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A POPULAR EXPOSITION OF THE MINERALS AND GEOLOGY OF CANADA.

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PART V.

(Continued from page 127.)

PALÆOZOIC ROCKS OF CANADA.

The formations of Palæozoic age, recognized in Canada, comprise, in ascending order: (1) A complete series of deposits belonging to the *Silurian Epoch*; (2) A succeeding series, referrible to the earlier part of the *Devonian Epoch*; and (3) A partial development of Carboniferous strata—these latter, however, being only found in Gaspé, at the extreme east of the Province.

SILURIAN STRATA:—The Silurian strata are usually subdivided into two series—the *Lower* and the *Upper* Silurians, respectively; but in Canada, the officers of the Geological Survey have recently adopted a third or additional group—the *Middle* Silurians. This latter group includes the lower portion of the Upper Silurian series as originally constituted.*

* The term "Upper Silurian," it should be observed, is employed in the preceding Parts of this Essay in its original signification; *i.e.*, as including the so-called "Middle Silurians" of the later system of division.

Lower Silurian Series:—This series comprises, in ascending order, the following subdivisions:—1, The Potsdam Group; 2, the Calciferous Group; 3, The Chazy Formation; 4, The Trenton Group; 5, The Utica Slate Formation; and 6, The Hudson River Formation.

Note:—The Calciferous and Chazy strata, as regards their occurrence in the neighbourhood of Quebec and throughout the Eastern Townships, are united by Sir William Logan under the term of the Quebec Group. It would also, perhaps, be more in conformity with Nature to unite the three latter divisions, as given above, and to arrange the whole as in the annexed Table. The term "Ontario Group" might be adopted for the proposed union of these higher formations.

Ontario Group.	Hudson River Formation. Utica Formation. Trenton Formation. Bird's Eye and Black River Formation.		
Quebec Group.	Chazy or Sillery Formation. Calciferous or Levis Formation.	=	The higher beds of the Upper Copper-bearing strata of L. Superior (?)
Potsdam Group.	Beauharnois Formation. Kaministiquia Formation. (?)	=	The bottom beds of the Upper Copper bearing strata of L. Superior (?)

The Potsdam Group:—This subdivision, until a comparatively recent period, was known as the *Potsdam Sandstone*. Its stratified deposits may be arranged under the heads of: deep-sea strata: shallow-sea or shore-line deposits; and altered rocks. Of the deep-sea strata of the Potsdam epoch, merely uncertain indications have at present been obtained Sir William Logan has suggested that some dark slates which are found to occupy a lower geological position than the Quebec beds of Point Levis,* may very possibly represent some of the deep-sea deposits of that period; whilst it is certain that the ordinary sandstones, of the epoch, were shore-line or coast deposits. This is proved by the presence of ripple marks, and tracks of crustacea or other animals, as well as by the general nature of the sediments of which these sandstones consist. The slates, however, may be of contemporaneous formation with the sandstones: a point at present unsettled. Another series of slate rocks and slaty conglomerates, somewhat resembling those of the Huronian series, associated with beds of chert (a flint-like variety of quartz, sometimes coloured black from the presence of anthracitic matter), grey dolomites, (weathering red), interstratified trap beds, and some

* In the pronunciation of this word the final letter is mute. Hence the word is often written Lévi.

argillaceous sandstones, occur in Thunder Bay, and especially near the Grand Falls of the Kaministiquia River, and probably belong to the Potsdam period. They overlie the Huronian rocks in unconformable stratification with these, and hence belong to a succeeding geological epoch. If of Potsdam age, the question again arises as to whether they represent a distinct series, older than the sandstone beds of the east, or whether they are to be considered of the same period of deposition. If older, they might be arranged as in the above table, under the name of the Kaministiquia formation. They are more or less altered by metamorphic action, and contain native copper, iron pyrites, and other metallic matters.

As the sandstones or shore-line deposits of the Potsdam Group form the most characteristic and widely-spread rocks of the period, as exhibited at least in Canada, it is necessary to refer to them in somewhat greater detail. In the table given above, they are designated as the Beauharnois Formation, from their especial development in the county of that name. They consist essentially of beds of sandstone of various colours, but chiefly white, green, red, brown, or yellowish; and of conglomerates of different degrees of coarseness. Many of the sandstones are fine-grained and of a purely silicious character, and some exhibit bands or stripes of different colours. With these beds, a few layers of dolomite or of more or less impure limestone are occasionally interstratified. Fossils, with the exception of fucoids, are of rare occurrence. In addition to the problematical *Scolithus* (see PART IV., page 97),* the most common is a species of lingula (*L. acuminata*, fig. 155), a genus which thus occurs in the very lowest of our fossiliferous rocks, and which, passing upwards through the entire series of geological formations, is still found in the seas of the existing age. Some remarkable fossil tracks occur also in our Potsdam beds. These belong to two distinct types or genera. The oldest, in point of discovery, were first made known by the late Mr. Abraham, of Montreal, in 1847. They were observed on the surface of a sandstone bed on the St. Louis River, in the County of Beauharnois, and were considered to be the tracks of a tortoise or some related chelonian. The examination of other examples,

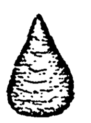


Fig. 155. - *Lingula acuminata* (Conrad).

* The *Scolithus* cavities figured on this page appear to differ from the common Canadian forms in being longer and more regularly cylindrical. The Canadian type is named *S. Canadensis* by Mr. Billings. (See Revised Report on the Geology of Canada.) p. 101.

however, led to the inference that they were really made by a much lower animal, an extinct crustacean, probably more or less akin to the modern *limulus*. The generic name of *Protichnites* has been bestowed on these tracks by Professor Owen. They present several

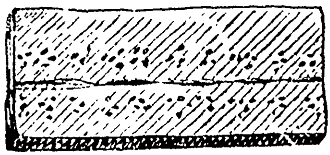


Fig. 156.—*Protichnites alternans* (Owen).

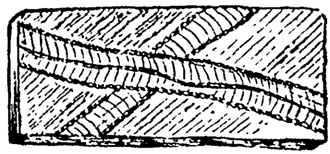


Fig 157—*Climactichnites Wilsoni* (Logan)

varieties, but exhibit essentially a narrow and often interrupted central groove with a parallel series of pit-marks on each side, as shewn in fig. 156. The groove is supposed to have been made by the caudal shield or tail-spine of the animal, and the pit-marks by the creature's claws. Tracks of *Protichnites* occur at other localities in Beauharnois, and likewise in Vaudreuil, &c., in Eastern Canada. They have also been found near the Town of Perth in the Township of Drummond, Canada West, where they are accompanied by the second kind of track impressions alluded to above. These latter exhibit narrow bands about five or six inches in width, with "beaded" edges, and usually a central beaded line crossed by a transverse series of curved or straight ridges: the whole presenting, as stated by Sir William Logan, a general resemblance to a rope-ladder. An idea of this appearance may be gleaned from fig. 157. On account of their ladder-like aspect, Sir William Logan has designated these tracks under the generic name of *Climactichnites*. Fig. 157 represents *C. Wilsoni* (Logan), so named from the discoverer of these latter impressions, Dr. Wilson of Perth, to whose explorations Canadian geology is also largely indebted in various other respects.

The more important economic materials of the Potsdam Group comprise building stones of good quality, as those from Lyn and Nepean employed in the construction of the Parliament Buildings at Ottawa; sandstones for glass-making purposes, being almost free from oxide of iron (Beauharnois, Vaudreuil), ; and sands and sandstones for lining the sides and floors of iron furnaces. The friable sandstone of the Township of Pittsburg (just east of Kingston), and other beds on the St. Maurice in Eastern Canada, are largely used for the latter purpose. To these materials must be added the native copper, native silver, silver glance, amethyst quartz, and sulphate of baryta, contained in the veins which traverse the bottom rocks of the upper copper-bearing series of Lake Superior on the coast and islands of Thunder Bay, as at Prince's Location west of Fort William,* &c.—always supposing the altered rocks in question to be really a portion of the Potsdam Group.

The sandstones and conglomerates of this group are developed chiefly in the Counties of Beauharnois, Vandreuil, Two Mountains, and Berthier in Eastern Canada; and in those of Grenville, Leeds, Lanark, Renfrew, and Carleton in Canada West. A narrow belt occurs also to the west of the gneissoid ridge that crosses the St. Lawrence at the Thousand Isles. This belt runs through the Townships of Pittsburg, Storrington, and Loughborough, and dies out a little to the west of Knowlton Lake. At these various localities the Potsdam beds lie in unconformable position on the upturned edges or between the foldings of the Laurentian rocks. Strata belonging to the Potsdam Group have likewise been traced out, by the officers of the Geological Survey, on the north shore of the Straits of Belle Isle; and the formation is also thought, on good evidence, to occur between the Mingan Islands and the adjacent coast. The thickness of the formation appears to vary from about forty feet or less, in some localities, to six or even seven hundred feet, in others. Interesting exposures occur more particularly at the following places:—Loughborough, Eel, and Knowlton Lakes; north shore of the St. Lawrence, a mile or two below Brockville; north shore and islands of Charleston Lake (Townships of Lansdown and Escott, in Leeds County): vicinity of Beverly in the Township of Bastard; Otty Lake, in Drummond Township, and surrounding district; Townships of Nepean and Gloucester, in Carleton County; Lake St. Louis; Lake of Two Mountains: Point St. Anne and Point du Grand Detour, in Vandreuil; Lachute, on the Rivière du Nord; River St. Maurice (various parts, near the Cachée, &c); and Hemmingford Mountain in the Township of that name, on the border line of the Province.† The name of this group is derived from

* When the earlier portions of this essay were printed, the upper copper-bearing rocks of Lake Superior had not been definitely separated from the underlying and greatly resembling Huronian series. This should be borne in mind with regard to the descriptions of certain minerals in Part II.

† Many interesting details and measurements in reference to these and other localities, will be found in the Revised Report on the Geology of Canada, issued by Sir William Logan and his colleagues.

Potsdam, near Ogdensburg, in the State of New York. This name was applied to it by the New York geologists, long before the Geological Survey of Canada was commenced.

The Calciferous Group:—This division was formerly known as the Calciferous Sand Rock formation, a name bestowed upon it by the New York Survey. The latter term, however, is to some extent a misnomer, since the prevailing or more characteristic strata (in the unaltered districts) are chiefly dolomitic limestones; although many contain, it is true, a considerable amount of sandy or silicious matter. A specimen from Rigaud gave to Prof. Hunt an amount of insoluble matter equal to 36·90 per cent.; and samples from near Prescott, and from the Beauharnois Canal (the latter containing casts of *Ophileta compacta*) yielded to the writer amounts varying from 27·12 to over 40 per cent. Other specimens from near Brockville and elsewhere, left, however, an insoluble residuum of less than 8 per cent.

The rocks of this group may be conveniently discussed under three heads, viz.:—Normal Deposits; Displaced and Altered strata of Eastern Canada; and Altered strata of Lake Superior.

Normal deposits of the Calciferous Group:— In Canada these consist principally of dark-grey dolomitic or magnesian limestones, many containing, as stated above, a certain amount of arenaceous matter. They are also interstratified very frequently with beds of grey, white, or brownish sandstone, varying in thickness from a few inches to four or five feet. The calcareous beds in many districts yield but a poor description of lime, and hence the term "bastard limestones," often applied to them by settlers and others. Small cavities lined or filled with calc spar, or more rarely with quartz, heavy spar, or gypsum, occur in some of the beds; and these and other beds occasionally exhibit in places a coarse concretionary structure. Fossils are of rare occurrence. The most common, perhaps, is the *Ophileta compacta*, fig. 158. Scolithus casts (figured on an earlier page) appear also in certain strata. In Western Canada, these normal Calciferous rocks are apparently unknown west of the gneissoid belt that crosses the St. Lawrence at the Thousand Isles. They may occur, however, in a thin band along

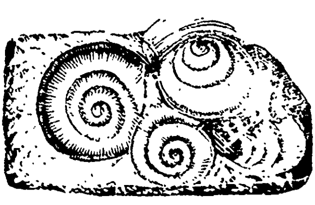


Fig. 158.—*Ophileta compacta* (Salter)

the inner or south-western edge of the outcrop of the Potsdam series in the Townships of Pittsburg and Loughborough, although no certain indications of their prese ~o have as yet been found. On the eastern side of the gneissoid belt, they are somewhat extensively developed—as shewn by the area marked 4 in the map a few pages further on (fig. 219) although more or less obscured by thick beds of Drift. Exposures occur in the Counties of Leeds, Grenville, Lanark, Renfrew, Carleton, &c., of this district. An important vein of lead ore (galena) occurs in this Formation in the Township of Ramsay, Lanark County. In Eastern Canada, these beds occupy also a considerable area, and occur in the Counties of Beauharnois, Vaudreuil, Two Mountains, Chambly, L'Assomption, &c. They have been discovered likewise, of late years, in the Mingan Islands and on the adjacent coast, a locality in which they have proved more fossiliferous than in other and more western sites.

Displaced and altered Calciferous Rocks:—The displaced strata and altered beds of this age in Eastern Canada, are known more especially as the *Quebec group.* Under this term, however, the succeeding Chazy beds (in an equally altered condition, and which cannot in this district be well separated from the Calciferous deposits) are also included. These strata, until a comparatively recent period, were thought to occupy a somewhat higher place in the Silurian series, or to lie at about the horizon of the Hudson River Formation, near the top of the Lower Silurians. The fossil evidence traced out by the skill and perseverance of Mr. Billings, Palæontologist to the Geological Survey of Canada, first shewed their true position. They consist of a series of grey, black, red, and green shales, in places over a thousand feet in thickness, with interstratified beds of dark and other coloured dolomites, limestones, and sandstones, holding graptolites, brachiopods, trilobites, and other foss In this condition, these beds occur

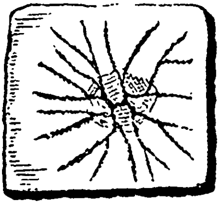


Fig. 159.
Graptolithus Logani (Hall).

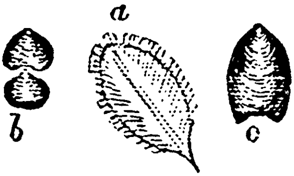


Fig. 160.
a. *Phyllograptus typus* (Hall).
b. *Obolella pretiosa* (Billings).
c. *Lingula Quebecensis* (Billings).

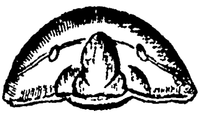


Fig. 161.
Conocephalites Zenkeri (Billings).

Fig. 162.
Bathyurus Saffordi (Billings).

more especially in the Island of Orleans, near Quebec, and in the district around Point Levis opposite the city. As they extend southwards from the St. Lawrence, both into the Eastern townships and into central Gaspé, and the intervening district, they become greatly altered by metamorphic agencies. The fossils are obliterated; and the shales and other strata are changed into gneissoid, talcose, chloritic, and epidotic schists; and also into fissile slates, serpentines, crystalline marbles, and other analogous rocks. Some of these hold large amounts of copper ore, chromic iron, magnetic and red iron ores, galena, &c.; and the sands and alluvial sediments, derived from their disintegration, contain native gold. (See the descriptions of these minerals in PART II). The unaltered or fossiliferous strata of this series present also an abnormal character, in being forced by a great dislocation and uplift into a position apparently higher than that occupied by the Trenton and other strata of really newer formation. This dislocation or great fault appears to be one of a connected series extending along the whole line of the Appalachian Mountains from Alabama to Eastern Canada. The immediate fracture along the line of which the Quebec Formation has been lifted up, is traced from the vicinity of Lake Champlain to a point just above Quebec, and from thence through the north part of the Island of Orleans, and along the Gulf of the St. Lawrence into the coast of Gaspé. The strata to the south and east of this dislocation are much disturbed, and inclined at high angles, even where they remain (as on the edge of the disturbed region) free from metamorphic or chemical alteration. Many of the rocks, both altered and unaltered, of this region, contain irregular fissures partially filled or lined with a peculiar anthracitic substance usually regarded as an altered bitumen. It is black, more or less lustrous, and usually very brittle. Sometimes (as also in more recent strata) it fills cavities in fossil corals and shells. It occurs more especially around Quebec, in the Island of Orleans, at Point Lévis, and in the townships of Acton, Grantham, St. Flavien, &c. It is occasionally taken for coal; but although chemically of the nature of certain varieties of this substance, it differs from it geologically, and essentially, by never occuring in true or workable beds, but only in irregular masses and narrow veins of no utility. Its ash does not exhibit any traces of vegetable structure, as seen in the ashes of all ordinary coals.

The following are the more important economic substances of the Quebec Group.* *a*) *Copper Ores*:—These comprise chiefly the yellow or common Pyrites, Purple Pyrites, and Copper Glance, occasionally mixed with small portions of native copper and native silver. The ores occur in large irregular or lenticular masses, or in beds, and yield from eight to about eighteen per cent. of metal. Workable quantities are known to exist in the townships of Acton, Upton, Wickham, Durham, St. Flavien, Leeds, Cleveland, Melbourne, Sutton, Chester, Ham, and Garthby; and indications of copper occur in many other localities of this metamorphic region. *b*) *Gold*:—Indications of gold have been met with near the Chaudière Rapids, and in a quartz vein in the township of Leeds. The gold of the alluvial districts will be referred to in connexion with the economic substances of the Drift Formation, as it occurs in the deposits of this latter age. *c*) *Chromic Iron Ore*:—(In beds in serpentine: townships of Ham, Bolton, and Melbourne. Mount Albert: Schickshock Mountains of Gaspé). *d*) *Hæmatitic* and *Magnetic Iron Ores*:—(in beds: townships of Brome and Sutton). *e*) *Galena*;—(Sutton, Chaudière Valley). *f*) *Carbonate of Magnesia*, *Soapstone*, and *Potstone*:—(Sutton, Bolton). *g*) *Marble*;—(Parish of St. Armand (white, black, &c). St. Joseph (red, with white veins). *h*) *Serpentine* and *Serpentine-Marble*:—(Mount Albert, Gaspé; St. Joseph, Beauce Co.; townships of Oxford, Melbourne, &c). *i*) *Roofing Slates*:—(Melbourne, Cleveland, Oxford, Tring, Kingsey. Walton's quarry, near Richmond (Melbourne township), is in active operation. The cost of the slates delivered and loaded on the cars at Richmond, is four dollars per 100 square feet for those of large size (24in. x 12), and two and a quarter dollars for the smaller size (11in. x 6). *j*) *Whetstones*:—(Stanstead, Hatley, Bolton, Kingsey).

Calciferous Strata of Lake Superior:—These strata form the

* The reader will find various details of much interest on the copper mines, slate quarries, &c., of the Eastern Townships and other counties of the Quebec Formation, in the Descriptive Catalogue of the Economic Minerals of Canada in the London International Exhibition of 1863, by Sir W. E. Logan.

higher beds of the upper copper-bearing series of the lake region,—the lower beds of this series, as explained above, being now generally referred to the Potsdam Group. They consist of quartzose sandstones, red and greenish sandstone conglomerates, various limestones and shales, and interstratified masses of compact and amygdaloidal trap. These beds are also intersected by numerous trap or greenstone dykes; and a vast mass of trap, in places of a basaltic character, generally caps the entire formation. The total thickness of the group is estimated by Sir W. Logan as not far short of 10,000 feet. The cavities in the bedded amygdaloidal traps are filled with agates, amethyst-quartz, calc spar, various zeolites, green earth, epidote, specular iron ore, native copper, &c. Some of the intrusive dykes are porphyritic, and a few consist of syenite. (See PART III). The greenstone dykes present everywhere a transverse columnar structure, and are frequently of great width. As they usually resist the disintegrating action of the water and the atmosphere better than the main body of the rocks which they traverse, they often stand out in relief and form buttress-like masses extending into the lake, so as to produce many natural harbors and breakwaters. The rocks of this series are also traversed by a considerable number of mineral veins belonging, according to the officers of the Survey, to two distinct systems, some being parallel with the range of the strata, whilst others run in a converse direction to this. The veinstones consist usually of calc spar, heavy spar, or quartz; but sometimes of chert or agate, or of the above substances mixed with various zeolites, fluor spar, copper, copper-glance, the common and purple copper pyrites, galena, and blende, in addition to much iron pyrites. The more important metallic sites comprise Prince's Location (native silver and silver glance); Harrison's Location, St. Ignace Island (native copper with native silver); Mamainse (native copper and copper ores); and Michipicotin Island. At the latter locality, native copper (in places slightly argentiferous) occurs not in a vein, but in nodules distributed through a bed of amygdaloidal trap. The other economic minerals of these rocks, include the sulphate of baryta (heavy spar) of Thunder Bay; the amethyst quartz of the same locality; and the agates of Michipicoten and St. Ignace.

Exposures of these higher beds of the upper copper-bearing series, occur principally on the south-east side of Thunder Bay, where they form an escarpment of white sandstone (the bottom rock of the higher group) about 200 feet high; also between Thunder Bay and Black

Bay; at Granite Islet, Point Porphyry, Edward Island, the mouth of the Neepigon River, the Battle Islands, St. Ignace, Michipicoten, Cape Gargantua, Batchehwahnung Bay, and Mamainse. (Various interesting details respecting these and other less prominent localities of the rocks in question, will be found in the Revised Report on the Geology of Canada by Sir William Logan and his colleagues.)

The Chazy Formation:—This series of strata derives its name from the town of Chazy, in Clinton county, N. Y. It forms a transition series between the underlying Calciferous beds and the overlying deposits of the Trenton Group. In Canada, it consists principally of grey, brownish-black, and other coloured limestones, with shales and calcareous sandstones, the latter chiefly at the base of the formation. The limestones are sometimes dolomitic, and sometimes bituminous; and they exhibit in places a concretionary structure. Many are highly fossiliferous. Some of the more common fossils comprise *Leperditia Canadensis* (a bivalve entamostracan, fig. 163), and *Rhynconella plena* (a brachiopod, fig. 164). Also, the coral *Stenopora fibrosa* (fig. 165*a*), which ranges into the higher rocks;

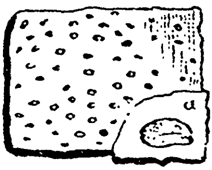


Fig. 163.—*Leperditia Canadensis* (Jones).

Fig. 164 —*Rhynconella plena* (Hall).

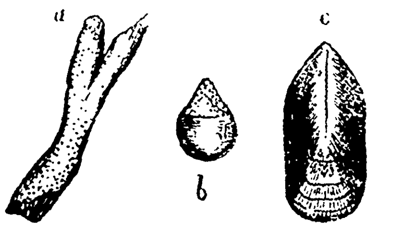


Fig. 165.—*a*. *Stenopora fibrosa* (Goldfuss).
b. *Bolboporites Americanus* (Billings).
c. *Lingula Lyellii* (Billings).

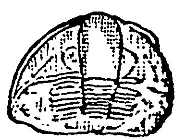


Fig. 166.—*Bathyurus Angelini* (Billings).

a peculiar form of uncertain character, *Bolboporites Americanus* (fig. 165 *b*); and *Lingula Lyellii* (fig. 165 *c*). This latter fossil at Allumettes Rapids on the Ottawa, is accompanied by numerous dark nodules consisting chiefly of phosphate of lime, and supposed to be coprolites. *Bathyurus Angelini* (fig. 166) is a trilobite belonging to this formation. It has been found in the townships of Huntley, Ramsay, Grenville, &c.

The principal economic materials of the Chazy beds (exclusive of those from the altered rocks of the Eastern Townships as described under the Quebec Group, above: some of these rocks being probably of Chazy age) comprise—a dolomitic limestone from the township of Nepean in Carleton county, yielding the well-known "Hull cement;" grey, and grey-and-red fine-grained limestones, capable of employment as marble, from Caughnawaga, Montreal, the Lake of Two Mountains, St. Dominique, and St Lin, in Canada East; a thin-bedded limestone, filled with *rhynconella plena*, and largely quarried for tombstones and table-tops, from L'Orignal on the Ottawa; an excellent sandstone for building purposes. from near Pembroke, in Renfrew county, on a higher part of the Ottawa River; and good limestones for the same purpose, from Montreal, Caughnawaga, Hawkesbury, and other localities.

The sandstones of the Sault Ste. Marie and surrounding district, (formerly regarded as belonging to the Potsdam Group), are now thought to be of Chazy age; but otherwise the Chazy formation has not been definitely recognized west of Kingston, although it may perhaps be slightly developed between the Potsdam sandstone and the limestones of the Black River formation in the townships of Storrington and Loughborough. In the area east of Kingston, between the Ottawa and the St. Lawrence, it occurs somewhat extensively. Exposures are seen in the townships of Nepean, March, Ramsay, Huntley, Hawkesbury, &c., of that region. It occurs also largely on the other side of the Ottawa, in the townships of Chatham, Grenville, Longueuil (Prescott county), and especially around the city of Montreal. It is found likewise in places farther east, between that point and the River Chicot; and again in the Mingan Islands.

The Trenton Group:—This group derives its name from Trenton in New York. The lower beds of the group have been separated from the higher beds, and referred to two distinct formations, called, respectively, the Bird's Eye and the Black River Limestones; but in Canada, a separation of this kind cannot be definitely carried out. As certain fossils, however, are restricted *locally* to the bottom beds of the group, or are more especially characteristic of these, the terms Bird's Eye and Black River Limestone, or the latter alone, is occasionally employed in reference to the beds in question: thus partially recognising two sub-formations, the Bird's Eye and Black River (united) below, and the Trenton proper, above. The strata of the entire group average from 600 to 700 feet, and consist almost wholly of limestones, usually of a grey or black colour, and more or less bituminous. Here and there a bed of sandstone, rarely exceeding two or three feet in thickness, and a thin seam of calcareous clay, may occur amongst the series; but limestone rocks essentially characterize the formation. Some of these are thick, and others thin-bedded, the latter passing into limestone shales. Fossils are exceedingly abundant in most of these beds. Those more especially characteristic of the lower sub-division, comprise:—*Tetradium fibratum* (fig. 167), *Columnaria alveolata* (fig. 168), *Stromatopora rugosa*

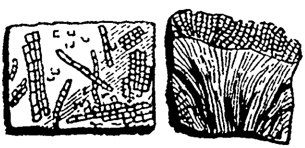


Fig. 167.- *Tetradium fibratum* (Safford).

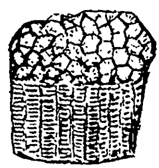


Fig. 168. - *Columnaria alveolata* (Goldfuss).

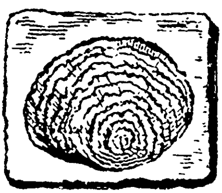


Fig. 169.—*Stromatopora rugosa* (Hall).

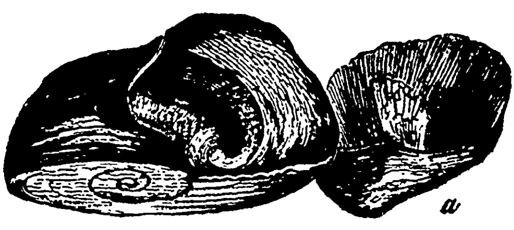


Fig. 170.—*Maclurea Logani* (Hall).

(fig. 169), *Maclurea Logani* (fig. 170), *Ormoceras* (Orthoceras) *tenuifilum* (fig. 171), *Ormoceras* (Gonioceras) *anceps* (fig. 172), and other orthoceratites with beaded siphuncle (see *ante*, PART IV.) Also species of *Lituites*, *Cyrtoceras*, and *Phragmoceras* (figs. 173, 174, and 175).

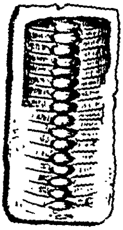


Fig. 171.—*Ormoceras tenuifilum* (Hall).

Fig. 172.—*Ormoceras anceps* (Hall).

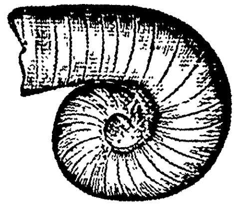


Fig. 173.—*Lituites undatus* (Hall).

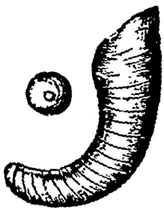


Fig. 174.—*Cyrtoceras annulatum.*

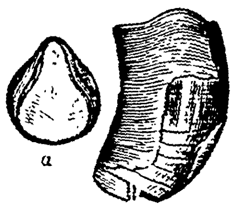


Fig. 175.—*Phragmoceras prœmaturum* (Billings).

Fig. 176.—*Oncoceras constrictum* (Hall).

The more characteristic or otherwise interesting fossils of the Upper or Trenton subdivision, properly so-called, are exhibited in the following figures. The zoological positions and affinities of these have already been indicated in PART IV.

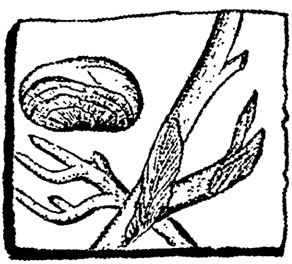


Fig. 177.—*Stenopora fibrosa** (Goldfuss).

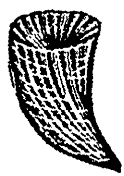


Fig. 178.—*Petraia cornicula* (Hall).

Fig. 179.—*Glyptocystites Logani* (Billings).

* The circular varieties of this coral are sometimes known as *S. petropolitana.*

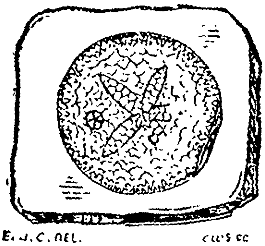


Fig. 180.—*Agelacrinites Billingsii* (Chapman).

Fig. 181.—*Lingula quadrata* (Hall).

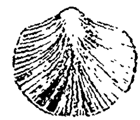


Fig. 182.—*Orthis testudinaria* (Dalman).

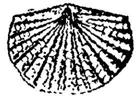


Fig. 183.—*O. pectinella* (Conrad).

Fig. 184.—*O. tricenaria* (Conrad).

Fig. 185.—*O. lynx* (Eichwald).

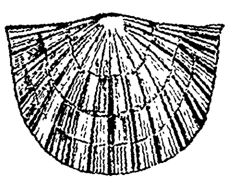


Fig. 186.—*Strophomena alternata* (Conrad).

Fig. 187.—*Rhynconella increbescens* (Hall).

Fig. 188.—*Camerella hemiplicata* (Billings).

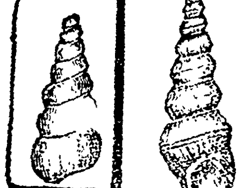


Fig. 189.—*Murchisonia gracilis* (Hall).

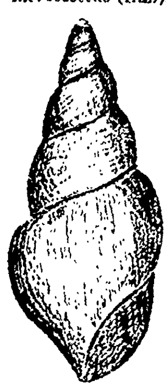


Fig. 190.—*M. subfusiformis* (Hall).

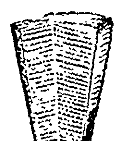


Fig. 191.—*Conularia Trentonensis* (Hall).

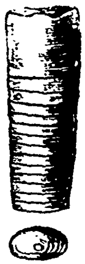


Fig. 192.—*Orthoceras lateralis* (Hall).

Fig. 193.—*O. bilineatum* (Hall).

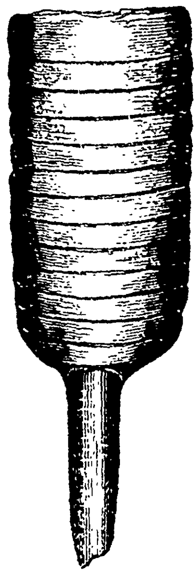


Fig. 194.—*Endoceras proteiforme* (Hall).

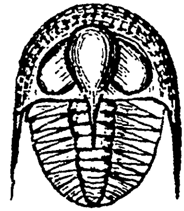


Fig. 195.—*Trinucleus concentricus* (Eaton).

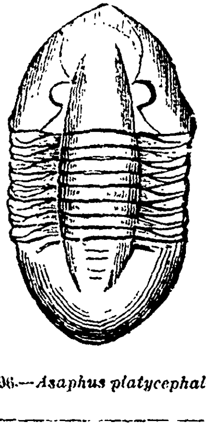


Fig. 196.—*Asaphus platycephalus*† (Stokes).

† *Asaphus megistos*, from Cobourg, is a closely related species, but with the posterior angles of the head-shield prolonged into horns. See *ante*, PART IV.

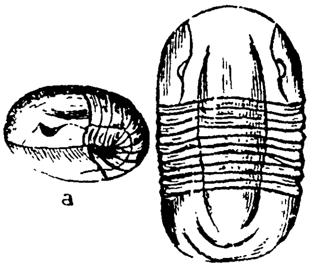


Fig. 196 *a.* *Illænus crassicauda* (Hall).

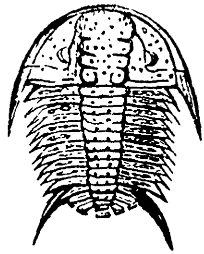


Fig. 197.—*Ceraurus pleurexanthemus* (Green).

Some of the limestones of the Trenton Group are sufficiently fine-grained to take a good polish, and hence to be employed as marble. To these belong, more especially, a dark or chocolate-brown variety from the River Mississippi in the township of Pakenham (Lanark Co.), and grey varieties from the township of Gloucester (Carleton Co.), and from Montreal. Good building stones are quarried in La Chevrotière (the so-called Deschambault stone, of which the principal buildings in Quebec are constructed), at Montreal, Point Claire, Mille Roches in Cornwall township, Kingston, Ox Point near Belleville, Cobourg, Lake Conchiching north of Lake Simcoe, and various other localities. The Lake Conchiching stone is highly silicious, and consequently difficult to dress, although exceedingly durable. Excellent lime is also obtained from most of the limestones of this group. A thin light-coloured bed belonging to the lower part of the series, and which may be traced with slight interruption from Marmora to Lake St. John in the township of Rama, yields also a lithographic stone of useful quality. Near the mouth of the Coldwater River on Georgian Bay, likewise, a thin greenish sandstone, quite at the base of the series, has been long used by the Indians for the manufacture of pipe-bowls, &c. It is easily worked at first, being comparatively soft until after exposure for some time to the atmosphere.

The limestones of the Trenton Group are extensively developed in both Western and Eastern Canada. In the former (see the Map, fig. 249, in which this group is denoted by the number 6), they occur largely in the counties of Prescott, Russell, Carleton, Renfrew, Lanark, &c., between the Ottawa and the St. Lawrence, and especially around Ottawa City; but they occupy a still more extensive area on the west side of the Laurentian belt, already so frequently alluded to as separating the Silurian deposits of the basin between the two rivers, from the same deposits of the region west of Kingston. In this latter district, they form the north shore of Lake Ontario to the neighbourhood of Cobourg, and stretch northwards into the townships of Loughborough, Portland, Camden, Hungerford, Madoc, Marmora, and Dummer; and northwestward along the southern outcrop of the Laurentian rocks up to near the mouth of the River Severn on Georgian Bay,—a line of small lakes occurring for a great part of this distance between the highly-tilted gneissoid strata and the nearly horizontal Black River and Trenton beds. From a little west of Cobourg, the other or more westerly limit of the Trenton outcrop runs also to the north-west, and comes out on Georgian Bay a short distance west of Collingwood. The whole of Lake Simcoe, with Balsam, Rice, and other smaller lakes, lies thus within the Trenton area; but the country is much covered by drift deposits, so that exposures of rock are not of very frequent occurrence except along the northern limit of the formation as given above, and at these points, the Black River or lower subdivision is chiefly exposed. The upper or Trenton beds, on the other hand, come out chiefly on Lake Ontario. Still farther to the west, the formation runs across the northern portions of Manitoulin Islands, and is also seen in Lacloche, Mississague. the Snake, and other smaller islands, along the north shore of Lake Huron. It occurs finally on the north part of St. Joseph Island at the entrance of St. Mary's River. The underlying sandstone of this island, as well as the sandstone beds of Sault Ste. Marie, formerly referred to the Potsdam series, are now looked upon as representatives, in this region, of the Chazy formation.

In Eastern Canada, exposures of the Trenton Group occur more particularly at and around the village of Caughnawaga, on the south bank of the St. Lawrence; at Point Claire; around Montreal; on Isle Jésus, Isle Bizard, &c.; at St. Lin, and in the environs of that village; at St. Rocque and other places on the Achigan, as well as on the rivers Naquarean, Bayonne, and Chaloupe, and here and there between these points and the River St. Maurice; at various places in the seigniories of Portneuf, Deschambault, and La Chevrotière; at Pointe aux Trembles on the St. Lawrence; Quebec and its vicinity; around the Montmorenci Falls; on the River Ste. Anne; at Cape

Tourmente and Cape Aux Rets; on the Gouffre river; in the seignory of Les Eboulemens; at Murray Bay; and at Lake St. John on the Saguenay. These localities of the Trenton Group in Eastern Canada, with others of less importance, are described very fully in Sir William Logan's Revised Report on the geology of the Province.

The Utica Formation :—This subdivision (named after the City of Utica in the State of New York) is generally known as the Utica Slate Formation. It comprises a series of dark-brown bituminous shales, interstratified here and there with a few beds of dark limestone. The shales weather light-grey, and yield by decomposition a soil of much fertility. In Western Canada, the entire thickness of the formation is under one hundred feet; but in parts of Canada East, it is at least three times that amount. Considerable difficulty, however, is experienced in separating the Utica beds from the overlying deposits of the Hudson River Group, and sometimes, also, from the underlying Trenton strata—certain fossils ranging throughout the three groups, and beds of passage occurring likewise between these. Anthracitic matter, as in many other of our rock formations, is occasionally found in thin coatings on the surface of the shale beds. In some districts, as in the townships of Collingwood and Whitby, C. W., these shales are sufficiently bituminous to yield profitable amounts of mineral oil and gas for illuminating purposes. The Collingwood shales have afforded about twenty gallons of oil to the ton; but the distilleries of that place have now ceased working, chiefly in consequence of the large and cheap supply of mineral oil furnished to commerce by the "oil-wells" of the West.

The following figures exhibit the more characteristic fossils of the Utica formation.

Fig. 198.—*Graptolithus pristis* (Hisinger).

Fig. 199.—*Lingula obtusa* (Hall.)

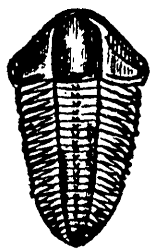


Fig. 200.—*Triarthrus Becki* (Green).

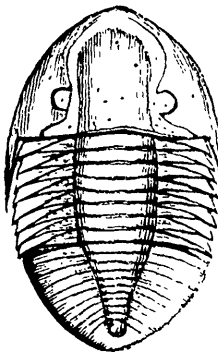


Fig. 201.—*Asaphus Canadensis* (Chapman).

In addition to the above forms, several species of brachiopods, which occur also in both the Trenton and Hudson River Groups, are also frequently met with. The most abundant of these comprise: *Orthis testudinaria* (fig. 182), *Strophomena alternata* (fig. 186), *Rhynconella increbescens* (fig. 187), and *Leptæna sericea* (fig. 204).

In Western Canada, the Utica formation (No. 7 on the map, fig. 249) occupies a small area in the immediate vicinity of Ottawa city, another in the township of Cumberland, and a third in Clarence and Plantagenet (Counties of Russell and Prescott); but it is far more extensively developed in the geological region on the western side of the gneissoid belt which crosses the St. Lawrence at the Thousand Isles. In this region, it forms the shore of Lake Ontario from a little west of Cobourg to the township of Pickering, and sweeps from these points to the north-west, coming out at Georgian Bay in the townships of Nottawasaga and Collingwood. Within the intervening space, however, it is entirely obscured by a thick capping of Drift deposits. It appears also in a narrow band in the Manitoulin Islands; more especially in the neighbourhood of Cape Smyth; and is obscurely seen on St. Joseph's Island. The best exposures in Western Canada, occur near Ottawa City; on and adjacent to the shore of Lake Ontario, in the township of Whitby; in Nottawasaga Bay under the "Blue Mountains," a few miles west of Collingwood Harbour; and at Cape Smyth and some of the neighbouring bays and small islands of the Manitoulin group.

The formation in Eastern Canada, presents in many localities a considerable developement. Exposures occur at Montreal, and in the vicinity of that city, where the shales are much penetrated by trap dykes; also on the Richelieu River, and in the adjoining district; here and there on the north shore of the St. Lawrence, between Montreal and Quebec, as on the St. Maurice and Achigon rivers; largely in the vicinity of Quebec itself, and more especially about Beauport and the Falls of Montmorenci, and along the north shore of the Island of Orleans; again near Cape Tourmente; and at Lake St. John on the Saguenay.

The Hudson River Formation.—The strata of this sub-division in Western Canada, consist essentially of arenaceous shales. These are chiefly of a bluish or greenish-grey colour, but become brown by weathering. They are occasionally interstratified with layers of ordinary sandstone, and with a few beds of limestone—their extreme thickness being about 700 feet. In Eastern Canada, the formation consists also in chief part of shales of a similar character, mixed with subordinate beds of bituminous shale, conglomerate, and limestone. Its thickness in the vicinity of Quebec is estimated at about 2000 feet; but in Western Canada, it does not exceed 700 or 750 feet in thickness. Many of its fossils are identical with those of the Trenton and Utica groups; but certain forms are peculiar to it; and others (such as *ambonychia radiata, modiolopsis modiolaris, &c.*) although occasionally occurring in the Trenton group, are more particularly characteristic of the present formation. The accompanying figures represent some of the most important of these fossilized remains.

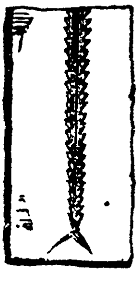


Fig. 202.—*Graptolithus bicornis* (Hall.)

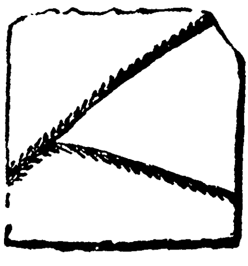


Fig. 203.—*G. ramosus* (Hall.)

Fig. 204.—*Leptæna sericea* (Sowerby)

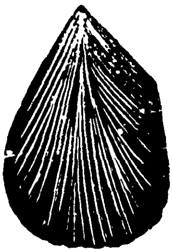


Fig. 205.—*Ambonychia radiata* (Hall.)

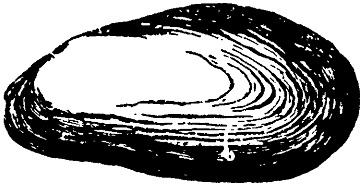


Fig. 206.—*Modiolopsis modiolaris* (Conrad).

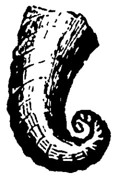


Fig. 207.—*Cyrtolites ornatus* (Conrad)

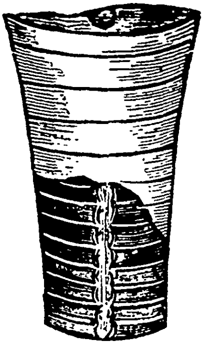


Fig. 208.—*Orthoceras crebriseptum* (Hall).

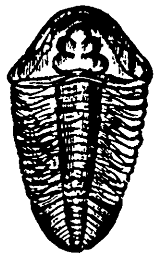


Fig. 209.—*Calymene Blumenbachii* (Brogniart).

In addition to the above, the following species (figured under the Trenton Group, on a preceding page) are also of common occurrence:—*Stenopora fibrosa* (fig. 177); *Petraia cornicula* (fig. 178); *Orthis testudinaria* (fig. 182); *Strophomena alternata* (fig. 186); *Rhynconella increbescens* (fig. 187); *Orthoceras bilineatum* (fig. 193); *O. lateralis* (fig. 192); *Trinucleus concentricus* (fig. 195); *Asaphus platycephalus* (fig. 196); *and Illænus crassicauda* (fig. 196 *a*).

In western Canada, the Hudson River formation occurs as an outlier in the vicinity of Ottawa City, associated with the bituminous shales of the Utica series. Its chief development in this section of the Province, however, is between the more western extremity of Lake Ontario, and the Western shores of Georgian Bay. It forms the shore-line of Lake Ontario from the River Rouge in the Township of Pickering (Ontario Co.), to the River Credit in Toronto township (Peel Co.); and sweeps from these points to the north and north-west, coming out on Georgian Bay in the townships of Collingwood, St. Vincent, Keppel, and Albemarle. Lonely Island and the other islands between Cabot's Head and the Manitoulins are also composed of Hudson River strata; and the formation runs through the Manitoulin group, and across Drummond Island—reappearing in Sulphur Island, and on the north shore of St. Joseph's Island, from whence it passes into Michigan. Instructive exposures, from which many fossils may be collected, occur more particularly on the banks of the Don, Humber, Mimico, Etobikoke, and Credit, along the southern outcrop of the formation. Also at Point Boucher in Nottawasaga Bay; Point Rich, Point William, Cape Crocker, and Point Montresor, further west along the coast. On Lonely and Rabbit islands, at Cape Smyth, and various points along the north shore of the great Manitoulin; and on the northern headlands of Cockburn Island.

In Eastern Canada, the formation is exposed more particularly on the banks of the Richelieu, about Chambly, and on the Rivière des Hurons and the Yamaska, these rivers probably running, according to Sir William Logan, on three parallel anticlinals. Also on the south shore of the St. Lawrence, between St. Nicholas and the Rivière du Chêne; around Quebec, and largely at the Montmorenci Falls; and on the north side of the Island of Orleans. It has been discovered also on Snake Island, Lake St. John; and likewise on the coast of Gaspé, between Cape Rosier and the River Marsouin, and more especially about the Magdalen River. Finally, the Hudson River Formation occurs in force along the north coast of the Island of Anticosti, where it is principally composed, however, of argillaceous limestone. The remarkable fossil bodies named *Beatricea* by Mr. Billings, were discovered at this locality, and also at Lake St. John, some years ago, by Mr. Richardson of the Geological Survey. These fossils resemble petrified fragments of the trunks and limbs of large trees. Their true nature is still doubtful, but they are generally regarded as belonging to an extinct genus of corals.

The Hudson River formation is not rich in economic materials, but it yields in places some tolerably good flagging stones. At the "Blue Mountain," in Collingwood township, whetstones of fair quality are also obtained from this formation; and certain strata near Quebec furnish a good hydraulic cement. A very strong cement has likewise been manufactured from a dark dolomitic bed of this age, occurring on the Magdalen River, in Gaspé.

Middle Silurian Series. The rocks of this series, as explained on a preceding page, originally formed part of the Upper Silurian division. They have been separated from the latter, by the officers of the Canadian Geological Survey, in consequence of certain peculiarities connected with their occurence in the Island of Anticosti. In this island, situated at the entrance of the St. Lawrence Gulf, the rocks in question contain fossils belonging to both the Lower and Upper Silurians (as occurring elsewhere), and thus appear to offer a traditional series, or middle term, between these two divisions.* They compose the "Anticosti group" of Sir W. E. Logan, with the overlying Guelph deposits; and present, in ascending order, the following formations:—(1.) The Medina and Clinton Formation; (2.) The Niagara Formation; and (3.) The Guelph Formation. These, as regards Western Canada, might fairly be grouped together, under the term of the *Niagara Group.*

Medina and Clinton Formation.—In the State of New York, the rocks of this subdivision constitute two more or less distinct sets of strata; but in Canada, the upper or Clinton series merges on the one hand into the underlying Medina beds, and, on the other, into the succeeding Niagara series. Its deposits consequently are partitioned off between these two formations, the term "Clinton" being, however, retained to designate the higher strata of the first or lowermost of these. Thus defined, the Medina and Clinton subdivision consists in Canada of red and green arenaceous shales, succeeded by a coarse and somewhat loosely consolidated sandstone of a red colour, with overlying soft red marls and shaly beds, striped and spotted with green, and capped by a bed of grey sandstone (known as the "grey band,") of from ten to twenty feet in thickness. These strata, about 614 feet in thickness at the western extremity of Lake Ontario, constitute the Medina series proper. The succeeding Clinton beds comprise a series of green, greyish, and red shales—the latter, highly ferruginous—with some interstratified limestones and dolomites. At the mouth of the Niagara River, the Clinton division, as thus defined, is merely a few feet thick; but it increases in thickness towards the north-west, and attains to about 180 feet on the shores of Georgian Bay, by Cabot's Head.

* The same holds good however, to some extent, in other localities.

In the annexed section, 1 indicates the higher portion of the Medina beds; 2, the grey band, which forms the upper limit of this series; 3, the Clinton strata; and 4, 5, and 6, the succeeding calcareous beds of the Niagara formation. In the Medina deposits, fossils are exceedingly rare. They appear with us to be limited to fucoids, and to a single species of lingula of a triangular or cuniform outline (*L. cuneata*.) The most characteristic fucoid is the *Arthrophycus Harlani*, (fig. 211), a form which occurs also, and more abundantly, in the Clinton beds. These latter contain, in addition, various corals, brachiopods, trilobites, &c.; many of which, however, belong likewise either to the succeeding Niagara formation, or to some of the Hudson River or Trenton beds of the Lower Silurian series. Some of the most abundant comprise: *Stenopora fibrosa*, (fig. 117,) *Heliopora fragilis*, (fig. 212,) *Favosites Gothlandica*, (fig. 214,) *Strophomena rhomboidalis*, (fig. 232,) *Orthis lynx*, (fig. 135,) *O. elegantula*, (fig. 218,) *Spirifer radiatus*, (fig. 220,) *Atrypa reticularis*, (fig. 240,) and *Calymene Blumenbachii*, (fig. 209.)

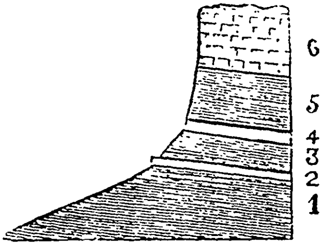


Fig. 210.

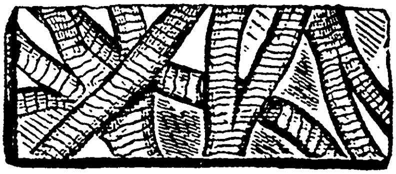


Fig. 211.—*Arthrophycus Harlani* (Hall.)

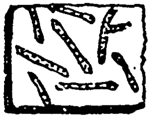


Fig. 212.—*Heliopora fragilis* (Hall.)

This formation (Nos, 9 and 10, the latter denoting the upper or Clinton beds, in the sketch map, figure 249) constitutes the greater portion of the south shore of Lake Ontario, and sweeps round the western extremity of the lake, by Hamilton, &c., to within a short distance of Oakville. From these points, it runs in a general northerly and north-westerly direction through East and West Flamborough, Nelson, Caledon, &c., up to the western extremity of Georgian Bay, where its higher strata form the lower and middle portion of the promontory of Cabot's Head. From Queenston, where it enters Canada, along the whole of this distance, the formation is capped by an escarpment or cliff-face of the succeeding Niagara strata; whilst the "grey band" at the top of the Medina subdivision proper, stands out in many places as a distinct terrace below the sloping bank formed by the out-cropping but debris-covered edges of the Clinton beds. Further to the west, the formation is seen in the Manitoulin Islands. Some of the more instructive exposures occur at Queenston, and in the gorge of the Niagara river; at the Welland Canal in Thorold; at St. Catherines; near Jordan in Louth township; on Stoney Creek, in Saltfleet; at Hamilton; Wellington Squaré; Dundas and its neighborhood; Waterdown in East Flamborough; Georgetown; Esquesing; on the River Credit in the township of Caledon; on several creeks in Nottawasaga; at Owen Sound and on the Sydenham River; and at Cape Commodore and along part of the adjacent coast up to Cabot's Head.

In Eastern Canada, the Medina and Clinton formation has not been definitely recognised; but Sir William Logan states that an escarpment of red shales overlying the Hudson River series, on the south shore of the St. Lawrence, between the rivers Nicolet and Gentilly, together with another restricted patch of a similar character, in that district, may very probably be referred to the Medina division.

The only important economic materials belonging to the formation, are derived from the Grey Band at the top of the Medina beds, and from a dark dolomitic limestone of the Clinton subdivision. The former yields an excellent building stone, and also grindstones of good quality, (Hamilton, Dundas, Waterdown, Georgetown, &c.,); whilst from the latter, about Thorold and St. Catherines more especially, a strong water-lime (known as Thorold cement) is largely manufactured.

The Niagara Formation:—The group of strata thus named, includes, in Canada, the upper portion of the Clinton subdivision as recognized by the geologists of the New York Survey, together with

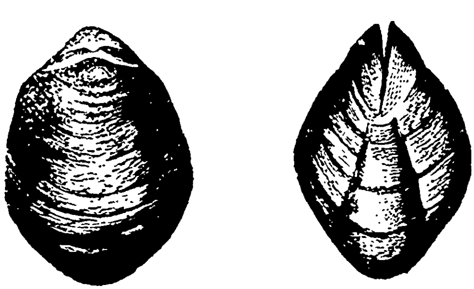


Fig. 213.—*Pentamerus oblongus* and *Internal cast.*

the Niagara beds proper. Thus defined, the formation consists at its lower part of about twenty feet of dark-grey limestone (in part dolomitic, and in which the well-known *Pentamerus oblongus,* fig. 213, first appears), followed by a considerable thickness of dark, more or less bituminous, thin-bedded limestones or calcareous shales, which in their turn are overlaid by dark, thick-bedded limestones, also of a bituminous character. These relations are shewn in the sections, fig. 210: beds 4, 5, and 6. At the Falls of Niagara, the calcareous shales make up a thickness of about 80 feet, and the thick-bedded strata which succeed, and over which the cataract breaks, exhibit about the same amount; but in adjoining localities it attains a thickness of 165 feet. Thin bands of gypsum occur in both the shales and limestones; and the latter contain, in various places, small cavities and fissures filled with crystals of calc spar, pearl spar or dolomite, gypsum, blende, galena, &c. They often enclose, also, peculiar casts of somewhat doubtful origin. The general form of these is shewn in figure 214. Casts of this kind occur not only in the present formation, but likewise occasionally in the Trenton limestones, and in the strata of the Onondaga and various other groups. They are generally known as *crystallites* or *epsomites,* and have probably been formed by the infiltration of carbonate of lime into spaces previously occupied by crystalline masses of sulphate of magnesia or soda, or of some other soluble mineral. Many of the Niagara beds are exceedingly rich in fossils. Some of the more characteristic of these (in addition to the *Pentamerus oblongus* depicted above) are shewn in the following figures:—

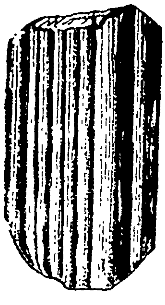


Fig. 214

Fig. 215—*Favosites Gothlandica* (Goldfuss).

Fig. 216.—*Halysites catenulatus* (Linnæus).

Fig. 217.—*Fenestella elegans* (Hall).

Fig. 218.—*Orthis elegantula* (Dalman).

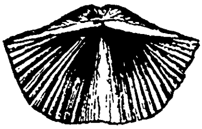


Fig. 219.—*Spirifer Niagarensis* (Conrad).

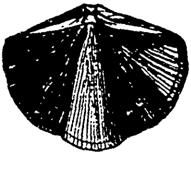


Fig. 220.—*S. radiatus* (Sowerby).

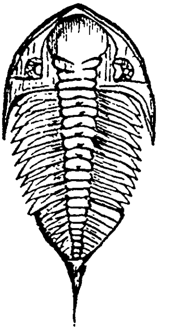


Fig. 221.—*Dalmannites limulurus* (Green).

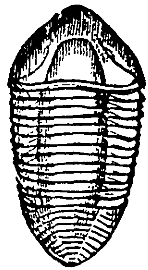


Fig. 222.—*Homalonotus delphinocephalus* (Green).

In addition to the above forms, *Strophomena rhomboidalis* (fig. 232), *Atrypa reticularis* (fig. 240), *Calymene Blumenbachii* (fig. 209), with various other species, are likewise more or less abundant. Some of the beds of this formation consist in great part also, of broken stems and other fragmentary remains of crinoids.

The Niagara formation (No. 11 in the sketch map, fig. 249) is well displayed around the great Falls and along the gorge of the Niagara River. The abrupt cliff-face or escarpment, which runs with slight interruption from that locality, to Cabot's Head on Georgian Bay, through portions of the Counties of Lincoln, Wentworth, Halton, Peel, Simcoe, and Grey, is made up principally of this series of strata. The formation constitutes also, Fitzroy Island, the "Flower Pots," &c., together with the southern portion of the Manitoulin Islands—from whence, turning to the south west, it extends along the western shore of Lake Michigan. Good exposures occur more particularly at the

Falls, and along the Niagara River between these and Queenston; also on the Welland Canal near Thorold: in the vicinities of Hamilton, Ancaster, Dundas, and Rockwood; at Belfontaine on the River Credit in the Township of Caledon; at various points in Mono, Mulmur, Nottawasaga, Artemisia, and Euphrasia Townships, where it forms high cliffs, more especially at the Nottawa and Beaver Rivers; Owen Sound and neighbourhood; Cape Paulet on Georgian Bay, and along the coast to Cape Chin; and likewise at Cabot's Head. At this latter locality, the lower part of the cliff, to a height of about 180 feet, consists of the Clinton subdivision—the Niagara beds resting upon this up to the summit of the promontory.

The annexed figure exhibits the Niagara and underlying strata as occurring in the gorge of the Niagara River between the Falls (*F*) and Queenston (*Q*). The dip of the beds, however, is unavoidably somewhat exaggerated.

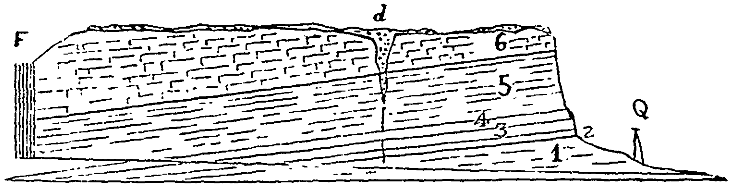


Fig. 223.—Section of the Niagara, Clinton, and Medina strata in the gorge of the Niagara River, between the Falls and Queenston.

1 = Red marls and shales (Medina).
2 " Grey Band" (Medina)
3 = Greenish shales (Clinton).
4 = Layer of Pentamerus limestone (Old Clinton; now referred to the Niagara Group).
5 = Calcareous shales (Niagara).
6 = Niagara limestone.
d, Drift and Post-Tertiary accumulations.

In the accompanying sketch, fig. 224, a section of the rocks across the Falls is shewn, with Goat Island (*G*) in the centre. No. 5, as in the preceding sketch, indicates the Niagara shales; No. 6, the thick bedded limestone; and *d* the Drift and Post-tertiary deposits. *A* denotes the American side, and *C* the Canadian shore. The Post-tertiary accumulations will be alluded to more fully in our description of the Drift and succeeding deposits; but it may be observed that the more recent of these accumulations contain shells of the *unio, cyclas, melania,* and other fresh-water types now inhabiting the river, and evidently indicate, as first pointed out by Sir Charles Lyell and Professor James Hall of Albany, an ancient and at one time continuous deposit spread over the original river-bed. Accumulations of a similar character occur, however, in various parts of the Western Province, and were produced by our lake waters when these were united into one vast fresh-water sea, as explained in a subsequent part of this Essay.*

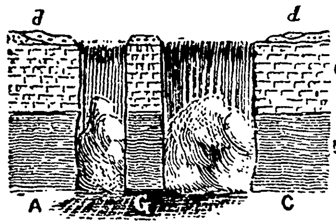


Fig. 224.

The limestones of the Niagara Formation yield excellent building materials, and quarries have been opened in these beds at Rockwood, Owen Sound, and other places.

In Eastern Canada, the Niagara strata, or rocks of the same geological horizon, are thought to occur in Gaspé, on the Chatte, Rimouski, and other rivers, and on Lake Metapedia; but much uncertainty still prevails with regard to the true position of these beds. They form the lower portion of the strata provisionally known as the "Gaspé limestones." In the Island of Anticosti in the Gulf of the St. Lawrence, however, there is a great display of limestone rocks undoubtedly of Middle Silurian age: the equivalents consequently of the Medina and Clinton, combined with the Niagara Formation. Along the more northern shore of the island, there runs a belt of Hudson River strata, as explained in our remarks under that formation; and this is succeeded by the limestones in question. These, with a few interstratified shales, occupy all the rest of the island, and make up, according to Mr. Richardson of the Geological Survey, a thickness of nearly 1,400 feet. The numerous fossils which they contain, have on the whole an essentially Upper Silurian character, but certain forms amongst them appear to establish a connecting link or passage between the Lower and Upper subdivisions of the Silurian series as

* See a paper by the writer, on the ancient extension of our lake area, &c., in the *Philosophical Magazine* for July, 1861, and in the *Canadian Journal*, Vol. VI, p. 221. Also an article by Robert Bell, of the Canadian Geological Survey, in the *Canadian Naturalist* Vol. VI.

originally recognised: hence the separation of the so-called Middle Silurian series—these Anticosti beds being taken as the type of the latter subdivision. The expediency of the separation, however, is somewhat questionable.

Finally, with regard to the Niagara Formation, it may be observed that limestone strata of apparently the same age, but resting on Huronian rocks, have been discovered at Lake Temiscamung, north of the great Laurentian water-shed which separates the northern geological area of Canada from the western and eastern areas of the south. See the general sketch of the distribution of our rock formations, a few pages further on.

The Guelph Formation:—The rocks of this formation, unlike the Niagara and other Canadian strata, have not been traced beyond the limits of the Province. The "Leclaire limestone" of Iowa, which at one time was thought to belong to the same geological horizon, is now referred by Professor Hall to the Niagara subdivision. The Guelph Formation, as known in Canada, follows the more western limit of the Niagara area, and occurs especially in the vicinities of Galt and Guelph. According to Sir William Logan, it appears to form a lenticular-shaped mass, gradually thinning out both westward in Lake Huron, and in the neighbourhood of Ancaster, in the east. Its greatest thickness is estimated at about 160 feet. Its strata consist essentially of white or light-coloured dolomites mostly of a peculiar semi-crystalline or granular texture. These yield excellent building materials.

Many of the enclosed fossils are identical with those of the Niagara beds, as *Favosites Gothlandica* (fig. 215), *Halysites catenulatus* (fig. 216), &c., but others appear to be confined to this formation.

Fig. 225.—Casts of *Megalomus Canadensis* (Hall).

Amongst these, the most characteristic is the *Megalomus Canadensis*, usually found in the form of internal casts, as shewn in fig. 224.*

As a general rule, the fossils in these beds are somewhat obscure, and not very abundant. The principal exposures of the formation occur on the River Speed in the vicinity of Guelph ; at Elora, on the Irwine and Grand River, where it presents vertical cliffs over eighty feet in height ; at Hespeler on a branch of the Great Western Railway, ; and lower down the Grand River, at Preston, Galt, and places in the township of Dumfries. At present, the Guelph formation can only be regarded as a provisional group, its strata appearing more or less to merge into the underlying Niagara beds, and in some localities, also, to offer a passage into the Onondaga deposits.

(To be Continued.)

ON THE TWO SPECIES OF ASTACUS FOUND IN UPPER CANADA.

BY T. J. COTTLE, ESQ.

Read before the Canadian Institute, April, 1863.

Of the fresh water *Lobsters* as restricted by M. Milne Edwards to the genus Astacus, that learned historian of the Crustacea, in his valuable monograph enumerates but five. Of these he gives one to Europe, two to the North East side of America, one to Chili, and one to Australia: since his book was published one has been added to the North West of this continent, under the name of Oreganus; and it is my intention to bring before the consideration of the Canadian Institute another, which I think, will form a new species indigenous to this Province, and which I propose naming (fodiens) as being appropriate to its habits. It is possible that it may have been already described, for the want of a good library of reference is a great impediment to the discrimination of species. I therefore feel a degree of diffidence in naming it.

The species described in the Natural History of the State of New York, as the only one belonging to it, is the Astacus Bartonii, and I

* This fossil is described in PART IV. as occurring in the Onondaga Group, the Guelph strata having been originally referred to that subdivision.

shall merely copy the description given in that book, as it is too well known to require further notice.

Astacus Bartonii, body with scattered punctures, rostrum mucronate concave elongated, suddenly attenuated, but with lateral angles rather than spines at the point of attenuation, no spines on the thorax; an acute triangular spine rather exceeding the rostrum in length articulated to the outer side of the base of the external antennæ, below the base of the spine on each side an oculiform tubercle, movable finger slightly shorter than its opposite, and a number of faveolæ or pits in such a regular series on both, as to produce the appearance of one or more elevated lines. Carpus with a deep furrow on its upper surface and one or more spines on its inner angle; shield with a transverse lunate furrow. The first segment of the middle caudal lamella, with one or two short spines on each side. Colour of the body and claws, greenish brown, tips of the rostrum of the hands and feet (and sexual appendices of the male) reddish; lighter beneath.

The other Canadian species, supposed to be undescribed may be thus characterised:—

Astacus fodiens (mihi) rostrum broad, short, triangular, acute, margined, concave throughout its length, edges smooth without spines. Carapace robust, rounded, much deeper than in Astacus Bartonii, plentifully marked with minute pits, granulated towards the stomachic region, not spinous. Claw stronger than in the preceding species, the movable finger with a strong tooth on the internal margin, external margin deeply denticulated, a well defined ridge along the whole length. Thumb with the internal margin less strongly toothed, smooth externally. Carpus with a strong spine on its inner margin and a deep furrow on its upper side, length 3 to 4 inches. Swamps and wet places common.

The author of the Natural History of the State of New York, and M. Edwards, both described an Astacus under the name of *affinis*, the former giving the habitat as the River Delaware, the latter as the rivulets of North America. Their two descriptions do not agree. In the first I see no resemblance to my Astacus, in the second a great deal: so much so, that I think we may, perhaps, both mean the same animal. M. Edwards gives, as his authority, Say's Crustacea of the United States, a work I have not been able to consult, but with which I should imagine the American author must be familiar. I shall quote both these descriptions that the members may compare them.

Astacus affinis of the New York work :—

Rostrum mucronate subcaniculate two spined, a spine behind each eye and a larger geminate one each side of the thorax, hand and thumb on the inner side, scabrous, length 3 by 3—River Delaware.

Astacus affinis of M. Milne Edwards. Rostrum short, nearly as broad as long, triangular and slightly toothed laterally. Carapace a little granular on the side of the stomachal region. Interior claws strong, carpus with a deep depression above, a large tooth within, and some tubercles below, hand rounded below; punctuated and tuberculated near the upper border. Fingers rather long and strong. Epistome short, widened without contraction or traverse groove, length 3 or 4 inches, inhabits rivers of North America.

The Astacus fodiens, is the first macrourous crustacean in which I have observed a burrowing habit, nor am I aware that this trait has been noticed by others. It is by no means unusual in some of the brachyura as in the genera Ocypoda, Cardisoma, &c., individuals of which so throng the sandy beaches and littoral marshes of the Antilles, but these crabs have strong legs, with the last joints armed with a hard sharp point well adapted for running and digging in the yielding sand. But not so with the delicate cheliferous legs of the slow-moving crawfish, which seem hardly able to bear its weight, apparently little fitted for tunneling its way through mud and clay: nevertheless, such is its destiny, for when the summer droughts have licked up the water on the surface of the swamps, where on the first arrival of spring this little crawfish had sported, it commences to seek by boring for the moisture of which it is deprived, and like an experienced well-digger, begins its work. The diameter of the hole is about an inch, and as it brings up the earth in its excavation t piles up the pellets round the circumference,.till it forms a chimney the height of three or four inches. Should an explorer trace these holes downward, he will invariably find them terminating in .water. In these burrows the animal lives during the whole of the dry season, deepening its hole as the receding water renders necessary during the night, as the freshly excavated wet earth lying round the entrance early in the morning testifies. I have never yet taken this species in streams or the Astacus Bartonii in swamps. I am unaware at what season of the year the intercourse between the sexes takes place, but I have found the eggs on the egg bearers in November, where they are carried during the whole winter and are hatched at the end of March or the beginning of

April. The young are then perfectly formed in every respect like the adults and undergo no metamorphosis, they remain attached to the parent till their first moult, which in some I kept in confinement did not take place till late in May, but I think it probably would have been earlier in a state of nature. The subject of the metamorphosis of the crustacea is one of great interest, and as yet of much uncertainty, though since the startling discovery of Thompson much has been done; yet how can we account for it, that some crustaceans as the genus now under consideration are hatched perfect, while according to M. Coste, the young of the nearly allied Palinuri constitute the old genus Phylopoma, and some have even asserted that the still more closely allied Homanus undergo change?

I was much surprised at the length of time required for incubation, being a fact I had not been aware of, but I find on the authority of M. Coste, that this habit is quite normal. He says "All the crustacea carry their eggs under their tail or some other part of the body where incubation takes place, this incubation is very generally slow, it does not take less than five or six months in Lobsters and Palinuri."

LIST OF PLANTS COLLECTED CHIEFLY IN THE IMMEDIATE NEIGHBOURHOOD OF LONDON, C. W.

BY W. SAUNDERS

A grateful acknowledgment is due Professor Hincks of University College, Toronto, for his unvarying kindness to the collector in determining a large number of the plants in the following list which, for want of time could not be named, while in a fresh condition. The Professor, from his extensive knowledge of the Flora of our country, has been enabled to determine with certainty from the dried specimens nearly all that have been submitted to him. There are, however, a few rare and interesting ones, which had not previously come under his observation, and which could not well be *positively* determined without fresh specimens. These will be found questioned, although in nearly every place the evidence furnished by the dry plant has been almost positive as to the entire correctness of the name given.

The mosses and lichens have been determined, chiefly from a collection kindly furnished by B. Billings, Jr., Esq., of Prescott, C. W.

It will be observed that several of the families are but poorly represented; for example, Salicaceæ, Cyperaceæ and Gramineæ. In these, and several of the others, much remains to be done to complete the list of our Western Canadian flora.

RANUNCULACEÆ.

Clematis Virginiana, L.; bank of Cove, one mile west of London; rare.
Anemone Virginiana, L.; common.
" Pennsylvanica, L.; common.
" nemorosa, L.; English's Woods; abundant.
Hepatica triloba, Chaix.; common.
" acutiloba, D.C.; not very common.
Thalictrum dioicum, L.; common.
" cornuti, L.; common.
Ranunculus aquatilis, L. var. divaricatus; very abundant at Cove.
" Purshii, Richards; in pond half a mile west of London.
" rhomboideus, Goldie; sandy fields; common.
" abortivus, L.; common.
" recurvatus, Poir.; banks of Cove; not common.
" Pennsylvanicus, L.; St. Catharines, C. W.
" fascicularis, Muhl.; common on G. W. R. R. track east of London.
" repens, L.; wet places; common.
Caltha palustrus, L.; abundant.
Coptis trifolia, Salisbury; English's Woods and elsewhere; common.
Aquilegia Canadensis, L.; common.
Hydrastis Canadensis, L.; Township of Williams, C. W.; common.
Actæa spicata, L. var. alba; common.
" " rubra; common.

MAGNOLIACEÆ.

Liriodendron tulipifera, L.; St. Catharines, C. W.

MENISPERMACEÆ.

Menispermum Canadense, L.; moist woods two miles north of London.

BERBERIDACEÆ.

Caulophyllum thalictroides, Michx.; rich woods; common.
Jeffersonia diphylla, Pers.; on banks of river, near Cove; common.
Podophyllum peltatum, L.; very common.

NYMPHACEÆ.

Nymphaea odorata, Ait.; abundant in Westminster pond, three miles south of London.

Nuphar advena, Ait.; common at Cove.

SARRACENIACEÆ.

Sarracenia purpurea, L.; border of Westminster pond; common.

PAPAVERACEÆ.

Chelidonium majus, L.; not uncommon.

Sanguinaria Canadensis, L.; rich woods; common.

FUMARIACEÆ.

Dicentra cucullaria, D.C.; wooded banks of Cove; common.

" Canadensis, D.C.; banks of Cove; common.

CRUCIFERÆ.

Nasturtium officinale, R. Br.; in creek half a mile west of London; abundant.

" palustre, D.C.; vicinity of Cove; abundant.

" armoracia, Fries.; not uncommon.

Iodanthus hesperidoides, Torr. and Gray; rare.

Dentaria diphylla, L.; English's woods; common.

" laciniata, Muhl.; banks of Cove; common.

Cardamine rhomboidea, D.C.; wet places; common.

" " var. purpurea, Torr.; borders of Cove: not uncommon.

" hirsuta, L.; common.

Arabis lyrata, L.; not common.

" hirsuta, Scop.; bank of river, near Cove; common.

" lævigata, D.C.; not uncommon.

Erysimum cheiranthoides, L.; rare.

Sisymbrium officinale, Scop.; in waste places everywhere; common.

Sinapis arvensis, L.; G. W. R. R. track, near Cove; common.

Lepidium Virginicum, L.: G. W. R. R. track, east of London; abundant.

Capsella bursa-pastoris, Mœnch.; everywhere; common.

VIOLACEÆ.

Viola blanda, Willd.; common.

" cucullata, Ait.; common.

" villosa, Walt, Nutt.; cemetery and open fields near English's woods; not very common.

" rostrata, Pursh.; English's woods and eleswere; common.

Viola Muhlenbergii, Torr. ; rather rare.
" striata, Ait. ; common.
" Canadensis, L. ; common.
" pubescens, Ait. ; common.

Cistaceæ.

Helianthemum Canadense, Michx. ; English's woods ; common.
Lechea major, Michx. ; rare.
" minor, Lam. ; not very common.

Droseraceæ.

Drosera rotundifolia, L. ; borders of Westminster pond ; common.
" longifolia, L. ; Westminster pond ; common.

Parnassiaceæ.

Parnassia Caroliniana, Michx. ; Port Stanley R. R. track ; not common.

Hypericaceæ.

Hypericum pyramidatum, Ait. ; Port Stanley R. R. track, two miles from London ; not common.
" perforatum, L. ; common.
" corymbosum, Muhl. ; common.
" ellipticum, Hook. ; rare.
" mu m, L. ; common.

Caryophyllaceæ.

Saponaria officinalis, L. ; G. W. R. R. track, one mile east ; common.
Agrostemma Githago, L. ; common.
Alsine Michauxii, Fenzle ; G. W. R. R. track, one mile east ; very common.
Arenaria serpyllifolia, L. ; common.
Stellaria media, Smith ; everywhere ; common.
" longifolia, Muhl. ; common.

Portulacaceæ.

Portulaca oleracea, L. ; waste grounds ; abundant.
Claytonia Virginica, L. ; banks of Cove ; abundant.

Malvaceæ.

Malva rotundifolia, L. ; common.
" moschata, L. ; roadsides ; not common.

Tiliaceæ.

Tilia Americana, L. ; common.

Oxalidaceæ.

Oxalis stricta, L. ; common.

GERANIACEÆ.

Geranium maculatum, L.; common.
" Robertianum, L.; woods near Cove; common.

BALSAMINACEÆ.

Impatiens fulva, Nutt.; common.

RUTACEÆ.

Zanthoxylum Americanum, Mill.; half a mile west of London; not uncommon.

AANCACARDIACEÆ.

Rhus typhina, L.; common.
" glabra, L.; common.
" Toxicodendron, L.; common.

VITACEÆ.

Vitis cordifolia, var. riparia, Michx.; common.
Ampelopsis quinquefolia, Michx.; common.

RHAMNACEÆ.

Rhamnus alnifolius, L'Her.; common in swampy places.
Ceanothus Americanus, L.; very abundant in cemetery.

CELASTRACEÆ.

Celastrus scandens, L.; woods, five miles north of London; not uncommon.
Enonymus Americanus, L.: English's woods; common.

SAPINDACEÆ.

Staphylea trifolia, L.; wooded bank half a mile west of London; common.
Acer spicatum, Lam.; not common.
" saccharinum, Wang.; common.
" rubrum, L.; common.

POLYGALACEÆ.

Polygala Senega, L.; G. W. R. R. track east, and cemetery; not uncommon.
" polygama, Walt.: sandy field near English's woods; rare.

LEGUMINOSÆ.

Lupinus perennis, L.; cemetery and G. W. R. R. track east; very common.
Trifolium pratense, L.; common.
" repens, L.; common.
Astragalus Canadensis, L.; G. W. R. R. track near Cove; common.

Desmodium acuminatum, D.C.; common.
" paniculatum, D.C.; rare.
Lespedeza capitata, Michx.; G.W.R.R. track; common.
Vicia Caroliniana, Walt.; rare.
Phaseolus helvolus, L.; G. W. R. R. track one mile east; not common.
Apios tuberosa, Mœnch; Port Stanley R. R. track two miles from London.

Rosaceæ.

Prunus Pennsylvanica, L.; common.
" Virginiana, L.; common.
" serotina, Erhart; not uncommon.
Spirea opulifolia, L.; rather rare.
" salicifolia, L.; common.
Agrimonia parviflora, Ait.; common.
Geum album, Gmelin; common.
" strictum, Ait.; common.
" rivale, L.; common.
" triflorum, Pursh; abundant in cemetery.
Waldsteinia fragarioides, Tratt.; common.
Potentilla norvegica, L.; common.
" canadensis, L.; G. W. R. R. track, and elsewhere; common.
" anserina, L.; common.
" palustris, Scop.; Westminster pond; common.
Fragaria vesca, L.; common.
Rubus triflorus, Richardson; common.
" strigosus, Michx.; common.
" villosus, Ait.; common.
" hispidus, L.; common in swamps.
Rosa Carolina, L.; G. W. R. R. track near Komoka, twelve miles from London.
" blanda, Ait.; common.
Cratœgus coccinea, L.; common.
" tomentosa, L.; not uncommon.
" " var. punctata, Jacq.; rather rare.
" crusgalli, L.; common.
Pyrus coronaria, L.; common.
" arbutifolia, L.; common.
Amelanchier Canadensis, Torr. and Grey; moist places; very common.

Onagraceæ.

Epilobium angustifolium, L.; G. W. R. R. track east, and elsewhere; common.
" palustre, L.; common.
" coloratum, Muhl.; common in wet places.
Œnothera biennis, L.; common.
" " " var. cruciata; common.
Ludivigia palustris, Ell.; very common.
Circaea alpina, L.; not common.

Grossulaceæ.

Ribes cynosbati, L.; common.
" hirtellum, Michx.; common.
" lacustre, Poir.; common in swamps.
" floridum, L.; very common.
" rubrum, L.; common.

Crassulaceæ.

Penthorum sedoides, L.; wet places; common.

Saxifragaceæ

Saxifraga Virginiensis, Michx.; common.
Mitella diphylla, L.; English's woods, and elsewhere; very common.
" nuda, L.; English's woods; rare.
Tiarella cordifolia, L.; common.
Chrysosplenium Americanum, Schwein; English's swamp; common.

Hamamelaceæ.

Hamamelis Virginica, L.; common.

Umbelliferæ.

Sanicula Canadensis, L.; rich woods; common.
" Marylandica, L.; not very common.
Heracleum lanatum, Michx.; not uncommon.
Archangelica peregrina? Nutt.; rare.
Thaspium barbinode, Nutt.; rare.
" aureum, Nutt.; common.
Zizia integerrima, D.C.; common.
Cicuta maculata, L.; wet places; common.
Sium lineare, Michx.; swamps; common.
Cryptotænia Canadensis, D.C.; rare.
Osmorrhiza longistylis, D.C.; rich woods; common.
" brevistylis, D.C.; rich woods; common.

Conium maculatum, L.; very abundant in lower part of city, near river.
Erigenia bulbosa, Nutt.; this very interesting and beautiful little plant is very common with us on the borders of rich woods.

ARALIACEÆ.

Aralia racemosa, L.; not uncommon in rich moist woods.
" nudicaulis, Michx.; English's woods, and elsewhere; common.
" triflora, L.; English's woods; abundant.
" quinquefolia, L.; four miles north of London; rare.

CORNACEÆ.

Cornus Canadensis, L.; rich woods; not common.
" stolonifera, Michx.; common.
" paniculata, L'Her.; not uncommon.

CAPRIFOLIACEÆ.

Lonicera parviflora, Lam.; common.
" ciliata, Muhl.; common in damp woods.
Diervilla trifida, Mœnch.; not uncommon.
Triosteum perfoliatum, L.; common.
Sambucus Canadensis, L.; common.
" pubens, Michx.; common.
Viburnum Lentago, L.; common.
" dentatum, L.; common.
" acerifolium, L.; rather rare.
" opulus, L.; common.

RUBIACEÆ.

Galium asprellum, Michx.; common.
" trifidum, L.; common in wet places.
" triflorum, Michx.; common in rich woods.
" lanceolatum, Torr.; rare.
" boreale, L.; very common.
Mitchella repens, L.; rich woods; common.

COMPOSITÆ.

Liatris cylindracea, Michx.; common in cemetery.
" spicata, Willd.; vicinity of Cove; very rare; abundant near Amerstburg, C.W.
Eupatorium purpureum, L.; common.
" perfoliatum, L.; very common.
" ageratoides, L.; not common.
Aster laevis, var. cyaneus, L.; not common.

Aster azureus, Lindl ; G. W. R. R. track ; not common.
" cordifolius, L.; common.
" saggittifolius, Willd. ; common.
" Tradescanti, L.; common.
" miser, L.? rare.
" simplex, Willd.; G. W. R. R. track, and elsewhere ; common.
" carneus, Nees. ; not common.
" longifolius, Lam. ; moist woods; not common.
" puniceus, L. ; common.
" Novæ-Angliæ, L. ; not common.
" nemoralis, Ait. ; rare.
Erigeron Canadensis, L. ; very common.
" bellidifolius, Muhl. ; not common.
" Philadelphicus, L. ; common.
" annuus, Pers. ; common.
" strigosus, Muhl. ; rare.
Solidago latifolia, L. ; rich woods ; common.
" cæsia, L. ; common at Cove.
" puberula, Nutt.
" altissima, L. ; very common.
" pilosa, Walt. ? rare.
" nemoralis, Ait. ; not common.
Inual Helenium, L.; Peters' swamp one mile west of London ; common.
Ambrosia artemesiaefolia, L. ; G. W. R. R. track east ; abundant.
Rudbeckia subtomentosa, Pursh.? moist places, Port Stanley R. R. track, two miles from London.
" fulgida, Ait. ; G. W. R. R. track ; not uncommon.
" hirta, L. ; G. W. R. R. track ; abundant.
Helianthus giganteus, L.; not uncommon.
" strumosus, L. ; rare.
" decapetalus, L. ; very common.
Bidens frondosa, L. ; not uncommon.
" cernua, L. ; common in wet places.
" chrysanthemoides, Michx. ; common in wet places.
Maruta cotula, D.C. ; very common in waste places.
Achillea Millefolium, L. ; abundant.
Tanacetum vulgare, L. ; common.
Artemisia biennis, Willd. ; common in waste places.
Gnaphalium polycephalum, L. ; common ; English's woods, and elsewhere.

Gnaphalium uliginosum, L.; rare.
Antennaria margaritacea, R. Brown; rare.
" plantaginifolia, Hook.; common.
Erecthites hieracifolia, Raf.; moist grounds; not uncommon.
Senecio aureus, L.; common in wet places.
Cirsium lanceolatum, Scop.; very abundant.
" discolor, Spreng.; English's woods; not uncommon.
" muticum, Michx.; swamp, two miles north of London.
" arvense, Scop.; common.
Lappa major, Gærtn.; very abundant.
Cichorium Intybus, L.; rare.
Hieracium scabrum, Michx.; not uncommon.
" Gronovii, L.; rare.
Nabalus albus, Hook.; G. W. R. R. track east; common.
" altissimus, Hook.; English's woods; common.
Taraxacum Dens-leonis, Desf.; everywhere common.
Lactuca elongata, Muhl.; Port Stanley R. R. track; common.
Sonchus asper, Vill.; banks of Cove; common.

LOBELIACEÆ.

Lobelia cardinalis, L.; wet ground; common.
" syphilitica, L.; common.
" inflata, L.; not uncommon.
" spicata, Lam.; G. W. R. R. track east; common.
" Nuttallii, Roem. and Sch.; banks of river Thames, near London; rare.

CAMPANULACEÆ.

Campanula rotundifolia, L.; banks of Thames, near Komoka, twelve miles from London; common.
" aparinoides, Pursh.; wet places; common.
" Americana, L.; rich woods; rare.

ERICACEÆ.

Vaccinium macrocarpum, Ait.; borders of Westminster pond; common.
" Pennsylvanicum, Lam.; common.
Chiogenes hispidula, Torr. and Gray.; boggy places; common.
Gaultheria procumbens, L.; common.
Cassandra calyculata, Don.; borders of Westminster pond; common.
Andromeda polifolia, L.; border of Westminster pond; common.
Kalmia glauca, Ait.; border of Westminster pond; common.

Pyrola elliptica, Nutt.; rich woods; not uncommon.
" secunda, L.; common.
Moneses uniflora, L.; under clumps of pines in English's woods.
Chimaphila umbellata, Nutt.; under pines in English's woods.
Monotropa uniflora, L.; woods near Westminster pond; common.

PLANTAGINACEÆ.

Plantago major, L.; common everywhere.
" lanceolata, L.; Port Stanley R. R. track, three miles from London; common.

PRIMALUCEÆ.

Trientalis Americana, Pursh.; English's swamp; common.
Lysimachia stricta, Ait.; rare.
" ciliata, L.; wet places; common.
Naumbergia thyrsiflora, Reichenb; Cove; common.

LENTIBULACEÆ.

Utricularia vulgaris, L.; stream on sides of G. W. R. R. track, half a mile west.
" cornuta, Michx.; banks of Westminster pond; abundant.

OROBANCHACEÆ.

Epiphegus Virginiana, Bart.; English's woods; common.
Conopholis Americana, Wallroth; woods near Westminster pond; rare.

SCROPHULARIACÆ.

Verbascum Thapsus, L.; everywhere common.
Linaria vulgaris, Mill.; common in waste places.
Scrophularia nodosa, L.; field near Cove; not common.
Chelone glabra, L.; swampy places; common.
Mimulus ringens, L.; wet places; common.
Veronica Americana, Schweinitz; common.
" serpyllifolia, L.; very common.
Gerardia quercifolia, Pursh.; Wesleyan cemetery and G. W. R. R. track; common.
Castilleia coccinea, Spreng.; G. W. R. R. track east; common.
Pedicularis Canadensis, L.: English's woods; abundant.

VETBENACEÆ.

Verbena hastata, L.; common in waste places.
" urticifolia, L.; not uncommon.

LABIATÆ.

Teucrium Canadense, L.; not common.

Mentha viridis, L.; common.
" piperita, L.; common.
" Canadensis, L.; common.
Lycopus Virginicus, L.; common.
" Europæus, L.; rare.
" " var. sinuatus, L.; rare.
Calamintha Clinopodium, Benth.
Hedeoma pulegioides, Pers.; common ten miles west of London.
Collinsonia Canadensis, L.; border of a field, two miles west of London.
Monarda didyma, L.; common.
" fistulosa, L.; half a mile west of London; common.
Lophanthus nepetoides, Benth.; fields near Cove; not uncommon.
Nepeta cataria, L.; common.
Prunella vulgaris, L.; common.
Scuttellaria integrifolia, L.; moist thickets; common.
" galericulata, L.; Port Stanley R. R. track, moist places; common.
" lateriflora, L.; borders of English's creek; not uncommon.
Marrubium vulgare, L.; common.
Galeopsis tetrahit, L.; rare.
Stachys palustris, L.; not uncommon.
Leonurus cardiaca, L.; common.

BORRAGINACEÆ.

Echium vulgare, L.; banks of river Thames; common.
Symphytum officinale, L.; not uncommon.
Onosmodium Carolinianum, D.C.; not uncommon.
Lithospermum officinale, L.; common.
" hirtum, Lehm.?; rare.
" canescens, Lehm.; rare.
Mysotis palustris, With.; wet places; common.
" " var. laxa, Lehm.; wet places; common.
" verna, Nutt.; rare.
Cynoglossum officinale, L.; common everywhere.
" Virginicum, L.; rare.
" Morrisoni, D.C.; G. W. R. R. track east; very abundant.

HYDROPHYLLACEÆ.

Hydrophyllum Virginicum, L.; banks of Cove; common.
" Canadense, L.; Cove; not common.
" appendiculatum, Michx.; Cove and elsewhere; common.

POLEMONIACEÆ.

Phlox divaricata, L.; English's woods and elsewhere; very common.

CONVOLVULACEÆ.

Calystegia spithamæa, Pursh.; G. W. R. R. track; common.

SOLANACEÆ.

Solanum nigrum, L.; common.
Physalis viscosa, L.; G. W. R. R. track east; common.
Datura stramonium, L.; waste places; common.

GENTIANACEÆ.

Halenia deflexa, Griseb.; rare.
Gentiana quinqueflora, Lam.; Wesleyan cemetery; common.
" crinita, Frœl.; moist woods two miles north-east of London; common.
" Andrewsii, Griseb.; borders of English's creek; not common.
Menyanthes trifoliata, L.; borders of Westminster pond and elsewhere; abundant.

APOCYNACEÆ.

Apocynum androsæmifolium, L.; G. W. R. R. track; abundant.

ASCLEPIADACEÆ.

Asclepias cornuti, Decaisne, waste places; common.
" phytolaccoides, Pursh.; Port Stanley R. R. track; common
" incarnata, L.; Port Stanley R. R. track; common.
" tuberosa, L.; G. W. R. R. track east; common.

OLEACEÆ.

Fraxinus Americana, L.; common.
" sambucifolia, Lam.; common.

ARISTOLOCHIACEÆ.

Asarum Canadense, L.; common.

PHYTOLACCACEÆ.

Phytolacca decandra, L.; Port Stanley R. R. track; not uncommon.

CHENOPODIACEÆ.

Chenopodium hybridum, L.; common.
" album, L.; a troublesome weed.
" botrys, L.; waste places; not uncommon.
" ambrosioides, L.; rare

AMARANTACEÆ.

Amaranthus albus, L.; a troublesome weed.

Montelia *tamariscina*, Nutt.; sandy flats near river Thames; not uncommon.

POLYGONACEÆ.

Polygonum amphibium, L.; Cove; not uncommon.
" nodosum, var. incarnatum, Pers.; not uncommon.
" Pennsylvanicum, L.; common.
" persicaria, L.; common.
" acre, H.B.K.; English's creek; common.
" aviculare, L.; common everywhere.
" " var. erectum, Roth.; common.
" Virginianum,? L.; creek three miles north of London.
" dumetorum, L.; borders of creek half a mile west of London.

Fagopyrum esculentum, Mœnch.; common.
Rumex verticillatus, L.; moist grounds, common.
" crispus, L.; everywhere common.
" sanguineus, L.; Port Stanley R. R. track two miles from London.

LAURACEÆ.

Benzoin odoriferum, Nees.; English's woods and elsewhere common.

THYMELACEÆ.

Dirca palustris, L.; common.

SANTALACEÆ.

Comandra umbellata, Nutt.; G. W. R. R. track east, common.

EUPHORBIACEÆ.

Euphorbia obtusata, Pursh.; St. Catherines roadsides, common.
Acalypha Virginica, L.; Cove; common.

URTICACEÆ.

Ulmus fulva, Michx.; common.
Urtica, gracilis, Ait.; common.
" dioica, L.; very common.
" purpurescens, Nutt.; rare.
Laportea Canadensis, Gaudich.; not uncommon.
Pilea pumila, Lindl.; common in wet places.
Bœhmeria cylindrica, Wild.; rich woods, three miles north-east of London; rare.
" lateriflora, Muhl.; rare.
Cannabis sativa, L.; common.

PLATANACEÆ.

Platanus occidentalis, L.; banks of river Thames; common.

JUGLANDACEÆ.

Juglans cinerea, L.; borders of Cove; common.
" nigra, L.; two miles west of London; not uncommon.
Carya alba, Nutt.; two miles north east of London; not common.

CUPULIFERÆ.

Quercus alba, L.; common.
Castanea vesca, L.; Hall's mills, seven miles from London; abundant.
Fagus ferruginea, Ait.; common.
Corylus Americana, Walt.; common.
Carpinus Americana, Michx.; common.
Ostrya Virginica, Willd.; not uncommon.

BETULACEÆ.

Betula excelsa, Ait.; not uncommon.

SALICACEÆ.

Salix discolor, Muhl.; not uncommon.
" sericea, Marshall.; common.
" rostrata, Richardson; common.
Populus tremuloides, Michx.; common.
" grandidentata, Michx.; not common.
" balsamifera, L.; common.

CONIFERÆ.

Pinus strobus, L.; very abundant.
Abies Canadensis, Michx.; common.
Larix Americana, Michx.; common.
Thuya occidentalis, L.; common.

ARACEÆ.

Arum triphyllum, Torr.; moist grounds; common.
Calla palustris, L.; Westminister pond; not common.
Symplocarpus fœtidus, Salisb.; wet places; commmon.
Acorus calamus, L.; wet places; commonr

TYPHACEÆ.

Typha angustifolia, L.; Port Stanley R. R. track, banks of creek three miles from London; common.
Sparganium simplex, Hudson.; Port Stanley R. R. track, three miles from London; not common.

LEMNACEÆ.

Lemna minor, L.; small ponds half a mile west; common.

NAIADACEÆ.

Potamogeton natans, L.; Cove; common.

ALISMACEÆ.

Alisma plantago, L.; common.
Sagittaria variabilis, var. sagittifolia, Pursh.; Cove; common.

ORCHIDACEÆ.

Orchis spectabilis, L.; common.
Gymnadenia tridentata, Lindl.; rare.
Platanthera orbiculata, Lindl.; under clumps of pines in English's woods; not common.
" bracteata, Torr.; rare.
" dilatata, Lindl.: English's swamp; common.
" psycodes, Gray.; English's swamp; common.
Goodyera pubescens, R. Brown.; rich woods; common.
Spiranthes gracilis, Bigelow.; G. W. R. R. track east; common.
Pogonia ophioglossoides, Nutt.; borders of Westminster pond; common.
Calopogon pulchellus, R. Brown.; Westminster pond; common.
Cypripedium pubescens, Willd.; English's swamps and elsewhere; common.
" spectabile, Swartz.; Westminster pond; rare.
" acaule, Ait.; Westminister pond; not common.

IRIDACEÆ.

Iris versicolor, L.; common.
Sisyrinchium Bermudiana, L.; common.

SMILACEÆ.

Smilax herbacea, L.; common.
Trillium erectum, L.; common.
" grandiflorum, Salisb.; common.
Medeola Virginica, L.; English's woods; not uncommon.

LILIACEÆ.

Smilacina racemosa, Desf.; common.
" stellata, Desf.; English's woods; rare.
" bifolia, Ker.; common.
Clintonia borealis, Raf.; English's woods; common.

Allium tricoccum, Ait. ; English's woods ; not uncommon.
Lilium Philadelphicum, L. ; G. W. R. R. track east ; common.
" superbum, L.; moist grounds, half a mile west of London ; not uncommon.
Erythronium Americanum, Smith. ; very common.

MELANTHACEÆ.

Uvularia perfoliata, L. ; English's woods and elsewhere ; common.
Streptopus roseus, Michx. ; rich woods ; common.

JUNCACEÆ.

Luzula pilosa, Willd. ; rich woods ; common.
" campestris, D. C, ; open field near English's swamp ; common.
Juncus effusus, L. ; not uncommon.
" filiformis, L. ; not uncommon.
" tenuis, Willd. ; very common.
" bufonius, L. ; common.

CYPERACEÆ.

Cyperus diandrus, Torr. ; banks of a stream near St. Thomas, seventeen miles from London.
" strigosus, L. ; rare.
Eleocharis olivacea, Torr. ; rare.
" palustris, R. Brown. ; common.
" rostellata,? Torr. ; not common.
" acicularis, R. Brown ; common.
Scirpus lacustris, L. ; common.
" sylvaticus, L. ; common.
Eriophoron Virginicum, L. ; borders of Westminister pond ; common.
" polystachyon, L. ; G. W. R. R. track, east ; not common.
" gracile, Koch. ; rare.
Carex bromoides, Schk. ; common.
" vulpina, L.; common.
" Deweyana, Schw. ; rare.
" stellulata, Good. ; rare.
" gracillima, Schw. ; not common.
" præcox, Jacq. ; very common.
" hystricina, Willd. ; not uncommon.
" tentaculata, Muhl. ; G. W. R. R. track, half a mile west.
" lupulina, var. polystachya, Muhl. ; not uncommon.
" cylindrica, Schw. ; rare.

GRAMINEÆ.

Phleum pratense, L. ; very common.
Agrostis scabra, Willd. ; not common.
" alba, L. ; common everywhere.
Muhlenbergia Mexicana, Trin. ; common.
Glyceria fluitans, R. Brown ; common.
Poa pratensis, L. ; common.
Bromus Kalmii ; not uncommon.
Elymus Virginicus, L. ; not common.
Gymnostichum Hystrix, Schreb.
Milium effusum, L. ; common.
Panicum glabrum, L. ; Gaudin. ; Cemetery ; common.
" latifolium, L. ; not uncommon.
" dichotomum, L. ; common.
" crus-galli, L. ; common everywhere.
Setaria viridis, Beauv. ; abundant.
Andropogon argenteus, Ell. ; not common.

EQUISETACEÆ.

Equisetum arvense, L. ; moist grounds half a mile west of London ; common.
" limosum, L. ; G. W. R. R. track near Komoka, C. W. ; common.
" hyemale, L. ; G. W. R. R. track ; common.
" variegatum, Schleisher ; English's wooods ; not uncommon.

FILICES.

Polypodium hexagonopterum, Michx. ; rich woods near Westminster pond ; rather rare.
Struthiopteris Germanica, Willd. ; half a mile west of London ; common.
Pteris aquilina, L. ; common.
" " var. caudata, L. ; common.
Adiantum pedatum, L. ; common.
Asplenium thelypteroides, Michx. ; English's woods ; not uncommon.
" Filix-fœmina, R. Brown ; common.
Cystopteris bulbifera, Bernh. ; rich woods ; common.
" fragilis, Bernh. ; banks of Cove ; common.
Aspidium thelypteris, Swartz. ; not uncommon.
" noveboracense, Willd. ; not common.
" spinulosum, Swartz. ; rich woods ; very common.

Aspidium Goldianum, Hook.; not common.
" cristatum, Swartz.; English's woods, common.
" marginale, Swartz.; common.
" acrostichoides, Swartz.; rich woods; very common.
Onoclea sensibilis, L.; English's woods; common.
Osmunda regalis, L.; English's swamp; common.
" Claytoniana, L.; swamp near Komoka, C. W.; common.
" cinnamonea, L.; English's woods; very abundant.
Botrychium lunarioides, Swartz.; field near English's woods, and elsewhere; not common.
" " var. obliquum, Muhl.; Wesleyan cemetery; not common.
" Virginicum, Swartz.; English's woods and elsewhere; common.

LYCOPODIACEAE.

Lycopodium lucidulum, L. rich woods; common.
" dendroideum, Michx.; not common.
" clavatum, L.; not uncommon.
" complanatum, L.; English's woods; common.
Selaginella apus, Spreng.; rare. I much regret that the exact locality where this very interesting little plant was found, has been for the time lost. It was somewhere within two or three miles of London.

MUSCI.

Loucobryum glaucum, Hampe.; not common.
Atrichum undulatum, Beauv.; common.
Polytrichum juniperinum, Hedw.; very common.
Bryum roseum, Schreb.; English's woods; common.
Mnium affine, Bland.; common.
" cuspidatum, Hedw.; common.
Bartramia pomiformis, Hedw.
Leskea rostrata, Hedw.; common.
Hypnum triquetrum, L.; common.
" Schreberi, Willd.
" molluscum, Hedw.
" imponens, Hedw.
" salebrosum, Hoffm.
" acuminatum, Beauv.

HEPATICÆ.

Fegatella conica, Corda.; very common.
Mastigobryum trilobatum, Nees.; not uncommon.

LICHENES.

Usnea barbata, Fr.; from trees on borders of Westminister pond; not common.
" angulata, Ach.; same locality as last.
Sticta pulmonaria, Ach.; common.
Parmelia terebrata, Mart.
" caperata, Ach.
" hypoleuca, Muhl.
Cladonia rangiferina, Hoffm.
" Floerkiana, Fr.; very common on decaying stumps in English's woods.

MEAN METEOROLOGICAL RESULTS AT TORONTO FOR THE YEAR 1862.

BY G. T. KINGSTON, M.A.
DIRECTOR OF THE MAGNETICAL OBSERVATORY.

The mean temperature of the year 1862 differed very slightly from the average of 22 years, being only 0°.23 in excess. The monthly means likewise conformed in an unusual degree to their respective averages, the mean deviation without regard to sign being 1°.42 in 1862, while the average of these deviations in 22 years was 2°.45.

As regards the distribution of temperature through the year, the first seven months, with the exception of May, were relatively cold, being on the whole 0°.75 below the average, while the temperature of the remaining five months exceeded the average by 1°.60, and, with the exception of November, were all relatively warm. January and February, though comparatively cold, do not supply examples of very low temperatures, the minimum of the year, —5°.2 on February 15, being the highest minimum that has occurred since 1847, and 7°.0 warmer than the average of the yearly minima. Again, while July was relatively cold it furnishes the highest maximum, 95°.5, that has been recorded since 1856, when the temperature reached 96°.6.

The year was on the whole deficient in rain, the total fall being less than the average by 4.795 inches. The excess of snow, which may be taken as equal to 2.377 inches of rain, still leaves a deficiency of 2.418 inches from the average annual precipitation. The lack of rain that occurred in April, May, and June, was in some degree compensated by the abundant snow in January, February, and March, which exceeded by 75 per cent. the usual fall, and served to maintain below the surface an amount of moisture sufficient for the supply of the more deeply rooted plants, and to mitigate the ill effects that might have been apprehended from the drought of the three following months.

In the following summary several of the results of 1862 are compared with the averages derived from a series of years, as well as with extreme values of analogous results that have occurred during the same series.

TEMPERATURE.

	1862.	Average of 22 years.	Extremes in 22 years.	
Mean Temperature of the Year.	44°.35	44°.12	46°.36 (in 1846).	42°.16 (in 1856).
Warmest Month	August.	July.	July, 1854.	Aug. 1860.
When the mean temperature of the month was	67.60	66.85	72.47	64.46
Coldest Month	January.	February.	Jan. 1857.	Feb. 1848.
When the mean temperature of the month was	21.71	22.98	12.75	26.60
Difference between the warmest and coldest months	45.89	43.87	..	..
Mean of deviations of monthly means from their respective averages of 22 years, signs of deviation being disregarded.	1.42	2.44	3.55 (in 1843 and 1857).	1.35 (in 1853).
Month of greatest deviation, without regard to sign	October.	January.	Jan. 1857.	..
When the mean of the month differed from the 22 years' average for that month by	3.2	3.9	10.7	..
Warmest Day	August 8.	July 20.	July 12,'45.	July 31,'44.
When the mean of the day was	79.08	77.28	82.32	72.75

TEMPERATURE—(*Continued.*)

	1862.	Average of 22 years.	Extremes in 22 years.	
	°	°	°	°
Coldest Day	January 3.	Jan. 24.	Feb. 6, '55, Jan. 22, '57.	Dec. 22, '42.
When the mean of the day was	2.42	—0.87	—14.38	+9.57
Highest temperature	95 5	90.4	99.2	82.4
Which occurred on	July 6.	July 22.	Aug. 24, '54.	Aug. 19, '40.
Lowest temperature	—5.2	—12 2	—26.5	+1.9
Which occurred on	Feb. 15.	Jan. 25	Jan. 26, '59.	Jan. 2, '42.
Range of the year	100.7	102.6	118.2 (in 1855).	87.0 (in 1847).

BAROMETER.

	1862.	Average of 18 years.	Extremes in 18 years.	
Mean pressure of the year	29.6248	29.6133	29.6679 (in 1849).	29.5860 (in 1852).
Month of highest pressure	January.	September.	June, 1849.	Sept. 1860.
When the mean pressure for the month was	29.7274	29.6629	29.8030	29.6733
Month of lowest pressure	March.	June.	Mar. 1859.	Nov. 1849.
When the mean pressure for the month was	29.5036	29.5624	29.4215	29.5868

	1862.	Average of 9 years.	Extremes in 9 years.	
Maximum pressure of the year	30.469	30.372	30.552	30.245
Which occurred	Nov. 15, at 10 a.m.	..	Jan. 1855.	Dec. 1854.
Minimum pressure of the year	28.805	28.592	28.286	28.849
Which occurred	March 3, at 11 p.m.	..	Mar. 1859.	Mar. 1858.
Range of the year	1.664	1.780	2.106 (in 1859).	1.429 (in 1860).

HUMIDITY.

	1862.	Average of 20 years.	Extremes in 20 years.	
Mean humidity of the year	77	78	82 (in 1851).	73 (in 1858).
Month of greatest humidity	February.	January.	Jan. 1857.	Dec. 1858.
When the mean of the month was	84	83	89	81
Month of least humidity......	May.	May.	Feb. 1843.	April, 1849.
When the mean of the month was	65	72	58	76

CLOUDS.

	1862.	Average of 10 years.	Extremes in 10 years.	
Mean cloudiness of the year ...	63	60	63 (in 1862).	57 (in '53&56).
Most cloudy month	November.	December.	Dec. 1858 Dec. 1860 Feb. 1861	Dec. 1857.
When the mean of the month was	79	75	83	73
Least cloudy month	May & Aug.	August.	July, 1853.	June, '61, May, '62, Aug. '62.
When the mean of the month was	45	45	34	45
Average cloudiness of the least cloudy months in each year, irrespective of the time of year when they occurred ..	..	41	..	..

WIND.

	1862.	Result of 14 years.	Extremes.	
Resultant direction	N 48° W	N 60° W	..	..
Mean resultant velocity in miles	2.03	1.82	..	..

WIND—(*Continued.*)

	1862.	Result of 14 years.	Extremes.	
Mean velocity, without regard to direction	7.33	6.78	8.55 (in 1860).	5.10 (in 1853).
Month of greatest mean velocity	April.	March.	Mar. 1860.	Jan. 1848.
When the mean velocity was.	9.77	8.60	12.41	5.82
Month of least mean velocity ..	September.	July.	Aug. 1852.	Sept. 1860.
When the mean velocity was	5.11	4.91	3.30	5.79

RAIN.

	1862.	Average of 21 years.	Extremes in 21 years.	
Total depth in the year in inches	25.529	30.324	43.555 (in 1843).	21.505 (in 1856).
Number of days in which rain fell	118	106	136 (in 1861).	80 (in 1841).
Greatest depth in one month fell in	July.	September.	Sept. 1843.	Sept. 1848.
When it amounted to	5.344	3.973	9.760	3.115
Rainy days were most frequent in	July & Aug	June.	June, 1857.	May, 1841.
When their number was	15	12	21	11
Greatest depth of rain in one day	1.555	2.138	3.360	..
Which fell on	April 21.	..	Oct.6,1849.	..
Greatest depth in one hour	0.845	..	..	..
Which fell between	6 a.m. and 7 a.m. July 23.	..	..	..

The distribution of rain through the day, both as regards depth and frequency, is given in the following table, derived from an hourly rain gauge in operation from April to November inclusive in 1861, and from April to October in 1862.

Periods.	6 A.M. to 10 A.M.	10 A.M. to 2 P.M.	2 P.M. to 6 P.M.	6 P.M. to 10 P.M.	10 P.M. to 2 A.M.	2 A.M. to 6 A.M.	Average of the six periods.
Depth, 1861	0.55	0.76	1.37	1.41	1.07	0.84	1.00
" 1862	1.18	0.93	1.00	0.92	0.97	1.00	1.00
" 1861 and 1862 combined ..	0.84	0.84	1.20	1.19	1.03	0.91	1.00
Frequency, 1861	0.84	0.84	1.02	1.06	1.08	1.16	1.00
" 1862	1.18	0.97	0.92	0.99	0.88	1.06	1.00
" 1861 & '62 combined	0.98	0.89	0.98	1.03	1.00	1.12	1.00

SNOW.

	1862.	Average of 19 and 22 years.	Extremes in 19 years and 22 years.	
Total depth in the year in inches	85.4	61.6	99.0 (in 1855).	38.4 (in 1851).
Number of days in which snow fell	72	57	87 (in 1859).	33 (in 1848).
Greatest depth in one month fell in	January.	February.	Feb. 1846.	Dec. 1851.
When it amounted to	27.4	18.0	46.1	10.7
Days of snow were most frequent in	January.	December.	Dec. '59. Jan. '61.	Feb. 1858.
When their number was	19	13	23	8
Greatest depth in one day	9.0	..	..	..
Which fell on	March 20.	..	..	..

RAIN AND SNOW (COMBINED).

Where ten inches of snow are considered as equivalent to one inch of rain.

	1862.	Average of 19 years and 22 years.
Total depth in the year	34.069	36.488
Number of days in which rain or snow fell	190	160*
Greatest depth in one month fell in	..	September.
When it amounted to	..	3.973
Days of precipitation most frequent in	..	December.
When their number was	..	18*

* These numbers include the cases when both rain and snow fell in the same day, and which have been reckoned both in the rain and snow tables.

The accompanying table is a general abstract of the meteorological observations made at the Magnetic Observatory, Toronto, during the year 1862 :—

GENERAL METEOROLOGICAL

Provincial Magnetical Observ

LATITUDE, 43° 39' 4" North; LONGITUDE, 5h. 17m. 33s. West.—Elevation above

	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.
Mean temperature	21.71°	22.50°	28.79°	39.56°	52.17°	60.52°	66.70°
Difference from average (22 years)	— 1.82	— 0.48	— 1.34	— 1 42	+ 0.78	— 0.84	— 0.15
Thermic anomaly (Lat. 43° 40' N.)	—11.09	—12.20	—11.31	—10.64	— 5.93	— 4.08	— 2.00
Highest temperature	44.5	37.8	43.2	68.0	78.5	85.4	95.5
Lowest temperature	— 2.6	— 5.2	8.0	14.5	32 4	39.4	48 2
Monthly and annual ranges	47 1	43.0	35.2	53.5	46.1	46 0	47.3
Mean maximum temperature	27.58	28.25	34 64	46.34	61.43	69.12	76.42
Mean minimum temperature	15.03	15.41	23.12	33.43	42.01	50.97	58.14
Mean daily range	12.55	12.84	11.52	12.91	19.43	18.14	18.28
Greatest daily range	25.8	30.0	23.6	23.5	37.0	31.8	31.9
Mean height of barometer	29.7274	29.6077	29.5036	29.7258	29.5895	29.5642	29.5474
Difference from average (18 years)	+.0940	—.0045	—.0787	+.1388	+.0049	+ 0018	—.0540
Highest barometer	30.300	30.138	29.828	30.117	29.942	30.109	29 957
Lowest barometer	28.965	29.011	28.805	29.076	29.238	29.163	29.196
Monthly and annual ranges	1.335	1.127	1.023	1.041	0.704	0.946	0.761
Mean humidity of the air	.81	.84	.82	.73	.65	.66	.72
Mean elasticity of aqueous vapour	.103	.107	.132	184	.253	.346	.472
Mean of cloudiness	.73	.78	.63	.65	.45	.60	.56
Difference from average (10 years)	+.02	+.07	+.04	+.07	—.07	+.07	+.10
Resultant direction, of the wind	N 26 W	N 55 W	N 12 W	N 50 E	N 52 W	N 26 W	S 89 W
" velocity of the wind	2.69	3.93	2.50	2.48	2.80	1.77	1.42
Mean velocity (miles per hour)	8.83	8.52	9.38	9.77	7.87	5.98	5.80
Difference from average (14 years)	+0.97	+0.44	+0.78	+1.90	+1.25	+0.71	+0.89
Total amount of rain	0.115	0.180	2.560	2.235	1.427	1.007	5.344
Difference from average (21 & 22 yrs)	—1.292	—0.866	+1.012	—0.163	—1.814	—2.093	+1.854
Number of days rain	5	9	8	10	8	10	15
Total amount of snow	27.4	23.1	18.5	0.2	0.0	...	...
Difference from average (19 years)	+13.77	+ 5.07	+ 9.73	— 2.31	— 0.10	...	...
Number of days snow	19	17	11	4	0	...	...
Number of fair days	10	10	16	17	23	20	16
Number of auroras observed	4	1	2	5	5	2	6
Possible to see aurora (No. of nights)	11	10	13	16	20	17	20
Number of thunderstorms	0	0	0	1	1	3	8

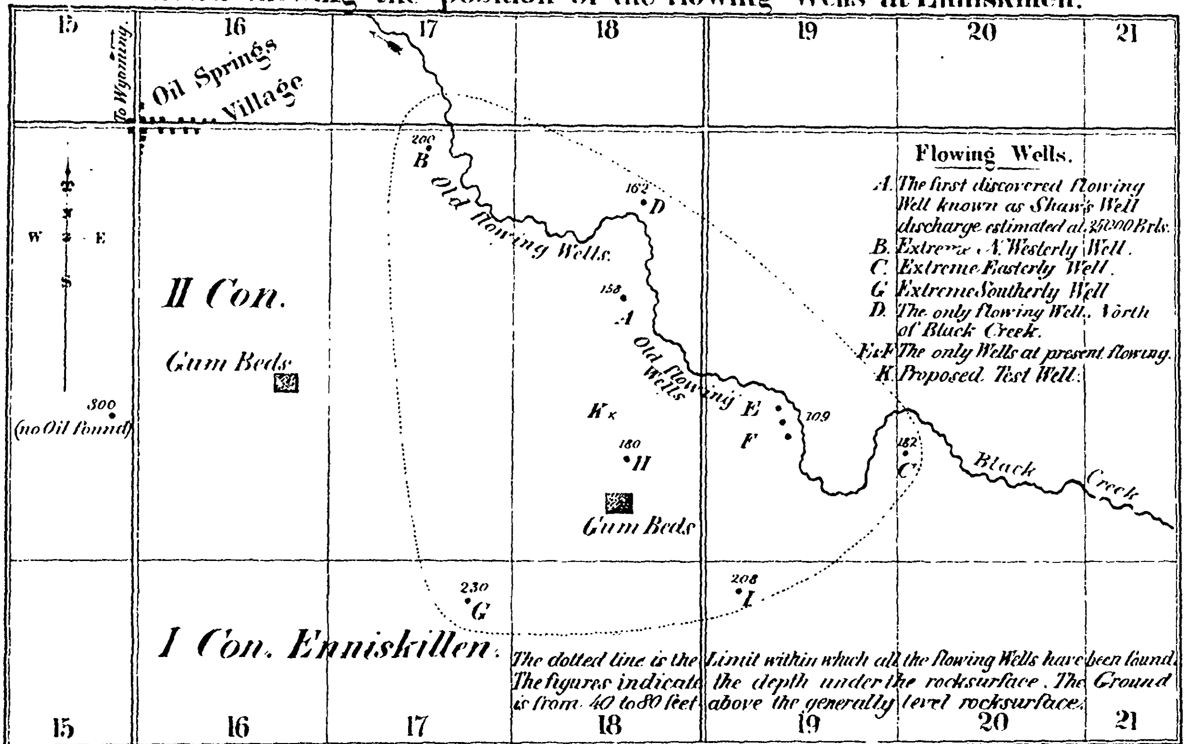
REGISTER FOR THE YEAR 1862.

atory, Toronto, Canada West.

Lake Ontario, 108 Feet; approximate Elevation above the Sea, 342 Feet.

Aug.	Sept.	Oct.	Nov.	Dec.	Year 1862.	Year 1861.	Year 1860.	Year 1859.	Year 1858.	Year 1857.	Year 1856.
° 67.60	° 59.59	° 48.70	° 35.58	° 28.78	° 44.35	° 44.22	° 44.32	° 44.19	° 44.74	° 42.73	° 42.16
+ 1.58	+ 1.68	+ 3.18	− 1.11	+ 2.67	+ 0 23	+ 0.10	+ 0.20	+ 0.07	+ 0.62	− 1.39	− 1.96
− 0.90	− 1.91	− 5.10	− 7.62	− 7.22	− 6.65	− 6.78	− 6.68	− 6.81	− 6.26	− 8.27	− 8.84
89.5	79.4	76.6	58.0	50.1	95.5	87.8	88 0	88.0	90 2	88.2	96.6
42.8	39.0	26.2	16.2	− 3.4	− 5.2	−20.8	− 8.5	−26.5	− 7.3	−20.1	−18.7
46.7	40.4	50.4	41.8	53.5	100.7	108.6	96.5	114.5	97.5	108.3	115.3
76 11	68.43	54.80	40.59	34.11	...	...	...	...	.	..	...
58.22	52.77	41.43	30.50	23.57	...	...	...	..	..	...	...
17.89	15.66	13.36	10.09	10.54	14.43	14.42	14 24	13.66	13.84	16.38	18.29
26.8	25.8	28.2	19.2	23.8	37.0	33.3	30.7	39 8	31.2	37.0	44.2
29.6161	29 6830	29.6188	29.6364	29.6778	29.6248	29.6008	29.5923	29 6209	29.6267	29.6054	29.5999
−.0052	+ 0201	−.0312	+.0225	+.0296	+.0115	−.0125	−.0210	+.0076	+.0134	−.0079	−.0134
29.977	30.031	30.039	30 469	30.453	30.469	30.330	30.267	30 392	30.408	30.361	30.480
29.326	29.107	29.047	29.132	29 105	28.805	28.644	28 838	28.286	28.849	28.452	28.459
0.651	0.924	0.992	1.337	1.348	1.664	1.686	1.429	2.106	1.559	1 909	2.021
.74	.80	.82	.80	.83	.77	78	77	.74	73	.79	.75
.510	.418	.300	.171	.142	.262	262	.260	.249	.259	.254	.244
.45	.47	.72	.79	75	.63	.62	.60	.61	60	.60	.57
.00	−.03	+.10	+.05	.00	+.03	+.02	.00	+.01	.00	.00	−.03
N 78 W	N 59 W	N 78 W	N 46 W	N 73 W	N 48 W	N 56 W	N 60 W	N 61 W	N 41 W	N 74 W	N 71 W
1.67	1.07	2.89	3.00	3.17	2.03	2.11	3.32	2.24	1.59	2.54	3.03
5.96	5.11	6.53	6.60	7.58	7.33	7.47	8.55	8.17	7.64	7.99	8.31
+0.79	−0.29	+0.67	−0.89	−0.60	+0.56	+0.70	+1.78	+1 40	+0.87	+1.22	+1.54
3.483	2.344	2.681	2.205	1.945	25.529	26.995	23.434	33.274	28.051	33.205	21.505
+0.532	−1.629	+0.199	−0.935	+0.400	−4.795	−3.329	−6 890	+2.950	−2.273	+2.881	−8.819
15	9	19	11	5	118	136	130	127	131	134	99
...	...	0.5	5.3	10.4	85.4	74.8	45.6	64.9	45.4	73.8	65.5
...	...	− 0.34	+ 2.20	− 4.26	+23.77	+13.17	−16.03	+ 3.27	−16.23	+12.17	+ 3.87
...	...	2	11	8	72	76	75	87	67	79	69
16	21	10	11	19	189	165	174	169	178	171	198
9	8	6	0	0	48	43	58	53	59	26	35
23	19	12	8	7	176	180	190	199	198	189	213
7	1	2	1	0	24	27	30	30	19	28	25

Sketch shewing the position of the flowing Wells at Enniskillen.



W C Chewett & Co Lith Toronto

NOTES ON THE PRESENT CONDITION OF THE OIL WELLS OF ENNISKILLEN.

BY SANDFORD FLEMING, ESQ., C.E.

Read before the Canadian Institute, February 29, 1863.

During a recent visit to the village of Oil-Springs, in the township of Enniskillen, I made the following notes on the present condition of the oil wells in that quarter.

The first flowing well discovered, was that known as the "Shaw Well," on Lot 13 in the Second Concession. The oil was "struck" in the early part of last year, and continued to flow spontaneously for about ten months. This well was formed by digging about fifty feet through clay to the rock surface, and then by boring one hundred and fifty-eight feet through the latter. The flow from this well has now entirely ceased, after discharging a total estimated quantity of 35,000 barrels.

During the past summer, or at least since the first discovery of the Shaw well, there have been found in all about thirty flowing wells, of more or less value, in this section. The yield of all these wells, as I was informed, was at one time as much as 12,000 barrels per day. They are all situated within an area of one square mile, and chiefly on the south bank of the Black Creek; only one having been discovered to the north of it. The number of flowing wells is now reduced to two, an old and a new one recently opened. These two wells are within one hundred feet of each other, and yield, it is said, over one hundred barrels per day each. Many of the old surface wells are now brought into requisition; and such of the old flowing wells as yet afford oil by pumping, are worked by hand. The total yield from the flowing wells and all other sources, at the present time, is said to be about four hundred barrels per day.

There is one remarkable peculiarity connected with the stoppage of the natural discharge of oil from the wells, which might here be mentioned. The deepest wells invariably have been those which first ceased to flow; and the two shallowest of all the thirty wells, are those only which now yield a natural discharge of oil.

I ascertained the depth of nine separate flowing wells, at points scattered over the whole oil-producing area, to be as follows :

The deepest well......	G	......is 230 feet in the rock.		
" next deepest......	I	......is 208	"	"
" "	B	......is 200	"	"
" "	C	......is 182	"	"
" "	H	......is 180	"	"
" "	D	......is 162	"	"
" "	A	......is 158	"	"
The shallowest wells	E	......is 109	At present flowing.	
	F	......is 109		

It ought to be borne in mind, that I give the depths under the *rock surface*, not under the surface of the ground; the former being nearly level, while the latter is very uneven. Over the surface of the rock, the thickness of clay ranges from forty feet in the flats of the creek to eighty feet on the banks.

The deepest well (G) was the first to fail; in fact this one only discharged 4,000 barrels in all. The next on the list (I), the "Feroe" well, failed. Then the wells (B and C) at opposite extremities of the oil-producing area gave way. Then well H, in the centre, and close by the gum beds, ceased flowing. Then various intermediate wells failed; until now the only old well flowing is F, with a depth of one hundred and nine feet under the rock surface; and its companion (E), recently made, within thirty or forty yards of it, and to the same depth in the rock, yields a copious supply.

In ceasing to give a discharge of oil, these wells seem to give no previous indications of a coming change. The iron pipe which conveys the fluid from the bore in the rock to a convenient height above the surface of the ground, continues to yield a discharge; but this discharge is suddenly changed, in most instances, from petroleum to salt water, and the water flows on in a continuous stream, as did the former substance.

The mention of some apparent anomalies may be of interest to those who desire to form satisfactory theories regarding the various phenomena connected with the mineral oils.

1. In the immediate neighbourhood of all the flowing wells, and on the next lot to what is termed the gum-beds, the rock was bored to a depth of three hundred feet—seventy feet lower than the lowest well—without finding the slightest trace of oil.

2. About twenty yards from the flowing well marked I, a second bore was made in the rock to a greater depth by seven feet than the first well, without finding oil.

3. In another case, the rock was bored about fifty feet from a good flowing well, and twenty-five feet deeper, without success.

4. But perhaps the most singular case is the following:—Some time after the "Shaw" well flowed so successfully, a second party bored the rock to the same depth about one hundred yards from it, and found a copious discharge of oil, but this second well had the immediate effect of reducing very materially the flow from the "Shaw" well. When either was plugged up, the other yielded a full discharge; but when both were allowed to flow, each yielded only a partial supply. A third party, owning a small oil lot between the two wells, commenced boring on a line drawn from the one to the other, at the distance of about thirty yards from the "Shaw" well; he naturally expected to rob both wells, whilst their owners (who by this time had formed a cöpartnership) had every reason to fear his certain success. All parties, however, were doomed to disappointment, as the third well proved an utter failure, although the rock was bored to a much greater depth than the other two wells.

I may mention, that although traces of petroleum have been found at several places beyond the immediate neighbourhood of the village of Oil Springs, viz. at Bothwell, at Tilsonburgh, and at other points within a circle of perhaps ten or fifteen miles; yet, with one single exception, I believe no flowing well has been struck beyond the limited area shewn on the sketch. The exception referred to is at Petrolea, on Lot 14 in 18th Concession, Enniskillen, and about six miles from Oil Springs village. The rock is here bored to a depth of three hundred feet—five hundred and sixty-three feet under the surface of the ground—and a constant stream of salt water and oil is discharged, equal to, it is estimated, 1,200 barrels per day; and of this yield, about one per cent., or twelve barrels per day, is found to be petroleum.

There are, at the present time, a great number of refineries in the neighbourhood of the springs; I had no means of ascertaining the exact number, but I was told that, reckoning large and small, they could not number much fewer than one hundred. The capacity of these refineries is estimated to be equal to 1,500 barrels of crude oil per day, whilst the total yield of the springs is said to be not much more than four hundred barrels.

The "oil-men," although discouraged, are not without hope; they think that, as in Pennsylvania, an increased supply of Petroleum will be found, by sinking wells to a greater depth; and accordingly, they are making arrangements, if they have not already commenced, to sink a test well, to the great depth of one thousand feet under the surface.

I was informed, that although only about 150,000 barrels of Petroleum have been shipped, a total quantity of 300,000 barrels must have been discharged, up to this date, from all the wells; about half of the total yield having been allowed to run to waste. To give some idea of the capacity of the hidden reservoirs in which the Petroleum has been stored, I may mention that 300,000 barrels are equal to nearly 2,000,000 cubic feet; and that if brought into one place, the crude oil discharged from the wells of Enniskillen would be sufficient to cover an area of five acres of land to a depth of ten feet!

TRANSLATIONS AND SELECTED ARTICLES.

INTRODUCTORY LECTURE OF A COURSE ON REMOTE ANTIQUITY.

Delivered at the Academy of Lausanne in Nov. and Dec., 1860.

BY A. MORLOT.

[The following Lecture has been selected for translation, not so much on account of its intrinsic merit as for the interest of the subject therein discussed, and as an admirable specimen of the foreign style of investigation. In a work recently published by one of the editors of this *Journal*, ("Pre-historic Man"), the reader will find the same subject treated with greater elaboration, and with due regard to an authority which the continental *savan* is too often content to ignore. For the translation itself, at once faithful and spirited, the *Journal* is indebted to the pen of a lady.—Ed.]

To infer from the known to the unknown, from what we see to what we do not see, is the practice of the whole world. The Arab of the desert when he sees at a great distance an eagle soaring in the air, in a peculiar manner, exclaims: "a lion." He knows that this eagle is waiting for the moment to pounce in his turn on the prey that a lion will soon leave.

Without going to make so distant a search, we see that every one has more or less the habit of forming opinions in an indirect way. It is thus we judge the character of a man, by his language, by his writing, by his dress. The proverb has consecrated it: "The dress makes the monk."

It is in the main, by the same proceeding that the jurist arives at moral proof, and that the *savant*, or we should rather say the student, for the *savant* is but a perpetual student, works out his doctrine. He commences by observation, which he combines with experiment, when it is possible for him to interpose by modifying the circumstances under which the observed phenomena occur, and he classifies, he makes co-ordinate, he compares his first results, the better to seize their bearings, and at last, going back from effects to causes, he arrives at the discovery of the grand principles, the laws which govern nature. Observation, with experiment when possible, comparison, and at last inference, by these is science constituted.

One of the most beautiful examples of the application of this process, has been presented by Geology, that science which has been able to remake the history of our globe anterior to the existence of the human species. But why should we stop at the moment, when, for the first time, an intelligent being appeared on this earth, peopled until then by animal creations, endowed only with instinct? Is not man al · an element of nature, and does not he also belong to the great plan of creation? We shall be told, that for the human epoch, we have the transmission of recollections by written documents, that is to say, by history so termed, and by oral recital, that is by tradition. But before the invention of writing, what constituted history; and before the development of language, in what consisted tradition? The origin of writing is not so obscure: that is to say, the starting point of history proper does not date from very far back. The origin of spoken language goes back naturally much further. But the study of languages shows that they slowly and gradually developed themselves, coming from a very rudimentary condition, corresponding necessarily to an equally rudimentary state of thought.

When did tradition begin to form itself, when did history proper take its birth? It is difficult to decide. For Southern Europe, dated and registered history goes back several centuries before the

Christian era. For that part of Europe situated north of the Alps, the historical epoch hardly opens before the Roman invasion, that is to say, about the commencement of the Christian era. We have some historical data and certain traditions going back somewhat more remotely, but they have no great importance, with regard to the investigations which we propose to make, and we shall eliminate them.

It is, then, these ante-traditional and ante-historic times, these which we designate under the name of Remote Antiquity, (*Haute Antiquité*), and which we are to make now the object of our study; thus, in considering only Northern Europe to the Alps, and in stopping towards the commencement of the Cristian Era, our task is thus clearly limited, a fact which we must not lose sight of.

Since the recollections of this long epoch are almost effaced, we must seek another kind of material to re-construct the past. We find ourselves here in precisely the same position as the Geologist who re-establishes the history of our globe; from him we will borrow his method, and our course will present necessarily much analogy to his.

The chief materials of the Geologist are, the remains of the animal and vegetable creation; that is to say, petrifactions or fossils buried in the strata which form, in a great part, the mass of a continent.

Instead of fossils, we have the productions of art and industry, which are to us as a mirror in which is reflected the image of man, his life and his entire civilization; for, by his work, we recognise the workman.* If from a bone the geologist is able to draw the complete animal, to which the piece once belonged, we can also as well with a single broken piece of pottery, reform the complete vase, and from the vase infer the maker. There is no extreme interval between a fragment of pottery and a human being, for everything holds together, everything is enchained in human economy, as everywhere in the reign of nature. The primitive inhabitant of our country has long ago disappeared, his mortal remains have returned to dust, his heroic narratives are forgotten, as well as his songs of love; the name even of the people—of the race lost; but the work of his hands still remains, and permits us to resuscitate our ancestors, to see how they lived and how they acted, to be present at their repasts, to examine their domestic industry, to recognize their commercial roads, to follow them to the chase and to battle, to surprise them in some of their religious observances, and to contemplate their funeral ceremonies. We thus transport ourselves into the past of our species, as the geologist has been able to make himself the contemporary of the phases of development of our planet. It is thus we understand the study of high antiquity or primitive Archæology.

We see that these researches deal with material objects, to vivify them and make them speak, as the geologist has the power of making stones speak. Nature is communicative when we know how to interrogate her; only we must not ask from times, when writing was unknown, to furnish us with proper names; for here they are entirely wanting,—whilst they play an important part in ordinary history. Thus, our studies will necessarily be limited to following the development of civilization, (in German *Cultur-geschichte*) in all that is allied to the acts of man, without touching speech. We can, to a certain point, *see* our ancestors but we cannot hear them, we observe them as if we were deaf and dumb.

It will be objected, perhaps, that to reconstruct thus the human past by means of the remains of industry, an abundance of means is necessary, which we do not possess; it will be said that antiquities are rare, and that fortunate discoveries are not frequent. But formerly it was thought fossils were also rare, and also exceptional; and now collections overflow with them, for they have been sought for and have been found abundantly, and beyond all expectation.

It is true, that with the exception of some monuments formed of great blocks and certain heaps of earth, time has rarely spared amongst the products of primitive industry those which rise above the surface of the earth. Especially is it the case in the countries with which we are occupied; and where the employment of masonry bound by mortar, dates only from the Romans. But let us consider that numerous generations have succeeded each other on the same ground—that they have sowed it with the minute remains of their activity, and that they have each in their turn passed away, carrying to their tombs what was most precious to them. We shall comprehend, then, that the vegetable earth, the mould, must be like one of those fossiliferous strata of the geologist, rich in documents of the past—only we must learn to find them, to recognize them, and to interpret them. The soil which we tread is veritably the tomb of the past—a vast grave, always open, and which will swallow us in our turn, with the remains of our industry, and to the profit of antiquaries to come.

It is equally true, that for the greater part of the time, the preservation of antiquities is but partial. Fleshy substances and vegetable matter have usually disappeared; and it is only metals, stone, pottery, glass, which have resisted. But it is the same with the remains of ancient organic creation, for it is in general but the solid parts of plants and animals that the strata of our globe have stored, under the form of fossils; nevertheless, the geologist has used them to much purpose. The task of the antiquary is not more difficult.

In certain cases, the preservation of the remains of antiquity is more perfect. Thus in turf-pits, and in the slime at the bottom of lakes, has been found vegetable matter, such as wood, certain fruits—even stuffs. When the object has been carbonised by fire, before falling in the water, it has become indestructible by chemical process. Thanks to this circumstance, there have been gathered in Switzerland even ears of wheat and bread, dating from several thousands of years. Far from being rare, the remains of antiquity will become abundant, as we seek for them better; and the materials to reconstruct the past of the human species will not be more defective than those by means of which the geologist reëstablishes the history of our globe.

It would seem, from that which precedes, that by beginning to form collections of antiquities, and by studying them rationally, in ever so trifling a degree, in no long time we ought to be able to know our true position, and to unravel the great features of our science—the fundamental principles of which are always very simple. Now, it is already long enough since we commenced to collect antiquities, but they were treated as fossils and many other objects of natural history were first treated; they were considered as mere curiosities when they were not made into amulets and charms. Then, when we desired to interpret their meaning, we began, as always happens at the birth of a science, by the most whimsical speculations, and by controversies as interminable as barren; so easily led astray is the human mind.

A proceeding which fetters progress still more, is that of attributing to the Romans all that is beautiful and skilfully worked, especially in objects made of metal, neglecting what is more ordinary, and arriving then, naturally enough, at the conclusion, that before the Roman invasion, the north of Europe to the Alps was only occupied by barbarous and savage hordes. Geology had to traverse a similar phase, when nothing could be seen in fossils but traces of the deluge.

These common mistakes have also prevailed in the south of Sweden and in Denmark, countries which abound in antiquities, and in which are found in particular numbers of axes and edges of flint. Some saw in these but instruments of sacrifice in Pagan times; others went so far as to believe these pieces proceeded from the thunderbolt, an origin which has also been attributed to certain fossils, such as belemnites. An idea can thus be formed of the state in which the question was found when the labors of M. Thomsen, Director of the Archæological Museum at Copenhagen, and of M. Nilsson, Professor of Zoology at the University of Lund in Sweden, commenced. These two illustrious veterans of the antiquaries of the North, too experienced to engage in the controversies then in vogue, set themselves to compare the antiquities of their countries with the products of industry among the people more or less savage of Oceanica and of other regions of the globe. This comparison led to a recognition of a remarkable similarity between the edged objects in flint of the north of Europe and the instruments of the modern populations who do not know the use of metals. Messrs. Thomsen and Nilsson remarked at the same time, that a whole series of northern tombs, characteristic enough, contained, in addition to the skeletons of the dead and pottery more or less coarse, instruments and arms of stone only, there being no relic of metal. They concluded naturally from this, that the first inhabitants of Europe had not known the use of metals, and had greatly resembled the savages of to-day, at least so far as relates to industry and material life. Another class of graves enclosed edged instruments and arms in metal, axes, knives, swords, lance-heads, but they were not made of iron or steel: they were of bronze, a mixture of brass and tin. Now, if iron had been known, it would certainly have been employed in preference to bronze, which is very inferior for all the purposes of cutting and carving. It follows then that bronze was known and used before iron, which was also brought into use later. Thus, the place taken by iron at the present day and for a long time past, with regard to industry and civilization in general, had previously been occupied by bronze, and, at a still more remote date, by stone. Thus we obtain the simple and practical distinction in antiquities of the age of stone, the age of bronze, and the age of iron. This classification, which recals that which Werner made of the geological strata into primitive, secondary, and tertiary, was introduced about thirty years ago. At first restricted in its application to the Scandinavian countries, it gradually extended to Germany, England, and Switzerland, and it now penetrates by Piedmont to Italy, rendering everywhere important services. We are now endeavouring to subdivide these three great principal phases in the development of civilization. The Danish antiquaries, at the head of whom is M. Worsaae, believe they can distinguish by the quality of the objects, and the mode of construction of the tombs, a first and second age of stone. The learned explorer of Mecklenburg, M. Lisch at Schwerin, thinks that the first centuries of the age of bronze were not acquainted with the casting of metal pieces, hollow inside, and that these indicate a considerable progress in the art of the founder, and characterise the last centuries of the age of bronze. At the same time, we begin to recognise in Denmark and in Switzerland a first age ante-historical of iron, and to distinguish it from a second age of iron joining on to historical times. In fine, it was necessary to begin by establishing, by means of large incisions (*coupures*), a small number of epochs clearly defined, as we at first established the great divisions of the earth in geology. But we are beginning now to recognise, as in geology, the indications of the gradual passing of one epoch into the other. Thus, although the presence of edged objects in bronze ordinarily excludes iron, there are, however, tombs like those at Hallstatt (Austrian Alps) which contain the bronze sword, with the iron knife or axe. But, then, an attentive study of the whole of the circumstances, shows that the tombs belong to a time of transition from bronze to iron. At Hallstatt, the transition evidently took place quietly and gradually. At other points, it seems to have been effected rudely enough, perhaps by the invasion of enemies, or by social revolutions, recalling geological perturbations which have so often established a decided difference between strata immediately superimposed.

We have just seen how the basis of our science has been established. This historical sketch has already revealed to us some fundamental principles; but it becomes us to consider more closely, and to place in detail our great means of practical research. In order to arrive at the comprehension of our species, we must naturally commence by learning its present state, by studying man, not only in civilised countries, but in following him wherever he has succeeded in establishing himself. That is to say, we must start from ethnology; and we have seen that it is precisely this proceeding which has most contributed to put the antiquaries of the north on the right path. Thus ethnology is for us, what physical geography is to the geologist. For we can understand the philosophy of the past of our globe only by first studying its present state, and by following the changes which operate on its surface, as Lyell, the reformer of geology, has so well taught us. Different people have had, in all times, their particular manner of fashioning and ornamenting the objects which they made, and they have always had their different habits, with which was connected the employment of particular objects. This is what constitutes what is vulgarly called the fashion, or, to use a more scientific term, style. In the north of Europe to the Alps, style or fashion, has always been uniform enough for a given period, but has constantly varied from one epoch to the other, precisely as fossil species have changed in type from one geological epoch to the other. The exterior character of an object often permits us to determine its age and that of the burial mound to which it belongs, as we can determine the age of a geological stratum by means of a single fossil when it is characteristic. In the north of Europe, bronze bracelets were worn during the age of bronze, and during the first age of iron; but their style was different, the fashion had changed. Thanks to this circumstance, we shall seldom be embarrassed when it is necessary to determine the age of a bronze bracelet, or even a fragment of such a bracelet. It does not suffice when we make excavations to gather antiquities to form collections. It is of the greatest interest to observe their associations, to determine what are the objects which are found together and are consequently of the same date, as it is of importance to reunite the fossils of the same strata. Taken separately, the latter often might not signify much, whilst together they may throw the brightest light on a whole phase of the past of our globe. In this view, tombs have a great importance, for they present collections of objects of the same date, without taking into account that the mode of sepulchre itself has varied from one epoch to the other, which again adds to the value of the observations. We have seen that the study of tombs has thus contributed much to putting the antiquaries of the north on the right road. The question of arrangement, so important in geology, is not less so as regards the remains of antiquity. The particular grouping of objects on the points where they meet, has often a special signification. Thus, to return to the tombs, their interior constitution, considered with care and minuteness, will reveal the funeral ceremony, and may furnish notions of the religious ideas and the different customs of the epoch. Sometimes, and it is found the most ancient custom, the body of the dead has been doubled down with the knees to the chin, as if to occupy the least possible space. At other times the body has been burnt, which would make us suspect fire-worship. Then the dead body has often been stretched at full length. Then there are several contemporary skeletons in the same tomb. Their particular arrangement and the whole circumstances would make us conclude that they were human sacrifices. We should find in this case the victims as if they had been thrown there negligently, whilst the central point had been reserved to the personage in whose honour the burial and sacrifices had been made. In observing the distribution of certain flints and fragments of pottery in the earth, accumulated on ancient sepulchres, Dr. Keller has inferred the custom of throwing these objects on the grave during its construction, which a curious passage of Shakspeare (*Hamlet*, Act V., Scene 1),* goes to confirm.

It would seem that the funeral ceremony was sometimes connected with a feast on the spot, and that, immediately after, the vases which had been used at the repast were broken, and the fragments scattered on the grave. At other times, entire vases, crushed by the pressure of the earth, appear to have contained provisions for the dead with

* *Note by Translator.*—We are referred by a note to the Memoirs of the Society of Antiquaries of Zurich (Vol. III., Cahier V., 1845), in explanation of this passage. Not being able to turn to the authority, we can only suppose that reference is made to the burial of Ophelia. The poet says,—

"Her death was doubtful;
And, but that great command o'ersways the order,
She should in ground unsanctified have lodg'd
Till the last trumpet; for charitable prayers,
Shards, flints, and pebbles, should be thrown on her,
Yet here she is allowed her virgin rites,
Her maiden strewments, and the bringing home
Of bell and burial."

"Maiden strewments" were the flowers and garlands which affection and devotion cast over the coffin of the young, as it were as a type of their innocence. It will be recollected as the Queen scatters flowers over Ophelia's grave, she says, "Sweets to the sweet." Our Protestantism has driven this ceremony from our churchyards, but it is a common practice in Southern Europe to this day.

whom they also buried his dress, arms, or other attributes of his trade, down to his dog, his horse, or even his wife.*

To the question of arrangement (*gisement*) is attached the order of superposition, which plays so essential a part in geology, as thence directly results the chronological order of succession of the different

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**Note by Translator.*—Some light is thrown upon this opinion by Mr. DuChaillu, in his late Explorations in Eastern Equatorial Africa, a country as primitive in its barbarism as we would wish to adduce as an example. The light of civilization reflected from the slave dealer, who appears to be the only representative of western development, must be necessarily small. Evidently, his success depends on depressing rather than elevating the savages with whom he comes in contact; so we may consider that we have in this section of the world, a man almost in the first stage of progress or the last of decadence.

"Near Feitch Point is the Oronugon burying ground, and this I went to see the following morning. It lay about a mile from our camp toward Saugatauga, from which it was distant about half a day's pull in a canoe. It is in a grove of noble trees, many of them of magnificent size and shape. The natives hold this place in great reverence, and refused at first to go with me on my contemplated visit, even desiring that I should not go. I explained to them that I did not go to laugh at their dead, but rather to pay them honor. But it was only by the promise of a large reward that I at last persuaded Niamkala, who was of our party, to accompany me. The negroes visit the place only on funeral errands, and *hold it in the greatest awe*, conceiving that here the spirits of their ancestors do wander about, and that these are not lightly to be disturbed. *I am quite sure that treasure to any amount might be left here exposed in perfect safety.* The grove stands by the sea shore; it is entirely cleared of underbrush, and, as the wind sighs through the dense foliage of the trees, and whispers in the darkened, somewhat gloomy grove, it is an awful place, even to an unimpressible white man. Niamkala stood in silence by the strand while I entered the domains of the Oronugon dead.

"*They are not put below the surface.* They lie about beneath the trees in huge wooden coffins, some of which, by their new look, betokened recent arrivals; but by far the greater number were crumbling away. There was a coffin falling to pieces, and disclosing a grinning skeleton within. On the other side were skeletons, already without covers, which lay in dust beside them. Everywhere were bleached bones and mouldering remains. *It was curious to see the brass anklets and bracelets in which some Oronugon maiden had been buried, still surrounding her whitened bones; and to note the remains of goods which had been laid in the same coffin with some wealthy fellow, now mouldering to dust by his side.* In some places *there remained only little heaps of shapeless dust, from which some copper, or iron, or ivory ornaments gleamed out to prove* that here, too, once lay a corpse.

"Passing into a yet more sombre gloom, I came at last to the grave of old King Pass-all, the brother of the present Majesty. *The coffin lay on the ground, and was surrounded on every side with great chests, which contained the property of his deceased Majesty. Among these chests and on top of them were piled huge earthenware jugs, glasses, mugs, plates, iron pots and bars, brass and copper rings,* strata, one stratum deposited on another being necessarily the most recent of the two. The antiquary has seldom a regular series superimposed like the strata of the geologist. It would be more often the case if we could examine the deposits which are formed at the bottom of lakes and seas. But in that case the geologist would have had the precedence, and would have traced the history of human kind so as to leave very little to glean after him. The materials of the antiquary are ordinarily all hidden in a thin layer of vegetable earth, and even this is sometimes wanting. There are, however, cases of superposition of deposits of human traces on dry ground; they are of great value, for they establish better and more surely than in any other manner the chronological order of succession of the different epochs. Thus all distinction of ages ought to be capable of being referred to direct observations of superposition of layers or deposits which would correspond to these ages. We have seen how the *savans* of the north arrived at their three ages of stone, of bronze, and of iron. Their result is without doubt very beautiful and satisfactory; but they have obtained it by a rather indirect way, and thus it is sometimes still contested. Here is one of these observations, since there is need of such to decide the question definitively. At Waldhausen, near Lubeck, existed one of these ancient tombs in the form of a hillock, or barrow, of 13 feet in height by 161 in circumference. It was examined by entirely levelling it. Under the summit was discovered a tomb of the age of iron, but very ancient, according to all appearance ante-historical. There was a skeleton in the mere ground, with fragments of coarse pottery, and a piece of iron eaten with rust. Lower down, about mid-way, three graves of the age of bronze presented themselves. They were small recesses in dry walls, containing each a cinerary urn filled with the remains of calcined bones, to which were added different objects in bronze, such as necklaces, hair pins, and a knife. At last at the base of the hillock was a tomb of the age of stone, formed with great rough blocks, and enclosing among other things coarse pottery and flint axes. Evidently the first inhabitants of the country had constructed, on the flat and natural soil, a tomb, according to the

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and other precious things which this old Pass-all had determined to carry at last to the grave with him. And, also, there lay around *numerous skeletons of the poor slaves who were, to the number of one hundred, killed when the king died*, that his ebony kingship might not pass into the other world without due attendance."
—*Explorations and Wanderings in Equatorial Africa, by Paul B. DuChaillu*, 1862; chapter xii.

custom of the time, and had covered it with earth; on the elevation thus produced they had, during the age of bronze, practised the funeral ceremonies of the epoch, and covered the whole with earth, doubling the height of the hillock. Finally, in the age of iron they had buried a corpse by digging a grave at the top of the tomb. What appeared at first one grave may thus furnish objects of very different ages, and it is of great importance to execute the search with the necessary care in order to determine the exact position of what is found there, if we do not wish to fall into grave errors Messrs. Castan and Delacroix, at Besançon, surprised at finding objects apparently brought together, the association of which did not appear to them natural, succeeded in establishing in the interior of the same grave, not of great elevation, interments of the Roman epoch superposed on Gallic graves of the first age of iron. They have thus decided the question of an indigenous civilization possessing iron, and anterior to the arrival of the Romans.

But the observations of superposition, notwithstanding all their worth, furnish only data of relative chronology, like those of geology, which does not recognise absolute dates; and yet we should like to know, when each of the three ages of stone, of bronze, and of iron commenced, and how long they each lasted. The most simple answer is to avow that we do not know. The introduction of iron is already an ante-historical event, even ante-traditional; how much more reason then, that the preceding ages of bronze and of stone should be beyond all recollection? It is only with the concurrence of geology that a solution of the problem can be arrived at; here is an example which shows how the data of absolute chronology may be obtained.

The alluvium of the torrent of the Tinière, which empties itself in the lake of Geneva, at Villeneuve, forms a cone of deposit, (*dejection*) regular enough,—a delta in the shape of a fan, of about 100 degrees of opening, 900 feet radius (at its least), and 4 degrees inclination. The works of the railroad have cut through this cone, perpendicularly to its axis, through a length of 1000 feet and a height, attained in the central or the most elevated part of the cone, of 32½ feet above the definitive level of the rails. The cut obtained may then be represented by an a[illegible]f a circle, or if we wish it, by a hyperbola, its vertex being elevated 32½ feet above a subtending chord of 1000 feet.

The interior constitution of the cone, thus opened, was found to possess great regularity, a proof that the formation of the cone took place gradually. The same rolled materials were seen in it, sand, gravel, and blocks, precisely as in the actual deposits of the torrent. There are a great many little differences in the constitution of the torrent from one year to another, but it is evident that in the end there is a compensation, and that when we go on to consider the series of centuries and the whole of the cone, as we do here, the influence of these temporary variations, depending on meteorological variations, disappear entirely, leaving apparent only the average and regular growth of the cone. We must also consider, that the alluvium of the torrent is fed by the degradation of the surface of its hydrographical basin, which necessarily contributes much to regulate the growth of the cone. This hydrographical basin is itself regular enough, and although its surface is much inclined, it does not present land slides or other accidents, which could have troubled the course of the torrent. The partial denudation of the hydrographical basin in modern times, may have accelerated a little the superficial degradation; but if this effect has been sensible, which is doubtful enough, an augmentation would result from it, and not a diminution of the dates which we are going to deduce. Modern embankments having driven the torrent a little to one side, towards the right shore, on the inclining or north flank of the cone, the alluvium has concentrated itself on this side, and has since then more forcibly raised the surface of the soil, since it could no longer reach the southern fall of the cone. The documents preserved in the archives of Villeneuve, prove that these embankments date from the year 1710, and their recent date is confirmed by the small thickness in the covering of vegetable earth on the incline of the cone protected by the dykes; there was not, where the culture of the earth had not intervened, more than two or three inches (six to nine centimetres), including the length occupied by the radicle of the turf. In this southern plane, thus protected by dykes, the works of the railway brought to light three layers of ancient earth, situated at different depths, and which had each in its time formed the surface of the cone. They were regularly intercalated in the gravel of the alluvium of the torrent, and exactly parallel to each other, and to the present surface of the cone, which was itself quite straight, and regularly inclined four degrees, following the line of the sharpest descent. It is evident that this parallelism of the layers between themselves and the present surface, proves, in the most direct manner, the regularity with which the cone has grown. The first of these ancient layers of vegetable earth, was followed, in the southern flank of the cone, on a surface of more than 15,000 square feet, it was from four to six inches in thickness, (twelve to eighteen centimetres) and was formed at a depth of four feet, (more exactly 1·14 metres, measured to the base of the layer) under the present surface of the cone. It dated from the Roman epoch, for it contained fragments of Roman tile, and there was found a Roman coin much defaced, but appearing to be anterior to the lower empire. The second layer of ancient earth was followed in the southern flank of the cone, on a surface of about 25,000 square feet, it was six inches thick, and was found at ten feet (more exactly at 2·97 metres, measured to the base of the layer) under the present surface of the soil. It afforded some fragments of pottery not varnished, and tweezers in melted bronze, characteristic by its style of the age of bronze. The third of these layers of ancient earth was exposed to view in the southern flank of the cone, on a surface of about 3,500 square feet; it was from six to seven inches thick, and was nineteen feet (more exactly 5·69 metres) under the present surface of the soil. It furnished fragments of very coarse pottery, of charcoal, bruised bones of animals, evidently the remains of repasts, and a human skeleton whose skull * was very round, very small, and remarkably thick, presenting the Mongol type.

This third layer can only be referred to the age of stone, although we have not had the good fortune of meeting a stone-axe, or anything of that kind. Let us note, that on one point of the southern flank of the cone, some charcoal was again found in a layer of gravel, a foot lower than the layer of vegetable earth of the age of stone; that is to say, twenty feet (more exactly at 6·09 metres) in depth, under the present soil. Let us note further, that under the layer of earth of the Roman epoch, there presented itself no trace of brick or tile. This is not without interest, when we know that the art of baking brick and tile was imported by the Romans to this country. Towards the centre of the cone, in the most elevated part of the cist or trench, the three layers in question disappear,—naturally, for it is here that the torrent has always had the greatest force, and that it has deposited the coarsest materials, comprehending round blocks about three feet in diameter, such as we see in the bed of the torrent. The more the torrent deviated to the right or the left of the central region of its delta, the smaller

* We learn that this skull was examined, measured, and determined, by J. M. P. Montagu, Esq., well known in the scientific circles of Montreal, some fourteen years back.

were the materials which it deposited on the two inclines of its cone; and the more easily could a layer of earth formed on the surface, after the preceding great inundations, remain in its place and be hidden under new alluvium; whilst towards the centre of the delta or cone, it must have been swept away by the violence of the water. Likewise, we further found in the gravel of the southern incline of the cone, at a point where the layer of earth of the age of bronze had disappeared, but still at ten feet in depth under the present surface, a hatchet in bronze, oxydised, and a bronze axe well preserved, which had not been rolled; the weight of these two objects would have made them remain in this place, whilst the earth which surrounded them apparently had been carried over by the torrent. If the three layers of ancient earth in question thus disappeared on one side, as they approached the centre of the cone, they re-appeared symmetrically on the other side, in the southern flank. They were never at a greater depth under the present surface; for the torrent, as we have seen, has concentred its alluvium on this incline, but they were always parallel to each other, and the vertical distances which separated the one from the other, were sensibly the same as on the other side of the centre, in the southern incline of the cone. There was, thus, in the northern flank of the cone, six feet in depth of the Roman layer, sufficiently thin at this point, based on the layer of the age of bronze, and ten feet in depth, of this latter, on the layer of the age of stone; we could not be mistaken in the layers, and take one for the other. That of the age of stone was too little interrupted in the centre, for it to be possible to mistake the direction it was necessary to take to find it again. The layer of the age of bronze was interrupted to a greater extent, but it could be distinguished in the two sides by its particular character. It was formed of a bluish clayey earth, resembling in appearance blue frozen mud, and bounded towards its upper and lower limits, by more sandy zones, coloured yellow by hydroxyde of iron and producing the effect of two layers, encasing between them the bluish bed; it was remarkable and indicates some particular cause. The deposit of the age of stone occasionally presented an analogous appearance; but it was only in spots, and not with the continuity of the age of bronze. As to the Roman layer of the northern side, it was known only by its height above the stratum of the age of bronze; no fragments of Roman tiles were found, but it was here only observed for a limited extent, in a length of about forty feet; whilst the stratum of the age of bronze showed itself in the northern side, very distinctly and regularly, for a length of 200 feet.

After all which precedes, we can see that it would be difficult to imagine a greater regularity in the entirety as well as in the details of the phenomena, and this circumstance renders perfectly legitimate the application of our calculus. So then, taking our departure from the observations and measurements made on and in the decline of the southern side of the cone, keeping account of the effects of the embankments, but augmenting their age to double; that is to say, giving them a date of three centuries, taking notice of the thickness of the vegetable earth on the present surface, considering that the volume of the cone increases as the cube of its radius, and that the depths of its different strata are thus not exactly in direct ratio with their age, and giving finally to the Roman layer an antiquity of at least thirteen centuries, or at most eighteen, although nineteen centuries have passed since the Romans invaded this country, we find for the layer of the age of bronze an antiquity of at least twenty-nine centuries or forty-two at most; for the layer of the age of stone an antiquity of at least forty-seven centuries or at most seventy; and for the whole of the cone a total age of seventy-four or at most 110 centuries. The author believes that we would approach near enough to the truth, by deducting only two centuries for the action of the dykes, and attributing to the Roman deposit an antiquity of sixteen centuries; that is to say, in bringing it to the third century of the Christian era. This would give to the layer of the age of bronze an antiquity of thirty-eight centuries, twenty centuries before Jesus Christ; and for the age of stone an antiquity of sixty-four centuries. But in order not to risk being too precise in counting the centuries, we will stop at the assertion, that the layer in question of the age of bronze has a date of from 3000 to 4000 years, and that of the age of stone from 5000 to 7000 years.

It is evident that each of our ancient soils would not represent the total length of each of the corresponding ages, but only some portion of each of these ages, the small period more or less long, during which the torrent has worked in the central region of its cone, without spreading itself on its sides, where vegetation could then have taken place. The surface of the cone, for the greater part of the time, must only have presented the appearance of a heap of stones, on which a few bushes grew. Thus we have not remarked traces of human occupation in the gravel intercalated between the three layers of ancient earth in question. The argillaceous nature of the latter appears to indicate that they owe their origin perhaps to inundations of an exceptional nature, forming deposits more muddy than stony, and this would have favored the development of vegetation, and thus have attracted man to the spot. Here might be raised the objection that, our three layers having been deposited by the torrent, the ancient *débris* which they have furnished could equally have been brought here by the torrent, which might have brought them from elsewhere; and in this case the age of the three layers would remain undetermined. But the ancient remains had been well preserved and had not been rolled by the torrent; the fragments of pottery and baked earth were angular, as were also the small pieces of charcoal disseminated in each of these three layers, which also all three contained whole shells, although very fragile, of different species of land mollusca. The objection is therefore inadmissible.

Let us remark here that the minimum date of twenty-nine centuries for the layer of the age of bronze corresponds well with deductions, purely arcæological, which on their part also bring back the introduction of iron into our countries to at least a thousand years before the Christian era. This identity is so far complete that the character of the tweezers found in the layer of the age of bronze indicates rather the end than the beginning of that age: so that if this minimum of twenty-nine centuries for the date of the layer of the age of bronze conforms to truth, that of forty-seven centuries for the layer of the age of stone, and of seventy-four centuries for the age of the entire cone, is so, *a fortiori*, in virtue of the calculation itself, whilst the maxima obtained may have remained below the reality. The maximum of 110 centuries in particular for the age of the entire cone, is evidently under rather than over the real figure. It would result, nevertheless, from the date found, that the modern geological epoch, to which the cone or delta of the Tinière corresponds, has not been very long, and that very soon after its commencement man invaded Europe, which is confirmed by the study of the turfy marshes in Denmark and Switzerland. Flints, cut by the hand of man, found in England and France in gravel, along with bones of elephants (*elephas primigenius*) and of other extinct species, make the apparition of man in Europe go back beyond what we ordinarily consider the modern geological epoch.

We have thus endeavoured to conquer for remote antiquity the data of absolute chronology, expressed in thousands of years. The occasion has been singularly advantageous it is true, but it has the great drawback of being the first and only one of its kind. Let us hope that others as favorable will present themselves, from which we may obtain good results; for as long as a fact remains isolated, the indications which we draw from it cannot be controlled by comparison, and the mind cannot rest entirely satisfied.

But what is the benefit of all these researches in the past when the present suffices to absorb us?

The question is legitimate, and it is right that we should conclude by some remarks on the end and utility of our study. When the philosophers of Ancient Greece exercised the subtilty of their minds in developing the properties of the conic sections, they did not imagine that they were laying the base of those modern processes by which we calculate astronomical tables, serving to guide the sailor in his course across the ocean. And now we no longer ask, what is the use of mathematics!

It is not a century since geologists would have been embarrassed to explain the practical utility of their researches. Now it is easy to answer by furnishing the most satisfactory examples of the application of geology to industry.

All real knowledge, the simplest secret drawn from nature, has necessarily its value, and will find, soon or late, its application in contributing to the well-being of humanity. But Science also requires time to clear its land, to work it, to sow it, and to ripen the harvest.

Besides, primitive Archæology is very young, younger even than its sister Geology; we must therefore not be astonished if it cannot glorify itself about the great services that it has already rendered. There are, however, some words of apology in its favor.

We really know a man only by his past life, by his youth, by his education, and by the whole of his antecedents; precisely as the naturalist does not thoroughly know an organic being until he has followed its development from the first germ. In the same way, the study of the past of humanity is indispensable in learning to appreciate its present state, and to arrive at the comprehension of the social relations which regulate the life of nations. Thus it will be a real gain, when the progress of scientific researches on the development of humanity shall have silenced these modern discussions, to which may be applied the bitter but true remark of the mathematician Littrow, relative to the scholastic controversies of the middle ages, viz., that to argue a subject well, the two parties must know nothing of it, seeing that if one understands something of it, the discussion is soon ended, and that when both see it clearly they cannot even commence.

Lastly, if the astronomer has succeeded in foretelling the movements of the celestial bodies because he has found out the laws of them, may we not hope with Condorcet that, if once the present condition of humanity be well understood as a necessary result of its past, we may succeed in sounding a little the mystery of its future! We are studying the past in order to comprehend the present, and possibly to obtain a glimpse of the future. M. M. K.

SCIENTIFIC AND LITERARY NOTES.

SALT WELLS OF MICHIGAN.

Professor Winchell has sent us a copy of his paper on the Saliferous Rocks and Salt Springs of Michigan, published in a recent number of the *American Journal of Science* (November, 1862). According to the author, the brine-holding strata of Michigan occupy three distinct geological positions. The lowest saliferous beds form part of the Onondaga Salt Group of the Upper Silurian Series, but these have not as yet been thoroughly explored. Seven hundred and fifty feet above the Onondaga deposits, lie the strata known as the Michigan Salt Group, the source of supply being probably the "Napoleon Sandstone" at their base. These strata have been fully discussed by Prof. Winchell in his "First Biennial Report." They belong to the horizon of the upper part of the Carboniferous limestone formation. Still higher in the series, the so-called "Parma Sandstone," immediately beneath the coal-measures proper, has been found to furnish a third supply of brine. The wells first sunk at Bay City, derived their supply from this source, but the borings are now carried down to the lower-lying Napoleon sandstone. The daily supply from these wells, along the Saginaw Valley, is stated to be "at least 25000 gallons each"—their united daily produce, with 22 blocks of kettles in operation, being about 1210 barrels. The cost of manufacture, per barrel, does not exceed sixty-four cents.

FOSSIL REPTILES FROM THE COAL-MEASURES OF NOVA SCOTIA.

The bones and other portions of Carboniferous reptiles, discovered some time ago by Dr. Dawson in Nova Scotia, have been examined by Professor Owen (*Journal of Geological Society*, August, 1862). The materials collected are referred to several distinct species of *Hylonomus* and to one species of *Dendrerpeton*: genera belonging to the Ganocephalous Order of Professor Owen's last classification. The author observes:—"*Dendrerpeton*, like *Hylonomus* and *Archegosaurus*, shows t' affinity (if it may be so called) or analogy to the ganoid fishes, not only in the character of the cranial bones, but in the retention of a covering of the body by ganoid scales: these are elliptic, smooth on their inner surface, with a slight indication of a ridge, about half the length of the scale, on the external surface—at least, in certain of the scales, and probably those along the back. The genus *Hylonomus* also, although with more minute and simple teeth, had the skin defended by similar elliptic or suboval ganoid scales. Much remains to be determined as to the structure of the skull; nevertheless such cranial bones as have been obtained, exemplify the Ganocephalous sculpturing; while the arrested state of ossification of the endoskeleton, and the characters of the limb-bones sustain the reference of the genus to the Order Ganocephala. After careful scrutiny of all the specimens confided to my inspection by Dr. Dawson, I have not met with any decisive evidence of a member of any of the orders of *Reptilia* represented by species of the Oolitic or later series of deposits. Some, as (*e.g.*) *Baphetes*, may be Labyrinthodont, but the rest are Ganocephalous; and *Baphetes* may possibly belong to this lower group of palæozoic air-breathing vertebrates."

CANADIAN INSTITUTE.

Session—1862-63.

FIRST ORDINARY MEETING—*6th December*, 1862.

No Quorum

SECOND ORDINARY MEETING—*13th December*, 1862.

Hon. J. H. Hagarty D.C.L., President, in the Chair.

I. George Beardmore Esq., elected provisionally by the council during the recess was balloted for, and declared duly elected.

II. *Donations received since the last meeting of the Institute were announced (see annual report.)*

III. *The following Papers were then read:*

By the Rev. Prof. W. Hincks, F.L.S.

"On certain vegetable monstrosities considered in reference to the question of the reality and permanence of species amongst organized beings."

P. Freeland, Esq. "Exhibited and described Smith and Beck's new universal Microscope."

IV. The requisite nominations for the election of office-bearers for the ensuing year were made, and the President announced the Annual General Meeting to be held on the 20th inst., to receive the Report of the Council, to elect office-bearers and members of Council for the ensuing year and for other business.

V. Prof. Chapman gave notice that at the meeting to be held on the 10th Jan., 1863, he would propose an amendment to the By Laws, Sec. VII. Regulation 1, to the effect that the words "Editor of the Journal" be added to the list of office-bearers, immediately before the words "and six other members."

ERRATA.

In the No. for March, page 137, line 12, *for* that of a man, *read* that of a woman.

" " page 159, *for* $\frac{\Delta x}{x} - \frac{\Delta y}{y}$ *read* $\frac{\Delta y}{y} - \frac{\Delta x}{x}$

" page 163, foot-note, *for* from 1848 to 1860, *read* from 1844 to 1848.

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

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

Day.	Barom. at temp. of 32°.				Temp. of the Air.				Excess of mean above Normal.	Tens. of Vapour.				Humidity of Air.			
	6 A.M.	2 P.M.	10 P.M.	Mean.	6 A.M.	2 P.M.	10 P.M.	ME'N		6 A.M.	2 P.M.	10 P.M.	M'N	6 A.M.	2 P.M.	10 P.M.	M'N
					°	°	°	°	°								
1	29.668	29.107	—	—	30.9	33.4	—	—	—	.157	.178	—	—	.90	.93	—	—
2	.636	.636	29.726	29.6547	17.2	18.3	6.0	13.47	—10.38	.068	.074	.055	.062	.72	.74	.95	.76
3	.807	.875	30.125	.9663	1.7	8.2	- 5.2	-0.18	—23.95	.038	.046	.032	.036	.80	.73	.90	.80
4	30.407	30.465	30.387	30.4123	-19.8	- 3.7	7.8	-4.52	—28.20	.016	.038	.051	.034	.87	.93	.82	.84
5	30.122	29.924	29.683	29.8882	15.4	21.5	28.4	22.67	— 0.92	.077	.109	.148	.116	.87	.92	.95	.93
6	29.602	.414	.719	.5733	24.8	25.2	24.4	24.67	+ 1.15	.126	.118	.117	.120	.95	.87	.89	.91
7	.837	.822	.890	.8667	23.3	29.8	23.0	24.37	+ 0.93	.110	.109	.106	.104	.87	.66	.86	.80
8	30.001	30.021	—	—	19.7	32.4	—	—	—	.096	.153	—	—	.91	.83	—	—
9	30.033	29.789	.368	.7113	24.8	26.2	34.9	29.27	+ 6.00	.120	.110	.109	.151	.88	.77	.98	.89
10	29.632	.854	30.018	.8598	31.3	30.6	25.1	27.97	+ 4.70	.143	.131	.108	.123	.81	.76	.80	.80
11	.968	.815	29.695	.8173	21.5	30.6	25.5	25.93	+ 2.67	.102	.115	.118	.111	.88	.67	.86	.80
12	.625	.553	.723	.6418	24.4	27.3	19.0	23.52	+ 0.27	.110	.133	.078	.104	.84	.89	.77	.81
13	.911	30.005	30.106	30.0255	3.5	20.8	10.0	11.72	—11.55	.044	.077	.059	.061	.87	.69	.87	.80
14	30.035	29.743	29.412	29.6907	20.1	27.7	34.2	23.72	+ 5.45	.041	.106	.187	.134	.85	.70	.95	.82
15	29.472	.617	—	—	34.9	35.6	—	—	—	.176	.121	—	—	.86	.59	—	—
16	.930	30.071	30.068	30.0315	24.1	26.2	16.8	22.05	— 1.32	.093	.103	.073	.089	.72	.73	.78	.74
17	30.001	29.870	29.835	29.8935	19.4	30.9	24.1	24.80	+ 1.43	.087	.083	.107	.096	.83	.48	.82	.73
18	29.730	.652	.547	.6360	20.5	34.9	34.5	30.80	+ 7.37	.087	.178	.174	.151	.79	.88	.87	.85
19	.471	.255	.083	.2467	35.3	36.7	34.5	35.38	+11.83	.198	.205	.192	.198	.96	.91	.96	.96
20	.113	.443	.707	.4888	38.0	28.0	20.8	25.23	+ 2.67	.172	.109	.097	.117	.81	.71	.87	.80
21	30.037	30.101	30.214	30.1570	5.0	10.4	6.0	7.50	—13.23	.049	.055	.049	.033	.90	.78	.85	.85
22	30.078	29.916	—	—	3.4	9.3	—	—	—	.045	.056	—	—	.90	.84	—	—
23	30.066	30.073	29.973	30.0358	4.9	20.1	19.0	14.50	— 0.42	.045	.035	.038	.076	.80	.78	.95	.85
24	29.810	29.800	.845	29.8260	17.2	30.6	25.5	24.73	+ 0.60	.031	.144	.118	.112	.85	.85	.86	.83
25	.868	.813	.789	.8115	23.3	34.5	29.1	29.15	+ 4.82	.103	.149	.133	.130	.82	.75	.82	.80
26	.662	.320	.238	.3722	32.4	34.9	36.7	35.18	+10.65	.163	.195	.213	.188	.91	.96	.98	.91
27	.319	.534	.840	.5922	36.0	34.2	27.7	31.72	+ 7.00	.172	.131	.125	.137	.81	.66	.84	.76
28	.912	.846	.642	.7597	24.8	30.9	29.1	28.22	+ 3.32	.112	.141	.133	.129	.84	.81	.82	.83
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
M	29.8075	29.7830	29.7797	29.7922	19.46	25.62	22.37	22.41	— 1.26	.101	.114	.116	.110	.84	.78	.88	.83

Day.	Direction of Wind.			Result't. Direction.	Velocity of Wind.					Rain in inches.	Snow in inches.
	6 A.M.	2 P.M.	10 P.M.		6 A.M.	2 P.M.	10 P.M.	Result't.	ME'N		
				°							
1	s b w	s b E	w b s	s 51 w	10.5	11.7	30.0	13.22	17.37	0.085	0.4
2	w b s	w	N b w	N 79 w	18.5	16.8	4.2	11.27	13.00	...	...
3	N	N N w	N N E	N 16 w	7.8	14.2	10.0	10.67	11.23	...	...
4	N N w	N E b N	E b s	N 71 E	7.0	10.0	16.2	10.19	12.72	...	1.0
5	E b s	s E b E	E s E	s 65 E	17.0	12.0	13.0	12.66	13.31	...	16.0
6	N E b E	N w	w	N 66 w	10.5	4.8	8.3	5.16	7.59	...	2.0
7	s w b w	s w b s	w b N	s 51 w	11.8	16.0	3.0	9.35	10.01	...	...
8	w s w	w	N	N 3 E	2.0	4.0	10.0	5.47	7.33	...	0.1
9	E b N	E	s s E	N 84 E	12.3	17.0	3.2	2.61	15.82	0.630	2.0
10	w b N	N w	Calm.	N 66 w	23.2	13.2	0.0	10.33	10.54	...	Inp.
11	N b E	E s E	N N E	N 80 E	3.8	8.0	6.5	3.49	5.96	...	...
12	N N E	N N E	N w b N	N 10 w	1.0	6.2	9.5	7.45	8.25	...	0.1
13	w N w	N w	N N E	N 7 E	4.5	1.8	6.8	3.48	4.51	...	...
14	E s E	E b s	s b E	s 29 E	9.0	15.8	8.0	7.68	14.50	0.015	...
15	w b s	w s w	s w b w	s 80 w	14.5	22.0	11.0	16.19	17.02	...	...
16	w N w	N w	N E b N	N 32 w	19.8	5.5	2.0	4.35	6.23	...	...
17	N N E	E N E	N E	N 51 E	5.5	11.0	4.6	5.51	6.05	...	...
18	N b E	E	E b N	N 82 E	5.0	10.0	3.0	5.18	5.91	0.040	...
19	E b s	N E	N N E	N 28 E	6.0	5.5	3.2	3.73	6.71	0.590	...
20	N N w	N w	w N w	N 38 w	16.5	23.0	14.2	18.38	19.10	...	Inp.
21	N	N	N b E	N 16 E	7.8	6.8	9.8	11.24	12.60	...	0.2
22	N E	E N E	N N E	N 43 E	21.0	16.0	6.5	12.53	12.91	...	0.2
23	N b E	Calm.	N E	N 46 E	8.0	0.0	3.5	3.35	4.00	...	...
24	N N E	s w b s	s w b w	s 53 w	4.2	5.0	7.0	4.91	5.81	...	...
25	w s w	s b w	s	s 18 E	3.3	9.8	2.2	1.62	4.98	Inp.	...
26	E N E	E b N	s E	N 89 E	12.0	9.8	4.0	2.22	8.67	0.060	...
27	s w b w	w	N w	N 76 w	8.4	26.0	6.0	11.89	13.26	...	Inp.
28	N b w	E s E	N E b E	N 63 E	2.4	7.0	9.0	7.58	8.28	...	...
...	...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...	...	...
M	....	....	....	....	9.76	11.03	7.67	...	10.13	1.450	22.0

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR FEBRUARY, 1863.

Highest Barometer . . . . 30.502 at 11 a.m. on 4th. } Monthly range=
Lowest Barometer . . . . 29.037 at midnight on 19th. } 1.465 inches.

Self-registering Ther.:
- Maximum temperature . . . . 41°5 on p.m. of 26th } Monthly range=
- Minimum temperature . . . . —19°8 on a.m. of 4th } 61°3
- Mean maximum temperature . . 30°06 } Mean daily range=14°58
- Mean minimum temperature . . 15°47 }
- Greatest daily range . . . . . . 35°6 from a. m. of 4th to a. m. of 5th.
- Least daily range . . . . 2°9 from a. m. to p. m. of 2nd.

Warmest day . . . 19th...Mean Temperature . . . 35°38 } Difference=39°90.
Col lest day . . . . 4th ...Mean Temperature . . . —4°52 }
Maximum { Solar . . . . 53°6 on p.m of 15th } Monthly range=
Radiation { Terrestrial . . . . —24°5 on a. m. of 4th } 8 ?.1
Aurora observed on 4 nights, viz., on 18th, 22nd, 23rd, and 25th; possible to see Aurora on 14 nights; impossible on 14 nights.
Snowing on 12 days; depth 22.0 inches; duration of fall 58.2 hours.
Raining on 7 days; depth, 1.450 inches; duration of fall, 40.7 hours.
Mean of cloudiness=0.66; below average, 0.05. Most cloudy hour observed, 2 p.m; mean=0.73; least cloudy hour observed, 10 p.m.; mean=0.60.

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

North.	South.	East.	West.
2527.34	1116.39	2183.40	2772.84

Resultant direction, N. 23° W.; Resultant Velocity, 2.27 miles per hour.
Mean velocity 10.13 miles per hour.
Maximum velocity 33.0 miles, from 10 to 11 a.m. on 20th.
Most windy day 24th—Mean velocity 19.10 miles per hour. } Difference 15.10
Least windy day 23rd—Mean velocity 4.00 miles per hour. }
Most windy hour, 10 to 11 a.m.—Mean velocity, 12.24 miles per hour. } Difference
Least windy hour, 9 to 10 p.m.—Mean velocity, 7.34 miles per hour. } 4.90 miles.

4th.—Very cold day; high barometric pressure; lunar halo and corona at 10 p.m. and midnight; rapid ascent of temperature.—5th. Great snow storm, and heavy drift from 10 a.m. of 5th to 10 a.m. of 6th.—9th. Stormy day, high wind: snow till 8.30 p.m.; sleet 3.30 to 4 p.m.; rain from 4 to 11 p.m.—11th. Solar halo during the forenoon.—18th. Solar halo 8 a.m; auroral light 7 to 9 p.m.—19th. Dense fog 6 a.m. to 2 p.m.; raining from 3 p.m. to 3 a.m. of 20th.—20th. Wind high and squally; rapid descent of temperature.—22nd. Auroral light, arches, and streamers, 9 to 11 p.m.—24th. Imperfect lunar halo at 9.30 p.m.—26th. Dense fo; 5 to 10.30 p.m.; lunar halo at 11 p.m.—28th. Imperfect lunar halo at 10 p.m.

February, 1863, was comparatively cold, wet, windy and clear; it was also remarkable for rapid Barometric movements and great corresponding changes of temperature.

COMPARATIVE TABLE FOR FEBRUARY.

YEAR.	TEMPERATURE.					RAIN.		SNOW.		WIND.		
	Mean.	Excess above Average, (26°1).	Maximum observed.	Minimum observed.	Range.	No. of days.	Inches.	No. of days.	Inches.	Resultant. Direction.	Resultant. Velocity.	Mean Force or Velocity
1840	23.0°	+ 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	26.0	+ 3.0	46.6	— 3.9	50.5	5	Imp	9	19.0	...	...	0.99 "
1846	20.4	— 2.6	41.4	—16.2	57.6	0	0.0)0	13	46.1	...	...	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	5.69ms
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	1.99	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	1.440	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	3.030	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.?	+ 3.1	44.6	—20.4	65.0	4	0.815	17	29.7	N 77 W	3.86	10.38 "
1862	22.5	— 0.5	35.6	— 3.7	39.3	3	0.180	17	23.1	N 55 W	3.93	8.52 "
1863	22.4	— 0.6	38.9	—19.8	58.7	7	1.450	12	22.0	N 23 W	2.27	10.13 "
Results to 1861.	22.93	...	44.15	—6.16	50.32	4.2	1.046	11.6	18.03	N 69 W	3.02	8.08
Exc. for 1863.	—0.57	...	— 5.25	— 13.64	+ 8.38	+ 2.8	+ 0.404	+ 0.4	+ 3.97	...	...	+2.05

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

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

Day.	Barom. at temp. of 32°.				Temp. of the Air.				Excess of mean above Normal.	Tens. of Vapour.				Humidity of Air.				Direction of Wind.			Resultant Direction.	Velocity of Wind.					Rain in Inches.	Snow in Inches.
	6 A.M.	2 P.M.	10 P.M.	MEAN.	6 A.M.	2 P.M.	10 P.M.	ME'N		6 A.M.	2 P.M.	10 P.M.	M'N	6 A.M.	2 P.M.	10 P.M.	M'N	6 A.M.	2 P.M.	10 P.M.		6 A.M.	2 P.M.	10 P.M.	Re-sul't	ME'N		
					°	°	°	°	°												°							
1	29.305	29.216	—	—	29.8	31.3	—	—	—	.154	.152	—	—	.93	.86	—	—	N E	N N W	W S W	N 10 W	13.0	11.0	1.5	3.97	7.10	...	1.5
2	.455	.466	29.469	29.4740	30.6	36.5	31.3	32.35	+ 6.93	.152	.174	.166	.160	.89	.80	.95	.88	S W	S W b S	E	S 63 E	0.5	3.2	2.0	0.78	5.07	...	2.0
3	.506	.564	.700	.6938	22.3	23.3	14.0	19.43	— 6.23	.107	.096	.065	.089	.89	.76	.82	.83	N E b N	N b W	N W	N 22 W	7.0	8.2	15.5	9.35	10.15	...	1.5
4	.847	.957	30.051	.9363	—1.2	14.3	6.0	7.0	—18.95	.039	.052	.013	.043	.91	.63	.75	.74	N W	N W b W	Calm.	N 38 W	5.5	12.0	0.0	4.61	4.77	...	...
5	30.030	.919	29.515	.8120	—3.4	24.1	29.8	18.78	— 7.42	.030	.107	.109	.089	.84	.82	.66	.78	Calm.	S S W	S b W	S 24 W	0.0	12.0	13.0	11.23	11.44	...	0.2
6	29.255	.416	.676	.4681	34.5	38.5	26.6	32.67	— 6.17	.166	.123	.112	.132	.83	.52	.77	.71	S W	W b N	W N W	N 81 W	18.0	21.2	2.0	10.24	11.99	...	...
7	.715	.639	.662	.6637	21.9	21.5	21.5	21.62	— 5.2[illegible]	.105	.102	.102	.102	.89	.88	.88	.88	N E b N	N E b E	E N E	N 48 E	1.5	9.0	8.0	9.16	9.41	...	1.5
8	.426	.383	—	—	17.6	24.4	—	—	—	.033	.036	—	—	.85	.73	—	—	N E b N	Calm.	S W b S	S 50 W	12.0	0.0	6.0	1.38	5.24	...	0.2
9	.321	.525	.638	.5422	28.8	28.0	26.6	26.82	— 0.70	.129	.082	.091	.100	.81	.53	.62	.68	W	W S W	S W b W	S 75 W	18.0	23.0	11.0	14.60	14.97	...	...
10	.771	.627	.474	.6128	16.1	34.2	29.8	27.48	— 0.33	.074	.116	.133	.119	.83	.75	.80	.77	W N W	S S W	S W b W	S 29 W	0.8	6.5	3.5	5.35	5.60	...	...
11	.403	.454	.624	.5023	26.9	27.7	17.6	23.77	— 4.47	.131	.092	.076	.098	.89	.60	.79	.75	W	N N W	W b N	N 31 W	0.5	17.0	2.0	8.76	8.91	...	...
12	.667	.728	.796	.7372	13.6	19.0	10.7	13.90	—14.65	.072	.060	.059	.063	.90	.57	.82	.77	W N W	W N W	N b W	N 36 W	6.0	12.2	0.5	6.40	6.69	...	...
13	.771	.719	.734	.7383	8.9	19.4	16.5	15.18	—13.78	.055	.040	.054	.065	.81	.76	.68	.74	N b E	N b W	W S W	N 68 W	0.5	9.5	9.5	5.95	7.17	...	0.2
14	.639	.514	.630	.6093	17.2	29.5	21.5	22.73	— 6.58	.075	.121	.069	.087	.78	.74	.59	.70	W b S	W S W	N N E	N 55 W	6.0	15.0	8.5	3.99	10.93	...	...
15	.751	.694	—	—	4.9	20.[illegible]	—	—	—	.039	.073	—	—	.71	.66	—	—	N E	E b N	N N E	N 45 E	11.5	17.2	11.0	11.87	12.33	...	0.2
16	.745	.790	.747	.7647	14.3	28.7	28.0	23.57	— 6.47	.055	.109	.117	.095	.78	.69	.76	.73	N	S S W	S W	N 86 W	7.0	3.8	2.5	0.91	3.33	...	0.2
17	.699	.548	.688	.6475	26.6	37.4	34.9	33.38	+ 2.93	.133	.170	.159	.153	.95	.76	.78	.80	S W b S	Calm.	N	N 7 W	0.5	0.0	6.8	4.12	6.92	...	...
18	.852	.932	30.069	.9873	18.7	23.7	15.8	19.20	—11.65	.070	.019	.078	.066	.68	.39	.88	.65	N b E	N	N b W	N 2 W	10.0	8.5	10.0	8.01	8.15	...	...
19	30.137	30.147	30.149	30.1450	11.1	24.1	19.7	18.78	—12.48	.050	.065	.090	.073	.83	.49	.84	.72	N b E	E b S	N N E	N 54 E	4.5	3.2	2.2	3.25	4.05	...	...
20	30.157	30.177	30.103	30.1433	21.5	25.5	26.6	25.02	— 6.65	.095	.083	.091	.090	.82	.60	.62	.66	N E b E	E	E b S	S 83 E	5.5	17.8	18.0	15.62	15.72	...	...
21	29.943	29.797	29.773	29.8330	27.7	29.1	33.1	30.02	— 2.07	.142	.155	.182	.160	.94	.96	.97	.96	E S E	E b S	S S W	S 54 E	14.5	10.5	3.8	6.21	6.99	0.030	3.0
22	.798	.805	—	—	32.4	39.2	—	—	—	.169	.199	—	—	.91	.83	—	—	Calm.	E b S	E	N 87 E	0.0	2.0	3.5	3.15	3.39	...	...
23	.790	.712	.675	.7268	34.2	35.2	34.9	34.40	+ 1.62	.152	.139	.177	.158	.77	.68	.86	.79	E b N	E b N	E b N	N 80 E	14.0	20.5	14.8	16.05	16.07	0.102	0.1
24	.569	.319	.312	.3712	36.7	39.2	41.4	38.25	+ 5.08	.205	.233	.232	.217	.94	.97	.89	.93	E	E b N	S	N 86 E	11.0	12.2	10.2	7.15	10.71	0.315	...
25	.215	.150	.324	.2237	36.3	38.5	33.4	36.18	+ 2.62	.210	.208	.171	.199	.98	.89	.89	.93	N N E	W N W	W S W	N [illegible] W	9.5	15.0	5.0	6.35	8.88	0.240	0.2
26	.359	.426	.642	.4893	31.3	34.9	29.5	31.53	— 2.45	.166	.144	.129	.143	.94	.71	.78	.80	W S W	W	N W b W	N 73 W	3.5	12.0	14.6	9.17	10.20	...	0.1
27	.752	.732	.695	.7287	23.0	37.4	30.9	32.10	— 2.32	.131	.137	.120	.129	.86	.61	.69	.72	W b S	S b W	S	S 35 W	6.2	3.0	1.8	2.80	5.24	...	0.1
28	.477	.270	.296	.3380	27.7	36.7	26.2	30.55	— 4.17	.135	.171	.110	.142	.89	.78	.77	.82	N E b N	E b N	N W	N 38 W	5.5	7.0	26.0	8.44	13.75	...	0.3
29	.405	.511	—	—	18.6	32.7	—	—	—	.090	.135	—	—	.89	.73	—	—	W N W	N W b W	W N W	N 53 W	21.8	28.0	21.0	20.27	21.10	...	Inp.
30	.899	.836	.718	.8073	21.2	36.0	30.2	29.23	— 6.27	.092	.126	.136	.120	.81	.59	.80	.75	N W	S b W	S	S 8 W	4.5	7.0	4.5	3.88	5.31	...	...
31	.478	.232	.352	.3642	25.5	39.9	19.7	27.93	— 7.97	.125	.182	.090	.127	.91	.73	.84	.80	N E b N	S b W	N N W	N 24 W	5.8	3.5	40.0	13.86	15.62	...	0.1
M	29.6693	29.6422	29.6770	29.6649	22.19	30.09	25.24	25.84	— 4.54	.112	.123	.114	.116	.86	.70	.79	.78	......	......	......	......	7.25	10.68	8.93	...	9.27	0.68[illegible]	1.4

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR MARCH, 1863.

Highest Barometer........................ 30.180 at 8 a. m. on 20th } Monthly range =
Lowest Barometer .... 29.129 at 8 a. m. on 25th } 1.051 inches.

Self-registing Thermom.
- Maximum Temperature .... 42°2 on p.m. of 31st } Monthly range=
- Minimum Temperature .... —4°0 on a.m. of 5th } 46°2
- Mean maximum Temperature .... 32°81 } Mean daily range=
- Mean minimum Temperature .... 19°42 } 13°39
- Greatest daily range ...... 39°6 from a.m. of 5th to a m. of 6th.
- Least daily range............ 4°3 from a.m. to p.m. of 3rd.

Warmest day......... 24th... Mean temperature......... 38°25 } Difference = 31°20.
Coldest day .... 4th... Mean temperature......... 7°05 }

Maximum Radiation. { Solar....................................65°5 on p.m. of 6th } Monthly range = 80°0
{ Terrestrial..........................—14°5 on a.m. of 5th }

Aurora observed on 5 nights, viz.,—12th, 20th. 25th, 29th, and 30th.
Possible to see Aurora on 18 nights; impossible on 13 nights.
Snowing on 17 days, depth 11.4 inches; duration of fall, 71.3 hours.
Raining on 4 days, depth 0.687 inches; duration of fall 26.1 hours.
Mean of cloudiness = 0.63. Above average 0.04.
Most cloudy hour observed, 2 p.m: mean = 0.71; least cloudy hour observed, 10 p.m.; mean, = 0.50.

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

North.	South.	East.	West.
2862.57	1127.49	1917.34	2800.70

Resultant direction N. 27° W.; Resultant velocity 2.62 miles per hour.
Mean velocity ....9.27 miles per hour.
Maximum velocity ....40.0 miles, from 9.30 to 10.30 p.m.
Most windy day ......29th............Mean velocity, 21.10 miles per hour. } Difference=
Least windy day......16th............Mean velocity, 3 33 ditto. } 17.77 miles.
Most windy hour ...1 p.m. to 2 p.m.........Mean velocity, 11.65 ditto. } Difference=
Least windy hour...2 a.m. to 3 a.m. ....Mean velocity 7.18 ditto. } 4.47 miles.

4th. Very cold day, clear and keen.—6th. Lunar halo from 11 p.m —8th. Solar halo at 4 p.m.—12th. Solar halo at 7 a.m.; auroral light at midnight.—14th. Solar halo at 9 and 10 a.m.—20th. Solar halo 7 and 8 a.m.; auroral light at midnight.—21st. Fog at midnight.—22nd. Fog at 6 a.m.—25th. Auroral light at 7.50 p.m.—27th. Lunar halo at 7.30 p.m.—28th. Solar halo at 7 and 8 a.m.—29th. Auroral light and bright streamers from 10 p.m.—30th. Lunar halo 9 p.m. to midnight; faint auroral light at 10 p.m. and midnight.—31st. Cold stormy night; wind high and in violent squalls.

March, 1863, was comparatively cold, dry, windy and cloudy,

COMPARATIVE TABLE FOR MARCH.

YEAR.	TEMPERATURE.					RAIN.		SNOW.		WIND.		
	Mean.	Excess above aver'ge (30 1)	Max. ob-served	Min. ob-served	Range.	No. of days.	Inches	No. of days.	Inches	Resultant. Direction.	Resultant. V'y	Mean Force or Velocity.
1840	33.3	+ 3.2	56.[illegible]	8.7	48.2	8	1.610	8	...	...	...	....
1841	27.7	— 2.4	53.[illegible]	— 6 9	60.4	5	1.170	7	...	...	...	0.51 lbs.
1842	35.8	+ 5.7	68.7	14.9	53.8	4	3.150	8	...	...	...	0.70
1843	21.3	— 8.8	38.[illegible]	— 2.8	41.4	2	0.625	18	25.7	...	...	1.18
1844	31.3	+ 1.2	50.[illegible]	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	6	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	5.80mls.
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	4.051	8	1.0	N 64° W	1.96	10.39
1860	34.5	+ 4.4	66.4	14.2	52.2	5	0.889	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
1862	28.8	— 1.3	41.4	9.3	38 1	8	2.530	11	18.5	N 12° W	2.50	9.38
1863	25.8	— 4.3	41.4	— 3.4	44.8	4	0.687	17	11.4	N 27° W	2.62	9.27
Results to 1861.	30.13	...	52.55	3.77	48.78	6.0	1.548	8.7	8.77	N 60° W	3.63	8.60
Exc. for 1863.	— 4.29	...	— 11.15	—7.17	— 3.98	— 2.0	— 0.861	+ 8.3	+ 2 63	....	.....	+ 0.67