto is not exactly similar in outline or in expanse to


Davenport Gravel Ridge
Section showing stratification and probable level of L. Ontario at a former period
Former Level of Water
Former Level of L. Ontario
Clay
Clay under Gravel deposit
Note.
The tinted portion of plan shows the land formerly covered by L. Ontario
The Northern Railway
250 to 300 feet above present level of L. Ontario
Terrace
Davenport Road
Village of Yorkville
CITY OF TORONTO
Bay of Toronto or Toronto Harbour
High ground from
Davenport Stn
Carlton Stn
Grand Trunk Railway
Weston Plank Road
Gravel Ridge
Dundas Street or Road
Village of Weston
River Humber
High ground
Sketch to accompany Notes on the Davenport Gravel Drift
by Sandford Fleming, Toronto.
Village of Carlton
Credit Western Railway
Humber Marsh
LAKE ONTARIO.
Fa s Bencke Lith Toronto

the one above attempted to be described, it most certainly appears to be identical in character.

These observations lead us to the reflection that the agencies of nature have been as they are now, ever active in changing and remodelling the earth's surface. We find entombed in these gravel heaps at least a trace of the history of bitter winters, perhaps long anterior to the first appearance of even the Red Men in the valley of the St. Lawrence: a rude indication of the direction of winds, and of the force of storms which spent their fury at a period equally early, and a long history (written by their own agency) of waves which rolled many fathoms over the spot where we are now assembled, recorded in characters which cannot easily be effaced, and which when carefully read cannot well be mistaken.

ON THE DEVONIAN FOSSILS OF CANADA WEST.

BY E. BILLINGS, F.G.S.

(*Continued from* Vol. VI. *page* 282.—No. XXVIII. *May*, 1860.)

Genus *Spirifera*.—Sowerby.

SPIRIFER.—*Of the generality of Authors.*

Generic characters.—Hinge-line straight and either greatly elongated, or equal to, or less than the width of the shell; the general form, triangular, quadrate, oval, or sub-circular. The ventral valve the largest, with a flat or concave area varying greatly in its dimensions; a triangular foramen beneath the beak, usually open but sometimes partially closed by an arched plate called a deltidium or pseudo-deltidium. Area of dorsal valve smaller than that of the ventral valve. Surface either ornamented with radiating ribs, or finely striated, or smooth. In the interior the spiral cones have their apices turned outwards as in *Spirigera*, but they are destitute of the complicated appendages of this last-named genus. The muscular impressions are somewhat similar in their general form and relative position to those of *Athyris*, but subject to great variation according to the species. Shell structure not punctated.

This genus ranges from the Lower Silurian up to the Trias. In Canada we have found no species below the Clinton group.

A great many species of this genus have been described as occurring in the Devonian rocks of the United States; and in Canada West there are apparently fifteen or twenty, but owing to the imperfection of the specimens, several of these must remain for a while undetermined.

SPIRIFERA MUCRONATA.—(Conrad.)

DELTHYRIS MUCRONATUS.—(Conrad.) *Annual Report of the Geological Survey of New York*, 1841, *p.* 54. Hall, Geology of New York, part 4, 1843, p. 198.

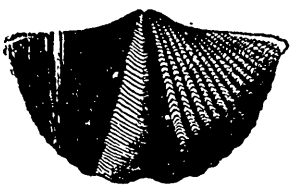


Fig. 59.

Fig. 60.

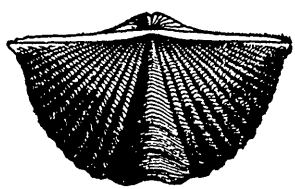


Fig. 61.

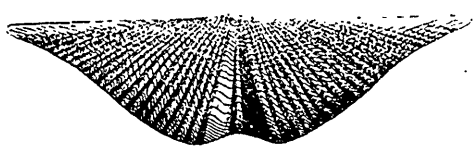


Fig. 62.

Fig. 59 *Spirifera mucronata.*—Ventral view. Fig. 60. Side view. Fig. 61. Dorsal view. Fig. 62. A long-winged variety of the same species.

Description.—This species varies from the semi-circular to the sub-triangular form. In general the hinge line is twice, and sometimes thrice the length of the shell; the cardinal angles acute, the side either straight or gently rounded and converging to the front margin, which is either straight or concave, and of the width of the mesial fold. The valves are moderately convex; the ventral more tumid than the dorsal; the mesial fold and sinus are rounded, and extend quite to the beaks; from fifteen to twenty not very prominent ribs on each side. The area of the ventral valve is very narrow, in the largest specimens scarcely more than half a line in height; the beak small, pointed and incurved over the area, but not in contact with the

umbo of the dorsal valve, a space of one-fourth to one-half of a line intervening. Area of dorsal valve sub-linear or about one-third the height of that of the ventral valve. The whole surface, in well preserved specimens, is covered with zigzag concentric imbricating striæ, from two to four in the width of one line.

Width on the hinge-line from one to two inches, usually one inch and a half. Length from beak to front from eight to twelve lines.

Locality and Formation.—Hamilton Group. Townships of Plympton and Bosanquet. Also found loose, or in boulders in the drift in numerous localities in the extreme western Counties of the Provinces.

Collectors.—A. Murray. J. Richardson. Also from W. B. Wells, Esq., Judge C.C. Chatham, C. W.

SPIRIFERA VARICOSA.—(Hall.)

SPIRIFER VARICOSUS.—(Hall.) *Tenth Annual Report of the Regents of the University of the State of New York*, 1857, *p.* 125.

SPIRIFER SUBMUCRONATUS OR SUBATTENUATUS + S. INUTILIS.—(Hall.) *Geology of Iowa.*

The species above quoted are all closely allied to each other, and also to *S. mucronata.* They differ from the latter in being in general a little smaller, and in having the umbo and beak of the ventral valve more prominent—the area of the same valve being consequently larger.

In the corniferous limestone numerous fragments and single valves have been collected, which most probably belong to *S. varicosa*, or to one or both of the others. I have referred them all to the former for the present provisionally, not being able to decide whether they are or are not identical therewith. At all events they must be most closely allied species.

Some of them have the mesial sinus regularly concave, while in others it is divided by an obscure ridge along the middle. The mesial fold on the dorsal valve is sometimes marked by a central groove, but often it is entire. The individuals thus marked should probably be referred to *S. bimesialis.* (Hall.) *Geol. Iowa.*

The following figures represent a specimen from the Corniferous, near Woodstock, with the length greatly less than the width and no median rib in the sinus.

Fig. 63.

Fig. 64.

This only differs from *S. mucronata* in the larger area of the ventral valve, as shewn in Fig. 60, and from *S. bimesialis* by the absence of the median rib in the sinus, and no groove on the mesial fold.

I do not pretend to decide that the above all belong to one species, or that they should be all referred to *S. varicosa*. There are numerous species of brachiopoda described by Prof. Hall and others, without figures or measurements, which never can be recognized or identified except by the persons who have the original specimens in their possession.

SPIRIFERA DUODENARIA.—(Hall.)

DELTHYRIS DUODENARIA.—Hall. *Geology of the 4th District of New York, p.* 17. *Fig.* 5. 1843.

Fig. 65. Fig. 66. Fig. 67.

Fig. 65. SPIRIFERA DUODENARIA.—(Hall.) Dorsal view of a large specimen.
Fig. 66. Shews the narrow area and the close approximation of the beaks.
Fig. 67. Dorsal view.

Description.—This species is distinguished by its smooth rounded ribs. The form is sub-semicircular or sub-triangular; the hinge-line straight extended, equal to the greatest width of the shell; both valves moderately convex; the dorsal valve usually flattened or concave near the cardinal extremity; the areas very narrow; beaks small, short, pointed, incurved, nearly in contact with each other. From twelve to fourteen strong rounded ribs, gradually decreasing in

size from the middle of the shell outwards, the grooves between them rounded. Surface usually smooth, but when well preserved, with fine concentric striæ. The mesial sinus is represented by the middle furrow of the ventral valve, and the fold by the middle rib of the dorsal.

The ordinary width of this species is ten or twelve lines on the hinge line, but some are sixteen lines. In a specimen of this latter size the area of the dorsal valve is scarcely half a line high, and that of the ventral valve two-thirds of a line. The former lies nearly in the plane of the margins of the shell, while the latter slopes a little outwards. The beak of the ventral valve is incurved so as to project a little over the plane of the area, and its point is within half a line of the umbo of the dorsal valve.

This species may be easily distinguished from *S. mucronata* and *S. varicosa*, by the form of the ribs, which are round instead of angular, twice the size of those of the other species, and separated by rounded grooves. The mesial groove or sinus is only slightly larger and more conspicuous than those next it on each side.

Locality and Formation.—Rama's Farm near Port Colborne. Near Woodstock.

Collectors.—A. Murray, E. Billings.

SPIRIFERA FIMBRIATA.—(Conrad.)

DELTHYRIS FIMBRIATA.—Conrad. *Journal of the Academy of Natural Sciences of Philadelphia*, Vol. VIII., p. 263.

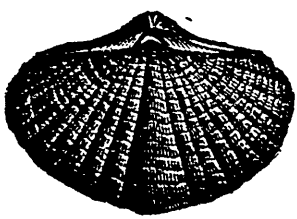


Fig. 68.

Fig. 69.

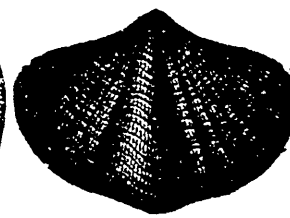


Fig. 70.

Fig. 68. *Spirifera fimbriata.*—Conrad. Dorsal view. Fig. 69. Side view. Fig. 64. Ventral view.

Description.—Transversely oval; hinge line shorter than the greatest width of the shell; cardinal angles rounded; mesial fold and sinus moderately rounded; from three to eight obscure ribs on each side;

width from nine to eighteen lines; length a little more than half the width.

The dorsal valve is moderately and pretty uniformly convex, gently or not at all depressed towards the cardinal angles; area, sub-linear, lying nearly in the plane of the lateral margins, not reaching the extremities of the h· ·e line; beak, small pointed, scarcely at all projecting over the area; mesial fold, rounded, not prominent, extending quite to the point of the beak; usually a large space at the cardinal angles, and extending thence along the hinge line to the sides of the beak without ribs; the latter in general obscure, rounded, not much elevated, and becoming obsolete before reaching the hinge line.

Ventral valve rather strongly convex in the upper half, the outline in a side view forming about one quarter of a sphere; the beak small, pointed, and incurved over the area; the latter shorter than the hinge line, sloping outwards at an angle of about 115° at its base with the plane of the lateral margins, above rather strongly incurved; foramen broad, and with a sharp ridge on each side, not always preserved. The mesial sinus is rounded or sub-angular, and extends quite to the point of the beak; a smooth space at the cardinal extremities as in the dorsal valve.

Surface of the perfect specimens beautifully ornamented with shallow rounded concentric furrows, from three to four in two lines, the ridges between the furrows having from five to eight small elongated tubercles in the width of one line.

Locality and Formation.—Occurs in the Corniferous Limestone at Rama's Farm, and at many places in the County of Haldimand. Also in the Hamilton Shales in the Township of Bosanquet. Good specimens rare.

Collectors.—J. DeCew, E. Billings, A. Murray.

Spirifera raricosta.—(Conrad.)

Delthyris raricosta.—Conrad. *Journal of the Academy of Natural Sciences of Philadelphia*, Vol. VIII., p. 262. Pl. 14, fig. 18. 1839.

Delthyris undulatus.—Vanuxem. *Geology of the Third District of the State of New York*, p. 132, fig. 3. 1842.

Description.—Sub-quadrate, sub-semicircular or oval; hinge-line equal to the greatest width or the shell or a little less; dorsal valve with five, and ventral valve with six, large rounded or sub-angular ribs;

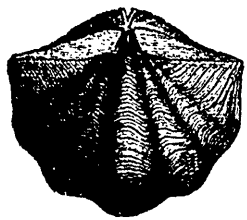


Fig. 71.

Fig. 72.

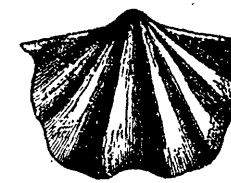


Fig. 73.

Fig. 71. *Spirifera raricosta.*—Conrad. Dorsal view. Fig. 72. Side view.
Fig. 73. Ventral view of a specimen with the shell exfoliated.

length of full grown individuals about one inch; width equal to or a little greater than the length.

The dorsal valve is most convex in the middle and more or less flattened or concave towards the cardinal angles; the area narrow sub-linear; the beak small pointed and together with the area strongly incurved over the hinge line; the middle rib corresponding to the mesial fold of an ordinary *Spirifera* is usually very prominent, rounded or sometimes a little flattened on the top; its width at the front margin, in a specimen fourteen lines wide, is about five lines, and it is well defined and prominent all the way to the point of the beak; the ribs next to it on each side, also reach the beak, but the two outer ribs become obsolete on approaching the hinge-line.

The ventral valve is most gibbous in the upper half, the umbo rather small but prominent, and the cardinal angles not flattened. The area is somewhat variable in its dimensions; and cannot be seen when the shell has been compressed; in large perfect specimens it is two lines high at the beak and half a line at the cardinal angles, and slopes outward at one angle of about 100° at its base, but is more or less arched towards the dorsal valve, so that its general direction is more nearly in the plane of the lateral margins. The beak is small pointed, always incurved over the area; the mesial furrows and four of the ribs extend quite to the point of the beak; the mesial furrow in all the specimens that I have seen is broadly rounded, while the lateral furrows are somewhat angular in the bottom.

The surface is usually covered with small lamellose, somewhat rough ridges of growth; but in the more perfect specimens with fine imbricating concentric lines, of which there are from four to eight in one line; all of these are undulated upwards in crossing the ribs.

The specimens vary in form from oval (those with a short hinge-line) to sub-quadrate or sub-semicircular.

This species is easily recognized even in fragments by its large rounded ribs. When partially exfoliated the ribs sometimes exhibit from one to three large rounded knobby prominences. In general, however, they are smooth.

Locality and Formation.—Near Port Colborne, and various places in the County of Haldimand.

Collectors.—A. Murray, J. DeCew, E. DeCew, E. Billings.

SPIRIFERA GREGARIA.—(Clapp.)

SPIRIFER GREGARIA.—Hall. *Tenth Annual Report of the Regents of the University of New York*, p. 127, 1857.

Fig. 74.

Fig. 75.

Fig. 76.

Fig. 74. *Spirifera gregaria.*—Dorsal view. Fig. 75. The same.—Side view. Fig. 76. Ventral view.

Description.—Shell semi-oval or sub-globular, varying greatly in the amount of the convexity. Hinge-line straight, equal to the greatest width of the shell; cardinal angles sometimes rounded. Ventral valve very convex, strongly and uniformly arched from beak to front, the outline sometimes forming a semi-circle; a deep angular mesial sinus extending from the front to the beak, on each side of which there are from seven to nine ribs. Umbo very much elevated, beak strongly incurved; area concave, next to the hinge-line inclining outwards at an angle of 45° to the plane of the lateral margin, but above suddenly arched over the hinge-line by the strong incurvation of the beak. Dorsal valve convex, with a strong mesial fold either somewhat angular or a little flattened along the ridge, or obscurely marked with an indistinct groove; seven to nine ribs on each side surface, often nearly smooth but sometimes marked with concentric zigzag lines. Width about three-fourths of an inch; length varying from a little less to a little more than the width.

In very convex specimens the umbo of the ventral valve is so

greatly developed that it rises above the hinge-line to a height equal to nearly one-half the length of the whole valve. Sometimes the beak of the ventral valve is incurved down nearly to the dorsal umbo, but in general there is a space of about half a line intervening.

Locality and formation.—This species has been found rather common on lot 43, concession 2, township of Middleton, in the Corniferous Limestone. According to Prof. Hall, it occurs "in the limestone of the Upper Heldenberg, (Onondaga and Corniferous) rarely in Eastern New York, common in Genesee and Erie counties, and in Ohio and Kentucky, in the same geological position."

I am indebted to Dr. B. F. Shumand for specimens from the Falls of the Ohio for comparison. These are more convex than any of ours, but of about the same size.

Collector.—J. De Cew.

Spirifera Parryana.—Hall.

Spirifer parryanus.—(Hall.) *Geology of Iowa*, Vol. I., page 509. Plate 4, fig 8 *a*, 6.

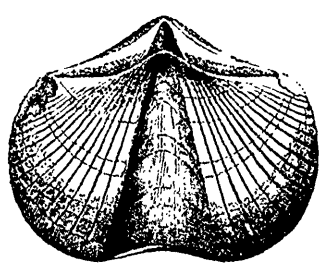


Fig. 77.

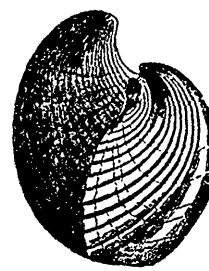


Fig. 78.

Fig. 77.—*Spirifera parryana.*—Dorsal view. Fig. 78. Side view of the same.

Description.—Transversely sub-elliptical or sub-quadrate; cardinal angles generally rounded; sides and front angles rounded; front margin somewhat straight or a little concave for about one-third the width in the middle. Both valves rather strongly convex, giving a sub-globose form to the whole shell; mesial fold and sinus rounded, and extending to the beaks. Area of ventral valve somewhat arcuate, and forming an angle of about 48° to the plane of the lateral margins. Surface with about eighteen flat, rounded ribs, separated by grooves one-fourth the width of the ribs; mesial fold and sinus not ribbed.

Width from one inch and a half to two inches. Length about five-sixths of the width.

Locality and formation.—Lowe's Mill, township of Bosanquet, Hamilton Shales.

Collector.—The only specimen found was collected by C. Robb, Esq., C. E.

SPIRIFERA SCULPTILIS ?—(Hall.)

Fig. 79.

The above figure represents an imperfect ventral valve (found by Mr. Robb along with *S. Parryanus,*) which appears to be identical with the species figured by Hall in the *Geology of New York,* Vol. IV., p. 202, under the name of *S. sculptilis.*

Genus CYRTIA.—(Dalman.)

Generic Characters.—Shell semi-circular or triangular; ventral valve extremely prominent and of a pyramidal shape; area large, usually incurved; foramen extending quite to the beak, closed except a small aperture near the beak by a convex deltidium. Dorsal valve flat or only moderately convex. The internal characters do not appear to differ greatly from those of *Spirifera.*

The shells of this genus are smaller in general than *Spirifera,* and the species are closely allied to each other.

CYRTINA is another genus exactly resembling *Cyrtia* in shape, but with the interior of the ventral valve divided by a mesial septum, which supports near the foramen a triangular chamber as in *Pentamerus.*

Not having seen the interior of the two following species, I leave them in the genus *Cyrtia* where they have been hitherto placed.

CYRTIA HAMILTONENSIS —(Hall.)

CYRTIA HAMILTONENSIS.—Hall. *Tenth Annual Report of the Regents of the University of the State of New York,* p. 166. 1857.

Description.—" Shell more or less obliquely triangular, pyramidal: hinge equalling the greatest breadth, and obtusely (or acutely) an-


Fig. 80.


Fig. 81.


Fig. 82.

Fig. 80.—CYRTIA HAMILTONENSIS.—Hall. Ventral view.
Fig. 81.—Side view.
Fig. 82.—Dorsal view. (The perforation not shewn near the beak in the figure, but exists in the specimen.)

gular at the extremities; dorsal valve depressed, nearly flat; beak scarcely elevated above the hinge-line; mesial fold small, bounded on each side by deeper and wider grooves than those between the plications, with sometimes a faint, narrow, longitudinal depression in the middle; ventral valve very convex, most prominent near the beak, which is very variable in elevation, and either straight or a little arched from the hinge, sometimes twisted on one side; sinus distinct, rounded or angular; area variable, triangular, generally high, often wider than high, arcuate or plane, finely striate in both ways, the vertical striæ scarcely visible; foramen very narrow, usually perforate above by an ovate aperture, and has at its base a small transverse arcuate slit. Surface ornamented by six to eight simple rounded plications on each side of the mesial fold and sinus, and marked by very fine concentric lines of growth. Under a good lens, minute granules may be seen on all parts of the exterior except the area and deltidium: interior minutely punctate."—(*Hall. Tenth Regents' Report*, above cited.)

Our specimens agree so exactly with the above description, that there can be no doubt of the identity of the species.

Locality and formation.—Townships of Bosanquet and Plympton. Hamilton shales.

Collectors.—A. Murray, J. Richardson, E. Billings.

CYRTIA ROSTRATA.—(Hall.)

A species of *Cyrtia* occurs in the Corniferous Limestone, only differing from *C. Hamiltonensis* in having the ribs larger and the surface marked with concentric imbricating lamellæ, instead of fine striæ. The only perfect specimen I have seen has five ribs on each side of the mesial fold and sinus. It is referred to *C. rostrata* provisionally.

Locality and formation.—Lot 45, Con. 1, Cayuga.

Collector.—J. De Cew.

Genus ATRYPA.—(Dalman.)

SPIRIGERINA.—D'Orbigny.

Generic characters.—Shell circular, ovate or sub-quadrate. Ventral valve with a small closely incurved or sometimes elevated beak. Surface smooth, striated, or with small ribs, and often strongly marked with concentric squamose lines of growth. Shell structure fibrous, impunctate. The spiral appendages are placed with their bases flat upon the inner surface of the ventral valve, and their apices directed into the hollow of the dorsal valve. In the interior of the ventral valve, the divaricator muscular scars occupy a large oval space in the upper half; the occlusor a much smaller circular or oval space near the beak, and inserted, as it were, between the others on rostral side In the dorsal valve the occlusors are four in number near the beak, two on each side of an obscure median ridge.

In fig. 83, a specimen of *A. reticularis* is represented lying on the ventral valve, the dorsal valve uppermost, shewing the position of the internal spires. The figure is taken from "Sandberger's Atlas."

Fig. 83.

ATRYPA RETICULARIS.—(Linn.)

ATRYPA RETICULARIS.—*Of the generality of Authors.*

ATRYPA IMPRESSA.—Hall, *Tenth Annual Report of the Regents of the University of New York*, p. 122.

Fig. 84.

Fig. 85.

Fig. 86.

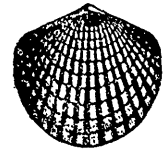


Fig. 87.

Fig. 84.—*Atrypa reticularis.*—Dorsal view. Fig. 85.—Side view.
Figs. 86 and 87.—A specimen with coarse ribs.

Description.—This species is variable in form (as are all that range through a number of formations). Specimens the size of those above figured are ovate; length a little greater than the breadth; sometimes both valves nearly equally convex, but in general the ventral valve is convex in the middle portion of the upper two-thirds, flattened to-

wards the sides, and with a broad shallow mesial depression towards the front. The dorsal valve is in general strongly convex; the hinge extremities rounded. The umbo and beak of the ventral valve are small, the latter sometimes a little elevated, but in general closely incurved.

Large specimens, twice the size of those above figured, are not uncommon in the Corniferous limestone. These are more elongate oval, or sometimes, owing to the wide straight hinge-line and projecting cardinal extremities, the form is sub-triangular.

The surface is covered with small radiating ribs, usually two or three in the width of one line. These are crossed by undulating concentric lines of growth, which give to the ribs a nodose or rugged aspect. In large specimens from the Devonian rocks of the Hudson Bay Company's Territory, the striæ are much finer, there being four or five in one line. In others they are much stronger. The shell when partially exfoliated, exhibits a whitish silken or pearly lustre. Individuals are sometimes found with the surface around the front margin covered with imbricating concentric lamellæ. Length usually about one inch or a little less, sometimes three inches.

Locality and Formation.—This species ranges from the base of Middle Silurian to the Devonian, and is found in most countries where these rocks have been recognized. In Canada West it occurs in numerous localities in the Clinton, Niagara, Oriskany, Corniferous, and Hamilton formations.

Genus STRICKLANDIA.—(Billings.)

STRICKLANDIA.—(Billings.) *Canadian Naturalist and Geologist*, Vol. 4, p. 132, April, 1859.

RENSSELÆRIA.—(Hall.) part. *Twelfth annual Report of the Regents of the State of New York*, p. 39, October 1859.

Generic Characters.—Shell, usually large, elongate-oval, transversely oval, or circular, sometimes compressed; valves nearly equal; a short mesial septum in the interior of the ventral valve, supporting a small triangular chamber beneath the beak as in *Pentamerus;* in the dorsal valve no longitudinal septa spires or loop yet observed; the whole of the internal solid organs, (so far as is yet known) consisting of two very short or rudimentary socket plates, which support prolonged calcified processes for the support of the cirrated arms. In all the

species known, the ventral valve has an area more or less developed. The valves articulate by teeth and sockets.

The genus *Rensselæria* (Hall) is closely allied to *Stricklandia*, the shells being of nearly the same shape and size. Prof. Hall has shewn that in the dorsal valve the calcified processes, in his genus, after being prolonged about two-thirds the length of the valve, are united so as to form a loop, (as in *Centronella*) with a backward projecting spine. I think it probable that when better specimens are procured, it will be found that *Stricklandia* has a similar loop. In *Rensselæria* there is no triangular chamber in the ventral valve.

This group of shells, (*Stricklandia*), although closely related to *Pentamerus*, differs from that genus in the following particulars:—1st. In *Pentamerus* the form is globular and the ventral valve much the largest. In *Stricklandia* the valves are nearly equal in size, and the form oval or heart-shaped, never globose. 2nd. In *Pentamerus* the dorsal valve has two and sometimes three well developed longitudinal septa, which in most of the species sustain a small triangular chamber, as in the ventral valve. In *Stricklandia* these septa are not developed, and the triangular chamber is entirely absent. It might be thought that the difference between the short or rudimentary socket-plates of *Stricklandia*, and the elongated mesial septa of *Pentamerus* should not be regarded as of sufficient importance to constitute a generic distinction, because it is only a difference in the extent to which identical parts are developed, the socket-plates of the former genus being a rudimentary state of the latter. When, however, we examine any group of closely allied genera, we find that all the grounds for separation consist in the various modifications of the same set of organs. The difference in the degree of the development of an organ is not always a good character, but when it is carried to such an extent that the whole form of the animal is affected in a particular manner, manifested in a number of species, then it becomes of generic value. If we take the several species of *Stricklandia* and compare them with the ordinary forms of *Pentamerus*, such for instance as *P. Knightii*, *P. galeatus*, *P. Sieberi*, *P. acutolobatus*, *P. caduceus*, &c., the difference in the external form of the two groups is so remarkable, that we would almost be warranted in separating them into two genera upon this ground alone; but when to the dissimilarity in the general form we add the difference in the internal structure, then there can be little doubt as to the correctness of the separation.

The following figures exhibit the difference between the generic forms of *Stricklandia* and *Pentamerus*.

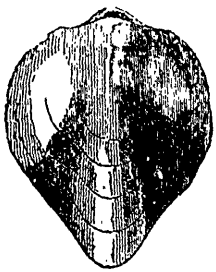


Fig. 88.

Fig. 89.

Fig. 90.

Fig. 88.—*Stricklandia lens*, dorsal view.
Fig. 89. The same side view, shewing that the valves are nearly equal in size.
Fig. 90.—*Pantamerus Knightii*, side view shewing the great difference in the size of the valves.

This genus ranges from the Middle Silurian up to the Devonian. It includes three English species long known under the names of *Pentamerus lens*, *P. liratus*, and *P. lœvis*. In Canada we have these three in the Clinton group at Anticosti, and also *Stricklandia Gaspensis*, (Niagara group) Gaspé, *S. Canadensis* (Clinton group) Thorold, C. W., *S. brevis*, perhaps a variety of the latter (Clinton) Anticosti. *Stricklandia elongata* is the only species known to me in the Devonian rocks.

STRICKLANDIA ELONGATA. (Vanuxem.)

PENTAMERUS ELONGATUS.—(Vanuxem.) *Geology of the Third District of the State of New York*, p. 132. 1842.

PENTAMERUS ELONGATUS.—(Hall.) *Geology of the Fourth District of the State of New York*, No. 34, Fig. 1.

MEGANTERIS ELONGATUS.—(Hall.) *Tenth Annual Report of the Regents of the University of the State of New York*, p. 123. 1857.

RENSSELÆRIA ELONGATA.—(Hall.) *Twelfth Annual Report of the Regents of the University of the State of New York*, p. 38. October, 1859.

Description.—Elongate-oval, somewhat variable in form, the sides convex, as in the above figure, or nearly straight and parallel, and in the latter case the front truncated or nearly straight. Valves varying in the amount of their convexity, sometimes nearly cylindrical above

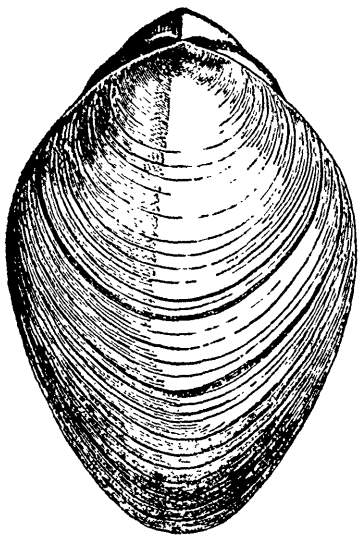


Fig. 91.

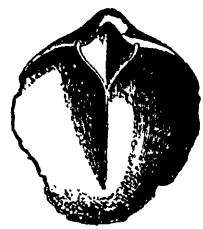


Fig. 92.

Fig. 91. *Stricklandia elongata.*—(Vanuxem.) Dorsal view of a specimen of a more nearly oval shape than usual.

Fig. 92. The same, interior of ventral valve, showing the small triangular chamber beneath the beak.

and compressed towards the front; the ventral valve in general the most convex, obtusely carinated from the beak along the middle in the upper half; the dorsal valve in the upper half often much flattened and broadly carinated in the middle, sometimes evenly convex. In many specimens the sides are abruptly compressed, so that a transverse section through both valves would be somewhat hexagonal in outline. The beak of the ventral valve is closely incurved over the umbo of the dorsal valve. Surface smooth but usually with several rough concentric imbricating ridges of growth most strongly developed towards the front.

Length from two to three or even four inches; width from one half to two-thirds of the length.

This appears to me to be a variable species, many of the specimens being somewhat broadly-oval, while others are elongate-oval or subcylindrical. So great are these differences that, without the intermediate forms, the extremes might readily be classified as distinct species. The specimens are seldom found perfect.

Locality and Formation.—At most localities of the Devonian rocks in the County of Haldimand, Oriskany Sandstone, and Corniferous Limestone.

Collectors.—E. DeCew. J. DeCew. E. Billings.

Genus PENTAMERUS.—(Sowerby.)

Generic Description.—Shell, globular or sub-globular, the ventral valve the larger, and usually with a prominent, greatly developed umbo. A strong mesial septum in the interior of the ventral valve, supporting a triangular chamber beneath the beak. "In the interior of the smaller (or dorsal valve) there are two distinct longitudinal septa, of variable dimensions; (between which a small median ridge is occasionaly found), to these the socket walls converge and join, forming two more or less developed and inclined plates, to the produced extremities of which were affixed the spiral cirrated arms." (Davidson, Introduction, p. 98.)

This genus ranges from the base of the Trenton Limestone up to the carboniferous rocks.

PENTAMERUS ARATUS.—(Conrad.)

ATRYPA ARATA and ATRYPA OCTOCOSTATA.—(Conrad.) *Annual Report on the Palæontology of New York*, p. 55, 1841.

PENTAMERUS ARATUS.—(Hall.) *Tenth Annual Report of the Regents of the University of the State of New York*, p. 120, 1857.

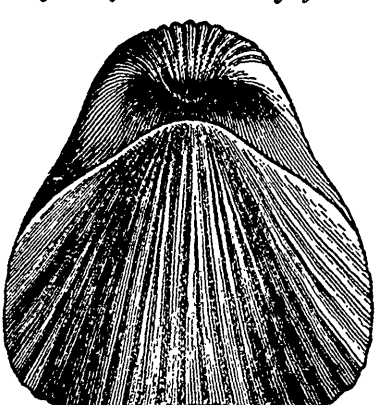


Fig. 93.

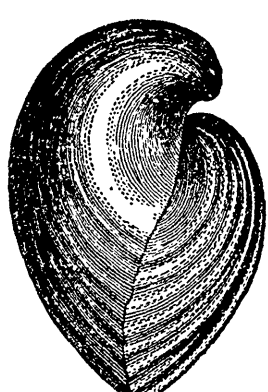


Fig. 94.

Fig. 93.—*Pentamerus aratus*, Dorsal view of a very large specimen.
Fig. 94.—Side view of the same specimen.

Description.—Shell, varying greatly in size and shape, ovate or sub-triangular, very convex or irregularly sub-globular. In large specimens the ventral-valve is very convex, with an exceedingly prominent and tumid umbo: the outline on a side-view is strongly arched from the beak to the front, the most rapid curvature being in the upper half; the beak is incurved, but not in contact with the umbo of the dorsal valve; a broad shallow mesial sinus originates at the front margin and becomes narrower and shallower, until, at length, it dies out before reaching the beak; in a front view the outline is sub-triangular. In small specimens the umbo and beak are proportionally much smaller, the form more nearly oval or nearly circular, and the mesial sinus occasionally obsolete. The dorsal valve is much the smaller, depressed convex, with a broad, slightly elevated mesial fold, on each side of which the shell is usually a little flattened, or even slightly concave; the mesial fold sometimes not at all developed. The surface is covered with coarse, unequal, sub-angular, or obscurely rounded ribs, from one line to one line and a half in width. These ribs increase in number from the beak towards the front, both by sub-division and the insertion of smaller ones between the larger. On each side of the beak there is a smooth space.

The only difference between this species and the well-known *Pentamerus galeatus* appears to be that, in the latter, the mesial sinus is on the dorsal and the fold upon the ventral valve.

In the following figures a small specimen is represented.

Fig. 95.

Fig. 96.

Locality and Formation.—This species occurs in the Oriskany Sandstone, and Corniferous Limestone, in various places in the County of Haldimand.

Collectors.—J. DeCew. E. DeCew. E. Billings.

Genus CENTRONELLA.—(Billings.)

CENTRONELLA.—Billings. *Canadian Naturalist and Geologist*, Vol. IV., p. 131. April, 1859.

Generic characters.—Shells, having the general form of *Terebratula*. Dorsal valve with a loop consisting of two delicate riband-like lamellæ, which extend about one-half the length of the shell. These lamellæ at first curve gently outwards, and then approach each other gradually, until at their lower extremities they meet at an acute angle; then becoming united they are reflected backwards towards the beak, in what appears to be a thin, flat, vertical plate. Near their origin each bears upon the ventral side a single triangular crural process.

This genus appears to stand between *Terebratula* and *Waldheimia*. In the former, the loop is short, not exceeding greatly one-third the length of the shell, and not reflected. In the latter, it extends nearly to the front, and is reflected, but the laminæ are not united until they are folded back.

CENTRONELLA GLANS-FAGEA.—(Hall.)

RHYNCONELLA GLANS-FAGEA.—Hall. *Tenth Annual Report of the Regents of the University of the State of New York*, p 125. 1857.

Fig. 97.

Fig. 97.—*Centronella glans-fagea.* Three views of a specimen of the usual size. These figures are too much rounded at the sides.

Description.—Shell smooth, ovate or sub-rhomboidal, greatest width about the middle, from which point the sides are nearly straight in the upper half, and converge to the beak at an angle of about 85°; front half rounded, sometimes with a sinus in the front margin. Ventral valve the larger, its outline forming a nearly regular arch from the beak to the front margin, strongly and broadly sub-carinate along the middle in the larger individuals, more uniformly convex in the small ones; beak long, strongly incurved over the dorsal valve, but not in contact therewith. Dorsal valve nearly flat, with a wide, shallow, mesial sinus, which, in some specimens, occupies nearly the whole width of the shell, but in others it is almost obsolete, and the

valve is then nearly flat. Length from two to three lines, width about the same.

The above description applies to the more common form of this species. Larger individuals from six to eight lines in length are occasionally found, but they do not seem to be so numerous as the smaller ones. In these, the dorsal valve is divided along the middle by a narrow, rounded sinus, which extends from the front nearly to the beak; on each side the shell is convex, sometimes rather strongly tumid. The ventral valve broadly carinate along the middle. The following figures represent the largest specimens that I have seen in different views.

Fig. 98.

Centronella tumida?

There are some intermediate sizes, but not sufficient to make out a series connecting these large individuals with the smaller. Should these constitute a distinct species, I propose to call it *C. tumida*.

Locality and formation.—Oriskany Sandstone and Corniferous Limestone, County of Haldimand. Also at Rama's Farm near Port Colborne.

Collectors.—J. De Cew, E. De Cew, E. Billings.

CENTRONELLA HECATE.—*N. Sp.*

Fig. 99.

Centronella Hecate.—*a.* A specimen with the dorsal valve removed, shewing the loop, which is covered with minute crystals of silex. *b.* Ventral view of another specimen. *c.* side view, *d.* dorsal view.

Description.—Elongate, oval, or sub-rhomboidal; apical angle from 45° to 60°; sides somewhat straight from the beak to about the middle, where, making a rounded angle, they converge towards the front margin, which is somewhat truncate for about one-third the width. Ventral valve strongly but broadly carinate from the beak along the middle to the front, descending with a flat or gently convex slope to

the sides; in outline only gently arched longitudinally; in some specimens nearly straight; the beak small, elongated, erect, and with a triangular foramen. Dorsal valve gently convex in the upper half, and with a wide shallow sinus in the lower half. Surface smooth. Length from two to four lines; width about three-thirds the length.

Locality and formation.—Oriskany Sandstone and Corniferous Limestone, County of Haldimand.

Collector.—J. De Cew.

CHARIONELLA CIRCE.—*N. Sp.*

Fig. 100.

Charionella Circe.—The first figure exhibits a specimen with the dorsal valve partly removed, shewing the internal spires. The other two figures are a side and ventral view of another specimen.

Description.—Elongate ovate, greatest width a little below the mid-length, above which the sides converge with a nearly straight or gently convex curve to the beak; apical angle between 60° and 75°; front half rounded, sometimes slightly truncate in the middle of the front margin. Both valves moderately and evenly convex. Ventral valve evenly arched from beak to front; beak incurved, but not in contact with the dorsal umbo, truncated by a circular aperture which is formed below by a deltidium; the sides of the umbo very obtusely sub-angular for about one-sixth of the length of the shell. Dorsal valve not quite so convex as the ventral, most prominent a little above the mid-length; the umbo moderately prominent; the shell narrowed and somewhat pointed towards the beak. Surface nearly smooth.

Length of specimen of average size—eight lines; width six lines; depth of both valves, four lines; difference between the length of dorsal and ventral valves, three-fourths of a line.

Associated with the above, are specimens of about the same length, which are proportionally broader, and with a shallow, mesial sinus extending from the front margin of the ventral valve nearly to the beak. The sides of the umbo or cardinal slopes are more angular, and the beak more prominent. The front margin, instead of being rounded, is straight, or even a little concave in the middle. These

may belong to the same species, but more specimens are required to determine this point.

Locality and formation.—Corniferous Limestone, County of Haldimand.

Collector.—J. De Cew.

Remarks on the genus Charionella.

Fig. 101.

A silicified fragment of the dorsal valve of *C. Circe* a little enlarged, shewing the absence of a regular hinge-plate.

Fig. 102.

A fragment of the ventral valve of *C. scitula?* shewing the deltidium and muscular impressions in part.

By treating partially silicified specimens of this genus with acids, I have ascertained that the structure of the hinge-plate differs from that of *Spirigera* in being either obsolete along the middle or anchylosed to the bottom of the valve. In *Athyris* = (*Meristella*, Hall) there is a well developed hinge-plate, supported beneath by a strong mesial septum, which extends sometimes nearly to the front of the valve. In *Charionella* there is either no mesial septum, or, one that is merely rudimentary. In one specimen there is a remarkable partition, which runs obliquely from near the beak to the margin near the front. It completely divides the internal cavity into two parts. This I believe to be not a mesial septum, but a temporary wall formed by disease of the animal, because both spires are crowded into the smaller of the two cavities, the larger being empty.

It is probable that further researches will bring to light other characters of the hinge-plate in other species, and I do not therefore confine the genus to such as have this organ constructed exactly as in *C. Circe* and *C. scitula*.

The species figured by De Verneuil under the names of *Terebratula, Schulzii, T. Bordii,* and *T. mucronata,* in the Bulletin of the Geological Society of France, 2nd Series, Vol. VII., Plate 3., have the aspect of this genus, and exhibit the same structure of the beak, foramen and deltidium of the ventral valve, and most probably have the same internal organization.

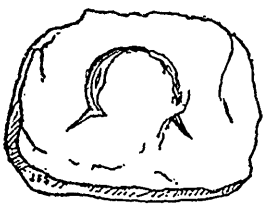
(To be continued.)

NOTE ON A NEW SPECIES OF TRIARTHRUS FROM THE UTICA SLATE OF WHITBY, CANADA WEST.

BY J. F. SMITH, JR.

(*Read before the Canadian Institute, 26th January*, 1861.)

The specimen here figured, was discovered about two years ago, in a piece of Utica Slate from Whitby. I had previously obtained, from the same locality, a side-piece of the head of a much larger individual, but did not describe it, as the specimen was too imperfect. The fact that this genus has been altogether described from fragments, may serve as an apology for adding a new species under the same circumstances. The genus *Triarthrus* is said to differ from the genus *Olenus*, as regards the head-shield, by the facial suture of the latter genus terminating at the posterior margin of the buckler; while in the former, it terminates at the angles as in *Calymene*. I do not think that this distinction will hold good as a generic character, for in the species here figured the suture does not terminate at the angles, but at the margin, as in *Olenus*. This distinction, however, is not well represented in the accompanying figure. I propose to call this new species *Triarthrus Canadensis*, as it is the third discovered in this Province. The only other species having long spines, is *Triarthrus spinosus* (Billings). By reference to Mr. Billings' description (*Can. Geol. Survey Rep.*, 1853-54, 55, 56, page 340) the difference in *T. Canadensis* will become at once apparent. The horns of the former are slender and cylindrical, and point, with a slight curve, almost directly downwards to the eighth pair of pleuræ. In *T. Canadensis*, they are flattish, and rather thick, with a groove running down the centre, and they extend at an angle of about 40°, evidently not farther than the fourth pair of pleuræ. The specimen before mentioned, and the one here figured, are the only ones yet discovered. Good specimens are therefore likely to be rare.



Triarthrus Canadensis.

SPECIMEN OF A FLORA OF CANADA.

(Continued from page 169.)

BY WILLIAM HINCKS, F.L.S., F.B.S.E.

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I follow Dr. Lindley's classification so far as the adoption of the Alliances, the mode of sub-dividing the class Exogens, the admission of his class Dictyogens, and the general series of the orders,—excepting that as I now propose to proceed no further than the Ferns, I have reversed the arrangement so as to leave the unfinished part at the end instead of at the beginning of my work. I differ from Lindley in rejecting his class Rhizogens, which, however, does not affect the Canadian Flora, in receiving the Ferns as a class under the name of Acrogens,—the Mosses and Hepaticæ being called Anophytes,—and in deeming it useful to reduce the seven classes thus admitted under three sub-kingdoms, which may, I conceive, be best named CRYPTOGAMÆ, MONOCOTYLEDONEÆ, DICOTYLEDONEÆ. My general scheme of the vegetable kingdom would therefore stand thus :—

			SUB-KINGDOMS.	CLASSES.
Plants	with stamens and carpels	Seeds: with two or more cotyledons	*Dicotyledoneæ*.....	Seeds enclosed in the carpel—the pollen acting through its tissues — I. EXOGENÆ.
				Seeds naked, the pollen acting directly on their surface. — II. GYMNOSPERMÆ
		Seeds: with only one cotyledon.	*Monocotyledoneæ*	Leaves net-veined, deciduous; root with the wood in a solid concentric circle. — III. DICTYOGENÆ.
				Leaves parallel-veined, permanent; root like the stem internally. — IV. ENDOGENÆ.
	with a lower type of the reproductive system		*Cryptogamæ*.....	Developed from a prothallus containing the proper reproductive organs. Stem with woody tissue and vessels. — V. ACROGENÆ.
				With stem and foliage distinct or confluent, consisting of cellular tissue only. — VI. ANOPHYTA.
				Stem and foliage undistinguishable; of cellular tissue only. — VII. THALLOPHYTÆ.

Lindley's sub-classes of Exogens stand thus :—

- Stamens and carpels ordinarily on the same flower
  - Calyx and torus adherent on the united carpels ..... EPIGYNOSÆ.
  - Carpels free; androecium adhering on the corolla, or both on the calyx ... PERIGYNOSÆ.
  - Carpels free: outer circles all distinct ..... HYPOGYNOSÆ.
- Stamens and carpels on different flowers ..... DICLINOSÆ.

The following table characterizes the alliances of the sub-class Epigynosæ, which are represented in the Canadian Flora :—

Epigynose Exogens

				ALLIANCES.
having a single envelope, or monochlamydeous				ASARALES.
almost constantly dichlamydeous	Corolla: Dialypetalous	Seeds: with copious albumen & small embryo	Seeds solitary in each carpel; large in proportion	UMBELLALES.
			Seeds numerous, minute	GROSSALES.
		with little or no albumen [Placentæ axile]		MYRTALES.
	Corolla: Synpetalous	Embryo: minute, amidst copious albumen		CINCHONALES.
		Embryo: with little or no albumen		CAMPANALES.

The first alliance is one of the least satisfactory, the uniting characters, however important, not being accompanied by any apparent marks of affinity: Santalaceæ are not even uniformly Monochlamydeous. Aristolochiaceæ seem to approach Dictyogens.

Asarales	ORDERS.
Carpels 3—6, usually 6; causing the fruit to have as many cells, with numerous seeds	ARISTOLOCHIACEÆ.
Carpels apparently several, but forming one cell, with few ovules, perfecting only one seed	SANTALACEÆ.

The order Aristolochiaceæ, abounding in equinoctial South America, and occurring more sparingly in North America, Europe (especially the basin of the Mediterranean), and India, remarkable for tonic

and stimulating properties, stands first in our series, out of its 130 species giving one, or possibly two, to our Flora:

Genus 1.—Calyx regular, with the three sepals more or less separated above; stamens 12; fruit fleshy, globular, opening irregularly. Stemless herbs, with aromatic-pungent rootstocks; kidney-shaped leaves, on long petioles, and a short pedunculed flower, close to the ground ..... ASARUM.

" 2.—Calyx tubular, the three sepals being united almost to their tips, the border being obscurely three-lobed. Tube variously inflated above the ovary; mostly contracted at the throat. Stamens six, adnate to the short fleshy stigma, which has as many lobes or angles as there are carpels. Twining shrubs, or upright perennial herbs..... ARISTOLOCHIA.

Asarum Canadense, L. — *Wild Ginger.* — Soft-pubescent: leaves kidney-shaped, more or less pointed: calyx bell-shaped, with the upper separate portion of the acute sepals widely and abruptly spreading: brown-purple inside; stamens awn-tipped. Hill sides in rich woods: not rare. Toronto, Hamilton.

ARISTOLOCHIA SERPENTARIA may be found in Canada.

A. SIPHO is cultivated as an ornamental climber.

The order SANTALACEÆ, named from Santalum, the genus which supplies the fragrant sandal-wood of the East, has with us but one genus, Comandra Nutt.

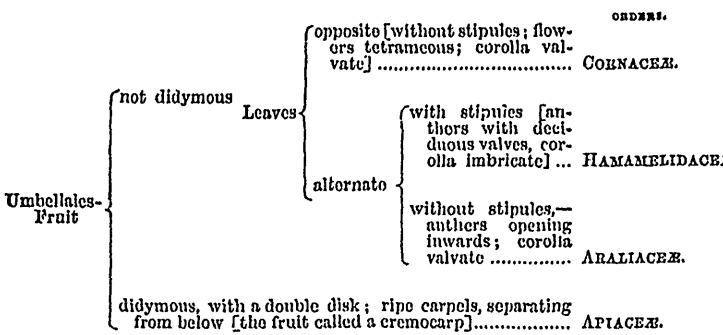
Calyx bell-shaped, becoming urn-shaped; lined above the ovary with an adherent disk, which has a five-lobed free border. Stamens on the edge of the disk between its lobes, opposite the sepals, to the middle of which the anthers are connected by a tuft of threads. Fruit drupe-like or nut-like, the tips of the persistent sepals forming a crown, the cavity filled by the globular seed. Low and smooth perennials, with herbaceous stems from a somewhat woody base or root, alternate sessile leaves, and greenish-white flowers in small umbel-like clusters.

C. Umbellata Nutt.—Peduncles several, and corymbose-clustered at the summit of the stem: several flowered: tube of the coherent calyx extending beyond the ovary, forming a neck to the fruit: free extremities of the sepals oblong: style slender: fruit dry: root forming parasitic attachments to the roots of trees. Stems 8′—10′ high, very leafy: leaves obovate oblong, 1′ long. Common. Toronto, &c.

C. livida, Richards.—Peduncles axillary, 3–5 flowered, shorter than the oval flaccid leaves: calyx-tube not extending beyond the

ovary: free extremities of the sepals ovate: style short: fruit pulpy, when ripe red. Leaves larger than in the last. Shore of Lake Superior and Northward.

Alliance UMBELLALES, known among the Epigynose, Dichlamydeous, Dialypetalous, Exogens, by the solitary large seed in each of two or more carpels. A very natural group, and contributing considerably to our flora. The following table will distinguish our Orders, including all which belong to the alliance excepting Bruniaceæ, which are all natives of Southern Africa and Madagascar:—



Hamamelidaceæ.—A small order, consisting of shrubs or low trees, chiefly found in Asia or South Africa; but of which one species is widely diffused in North America; another of a different genus occurring in the Southern U. S.

Hamamelis, L.

Flowers in axillary clusters or heads, usually surrounded by a scale-like three-leaved involucre. Cal. of four sepals, with two or three bractes at its base. Petals four, strap-shaped, long and narrow, spirally involute in the bud. Stamens eight, four alternating with the petals, anther-bearing; the others imperfect, scale-like. Carpels two, with short styles. Pod opening from above loculicidally; bursting elastically into two pieces. Shrubs with straight-veined leaves, and yellow perfect or polygamous flowers.

H. Virginica, L.—*The Witch Hazel.*—Leaves obovate or oval, wavy-toothed, somewhat downy when young. Shrub, blossoming late in autumn, when the leaves are falling, and maturing its seeds the next summer. Common in Canada, Toronto, &c.

Cornaceæ.—A small order, consisting of trees and shrubs, with a few herbs, known by their generally opposite, exstipulate leaves,

tetramerous flowers with valvate æstivation, and fruit of two or more coherent single-seeded carpels, with the calyx adherent. Referring Nyssa (which, however, is not a Canadian genus) to Alangiaceæ among the Myrtales, Cornus is our only genus, of which we have seven species out of 20 which are known.

§ 1.—Flowers greenish, collected in a head or close cluster, which is surrounded by a large showy 4-leaved corolla-like white involucre. Fruit bright red.

1. CANADENSIS, L.—*Dwarf Laurel: Bunch-berry.*—Stems low and simple (5′—7′ high), from a slender, creeping, and subterranean rather woody trunk. Leaves scarcely petioled; the lower scale-like, the upper crowded into an apparent whorl in sixes or fours, ovate or oval-pointed; involucral leaves ovate; fruit globular. Woods: common in Canada—Toronto, Montreal. June.

2. C. FLORIDA, L.—*Flowering Dogwood.*—Leaves ovate, pointed, somewhat acute at the base; involueval leaves inversely heart-shaped or notched (1½′ long); fruit oval; a tree 12°—30° high. Western Canada, rare; Hamilton. May and June.

§ 2.—Flowers white, in open and flat spreading cymes: involucre none: fruit spherical.

* *Leaves all opposite.*

3. C. CIRCINATA, L'Her.—Branches, greenish warty-dotted; leaves round-oval, abruptly pointed, woolly underneath (4′—5′ broad): cymes flat: fruit light blue. Shrub 6°—10° high. Copses: not uncommon—Toronto, Hamilton, Montreal. June.

4. C. SERICEA, L.—Branches purplish: the branchlets, stalks, and under surface of the narrowly ovate or elliptical pointed leaves, silky-downy (often rusty), pale and dull: cymes flat, close: calyx-teeth lanceolate: fruit pale blue: flowers yellowish-white. Wet places, common—Toronto, Montreal. June.

5. C. STOLONIFERA, Michx.—*Red Osier.*—Branches, especially the osier-like annual shoots, bright red-purple, smooth: leaves ovate, rounded at the base, abruptly short-pointed, roughish, with a minute close pubescence on both sides, whitish underneath: cymes small and flat, rather few-flowered, nearly smooth: fruit white or lead-colour.

Increasing by prostrate or subterranean suckers, so as to form large dense clumps 3°—6° high. Wet places and by streams, common—Toronto, Hamilton, Montreal.

6. C. PANICULATA, L'Her.—Branches gray, smooth: leaves ovate-lanceolate, taper-pointed, acute at the base, whitish but not downy beneath: cymes convex, loose, often panicled: fruit white, depressed, globose: 4°—8° high, much branched, bearing a profusion of pure white blossoms. Thickets—Toronto, Hamilton.

** *Leaves mostly alternate, crowded at the end of the branches.*

7. C. ALTERNIFOLIA.—Branches greenish, streaked with white alternate leaves, ovate or oval, long-pointed, acute at the base, whitish, and minutely pubescent underneath: fruit deep blue. Shrub or tree 8°—20° high, generally throwing its branches to one side in a flattish top, and with broad very open cymes. Copses, not uncommon—Toronto, Hamilton, Montreal.

C. Florida deserves culture for its beauty. The barks of *C. Florida, circinata*, and *sericea* are counted amongst the best tonics of North America.

Araliaceæ.—An order very closely allied to *Apiaceæ*, but the fruit, usually consisting of more than two carpels, even when reduced to two, is not a cremocarp, nor is there ever a double epigynous disk. The plants are generally stimulant and aromatic. Many of the species are woody. The number of species recorded is 160, contained in 21 genera, of which we have five species usually referred to two genera, though Dr. Gray reduces them to one. The reduced number of carpels in Panax, with the increased tendency to the suppression of one circle of the essential organs, seems to me to justify retaining the genus.

Carpels { Styles 2—3: flowers dioecciously polygamous [sepals completely adherent] ..... PANAX.
Styles 5: flowers perfect or monoecciously polygamous [apices of the sepals free, forming five short calyx-teeth] ..... ARALIA.

Panax, L.—*Wild Ginseng.*

1. P. QUINQUEFOLIUM, L.—*False Ginseng.*—Root spindle-shaped, often forked, 4'—9' long, aromatic: stem 1° high: leaflets long-stalked, mostly five, large and thin, obovate-oblong, pointed; styles

mostly two: fruit red. Rich mountain woods—July—Montreal, Dr. Holmes; Hamilton. Sent from the United States to China, as a substitute for the true Ginseng.

2. P. TRIFOLIUM, L.—*Dwarf Ginseng: Ground Nut.*—Root globular, deep in the ground, pungent, not aromatic: stem 4′—8′ high: leaflets 3—5, sessile at the summit of the leaf-stalk, narrowly oblong, obtuse: styles usually three: fruit yellowish. Woods—May and June—Toronto, Hamilton.

Aralia, L.—*Spikenard—Wild Sarsaparilla.*

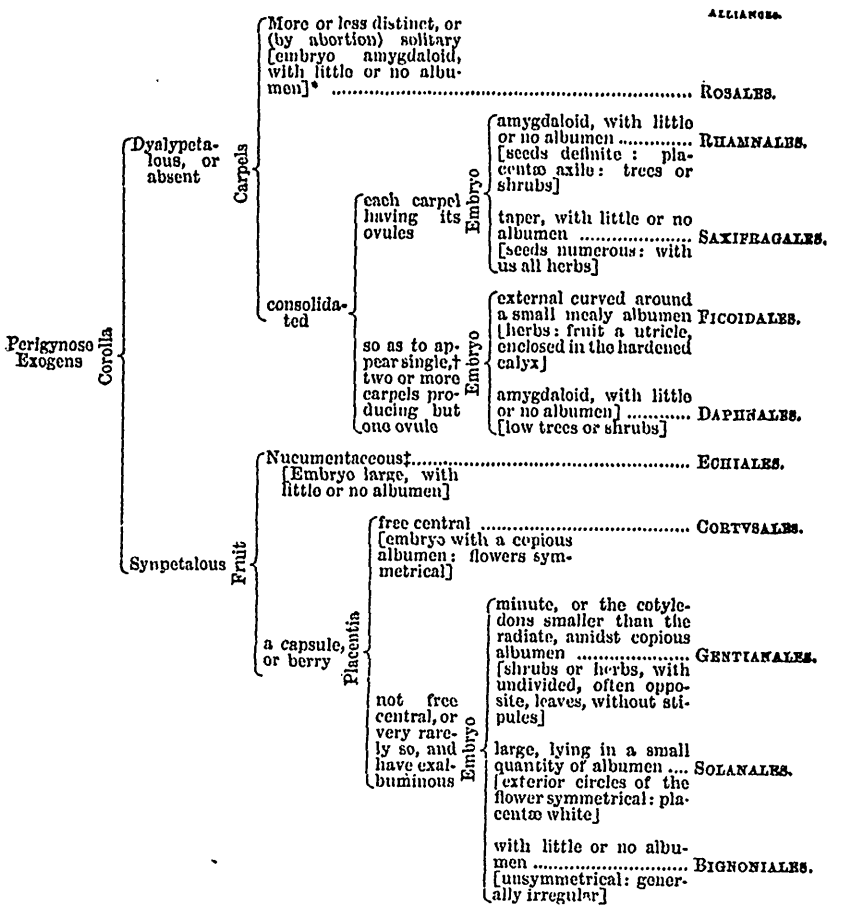
1. A. RACEMOSA, L.—*Spikenard.*—Herbaceous: stem widely-branched: leaflets heart-ovate pointed, doubly-serrate, slightly downy: umbels racemose-panicled: styles coherent below. Rich Woodlands—July—Toronto, Hamilton, Montreal.

1. A. NUDICAULIS, L.—*Wild Sarsaparilla.*—Stem scarcely rising above the ground, with a single long-stalked leaf and a shorter naked scape, with 2—7 umbels: leaflets oblong-ovate or oval, pointed serrate, five on each of the three divisions. The aromatic horizontal roots used as a substitute for sarsaparilla. Moist woods—May and June—Toronto, Hamilton, Montreal.

A. hispida, Michx.—*Bristly Sarsaparilla.*—Stem 1°—2° high, bristly, leafy, terminating in a peduncle bearing several umbels: leaves twice pinnate, leafllets oblong-ovate acute, cut-serrate. Rocky places—June—Three Rivers, Dr. Holmes.

Hedera helix (the Ivy) and *Adoxa Moschatellina* (the Muscadel) are the European representatives of this order. *Aralia spinosa* (the Angelica tree) grows as far north as Pennsylvania, and is cultivated.

I conclude this specimen by giving a tabular view of the alliances of *Perigynose Exogens,* and of the orders in one alliance, selected for its important relation to our flora:

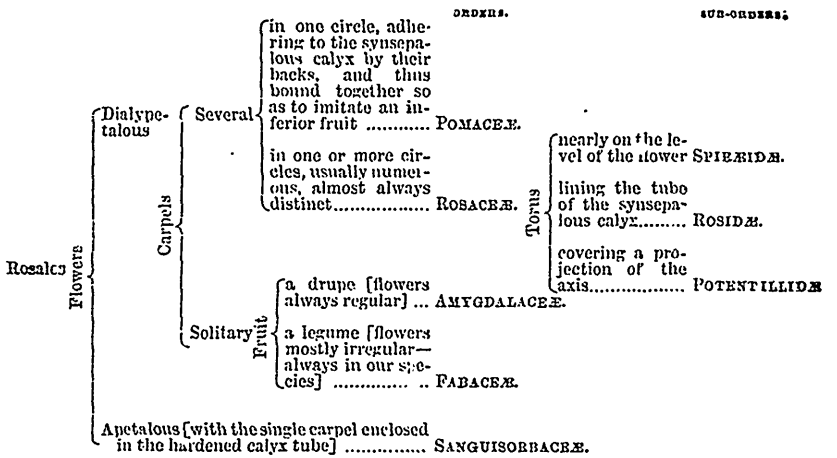


* The Rosal alliance, though a very natural one, is not easily defined, so as to remove the doubts of the inexperienced. Rosa itself, in which the torus bearing the numerous distinct carpels, lines the coherent lower portion of the calyx, producing from its border the petals

[*See over.*

† The character here employed does not apply to all Ficoidals, but belongs to the only order of the alliance of which there is an example in our Flora. The plants of this division are described as having a single carpel; but Dr. Lindley, though using the ordinary language, points out the probability that the fruit is formed by a union of carpels; and after examining many cases, I am so convinced of the correctness of this view that I do not hesitate to adopt it.

‡ The nucumentaceous fruit consists of one-seeded nuts, or of clusters of them, separate or separable In the orders Boraginaceæ and Lamiaceæ, the so-called four nuts evidently belong to two carpels, each having a single seed at each side, so that there are two united styles and two more or less distinguishable stigmas.



SELECTED ARTICLES AND TRANSLATIONS.

ON THE PRIMORDIAL FAUNA AND POINT LEVI FOSSILS.

BY JAMES HALL.

[In the January number of the *Journal* (page 40 of this volume) we inserted an interesting communication, on "The Fauna of the Quebec group of Rocks, and the Primordial Zone of Canada," addressed by the Director of our Geological Survey, SIR WILLIAM LOGAN, to M. BARRANDE. We now give some additional remarks on this subject (extracted from the last number of the *American Journal of Science and Arts*), by Professor Hall.* The age of these strata, it will be seen, is still considered by Professor Hall to be an unsettled point. His analysis

and stamens; and still more Pomaceæ, in which the calyx adheres on the backs of the single circle of carpels, and binds them together, the petals and stamens being in the same position as in Rosa, might appear to be Epigynose. Sanguisorbaceæ, with the solitary carpel enclosed in the hardened synsepalous calyx, greatly resemble such Ficoidals as Sclerauthus. Many Fabaceæ would be easily taken to be Hypogynous. Yet with a knowledge of the sources of difficulty, and with the clear definition of the Orders, the careful student will soon obtain satisfaction.

* "Letter from James Hall, Palæontologist of New York, to the Editors of the *American Journal of Science and Arts*." Dated January 23rd, and published in the March number of that Journal.

of the Quebec fossils certainly presents some curious and apparently antagonistic results, as regards the assumed primordial character of the rocks in question. If, however, the fossiliferous beds of the Quebec series be not strictly "primordial," we can scarcely look upon them otherwise than as representing the base of Barrande's second zone—the original view, we believe, of Mr. Billings: or rather perhaps, as constituting beds of passage between the first and second zones, and thus linking together the Primordial and Lower Silurian formations (specially so-called)—a fact of much interest. The dark shales which underlie the Quebec group, represent probably, as surmised by Sir William Logan, the true primordial series. But if these Quebec or Point Levi strata appear thus to be somewhat higher than the actual primordial zone, their fossil contents must compel us, at the same time, to regard them as occupying a lower horizon than that of the Hudson River deposits; although it will probably be found, in the sequel, that throughout the whole of our lower fossiliferous rocks, from the earliest fossil-containing bed to the top at least of the Lower Silurian series, no strongly-marked lines of demarcation can be drawn. Professor Hall objects to the Vermont trilobites being received as evidence of the age or position of the rocks in which they occur, on the plea that these trilobites are not true *Oleni*, but belong to other genera. If this be allowed, the type is nevertheless strongly Olenian, so to say, and, as such, evidently indicative of a low geological horizon. It might be urged against this, it is true, that the genus *Triarthrus*, of the Utica Slate, belongs also to the same type; but the affinities of this latter lie, as it were, between *Olenus* and *Calymene*, an ascending type: whilst the Vermont forms hold an intermediate position between *Olenus* and *Paradoxides*. There is thus, between the two, an essential difference.—E. J. C.]

In the Twelfth Annual Report of the Regents of the University upon the State Cabinet of Natural History, I published descriptions of three species of Trilobites from the shales of the town of Georgia in Vermont, referring them to the age of the Hudson River group. These trilobites had been in my possession for some two years or more; and knowing the great interest that would attach to them, whenever published, I had waited, hoping that some new facts might be brought out touching the stratigraphical relations of these rocks in the town of Georgia.

After the descriptions had been printed and a few copies distributed, I learned that Sir William Logan was at that time actually investigating the rocks of that part of Vermont. Desiring to know the results of his latest researches in regard to the stratigraphical relations of these rocks, I withheld the final publication till the Meeting of the American Association for the Advancement of Science, in Springfield, and there showed to Sir William my descriptions as they now stand in the

Report, and I then received his authority for the addition of the note which was appended.

This in a few words is a simple history of the matter relating to the publication of these species. I made no remarks or comparisons with the primordial fauna of Barrande in Bohemia, knowing that these features would be at once recognized by every palæontologist; while their reference to the genus Olenus showed my appreciation of the nature of the fossils.

I received a copy of the communication of M. Barrande, from Sir William Logan in September, a few days before setting out for my field duties in Wisconsin. Since my return to Albany, constant and pressing occupation has left me no time to consider a reply to a question of so much importance.

Later discoveries in the limestones associated with the shales at Quebec leave no longer a doubt, if any could have been entertained before, that the shales of Georgia, Vermont, are in the same relative position; and we must regard these three trilobites as belonging to the same fauna with the species enumerated by Sir William Logan as occurring in the Quebec group. Left to palæontological evidence alone, there could never have been a question of the relations of these trilobites, which would at once have been referred to the primordial types of Barrande.

Sir William Logan yields to the palæontological evidence, and says, "*there must be a break.*" He gives up the evidence of structural sequence which he had before investigated and considered conclusive; and having heretofore relied upon the opinion of the distinguished Geologist of Canada in regard to a region of country to which my own examinations had not extended, I have nothing left me but to go back to the position sustained by palæontological evidence. Let us for a moment examine this palæontological evidence.

The identifications of the fossils of the Quebec group, certainly show a remarkable agreement between the trilobites of this group and those of the Potsdam sandstone, in the occurrence of *six species* of *Dikellocephalus* and one of *Menocephalus;* while the occurrence of many others is in agreement or not incompatible with the fauna of the Potsdam and Calciferous sandstones. The comparative values of the Trilobitic faunæ of this group and of the primordial zone of Europe, as established by Barrande, is better shown in a tabular form which I here append.

The Crustacean fauna of the primordial zone of Europe.

Paradoxides, -	These genera are all limited to the *faune primordiale*, and none of the other European genera of trilobites are known in this fauna.
Olenus, - -	
Peltura, - -	
Conocephalus, -	
Ellipsocephalus,*	
Hydrocephalus, -	
Sao, - - -	
Arionellus, - -	
Agnostus, - -	Of the first and second fauna.
Amphion - -	Placed with doubt in the first fauna, and is well developed in the second fauna.

The Crustacean fauna of the Quebec Group.

Conocephalus, -	Genera of the *primordial zone.*
Arionellus, - -	
Agnostus, - -	A genus passing from the first to the second fauna.
Dikellocephalus, -	Genera of the Potsdam period.
Menocephalus, -	
Bathyurus, - -	Quebec Group.
Asaphus, - -	Of the second fauna.
Illænus, - -	Of the second and third fauna.
Amphion,	Of the second fauna; and doubtfully of the first fauna in Sweden.
Ceraurus = Cheirurus,	Of the second and third Silurian faunæ, and of the Devonian fauna.

We have therefore in the Quebec Group, two established genera of the primordial zone; one, Agnostus, which passes from the primordial to the second fauna: one, Amphion, cited as doubtful in the first fauna in Sweden, and known to be in the second; and three,—Asaphus, Illænus, and Cheirurus, which begin their existence in the second fauna. Of these, Asaphus begins and ends in the second; Illænus begins with the second and continues to the third; while Ceraurus (= Cheirurus) begins in the second, extends through the third Silurian, and appears in the Devonian fauna.

Bathyurus is a new genus, and as yet has no stratigraphical value in comparisons. Those which I described as Olenus have proved to be not true Oleni; and though much resembling that genus, are nevertheless distinct; and I have proposed the names *Barrandia* and *Bathynotus* for the two forms.† These have yet no stratigrahpical

* Not Elliptocephalus of Emmons.

† Thirteenth Annual Report of the Regents of the University of N. Y., on the State Cabinet of Natural History, Albany, December, 1860.

value, except so far as their relations to established genera may aid in that direction.

The genera *Dikellocephalus* and *Menocephalus* are of the Potsdam group; and so far, the Quebec group is in parallelism with the Potsdam and Calciferous strata.

Of the other genera, we know Asaphus, Illænus, and Ceraurus (= Cheirurus) in the Trenton limestone and Hudson River groups; Illænus and Ceraurus, Niagara age, or the third fauna of Barrande; while Ceraurus occurs also in the Devonian of Europe. Amphion is known in the second fauna in Europe, and doubtfully in the first.

Ceraurus does not occur in this country, so far as I know, above the Niagara group; though known in the Devonian rocks of Europe.

The following tabular arrangement of the genera found in the Quebec group will serve to express more distinctly the relations of the Crustacean fauna of these rocks.

The letters at the head of the columns have the same reference as those used in the communicalion of Sir William Logan.

	A	A^1	A^2	A^3	A^4	B^1	B^2	B^3
Arionellus,	....	—	4	....	....	....	....	....
Conocephalus,	....	—	1	....	....	....	....	....
Agnostus,	....	—	3	1	....	....	....	....
Dikellocephalus,	....	—	6	....	....	....	....	....
Menocephalus,	—	1	—	—	—	....	....	....
Bathyurus,	....	—	4	4	1	....	....	1
Barrandia, } *Shales of*	....	....	....	....	....	....	....	....
Bathynotus, } *Georgia, Vermont.*	....	....	....	....	....	....	....	....
Amphion,	....	....	....	2	....	....	....	....
Asaphus,	....	1	....	....	1	....	....	1
Illænus,	....	....	....	....	....	....	....	2
Cheirurus (Ceraurus),	....	....	....	2	....	....	....	....
Leperditia,	....	....	....	....	....	....	1	....
Lingula,	2	—	2	....	....	....	....	....
Discina,	....	—	1	....	....	....	....	....
Orthis,	1	—	1	2	1	11	1	3
Leptæna,	....	—	1	1	....	1	....	....
Strophodonta,	....	—	....	1	....	....	....	....
Camerella,	....	....	1	1	1	....	1	....
Cyrtodonta?	....	....	....	1	....	....	....	....
Maclurea,	....	....	....	....	....	....	....	1
Murchisonia,	....	....	....	3	....	....	....	1
Pleurotomaria,	....	....	....	7	....	....	....	2
Helicotoma,	....	....	....	2	....	....	....	1
Straparollus,	....	....	....	2	....	....	....	....
Capulus,	....	....	....	2	....	....	....	....
Ophileta,	....	....	....	....	....	....	....	1
Nautilus,	....	....	....	....	....	....	....	1
Orthoceras,	....	....	....	....	....	....	....	3or4

	A	A^1	A^2	A^3	A^4	B^1	B^2	B^3
Cyrtoceras,	....	....	....	....	....	....	....	1
Crinoidal columns,	....	....	....	....	....	....	....	....
Tetradium,	1	....	....	....	....	....	....	....
Dictyonema,	3	....	....	1	....	....	....	....
Graptolithus,	25	....	....	....	....	....	....	....
Retiolites,	1	....	....	....	....	....	....	....
Reteograptus	2	....	....	....	....	....	....	....
Phyllograptus,	5	....	....	....	....	....	....	....
Dendrograptus,	3	....	....	....	....	....	....	....
Thamnograptus,	3 [?]	....	....	....	....	....	....	....

In this table we find, of previously recognized trilobites of the primordial fauna, two genera and five species; of previously known genera of the second and third faunæ, *four genera* and eight species; *two genera* before known in the Potsdam sandstone and seven species, and of Agnostus, which is of the first and second faunæ, two species; and one new genus with nine species.

These are certainly very curious results; and a modification of our views is still required to allow four genera and eight species, (or leaving out Amphion) three genera and six species of the Trilobites of the second fauna to be associated with two genera and five species of Trilobites of the primordial fauna, and yet regard the rocks as of primordial origin.

The Brachiopodous genera, Lingula, Discina, Orthis, Leptæna, and Strophomena, have a great vertical range, and are known in the Lower and Upper Silurian, and most of them in the Devonian; while Camerella so far as known is a Lower Silurian form of the second fauna, (perhaps also in a lower position).

Of the Gasteropoda, Maclurea and Ophileta are restricted to Lower Silurian rocks, but occur mainly in the second fauna. The other genera occur likewise in the second fauna and in the Upper Silurian rocks, as well as some of them in Devonian. The same is true of the Cephalopoda enumerated.

Tetradium is known in the second fauna of the lower Silurian rocks, and in the upper part of the Hudson River group at the west. Dictyonema is a genus known from Lower Silurian to Devonian strata.

Graptolithus proper extends to the Clinton group of New York; and the same is true of Reteograptus. Thamnograptus occurs in the rocks of the Hudson River group near Albany, and in the Quebec rocks. Phyllograptus and Retiolites are known in the Quebec rocks

only; while the typical form of Dendrograptus occurs in the Potsdam sandstone, and, likewise, in three other species, in the Quebec rocks.

We find, therefore, in the other genera except trilobites, very little satisfactory evidence on which to rely in the present state of our knowledge, for determining the position of these strata.

In the present discussion, it appears to me necessary to go further, and to inquire in what manner we have obtained our present ideas of a primordial, or of any successive faunæ. I hold that in the study of the fossils themselves there were no means of such determination prior to the knowledge of the stratigraphical relations of the rocks in which the remains are inclosed. There can be no scientific or systematic palæontology without a stratigraphical basis. Wisely then, and independently of theories, or of observations and conclusions elsewhere, geologists in this country had gone on with their investigations of structural geology. The grand system of the Professors W. B. and H. D. Rogers has been wrought out not only for Pennsylvania and Virginia, but for the whole Appalachian chain; and the results were shown in numerous carefully worked sections. In 1843, '44 and '45, I had myself several times crossed from the Hudson River to the Green Mountains, and I found little of importance to conflict with the views expressed by the Professors Rogers in regard to the chain farther south, except in reference to the sandstone of Burlington, and one or two other points, which I then regarded as of minor importance.

Sir William Logan had been working in the investigations of the geology of Canada; and better work in physical geology has never been done in any country.

This then was the condition of American geology, and investigators concurred, with little exception, in the sequence based on physical investigations. As I have before said, our earliest determinations of the successive faunæ depend upon the previous stratigraphical determinations. This, I think, is acknowledged by Mr. Barrande himself, when he presents to us, as a preliminary work, a section across the centre of Bohemia. With all willingness to accept Mr Barrande's determination, fortified and sustained as it is by the exhibition of his magnificent work upon the trilobites of these strata, we had not yet the means of parallelizing our own formations with those of Bohemia by the fauna there known. The nearest approach to the type of primordial trilobites was found in those of the Potsdam sandstone of the north-west, described by D. D. Owen; but none of these had

been generically identified with Bohemian forms ;* and the prevailing opinion, sanctioned, as I have understood by Mr. Barrande, was that the primordial fauna had not been discovered in this country, until the re-discovery of the Paradoxides Harlani, at Braintree, Mass. The fragmentary fossils published in vol. I., Palæontology of New York, and similar forms of the so-called Taconic System, were justly regarded as insufficient to warrant any conclusions. It then became a question for palæontologists to decide, whether determinations founded on a physical section in a disturbed and difficult region of comparatively small extent, were to be regarded as paramount to determinations founded on a distance in the line of strike of five or six hundred miles ; and those of Sir William Logan over nearly as great an extent from Vermont to Gaspé.

It is not possible for me, at this moment, to give the time necessary for a full discussion of this most important subject. In presenting these few facts in this form, I am far from doing it in the spirit of cavilling, or as an expression of distrust in any direction. It is plain that the case is not met in Mr. Barrande's plan of successive Trilobitic faunæ ; and the facts yet brought out do not serve to clear up the difficulty. It is evident that there is an important and perplexing question to be determined,—one that demands all the wisdom and sagacity of the most earnest inquirers, and one which calls for the application of all our knowledge in stratigraphical geology and in palæontology ;—one in which coöperation, good will and forbearance are required from every one, to harmonize the conflicting facts as they are now presented. The occurrence of so many types of the second fauna in the rocks at Point Levi, associated with a smaller number of established primordial types, offers us the alternative of regarding these strata as of the second stage, with the reappearance of primordial types in that era, or of bringing into the primordial zone several genera heretofore regarded as beginning their existence in the second stage : in either case, so far as now appears, conflicting with the scheme of Mr. Barrande in reference to the successive faunæ of Trilobites as established in Bohemia and in the rest of Europe.

For myself I can say, that no previously expressed opinion nor any "*artificial combinations of stratigraphy previously adopted*" by me, shall prevent me from meeting the question fairly and frankly. I

* The glabellæ of small trilobites undistinguishable from Conocephalus occur in the Potsdam sandstone near Trempaleau, Wisconsin, on the Mississippi river.

have not sought a controversy on this point, but it is quite time that we should all agree that there is something of high interest and importance to be determined in regard to the limitation of the successive faunæ of our older palæozoic rocks.

Albany, N. Y., January 23, 1861.

ON THE PURIFICATION OF THE JUICE OF THE BEET-ROOT, IN THE MANUFACTURE OF BEET-ROOT SUGAR.

BY M. EMILE ROUSSEAU.

Translated, with slight condensation, from the Comptes Rendus, of January 14th, 1861.

Two substances, which oppose themselves more especially to the extraction of the saccharine matter of the beet-root, are always found in the juices of that vegetable. The first of these belongs to the class of albuminous and caseous matters, and undergoes all the modifications produced by reagents on solutions of albumen and caseine. Both lime salts and lime itself effect coagulation, but, with the latter, the saccharine juices remain alkaline after being treated with carbonic acid. This arises from the solution of a portion of the vegetable matter by the lime, and its retention in chemical combination, as shewn lately by M. FREMY; or by the liberation, by means of that reagent, of the potash or soda contained naturally in these juices. The two effects are indeed produced simultaneously, giving rise to an altered condition which is felt more particularly in the final stages of the manufacture.

The other substance, alluded to above, is an uncoloured product, at least whilst contained in the vegetable cell, but, from its avidity for oxygen, it becomes rapidly coloured by exposure to the air, and is otherwise modified by the action of oxidizing agents, so as to become entirely transformed into the well-known brown matter which originates during the evaporation of vegetable juices. In a recent memoir by M. CHATIN, the existence of this substance is confirmed in other ways. When deprived, for example, of all albuminous matter, it reduces

salts of silver, binoxide of mercury, &c. With the latter compound the solution even assumes the natural tint that takes place in sugar after long exposure to the air.

These facts established, it becomes evident that, in order to simplify the production of beet-root sugar, the following reagents must be sought for.

First, a substance of slight solubility, capable of coagulating all albuminous matters; free from deleterious action on the sugar; innocuous in itself; easily withdrawn from the syrup, in case a small quantity should remain in solution; and finally, of low price.

Secondly, an additional substance possessing a certain oxidizable power, capable of either destroying at once the coloring matter, or of transforming this into the brown compound, and afterwards absorbing it; and possessing also the innocuous qualities, absorbing action, and low price of the preceding substance, together with the capability of being indefinitely reproduced.

Sulphate of lime, either in the natural state or in that of Plaster of Paris, fulfils the first conditions more perfectly than any other substance that I have experimented with. It is neutral (a condition that I regard as essential)—is without action on the sugar, very slightly soluble, innocuous, cheap, and possessed of remarkable coagulating powers with regard to the albuminous matters of vegetable juices generally, and of those of beet-root in particular. A very small quantity, indeed, is sufficient to produce this effect. The process of purification can thus be carried on to great advantage: the scum is thick and easily collected, and the juice is readily drawn off in a proper state of limpidity.

This reagent, however, which completely removes all coagulable substances, does not touch the colouring matter. The juice consequently, after the separation of the scum, quickly assumes a dark tint. Animal-black is almost without action upon this; it only removes the oxidized matters, so that the partially-decolorized juice soon regains its former hue. An oxidizing body is therefore required, in order to effect at once that which the air produces only after long exposure.

Amongst the numerous bodies which I have examined under this point of view, and which I need not enumerate here, the hydrated sesqui-oxide of iron affords the best results. If, for example, after

the removal of all the coagulable matters by the use of sulphate of lime, the saccharine juice be agitated in the cold, or at a temperature under ebullition, with hydrated sesqui-oxide of iron, the liquor passes through the filter entirely decolorized, and purified moreover from almost all traces of foreign substances. In addition to this, the reagent in question, by its well-known property of absorbing alkaline and and earthy salts, removes any small amount of sulphate of lime that may remain in solution. In this manner, the juice, which after the first purification by sulphate of lime, reduces nitrate of silver, bin-oxide of mercury, &c., becomes without action on these bodies after its treatment with the peroxide of iron.

Under normal conditions the juice thus purified, is perfectly neutral to test-papers; and it may be kept in contact with the air for several days without exhibiting the slightest change or coloration. This is conclusive as to the fact that all matters capable of acting as a ferment, have been removed. It boils easily, and remains uncolored under the action of heat. When brought to the proper consistency, the syrup possesses only the pale yellowish tint of all pure syrups. Its taste is pleasant, and altogether free from that disagreeable saline flavour that is found in ordinary beet-root syrups; and in addition to this, it preserves a remarkable clearness and fluidity. It also crystallizes readily, yielding colorless crystals. Finally, as a conclusive test of the degree of purification obtained by this process, the prepared syrup, brought down to 30° of the areometer by the addition of a proper quantity of water, may be mixed with a large excess of alcohol at 90° without exhibiting any turbidness or yielding the slightest deposit, even after the lapse of several days. Besides which, it does not retain the least trace of iron.

The fabrication of beet-root sugar becomes reduced, consequently, to the following simple processes. The saccharine juice is first to be warmed in a caldron or other convenient vessel with a small quantity (a few thousandths) of sulphate of lime. Common or native gypsum answers best for this purpose. The coagulated matters then collect into a thick scum. Secondly, the clear juice, thus partly purified, is to be agitated with some peroxide of iron. Thirdly, after the separation of th 'atter, the juice has only to be subjected to the necessary evaporation. The sulphate of lime and the peroxide of iron remove all foreign matters from the sugar, and yield it nothing in return.

The requisite amount of these substances is best learned by experience. The oxide of iron is most conveniently employed in the form of a paste containing from 70 to 80 *per cent.* of water. In no case will more than eight or ten parts of this be required to each one hundred parts of the juice.*

E. J. C.

SCIENTIFIC AND LITERARY NOTES.

GEOLOGY AND MINERALOGY.

NOTES ON THE GEOLOGY OF THE TOWNSHIPS OF WINDHAM AND MIDDLETON, COUNTY OF NORFOLK, C. W.—BY J. DE CEW, PROVINCIAL LAND SURVEYOR.

To the Editor of the Canadian Journal.

SIR,—In a recent tour made through the county of Norfolk for the purpose of collecting fossils and studying the geology of the district, I was much interested with the deposits of the townships of Windham and Middleton; and believing that a communication briefly setting forth the peculiarities of that region might be perused with interest by some of the readers of your valuable *Journal*, I am induced to offer the following remarks:—

The stratified rocks of these townships belong to the Oriskany sand and Corniferous limestone formations. Of the Oriskany sandstone there is but one exposure, occurring in the north-east angle of the township of Windham. This exposure, on account of its hardness, forms a regular escarpment about five feet in thickness, dipping slightly to the south-west, with a strike north-west and south-east, and is traceable throughout a distance of about three-fourths of a mile. This formation is regarded by the Canadian and New York Geologists as the base of the Devonian System, and its composition is too well understood to require notice in this short essay. I might, however, remark, that this exposure is much harder, and contains a larger proportion of feldspar and fewer fossils, than any other I have yet examined.

The fossils met with comprise:—

Favosites Hemispherica..... Yandell and Shumard.
Zaphrentis prolifica .... Billings.
Orthis. (An imperfect example.)
Strophomena depressa. (Very abundant)..... Linn.
Strophomena ampla.
Pentamerus aratus.
Spirifer —.
Platyostoma ventricosa.

* It may not be out of place to observe that both sulphate of lime and hydrated sesquioxide of iron, (the latter in the form of bog iron ore and yellow ochre) occur abundantly in Western Canada. For special localities, see the present volume of this Journal, pages 151 and 161. Also vol. V., page 175.—*Translator.*

Of the Corniferous limestone I found but one regular outcrop, occurring immediately above the Oriskany sandstone formation, and forming unmistakeably, therefore, the base of the formation. This exposure is about the eighth of a mile in width, and extends north-west into the township of Burford, (where it immediately disappears), and south-east into the township of Townsend. The northern edge of this exposure, consisting of a few thin strata, is no doubt in its proper situation, while the remaining portions have been broken and dragged from their original position by the powerful agencies at work during the drift epoch. This rock consists of a light grey, flinty limestone, weathering almost white, and is far more abundant in corals than in shells. This, it may be observed, is the case with the base of the formation wherever met with, while higher up the shells predominate. The following are the fossils met with in this place:—

Favosites hemispherica..... Yandell and Shumard.
——— *turbinata* ..... Billings.
Michelinea convexa..... ..... D'Orbigny.
Heliophyllum Canadense..... Billings.
Syringopora tubiporoides ..... Yandell and Shumard.
Zaphrentis prolifica..... ..... Billings.
——— *gigantea* ..... Lesueur.
Eridophyllum Simcoense..... Billings.
Cystiphyllum grandis ..... Billings.
Strophomena ampla.
——— *depressa.*
Atrypa reticularis ..... Linn.
Platyostoma ventricosa.
Platyceras ———(?)

with fragments of *Orthoceras* (one species).

A second and far more extensive exposure occurs in the south-western portion of the same township, and extends south-westerly into the township of Middleton. It is about the fourth of a mile in width, and two miles long, and consists of a dark grey limestone abounding in organic remains. At this place I found no rock which appeared to be in its original position, but huge detached portions lay scattered in great abundance over the surface of the ground, intermixed with the granitic boulders and other detritus of the drift period. Many of these limestone boulders are exceedingly large, and are quarried from the ground for various building purposes. I examined one which contained thirty cords of stone, and was credibly informed that many such had been quarried out where there was no appearance of limestone near them. In some places these boulders cover the ground so thickly as to render it unfit for cultivation. In the township of Middleton, this ridge is cut by Big Creek at Croton Mills. The banks of the creek are at this place about ninety feet high, and exceedingly steep, the valley presenting the appearance of having been worn by the stream passing through it. The bed of the stream is composed of sand, pebbles, and boulders, similar to the surrounding country. At a short distance to the west of the creek the limestone ceases to appear, although the granitic boulders are as abundant as upon the east side.

From this exposure, the following fossils were obtained in the township of Windham:—

Zaphrentis prolifica ..... Billings.
Euomphalus (not named; a very beautiful species.)
Orthoceras (one species, not named.)

In the township of Middleton:—

Stenopora (resembles *S. petropolitana.*)
Fistulipora Canadensis ..... Billings.
Zaphrentis prolifica ..... Billings.
Heliophyllum Canadense ..... Billings.
Michelinea convexa ..... D'Orbigny.
Crinoids (two or three species.)
Orthis (apparently two species; imperfect specimens only were obtained.)
Strophomena (two species, not named.)
Athyris rostrata, or a closely allied species, ... Hall.
Atrypa reticularis (very abundant) ..... Linn.
Pentamerus aratus.
Spirifera accuminata (common) ..... Conrad.
——— *gregaria* ..... Clapp.
——— (not named.)
Lucina Eliptica ..... Hall.
——— (one species, not named, found in Windham.)
Conocardium trigonalis ..... Hall.
Platyceras (?)
Loxonema (two species, not named.)
Lituites (?) (one specimen.)
Phacops bufo.
Dalmannites (not named.)

The surface of the area between this exposure and the one in the north-east angle of Windham is covered with fine sand in which boulders rarely occur.

Cayuga, C. W. J. DECEW, P.L.S.

ERUPTIVE SERPENTINES OF TUSCANY.

The origin of Serpentine Rock is still a somewhat debateable point in Geology. Whilst most observers look upon this rock as partly of eruptive and partly of metamorphic origin, according to locality, others, and especially those of the more modern school, appear inclined to consider it in all cases as a metamorphic product. Careful records of its conditions of occurrence, therefore, in different regions, become of general interest and value. In this view, we have embodied in our Geological Notes, the following extract from an interesting memoir communicated by W. P. JERVIS, Esq., F.G.S., to the Geological Society of

London.* Although so different in geological age, the district described by Mr. Jervis appears to have many characters of a more or less general resemblance to those of our Eastern Townships. After describing the products, &c., of four distinct eruptions of Serpentine, Mr. Jervis proceeds as follows:—

"The topographical appearance of the serpentine-eruptions is very characteristic; there is an entire absence of those undulating chains or eminences, melting insensibly into one another, which enable us to classify hills into groups. These rocks form dykes, but more generally constitute whole hills of conical form, rising abruptly to a considerable height, and terminating in rugged, sharp summits. The older rocks have been much upturned and elevated, and are thrown off in every direction,—the serpentine, forming the nucleus of the mountains so abundant along the west coast of Tuscany, Modena, and Piedmont, generally reaching the surface somewhere near the centre, and forming (if I may be permitted the expression) a "periclinal" axis.

The older rocks, nearer the focus of action, are the most disturbed. No feature regarding this serpentine is more important than that of its being almost invariably accompanied by rich ores of copper at its junction with the metamorphosed schists or gabbro rosso. These two rocks, similar in name, are entirely distinct in most other respects: one is an aqueous, the other an igneous rock.

Many minerals are peculiar to the junction of the gabbro rosso and the Miocene serpentine; they are chiefly zeolites. The commonest is caporcianite, a white crystalline mineral, tinged with pink, in structure resembling analcime. These zeolites *all contain magnesia.* They are,—

	Magnesia per cent.		Magnesia per cent.
Savite, containing	13·50	Portite	4·87
Schneiderite	11·03	Sloanite	2·67
Picranalcime	10·25	Humboldtite	2·12
Picrothomsonite	6·27	Caporcianite.....	1·11

Miemite (dolomite) contains 42·5 per cent. of magnesia; "gabbro," from La Spezia, 24·4.

Calcareous spar also occurs in limpid and extremely obtuse rhombohedral crystals; it probably owes its origin to the metamorphosis of the limestones. I consider all these minerals to have been produced at the period of the intrusion of the Miocene serpentine, from whence they doubtless derived their magnesia. It is also interesting to find that large quantities of the limestone in the neighbourhood have been altered into dolomites,—the miemite, a delicate greenish rock of the same colour as aquamarine, being a double carbonate of lime and magnesia.

The copper from the serpentine is not associated with galena and blende as with us, but is accompanied by many asbestiform minerals.

The action of the serpentines on the limestones which they have traversed is very varied. Near Matarana I noticed the action on a mouse-coloured limestone, where peroxide of iron had imparted a brick-red tinge to various parts of the

* On certain Rocks of Miocene Age in Tuscany, including Serpentine, Copper Ores, Lignite, and pure Alabaster used in Sculpture. By W. P. Jervis, Esq., F.G.S. *Quarterly Journal of the Geological Society.* (Vol. XVI.) No. 64.

mass. Within a yard or two of the serpentine the rock had been apparently broken into fragments, which had been cemented by delicate veins of serpentine flowing into and filling up the cracks. This beautiful metamorphic rock, called "Ofiocalce," is, in fact, calcareous serpentine: it forms a rich combination of colours—deep red and dark green, with interlacing veins of pure-white calcareous spar. I would offer this explanation: total decomposition of the limestone was prevented by the pressure; the carbonic acid was partially expelled; the heat decomposed the carbonate of iron which was present in minute quantities, and completely peroxidized its protoxide of iron, which, being no longer isomorphous with the pure carbonate of lime, was rejected as the latter crystallized out in various parts. If I am not mistaken, this would prove that the crystallization of carbonate of lime in prisms (as arragonite) only takes place within *limited degrees of temperature, above and below which* the crystalline system is the *Hexagonal.*

The copper-mine of Monte Catini is found at the junction of the gabbro rosso and the Miocene serpentine; the ore is invariably in the latter. It is one of the finest to be seen anywhere, and [its working] dates at least from the Florentine Republic. Cosmo I. re-opened it in 1562; but it was not regularly worked, and, from want of experience, little was done until 1837. The indications appear to have been very favourable at the outset; but the successive proprietors failed to realize their desires, until the present company sunk to a depth of 400 feet, following the indications of ore or "vein" lying E. and W., dipping at an angle of 45° S.; they then found an immense mass of copper-ore, from which they extracted 330 tons; about 100 feet lower a second deposit has lately been reached, the breadth of which I should estimate at 60 feet. The various ores of copper are met with in rounded masses, enveloped in serpentine; these nodules constitute a species of conglomerate,—some of the masses being ore, others boulders of serpentine, dispersed through a matrix of steatitic clay. The nodules on being broken open are found to contain chalcopyrites, or bornite,* more rarely oxide of copper, grey copper, and native copper. In physical appearance the chalcopyrites differs entirely from that obtained from our mines: thus it is not lamellar or crystallized, but hard, compact and massive, and has precisely the same structure as bornite, into which it insensibly passes in the same nodules. This pyrites is not mixed up with gangue, but perfectly pure, which can be accounted for by the expulsion of impurities, favoured, as it must have been, by the nodular condition of the masses. The friction has produced a considerable quantity of fragmentary pyrites of the size of gravel, which is all washed and employed. I believe I am correct in asserting that iron-pyrites is nowhere found with the serpentine, even along with the ores of copper. One of the greatest advantages in working these mines is the softness of the steatitic rock. Other mines are established at Libbiano, Monte Castelli, &c.: they are newer, and have been hitherto less fortunate. Most probably, as Professor Pilla observed, the deposits whence the rich outlying indications proceeded will be met with further down.

Closely associated with the serpentine, chalcedony is found in large quantities

* Purple Copper Pyrites,=*Erubescite* of Dana, *Phillipsite* of Beudant and Dufrenoy.—E. J. C.

north of Monte Verdi; it occurs in regular veins, of considerable size. The mineral is found in blocks smooth at the surface and mammillated internally—often cavernous. I saw some remarkable masses, several feet long, in which small pieces had been cemented together by a fresh development of chalcedony, resulting in a compact siliceous conglomerate without any flaw. The pebbles were principally buff-coloured or green, the cement colourless. The neighbourhood affords specimens showing every gradation between opaque black flint, jasper, agate, chalcedony, and waxy opal."

MINERALOGICAL NOTICES.

American Meteorites:—Professor J. Lawrence Smith has communicated analyses of three new meteorites to the March number of the "American Journal of Science and Arts." 1. *Lincoln County Meteorite:* Ash grey, with white, yellowish, and dark patches, and shining pitch-like crust. Sp. gr. 3·20. Total weight, 8lbs. 14½oz. Seen to fall, August 5th, 1855. Consists chiefly of pyroxene, with disseminated olivine and orthoclase, and a half-per-cent of nickeliferous iron. 2. *Oldham County Meteorite:* Sp. gr. 7·89. Total weight, 112lbs. Date of fall unknown. Contains: Iron, 91·21; Nickel, 7·81; Cobalt, 0·25; Copper, a trace; Phosphorus, 0·05. 3. *Robertson County Meteorite:* Sp. gr. 7·85. Total weight, 37lbs. Time of fall unknown. Contains, (in addition to nodular granules of iron pyrites, sparingly scattered through its mass): Iron, 89·59; Nickel, 9·12; Cobalt, 0·35; Copper, a trace; Phosphorus, 0·04.

Rutile.—Wolfram.—Cerite: Professor H. Sainte-Claire Deville has detected small quantities of both vanadic and molybdic acid in the Rutile of Saint-Yrieix (Department of the Haute Vienne, France.) Also feeble traces of tantalic acid in the Wolfram of Saint-Leonard; and small amounts of titanic acid and tellurous acid (with traces of vanadium) in the Cerite of Bastnaes, Westmannland, Sweden. "*Sur la présence de quelques éléments ordinairements très-rare dans des substances plus communes.*" *Annales de Chimie et de Physique: Mars*, 1861.

Chrome Garnet:—Professor T. Sterry Hunt, of the Geological Survey of Canada, has kindly sent us the following notice: "A beautiful, emerald-green, transparent garnet is found in Orford, C. E. It occurs massive, granular, and crystallized in calcite, and is associated with Millerite, (sulphuret of nickel.) The finest crystals, which are not, however, above a line in diameter, occur in druses in the massive variety. They are dodecahedrons, sometimes offering replacements on their edges. This garnet resembles the Uwarowite of the Ural Mountains, but differs somewhat in composition, being a lime-alumina garnet containing about six per cent. of oxide of chromium."

Calcite and Arragonite:—Professor Gustav Rose has published in *Poggendorff's Annalen* a series of interesting experiments on the formation of calcite and arragonite, in continuation of his previous researches on that subject. These experiments fully confirm the assertions of Bishof, that arragonite is capable of forming at a low temperature, especially in dilute solutions; and they serve thus, to explain the occurrence of that form of carbonate of lime in the gypsum deposits of certain localities, as well as in the substance of fossil shells, etc.

Professor Rose's investigations shew, also, that although arragonite generally results from crystallization at high temperatures, yet, in concentrated solutions, crystals of calcite, at these temperatures, are equally capable of formation. This fact, as observed by the author, is not without important bearings on some of the natural conditions of occurrence of calc spar. *Ueber die Umstände unter denen der Kohlensaure Kalk sich in seinen heteromorphen Zuständen als Kalkspath Arragonit, und Kreide abscheidet.—Pogg. Ann. Januar*, 1861. E. J. C.

PUBLICATIONS RECEIVED.

Descriptions of New Species of Crinoidea, from Investigations of the Iowa Geological Survey. By James Hall. Albany: February 25, 1861.—The publication of the concluding portions of the Reports of the Geology and Palæontology of Iowa being for a time suspended, Professor Hall has issued these descriptions in order to claim priority for various new species that may probably appear under other names in the forthcoming Report on the Geology of the neighbouring State of Illinois. In addition to numerous crinoids belonging to the genera Actinocrinus, Platycrinus, &c., two new star-fishes are described.

Observations upon the Geology and Palæontology of Burlington, Iowa, and its Vicinity. By Charles A. White.—This is an interesting article reprinted from the *Boston Journal of Natural History*. The rocks described, range from the Chemung beds (Devonian) to the Burlington Limestone of the Carboniferous group; and in addition to classified lists of fossils, notices of seven new species of Devonian Brachiopoda are given.

On certain Theories of the formation of Mountains. By E. Billings, F.G.S.

Notes on the Geology of Murray Bay, Lower St. Lawrence. By J. W. Dawson, LL.D., F.G.S.—The above are valuable reprints from the *Canadian Naturalist and Geologist*. This journal, so ably conducted in itself, and so faithful an expositor of the natural history of the Province, fully deserves the strongest encouragement and support.

On the Amounts of Lead contained in Silver Coins. By C. W. Eliot, and Frank H. Storer.—In this pamphlet, reprinted from the Proceedings of the American Academy of Arts and Sciences, the authors give the results of their examination of various silver coins from American, Spanish, English, and other mints. Small amounts of lead were found in nearly all: the highest (=·3846 per cent.) in some English shillings of 1816. A five-franc piece of Napoleon III. yielded also a comparatively high amount (= ·3546 per cent). In connexion with this subject, the authors discuss the causes of the impurity in question, more especially as regards the United States coinage, and offer various practical remarks of much interest.

Ninth Supplement to Dana's Mineralogy. By Geo. J. Brush, Professor of Mineralogy in Yale College.—In the regretted indisposition of Professor Dana, the preparation of the half-yearly supplement to that author's System of Mineralogy has been again undertaken by Professor Brush. The present supplement contains a list of the principal publications issued since the date of the last or

eighth Report of this series, together with carefully-prepared and judicious analyses of the various memoirs published during this interval in home and foreign journals. We quite agree with Professor Brush in his non-reception, as true species, of the Uranophane of Websky, the Pinitoid of Knop, and other similar products of decomposition. Names thus given, should not be permitted even to obtain an entrance into our already over-burdened list of synonymes.

E. J. C.

CANADIAN INSTITUTE.

SESSION—1860–61.

SIXTH ORDINARY MEETING—*2nd February*, 1861.

Professor DANIEL WILSON, LL.D., President, in the Chair.

I. *The following Gentlemen were elected Members.*

DOCTOR CHARLES JONES, Toronto.
W. SAUNDERS, Esq., London, C. W.
G. ARTHURS, Esq., Toronto.

II. *The following Donations for the Library were announced, and the thanks of the Institute voted to the donor:*

From W. Hay, Esq., Architect, Toronto.
"British Columbia, &c.," by W. C. Hazlett. One Vol.
"Tales, Sketches and Lyrics," by the Rev. R. J. Macgeorge. One Vol.

III. *The following Papers were read:*

1. By C. Robb, Esq., Civil Engineer:
"On the Petroleum Springs of Canada West."
2. By Prof. T. Sterry Hunt, F.R.S. (Read by Prof. Croft, D.C.L.)
"On the Theory of Types in Chemistry."

SEVENTH ORDINARY MEETING—*9th February*, 1861.

Professor DANIEL WILSON, LL.D., President, in the Chair.

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

ALEXANDER LUMLEY, Esq., Toronto.

II. *The following Papers were then read:*

1. By the Rev. Prof. Hatch, M.A.
"On the Gutturals of the Latin Alphabet and their Indo-European Affinities.
2. By Prof. D. Wilson, LL.D.
"Familiar Notes and Illustrations of the Hebridian Islands and their Inhabitants."

EIGHTH ORDINARY MEETING—16*th February*, 1861.

Professor DANIEL WILSON, LL.D., President, in the Chair.

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

HUGH R. FLETCHER, Esq., Bruce Mines.

II. *The following Papers were read:*

1. By Prof. G. T. Kingston, M.A.
"Annual Meteorological Report for 1860."
2. By Dr. W. Kerr, of Galt, (read by the Secretary.)
"On the efficacy of some Canadian Plants in diseases of the Mucous Membrane."

NINTH ORDINARY MEETING—23*rd February*, 1861.

Professor DANIEL WILSON, LL.D., President, in the Chair.

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

ELMES HENDERSON, Esq., Trinity College, Toronto.

II. *The following Papers were read.*

1. By T. C. Wallbridge, Esq.
"On the mound structures of Southern Ohio, in the vicinity of St. Louis Cincinnati and Newark."
2. By the Rev. Prof. W. Hincks, F.L.S.
"An attempt at a new Theory of Human Emotions."
3. By Prof. T. Sterry Hunt, F.R.S. (read by Prof. Croft, D.C.L.)
"On the nature of Atmospheric Nitrogen and Ozone."

TENTH ORDINARY MEETING—2*nd March*, 1861.

Professor DANIEL WILSON, LL.D., President, in the chair.

I. *The following Donations for the Library were announced, and the thanks of the Institute voted to the Donors.*

From the Hon. East India Company.
1. Magnetical and Meteorological observations taken at Bombay, 1858. 1 vol.
From C. J. S. Bethune, B.A., Trinity College, Toronto.
Dr. Mantell's Pictorial Atlas of Fossil Remains. 1 vol.

II. *The following Gentlemen were elected Members.*

JOHN SCHULTZ, Esq., M.D., Red River Settlement.
JAMES S. MCMURRAY, Esq., Toronto.

III. *The following Papers were read:*

1. By the Rev. Professor E. Hatch, M.A.
"Arabian Metaphysics."
2. By S. Fleming, Esq., C.E.
"Notes on the Davenport Gravel Drift."
3. By the President, Dr. Daniel Wilson.
"The Value of Certain Characteristics of Physical Conformation in which Man approximates to the Lower Animals, with illustrations."

ELEVENTH ORDINARY MEETING—*9th March*, 1861.

I. *The following Donations for the Library and Museum were announced, and the thanks of the Institute voted to the donors:*

For the Library. From the Department of Education, Lower Canada:

1. Journal of Education, Lower Canada, 1860. 1 Vol.
2. Journal de L'Instruction Publique, 1860. 1 Vol.

For the Museum. From Henry Palmer, Esq.:

A New Portable Voltaic Battery.

II. *The following Papers were read:*

1. By Henry Palmer, Esq.:
"Description of a New Portable Voltaic Battery. (Read by P. Freeland, Esq.)
2. By Professor Croft:
"Notes on Canadian Manufactures."

TWELFTH ORDINARY MEETING—*16th March*, 1861.

Prof. DANIEL WILSON, LL.D., President, in the Chair.

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

RICHARD HARRISON, Esq., Toronto.

II. *The following Papers were read:*

1. By Dr. C. B. Hall:
"On the Vagaries of Medicine."
2. By Professor Chapman;
(1) "Some Notes on the Drift Deposits of Western Canada, and on the Ancient Extension of the Lake Area of that District."
(2) "Remarks on the genus Orthoceras, in illustration of a remarkably large example recently obtained from the Trenton Limestone of Collingwood, C. W."

THIRTEENTH ORDINARY MEETING—*23rd March*, 1861.

Prof. DANIEL WILSON, LL.D., President, in the Chair.

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

From J. Dykes Campbell, Esq.

The North American Review, from 1854 to 1860. (Nos. for July and October, 1860, wanting.)

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

GEORGE DURAND, Esq., Toronto.

III. *The following papers were read:*

1. By Dr. Woods, Army Medical Staff, Toronto:
"On Sanitary Science in connection with Human Progress."
2. By the Rev. Professor Hincks, F.L.S.:
"Note on the Structure of the Fruit in the Order Asteraceæ or Compositæ."

FOURTEENTH ORDINARY MEETING—*6th April*, 1861.

Professor DANIEL WILSON, LL.D., President, in the Chair.

I. *The following Donations for the Library and Museum were announced, and the thanks of the Institute voted to the Donors.*

For the Library:—

From Dr. G. D. Gibb, London:

1. On Canadian Caverns.

2. From France: Annales des Mines (one number.)

3. From Natural History Society of New York:—Annals, vol. 7, April, May, 1860. Nos. 4–9.

4. From Professor Lawson, Kingston:—On the structure and development of Botrydum granulatum.

For the Museum:—

From Dr. Morris, on behalf of Major Elliott:

1. An Indian Maul, found on the American side of Lake Superior, in 1851.

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

CHARLES DURAND, Esq., Toronto.

III. *The following Paper was read:*

By the Rev. Professor Hincks, F.L.S.

"An attempt at an improved Scientific Arrangement of Fruits."

Mr. George Wilson was nominated by the President, and Mr. Samuel Spreull by the Meeting, and these Gentlemen were appointed Auditors for the current year.

At the close of the Session, a very numerously attended Conversazione was held in the Masonic Hall, Toronto, the rooms of the Institute not being sufficiently large to accomodate the number of guests invited on this occasion. The following programme was successfully carried out:

"Canadian Institute,—Conversazione in the Masonic Hall, Friday, April 12th, at 8 P.M. Order of Proceedings:

Communication by the President, Professor Wilson, LL.D.

"Illustrations of assigned Traces of Intercourse between the Old World and the New World, prior to Columbus."

"Oxycalcium Microscope."—P. Freeland, Esq.

"Illustrations of Electrical Phenomena with Rhumkorff's Battery."—Professor Croft, D.C.L.

"First Change of Objects in the Microscopes."—By Drs. Bovell and Richardson, and P. Freeland, Esq.

"Trochilidæ, or Humming Birds."—Prof. Hincks, F.L.S.

"Second Change of Objects in the Microscopes."

"Oxycalcium Microscope: Second Exhibition.

"Third Change of Objects in the Microscopes."

*** In addition to the numerous microscopes exhibited at this meeting, the Council obtained the use of a fine instrument belonging to D. L. Macpherson, Esq., for which a special vote of thanks was awarded.

MONTHLY METEOROLOGICAL REGISTER, AT THE PROVINCIAL MAGNETICAL OBSERVATORY, TORONTO, CANADA WEST—FEBRUARY, 1861.

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

Day.	Barom. at temp. of 32°. 6 A.M.	2 P.M.	10 P.M.	MEAN.	Temp. of the Air. 6 A.M	2 P.M	10 P.M	ME'N	Excess of mean above Average	Tens. of Vapour. 6 A.M	2 P.M	10 P.M.	M'N	Humidity of Air. 6 A.M.	2 P.M.	10 P.M.	M'N	Direction of Wind. 6 A.M.	2 P.M.	10 P. M.	Resultant Direction.	Velocity of Wind. 6 A.M	2 P.M	10 P.M	Result.	ME'N	Rain in Inches.	Snow in Inches.
1	29.650	29.532	29.263	29.4628	7.8	24.8	29.8	20.50	— 2.38	.056	.120	.154	.111	.91	.90	.93	.93	Calm.	E	E b N	N 76 E	0.0	5.8	13.5	7.50	8.09	...	7.0
2	.156	.257	.625	.3722	29.5	30.2	23.0	26.85	+ 3.00	.158	.149	.113	.135	.97	.89	.92	.92	N b W	N W	W N W	N 52 W	3.5	17.5	9.2	11.63	11.86	...	...
3	.902	30.008	—	—	12.9	14.7	—	—	—	.075	.078	—	--	.96	.94	—	—	NW bN	W N W	SW bW	S 85 W	12.2	6.0	6.0	5.30	7.19	...	...
4	.885	29.786	.853	.8367	22.3	30.9	27.0	26.83	+ 3.15	.115	.149	.129	.131	.96	.86	.88	.89	S W	SW bW	W b N	S 59 W	11.5	11.5	1.5	7.24	7.63	...	Inp.
5	.821	.696	.453	.6638	26.2	29.1	25.5	26.67	+ 3.08	.131	.133	.133	.126	.92	.82	.96	.87	W b N	S W	SW bW	S 57 W	2.0	3.0	9.5	7.88	8.19	...	0.1
6	.324	.138	.263	.2400	23.7	32.0	18.7	24.55	+ 1.03	.090	.135	.089	.105	.70	.74	.87	.77	S W b S	SW bW	N W	N 88 W	24.0	20.0	6.4	9.27	16.16	...	2.0
7	28.947	.544	.930	.5288	8.9	—9.8	-17.9	-7.72	—31.15	.056	.027	.015	.030	.86	.96	.70	.81	N	N W	N	N 44 W	15.0	35.4	2.0	19.07	19.76	...	8.0
8	30.026	30.125	30.120	30.1002	-15.6	—2.1	—0.8	-5.23	—28.60	.021	.036	.034	.033	.95	.90	.81	.90	N N W	W S W	N	N 60 W	4.4	13.0	6.5	3.91	6.39	...	0.5
9	30.100	29.945	29.830	29.9505	7.8	21.5	21.5	18.10	— 5.17	.056	.095	.109	.090	.91	.82	.93	.89	N b E	E b N	N b E	N 70 E	6.8	13.5	2.4	6.96	7.62	...	Inp.
10	29.759	.812	—	—	29.5	42.1	—	—	—	.150	.195	—	—	.92	.72	—	—	Calm.	S S W	N	N 49 E	0.0	0.4	8.5	3.51	3.97	...	...
11	.693	.350	.272	.3950	39.6	43.7	39.9	41.52	+18.25	.227	.235	.241	.250	.94	.94	.98	.95	N E b E	N E b E	N E b E	N 50 E	6.0	5.5	3.8	3.05	4.08	0.300	...
12	.205	.140	.390	.2663	35.6	35.8	31.3	33.70	+10.45	.203	.174	.144	.168	.97	.83	.81	.86	W S W	S S W	W b S	S 57 W	4.5	14.5	27.8	12.49	13.39	...	0.2
13	.579	.776	.859	.7528	31.3	33.8	26.6	30.28	+ 7.03	.160	.158	.134	.145	.90	.80	.93	.86	W N W	W b N	N E b N	N 55 W	7.5	12.5	9.2	9.38	12.37	...	...
14	.898	.694	.467	.6620	26.9	29.8	30.2	28.85	+ 5.58	.131	.109	.157	.131	.89	.66	.93	.82	N E b N	E N E	E N E	N 63 E	9.5	24.5	18.8	19.85	20.06	0.045	1.0
15	.229	.028	.078	.1075	31.6	31.3	32.7	32.05	+ 8.80	.170	.174	.181	.176	.96	.99	.97	.97	E N E	N E	S W b S	S 76 E	15.8	8.5	2.0	1.62	10.34	...	6.0
16	.194	.260	.183	.2135	31.6	33.8	29.8	31.27	+ 7.90	.148	.137	.140	.140	.83	.70	.84	.79	S W	S W	NW b N	S 58 W	16.6	9.5	3.0	6.85	8.22	...	0.3
17	.130	.183	—	—	25.2	31.3	—	—	—	.122	.130	—	—	.90	.70	—	—	W b S	W b S	W S W	S 72 W	11.0	22.5	9.0	10.69	10.78	...	0.1
18	.396	.478	.607	.5048	27.8	29.8	25.5	27.25	+ 3.82	.132	.125	.098	.119	.89	.75	.70	.79	S W	W S W	W	S 76 W	5.5	14.0	12.5	9.65	9.78	...	...
19	.593	.440	.212	.3987	21.2	29.5	31.3	27.50	+ 3.97	.105	.144	.160	.138	.93	.87	.90	.90	W	S E b S	S	S 19 E	1.5	12.0	8.5	7.56	9.32	...	2.0
20	.110	.130	.224	.1625	32.0	34.5	28.8	31.40	+ 7.78	.166	.137	.129	.145	.91	.68	.81	.81	W S W	W b S	W	S 85 W	9.2	14.2	7.2	12.89	13.34	...	0.5
21	.367	.528	.703	.5528	23.7	27.0	22.3	23.87	+ 0.13	.083	.086	.107	.089	.65	.58	.89	.70	W N W	NWbW	W N W	N 60 W	20.0	29.2	21.2	20.06	20.17	...	Inp.
22	.845	.756	.584	.7163	17.2	20.5	24.8	21.02	— 2.80	.081	.086	.120	.097	.85	.79	.90	.85	N N W	E b N	E	N 76 E	4.0	6.5	16.0	10.44	11.13	...	2.0
23	.353	.095	.108	.1757	24.8	30.6	34.5	29.60	+ 5.67	.126	.168	.123	.139	.95	.98	.60	.85	E.	E	W b S	S 57 W	18.2	12.6	24.2	3.31	16.43	0.430	Inp.
24	.414	.847	—	—	16.9	15.1	—	—	—	.053	.032	—	—	.56	.35	—	—	N W	NWbW	W b S	N 59 W	31.0	20.0	4.5	13.01	14.57	...	...
25	.925	.728	.573	.7338	19.7	32.7	35.2	29.67	+ 5.33	.090	.113	.175	.128	.84	.59	.85	.76	W S W	S W b S	S W	S 45 W	14.0	21.0	4.5	12.31	12.58	...	...
26	.675	.774	.805	.7613	29.1	40.3	29.5	33.40	+ 8.87	.126	.193	.129	.146	.78	.80	.78	.76	W S W	Calm.	N N W	N 21 W	1.0	0.0	0.5	0.66	1.51	...	...
27	.839	.828	.860	.8467	26.2	41.4	4..4	36.15	+11.43	.124	.171	.187	.166	.87	.64	.72	.78	N N E	S W b W	NWbW	N 77 W	4.0	3.8	11.8	3.76	5.12	...	...
28	.876	.693	.438	.6550	35.3	40.5	34.5	37.32	+12.42	.170	.190	.192	.187	.83	.75	.96	.84	S W	E b N	W N W	N 54 W	2.8	5.2	4.0	3.04	6.18	0.040	...
M	29.5663	29.5300	29.5315	29.5441	23.49	28.82	26.05	26.06	+ 2.39	.122	.136	.133	.130	.88	.80	.86	.84	.....	.....	.....	.....	9.34	13.00	9.07	.....	10.58	0.815	29.7

Highest Barometer ..... 30.144 at midn't., on 8th } Monthly range=
Lowest Barometer ..... 28.979 at 7 p.m., on 23rd } 1.165 inches.

Self-registering Thermom.
- Maximum Temperature ..... 46°0 on p. m. of 28th } Monthly range=
- Minimum Temperature ..... —20°8 on a. m. of 8th } 66°8
- Mean maximum Temperature ..... 32°37 } Mean daily range=
- Mean minimum Temperature ..... 18°54 } 13°83
- Greatest daily range ..... 32°4 from a. m. to p. m. on 9th.
- Least daily range ..... 3°2 from a. m. to p. m. on 18th.

Warmest day..... 11th... Mean temperature..... 41.52 } Difference = 49°24.
Coldest day..... 7th... Mean temperature.....—7°72 }
Maximum } Solar..... 71°5 on p. m. of 10th } Monthly range=
Radiation. } Terrestrial.....—28°5 on a. m. of 8th } 100°0.
Aurora observed on 3 nights, viz.: 10th, 27th, and 28th.
Possible to see Aurora on 8 nights; impossible on 20 nights.
Snowing on 17 days; depth 29.7 inches; duration of fall 93.6 hours.
Raining on 4 days,—depth 0.815 inches; duration of fall 21.1 hours.
Mean of cloudiness = 0.83. Above average 0.12.
Most cloudy hour observed, 8 a. m., mean = 0.90; least cloudy hour observed, midnight, mean, = 0.78.

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

North.	South.	East.	West.
2056.49	1458.92	1571.40	4093.65

Resultant direction N. 77° W.; Resultant velocity 3.86 miles per hour.
Mean velocity..... 10.58 miles per hour.
Maximum velocity ..... 39.6 miles, from 2 to 3 p. m. on 7th.
Most windy day .....21st..... Mean velocity, 20.17 miles per hour. } Difference=
Least windy day.....26th..... Mean velocity 1.51 ditto. } 18.66 miles.
Most windy hour ....noon to 1 p.m.....Mean velocity 13.75 ditto. } Difference =
Least windy hour .... 10 to 11 p.m.....Mean velocity 8.81 ditto. } 4.94 miles.

2nd. Fog from 6½ to 9 a.m.—7th. Very cold stormy day.—8th. Very cold day.—10th. Fog from 7 to 10 a.m.—11th. Dense fog from 2 p.m. to midnight.—12th. Ground fog at 6 a.m.—16th. Solar halo at 4 p.m.—20th. Perfect lunar corona from 7 p.m. to midnight.—23rd. Dense fog from 4 p.m.—25th. Solar halo at 2 p.m.—26th. Lunar halo at midnight.—28th. Fog from 10 a.m. to noon; solar halo at 4 p.m.

Great Barometric movement. { 7th, 6 a.m. = 28.947 / 8th, midn't. = 30.144 } Ascending range in 42 hours, = 1.197.
Ditto. { 8th, midn't. = 30.144 / 12th, 2 p.m. = 29.140 } Descending range in 86 hours, = 1.004.
Great Thermom. movement. { 6th, p.m = 35.0 / 7th, midn't. — 20.8 } Descending range in 34 hours, = 55.8.
Great Thermom. movement. { 7th, midn't. — 20.8 / 10th, 2 p. m. 43.0 } Ascending range, in 62 hours, = 63.8.

The Resultant Direction and Velocity of the Wind for the month of February, from 1848 to 1861 inclusive, were respectively N. 69 W. and 3.02 miles.

COMPARATIVE TABLE FOR FEBRUARY.

Year.	Temperature. M'n.	Diff. from Aver.	Max. ob'd.	Min. ob'd.	Range.	Rain. No. of days.	Rain. Inch's.	Snow. No. of days.	Snow. Inch's.	Wind. Resultant Direction.	Wind. Resultant V'y.	Wind. Mean Force or Velocity.
	°	°	°	°	°							
1840	28.0	+5.0	49.1	— 8.3	57.4	8	1.475	6	...	...	...	.....
1841	22.4	—0.6	43.4	— 0.3	43.7	1	Inap	9	...	...	...	0.61 lbs.
1842	26.9	+3.9	48.7	+ 2.5	46.2	8	3.625	9	...	...	...	1.03
1843	14.5	—8.5	37.5	—10.2	47.7	1	0.475	21	14.4	...	...	1.05
1844	26.0	+3.0	47.1	— 0.4	47.5	4	0.430	7	10.0	...	...	0.43
1845	26.6	+3.0	46.6	— 8.9	50.5	5	Imp.	9	19.0	...	...	0.99
1846	20.4	—2.6	41.4	—16.2	57.6	0	0.000	13	46.0	...	...	0.65
1847	21.5	—1.5	42.2	— 1.0	43.2	2	0.550	13	27.3	...	...	0.69
1848	26.6	+3.6	46.9	— 0.6	47.5	4	0.775	8	10.8	N 65° W	2.53	5.69 mls.
1849	19.5	—3.5	41.1	— 9.2	50.3	2	0.240	13	19.2	N 41° W	1.48	6.58
1850	26.0	+3.0	49.2	+ 1.3	47.9	7	1.235	9	23.1	N 80° W	3.43	7.61
1851	27.6	+4.6	50.2	+ 1.3	48.9	7	2.600	4	2.4	N 64° W	1.93	6.94
1852	23.4	+0.4	41.2	— 3.2	44.4	3	0.650	11	13.0	S 75° W	3.34	6.42
1853	24.1	+1.1	43.4	— 0.6	44.0	4	1.030	15	12.6	N 49° W	2.51	7.30
1854	21.1	—1.9	42.7	— 5.7	48.4	5	1.460	15	18.0	N 7° E	1.73	6.91
1855	15.4	—7.6	37.3	—25.0	62.3	2	1.770	14	21.8	N 40° W	4.34	8.17
1856	15.7	—7.3	35.3	—18.7	54.0	0	0.000	8	9.7	N 81° W	7.70	10.71
1857	28.5	+5.5	51.2	— 5.9	57 1	11	3.050	11	11.7	S 78° W	3.68	9.82
1858	17.0	—6.0	40.9	— 6.6	47.5	1	Inap	16	26.7	N 72° W	3.22	9.12
1859	26.0	+3.0	43.3	+ 3.9	39.4	6	0.455	14	8.3	N 54° W	2.72	8.50
1860	22.8	—0.2	48.1	— 8.4	56.5	7	1.330	13	18.8	N 61° W	3.28	8.73
1861	26.1	+3.1	44.6	—20.4	65 0	4	0.815	17	29.7	N 77° W	3.86	10.58
M	22.98	...	44.15	—6.16	50.32	4.2	1.046	11.6	18.03	.....	...	8.08 Ml.
Diff. from	+ 3.08	...	+ 0.45	— 14.24	+ 14.68	— 0.2	— 0.231	+ 5.4	+ 11.67	.....	...	+ 2.50

MONTHLY METEOROLOGICAL REGISTER, AT THE PROVINCIAL MAGNETICAL OBSERVATORY, TORONTO, CANADA WEST,—MARCH, 1861.

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

Day.	Barom. at temp. of 32°.				Temp. of the Air.				Excess of mean above Average	Tens. of Vapour.				Humidity of Air.				Direction of Wind.			Resul't. Direction.	Velocity of Wind.					Rain in inches.	Snow in inches.
	6 A.M.	2 P.M.	10 P.M.	Mean.	6 A.M	2 P.M	10 P.M	M'E'N		6 A.M.	2 P.M.	10 P.M.	M'N	6 A.M	2 P.M.	10 P.M.	M'N	6 A. M.	2 P. M.	10 P.M.		6 AM.	2 P.M.	10 P.M.	Result'.	M'E'N		
					°	°	°	°	°												°							
1	29.542	29.568	29.496	29.5445	41.7	42.6	36.7	39.72	+14.50	.218	.206	.204	.206	.82	.75	.95	.85	w b N	s w	E b N	N 50 W	8.0	1.8	3.0	0.42	2.60	0.007	...
2	.477	.336	.242	.3387	36.0	39.2	36.0	37.42	+12.00	.196	.216	.206	.209	.93	.90	.97	.93	N b w	Ca m.	N	N 35 W	2.0	0.0	0.5	0.48	1.81	0.080	...
3	.111	.141	—	—	43.2	42.8	—	—	—	.278	.268	—	—	.99	.98	—	—	W	N W b N	S W b W	S 85 W	2.0	11.2	7.0	5.47	6.85	0.170	...
4	.303	.316	.532	.4027	33·1	34.0	23.3	29.35	+ 3.35	.160	.084	.088	.109	.85	.42	.70	.66	S W b S	W b N	W	S 85 W	12.0	34.5	27.5	15.27	17.25	...	2.5
5	.603	.648	.672	.6518	16.5	22.8	21.5	19.55	— 6.65	.082	.060	.109	.080	.90	.50	.93	.76	W	W	S W b W	S 80 W	5.8	21.4	15.5	16.81	17.83	...	0·1
6	.435	.471	.787	.5820	22.3	24.4	6.8	17.47	— 9.03	.100	.061	.045	.068	.83	.46	.45	.68	S W b W	W N W	N N W	N 55 W	15.5	32.2	17.6	21.27	22.62	...	0·2
7	30.060	30.103	30.024	30.0553	-2.6	9.3	16.1	8.20	—18.62	.033	.062	.074	.055	.87	.93	.83	.84	N W b N	W N W	S E b S	S 74 E	8.5	3.5	6.6	1.72	6.61	...	...
8	29.763	29.411	29.331	.4817	24.4	34.7	38.5	33.12	+ 5.88	.103	.145	.182	.149	.78	.73	.78	.77	E S E	E b N	N W	N 44 E	11.5	12.8	10.5	2.45	9.70	0.050	0·2
9	.341	.307	.283	.3128	32.7	38.8	34.2	34.63	+ 7.12	.172	.161	.168	.162	.92	.67	.85	.81	S W	W b S	S W	N 87 W	5.8	7.2	9.6	8.45	9.69	...	0·1
10	.519	.748	—	—	24.8	21.5	—	—	—	.126	.075	—	—	.95	.66	—	—	N N W	N W b N	N W b N	N 33 W	16.0	20.0	14.0	14.30	14.54	...	...
11	.930	.842	.606	.7950	9.3	32.0	31.6	24.90	— 3.33	.056	.143	.148	.116	.84	.79	.83	.81	W N W	S W b S	S W	S 55 W	4.5	14.0	18.0	13.36	14.23	...	Inp.
12	.597	.688	.622	.6388	32.0	28.0	25.5	27.40	— 1.15	.158	.082	.118	.111	.87	.53	.86	.74	W	E b N	E	N 51 E	7.0	10.2	17.5	8.38	11.61	...	1.0
13	.576	.785	.928	.7702	19.0	25.5	19.0	21.35	— 7.62	.091	.090	.091	.091	.89	.65	.89	.80	N W b N	N N W	N	N 10 W	9.2	15.4	10.2	9.24	10.92	...	...
14	.903	.815	.777	.8253	17.2	25.1	18.3	20.38	— 8.03	.081	.094	.080	.088	.85	.69	.81	.79	N E	E b S	W N W	N 45 E	9.0	7.4	5.0	2.96	5.18	...	0.2
15	.773	.688	.546	.6578	16.5	33.4	29.5	26.77	— 2.95	.083	.134	.136	.119	.90	.70	.83	.81	N W b W	S b E	S W	S 11 W	3.5	2.4	2.0	3.37	3.88	...	...
16	.330	.154	414	.3187	25.2	38.3	22.6	28.12	— 1.92	118	.168	.089	.122	.87	.72	.72	.74	S W b S	S E b E	N W b W	N 56 W	0.5	0.5	33.0	13.30	15.81	...	...
17	.779	.936	—	—	1.0	8.2	—	—	—	.036	.035	—	—	.76	.54	—	—	N W b N	N N W	N W b N	N 30 W	27.0	15.8	9.0	13.65	13.79	...	...
18	30.176	30.130	30.036	30.1087	-4.1	7.1	6.0	3.48	—27.37	.028	.042	.047	.041	.80	.68	.80	.77	N b E	E b N	N N E	N 38 E	6.5	3.4	6.0	6.26	6.70	...	...
19	30.000	29.955	29.926	29.9550	2.1	18.3	15.8	12.77	—18.50	.045	.062	.072	.059	.91	.61	.80	.75	N N E	E N E	N N E	N 49 E	9.0	5.8	2.5	4.87	5.23	...	...
20	29.855	.679	.504	.6617	12.9	25.9	24.1	22.20	— 9.47	.063	.091	.114	.098	.80	.66	.87	.81	N N E	E	E N E	N 67 E	3.5	18.2	10.2	7.96	11.16	...	2.0
21	.515	.585	.713	.6092	20.8	30.2	24.4	25.32	— 6.77	.103	.131	.110	.113	.92	.78	.84	.83	W	N N W	N W	N 34 W	4.8	14.2	6.8	9.47	10.02	...	0.5
22	.780	.742	.688	.7222	23.3	36.7	28.4	30.37	— 2.12	.103	.164	.126	.131	.82	.75	.81	.77	N W b W	S W b S	Calm.	N 61 W	10.0	5.0	0.0	2.11	3.61	...	...
23	.490	.145	.190	.2652	32.7	37.4	33.8	34.47	+ 1.68	.173	.213	.145	.178	.92	.95	.75	.88	E	E	W S W	S 55 W	4.0	6.5	29.5	9.03	13.17	0.210	Inp.
24	.319	.660	—	—	28.4	27.3	—	—	—	.119	.111	—	—	.76	.74	—	—	W S W	W b N	S W b W	N 76 W	25.2	31.5	3.0	14.07	15.55	...	0.1
25	.858	.582	.534	.6382	30·9	37.4	39.6	36.18	+ 2.62	.164	.143	.237	.183	.95	.64	.97	.85	S b E	E N E	N b E	N 81 E	8.0	8.5	0.5	4.22	5.65	0.468	...
26	.386	.278	.254	.2942	39.9	41.0	36.0	38.97	+ 4.98	.241	.237	.206	.227	.98	.92	.97	.95	E	N N E	E	N 74 E	6.8	4.0	16.2	6.77	8.56	0.865	...
27	.097	.226	.568	.3135	37.0	41.0	32.7	37.22	+ 2.80	.209	.200	.150	.190	.95	.78	.80	.84	S E b S	S W b W	W	S 82 W	3.2	14.5	21.0	17.25	18.71	...	Inp.
28	.762	.873	.858	.8440	26.3	34.9	33.8	32.02	— 2·70	.123	.139	.166	.140	.86	.68	.85	.77	N W b W	W b S	Calm.	N 77 W	21.0	12.8	0.0	3.24	8.73	...	...
29	.69½	.444	—	—	33.4	36.0	—	—	—	.163	.196	—	—	.85	.93	—	—	E	E b N	N E b E	N 47 E	19.0	4.2	5.0	5.62	11.12	0.275	...
30	.286	.744	30.019	.7197	34.2	33.8	28.7	31.63	— 3.87	.160	.136	.130	.138	.81	.70	.83	.78	N W b W	N W b N	Calm.	N 41 W	28.8	23.5	0.0	13.36	13.87	...	0.2
31	30.104	30.160	—	—	28.7	32.4	—	—	—	.123	.138	—	—	.77	.75	—	—	E N E	S E b E	E	S 89 E	2.2	8.5	12.0	10.29	10.45	...	...
M	29.6357	29.6028	29.6220	29.6206	23.17	30.87	26.52	26.92	— 3.46	.123	.131	.130	.127	.87	.70	.84	.80					9.67	12.19	10.30		10.56	2.125	7.1

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR MARCH, 1861.

Highest Barometer . . . . . 30.200 at 8 a. m. on 18th. } Monthly range=
Lowest Barometer . . . . . 29.034 at 7 p. m. on 23rd, } 1.166 inches.

Self-registering Ther.:
- Maximum temperature . . . . 47°4 on a.m. of 3rd } Monthly range=
- Minimum temperature . . . . —5°2 on a.m. of 18th } 52°6
- Mean maximum temperature . . 33°53 } Mean daily range=12°82.
- Mean minimum temperature . . 20°71 }
- Greatest daily range . . . . . 38°3 from p.m. of 7th to a. m. of 8th.
- Least daily range . . . . . 3.5 from a.m. to p. m. of 30th.

Warmest day . . 1st ... Mean Temperature . . .=39°72 } Difference=36°24.
Coldest day . . . 18th ... Mean Temperature . . .= 3°48 }
Maximum { Solar . . . . . 69°5 on p. m of 1st } Monthly range=
Radiation { Terrestrial . . . . . —11.3 on a. m. of 18th } 80°8.

Aurora observed on 6 nights, viz: 9th, 13th, 14th, 15th, 19th, and 30th; possible to see Aurora on 16 nights; impossible on 15 nights.
Snowing on 14 days: depth, 7.1 inches; duration of fall, 44.5 hours.
Raining on 8 days; depth, 2.125 inches; duration of fall, 55.2 hours.
Mean of cloudiness=0.62, above average .03; most cloudy hour observed 6 a. m., mean =0.66; least cloudy hour observed 2 p. m., mean=0.59.

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

North.	South.	East.	West.
2317.49	1584.71	1741.95	4336.56

Resultant direction, N 54° W; Resultant Velocity, 4.33 miles per hour.
Mean velocity 10.56 miles per hour.
Maximum velocity . . . 36.2 miles, from 7 to 8 p.m. on the 6th.
Most windy day . . 6th—Mean velocity 22.62 miles per hour.
Least windy day . . 2nd—Mean velocity, 1.81 do
Most windy hour, 1 to 2 p. m.—Mean velocity, 12.75 miles per hour. } Difference
Least windy hour, 6 to 7 p. m.—Mean velocity, 8.83 do. } 3.92 miles.

1st. Dense Fog from 10 p. m.; mild day.—2nd. Dense Fog all day; mild day.—3rd. Dense Fog, a. m.; emitting an unpleasant odour.—7th. Solar Halo during forenoon, (very distinct).—11th. Solar Halo at 4.30 p. m.—17th. Cold, stormy day.—18th. Very cold day.—19th. Solar Halo, 4.40 p. m.; Lunar Halo, 7.30 to 10 p. m.—20th. Solar Halo, 6 to 8 a. m., (well defined).—22nd. Lunar Halo, 10.15 p. m.—24th Lunar Corona at 7 p. m.—28th. Imperfect Solar Halo at 1 p. m.—29th. Thunderstorm, 4 to 5.30 p. m., (first of season)

Rapid Changes of Temperature.

16th, p. m., = 44.0 registered } Range in 16 hours = 43.8.
17th, a. m., = 0.2 "
16th, p. m., = 44.0 registered } Range in 41 hours = 49.2.
18th, a. m., = — 5.2 "

Rapid Changes of Barometer.

16th, 2 p. m., = 29.154 } Ascending Range in 42 hours = 1.046.
18th, 8 a. m., = 30.200 }
18th, 8 a. m., = 30.200 } Descending Range in 131 hours = 1.166.
23rd, 7 p. m., = 29.034 }

The Resultant Direction and Velocity of the Wind for the month of March, from 1848 to 1861 inclusive, were respectively N. 60° W., and 3.63 miles.

COMPARATIVE TABLE FOR MARCH.

YEAR.	TEMPERATURE. Mean.	Difference from Average.	Maximum observed.	Minimum observed.	Range.	RAIN. No. of days.	Inches.	SNOW. No. of days.	Inches.	WIND. Resultant Direction.	Resultant Velocity.	Mean Velocity
	°	°	°	°	°					°		
1840	33.3	+ 3.2	56.9	8.7	48.2	8	1 640	8	...	...	...	...
1841	27.7	— 2.4	53.5	— 6.9	60.4	5	1.170	7	...	...	...	0.51lbs
1842	35.8	+ 5.7	68.7	14.9	53.8	4	3.150	8	...	...	...	0.70 "
1843	21.3	— 8.8	38.6	— 2.8	41.4	2	0.625	18	25.7	...	...	1.18 "
1844	31.3	+ 1.2	50.3	9.6	40.7	8	2.470	8	14.0	...	...	0.57 "
1845	35.4	+ 5.3	61.7	9.9	51.8	5	imp.	8	2.8	...	...	0.66 "
1846	33.1	+ 3.0	49.3	7.6	41.7	9	1.965	5	2.3	...	...	0.30 "
1847	26.2	— 3.9	44.3	4.8	39.5	5	0.850	6	4.2	...	...	0.71 "
1848	28.6	— 1.5	58.9	0.9	58.0	5	1.220	6	9.7	N 66 W	2.03	5.80ms.
1849	33.5	+ 3.4	53.4	15.4	38.0	7	1.525	2	2.3	N 3 W	1.48	5.37 "
1850	29.8	— 0.3	46.0	6.0	40.0	2	0.745	7	11.2	N 52 W	2.62	7.62 "
1851	32.4	+ 2.3	58.7	13.1	45.6	3	0.770	9	8.8	N 21 W	1.93	7.65 "
1852	27.7	— 2.4	44.8	— 3.2	48.0	8	3.080	12	19.5	N 8 W	0.71	5.81 "
1853	30.6	+ 0.5	56.3	— 0.1	56.4	6	1.080	8	7.1	N 58 W	2.60	5.96 "
1854	30.7	+ 0.6	52.8	10.4	42.4	9	2.425	3	2.8	N 53 W	3.39	8.03 "
1855	28.5	— 1.6	48.6	— 2.9	51.5	5	1.485	11	18.1	N 88 W	4.76	9.95 "
1856	23.1	— 7.0	39.3	—13.6	52.9	0	0.000	12	16.2	N 71 W	7.68	11.39 "
1857	27.8	— 2.3	56.5	— 3.9	60.4	4	0.335	15	11.3	N 63 W	6.63	10.84 "
1858	28.4	— 1.7	54.1	— 5.5	59.6	10	0.917	6	0.2	N 58 W	5.45	8.56 "
1859	36.3	+ 6.2	53.7	10.4	43.3	15	4.054	8	1.0	N 64 W	1.96	10.39 "
1860	34.5	+ 4.4	66.4	14.2	52.2	5	0.882	11	2.4	N 64 W	7.61	12.41 "
1861	26.9	— 3.2	43.2	— 4.1	47.3	8	2.125	14	7.1	N 54 W	4.33	10.56 "
Mean	30.13	...	52.55	3.77	48.78	6.0	1.548	8.7	8.77	...	...	8.60
Diff. from Av'ge.	—3.21	...	—9.35	..87	—1.48	+ 2.0	+ 0.577	+ 5.3	— 1.67	...	...	+ 1.96

MONTHLY METEOROLOGICAL REGISTER, ST. MARTIN, ISLE JESUS, CANADA EAST—FEBRUARY, 1861.

(NINE MILES WEST OF MONTREAL.)

BY CHARLES SMALLWOOD, M.D., LL.D.

Latitude—45 *deg.* 32 *min. North. Longitude*—73 *deg.* 36 *min. West. Height above the Level of the Sea*—118 *feet.*

Day:	Barom. corrected and reduced to 32°			Temp. of the Air.—F.			Tension of Vapour.			Humidity of Air.			Direction of Wind.			Horizontal Movement in Miles in 24 hours.	Mean of Ozone.	Rain in inches.	Snow in inches.	WEATHER, &c. A Cloudy sky is represented by 10; A cloudless sky by 0.		
	6 A.M.	2 P.M.	10P.M.	6 A.M.	2 P.M.	10P.M.	6 A.M.	2 P.M.	10 P.M.	6A.M.	2P.M.	10PM	6 A.M.	2 P.M.	10 P.M.					6 A.M.	2 P.M.	10 P.M.
1	29.512	29.612	29.024	17.1	20.6	20.0	.078	.085	.091	83	78	85	N E b E	N E b E	N E b E	277.46	6.5	...	1.75	Snow.	Sleet.	Cu. Str. 10.
2	482	495	601	19.0	20.1	20.6	087	091	085	84	85	78	N E b E	N N E	s w	110.10	5.5	...	...	Cu. Str. 10.	Do.	Do. 10.
3	30.064	30.184	30.331	7.8	6.0	— 9.5	040	035	022	64	61	78	N b w	w b N	s s w	269.40	4.0	...	...	Do. 6.	Clear.	Clear. Z. lt. br.
4	245	137	170	—11.3	0.0	1.1	014	033	038	58	85	51	E b N	N E	N E	28.50	4.5	...	0.70	Clear.	Cu. Str, 10.	Cu.Str.9.Rain.
5	29.612	000	29.914	24.2	29.2	23.0	123	136	106	93	84	86	s w	s	s w	13.74	4.5	Inap.	...	Cu. Str. 10.	Do. 10.	Snow.
6	30.157	29.408	463	7.2	30.3	24.6	042	142	094	70	84	73	s s w	w s w	s b w	557.10	3.5	...	1.60	Snow.	Heavy Drift.	Loud & heavy
7	29.420	517	880	— 6.0	— 6.0	—21.8	024	022	011	70	68	64	N E b E	N	N b w	557.10	3.5	...	...	Clear.	Clear.	Clear. [drift.
8	30.214	30.307	30.388	—37.1	—14.1	—19.5	001	011	012	09	74	67	w b s	w s w	w s w	444.80	3.0	...	...	Clear.	C. C. Str. 4.	Cu. St. 10.
9	585	537	392	—24.0	0.0	— 7.0	009	027	019	60	61	60	w s w	N E b E	N E b E	98.40	3.0	...	...	Do.	C. C. Str. 4.	Cu. St. 10.
10	162	114	094	7.0	27.2	31.9	045	105	152	76	80	89	N E b E	s	E	116.60	3.5	...	...	Sleet.	Sleet.	Slight Rain.
11	170	29.936	29.770	27.2	44.3	40.1	127	240	225	86	82	91	N E b E	E S E	E S E	80.10	5.0	0.121	...	Slight Rain.	Cul. Str.10.	Cu. Str. 10.
12	29.631	371	448	39.4	43.7	36.2	210	248	190	86	87	88	S S E	s s w	w s w	74.50	5.0	0.640	...	Cu. St. 10.	Do. 10.	Clear. Au.Bor.
13	571	810	30.061	32.0	30.8	21.6	147	142	100	81	80	79	w s w	w s w	w s w	170.80	2.5	...	...	C. C. Str. 8.	Do. 10.	Do.
14	30.088	30.201	174	8.4	33.8	22.4	048	144	095	97	75	80	w	w	N E b E	30.80	3.0	...	...	Clear.	Clear.	Cu. Str. 10.
15	29.914	29.720	29.499	19.6	22.5	19.9	081	084	081	77	71	77	N E b E	N E b E	N E b E	437.70	4.5	...	2.10	Nim. 10.	Snow.	Snow.
16	504	614	654	9.0	29.4	20.4	051	136	085	37	82	78	N E b E	N E b E	N E b E	250.80	4.5	...	1.46	Snow.	Cu. Str. 4.	Light Cirr. 2.
17	125	101	350	27.6	31.8	31.1	141	149	140	91	84	80	N E b E	w b N	s w	196.50	6.0	...	7.26	Do.	Snow.	Cu. Str. 10.
18	502	552	746	21.7	31.2	23.7	090	136	100	78	77	79	w	w	N b w	247.70	4.0	...	...	Cu. Str. 10.	Cu. Str. 10.	C. C. Str. 8.
19	849	850	727	9.4	34.1	11.8	050	155	051	70	79	76	w s w	s s w	N E b E	43.10	3.0	...	...	Clear.	C. C. Str. 4.	Cirr. 4.
20	584	300	267	14.1	29.8	24.1	063	148	111	80	89	86	N E b E	N E b E	w s w	100.00	3.0	...	6.51	Snow.	Snow.	Cu. Str. 10.
21	342	541	841	26.0	27.4	11.1	111	123	057	81	82	79	w s w	w s w	w b N	245.40	3.0	...	...	C. C. Str.10.	Cu. St. 6.	C. C. Str. 4.
22	977	065	009	— 1.0	11.0	2.0	023	048	034	69	69	71	w b N	w	w	253 89	2.0	...	...	Cum. 2.	Clear.	Cirr.2. Lu. ha.
23	30.030	544	495	3.0	8.4	6.0	036	042	043	72	66	75	N E b E	N E b E	N E b E	228.20	5.0	...	5.47	Cu. Str. 10.	Snow.	Snow.
24	29.371	711	30.090	16.1	16.1	6.7	074	074	037	83	83	62	w	w b N	w b N	418.00	3.5	...	...	Clear.	Cum. 4.	Cirr. Str. 2.
25	30.104	30.060	29.954	2.0	32.0	25.2	034	149	117	71	84	87	w n w	s w	s b E	233.30	2.0	...	...	Do.	Clear.	C. C. Str.10.
26	29.827	29.757	30.061	27.4	35.4	32.5	123	177	156	84	85	85	w s w	w	s w	177.90	3.0	...	...	Do.	Cu. Str. 10.	Cu. Str. 6.
27	30.189	30.063	039	17.2	53.2	40.2	079	328	225	82	85	89	s s E	w s w	w s w	4.30	2.0	...	...	Do.	Clear.	Clear. Au.Bor.
28	010	000	29.910	30.2	53.1	38.0	147	348	193	89	86	86	s w	s b w	s b w	126.00	2.0	...	...	Do.	Do.	Cu. Str. 10.
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