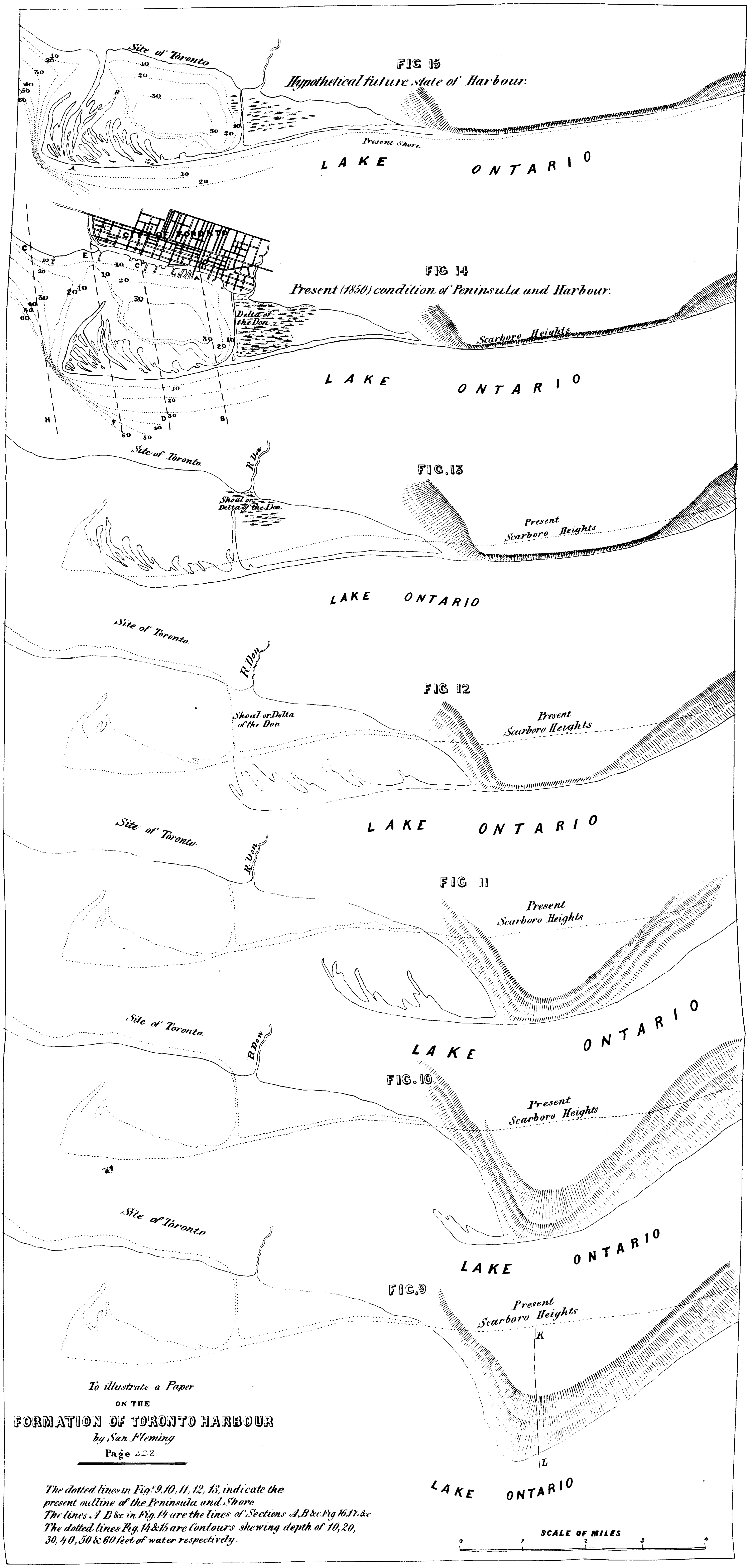
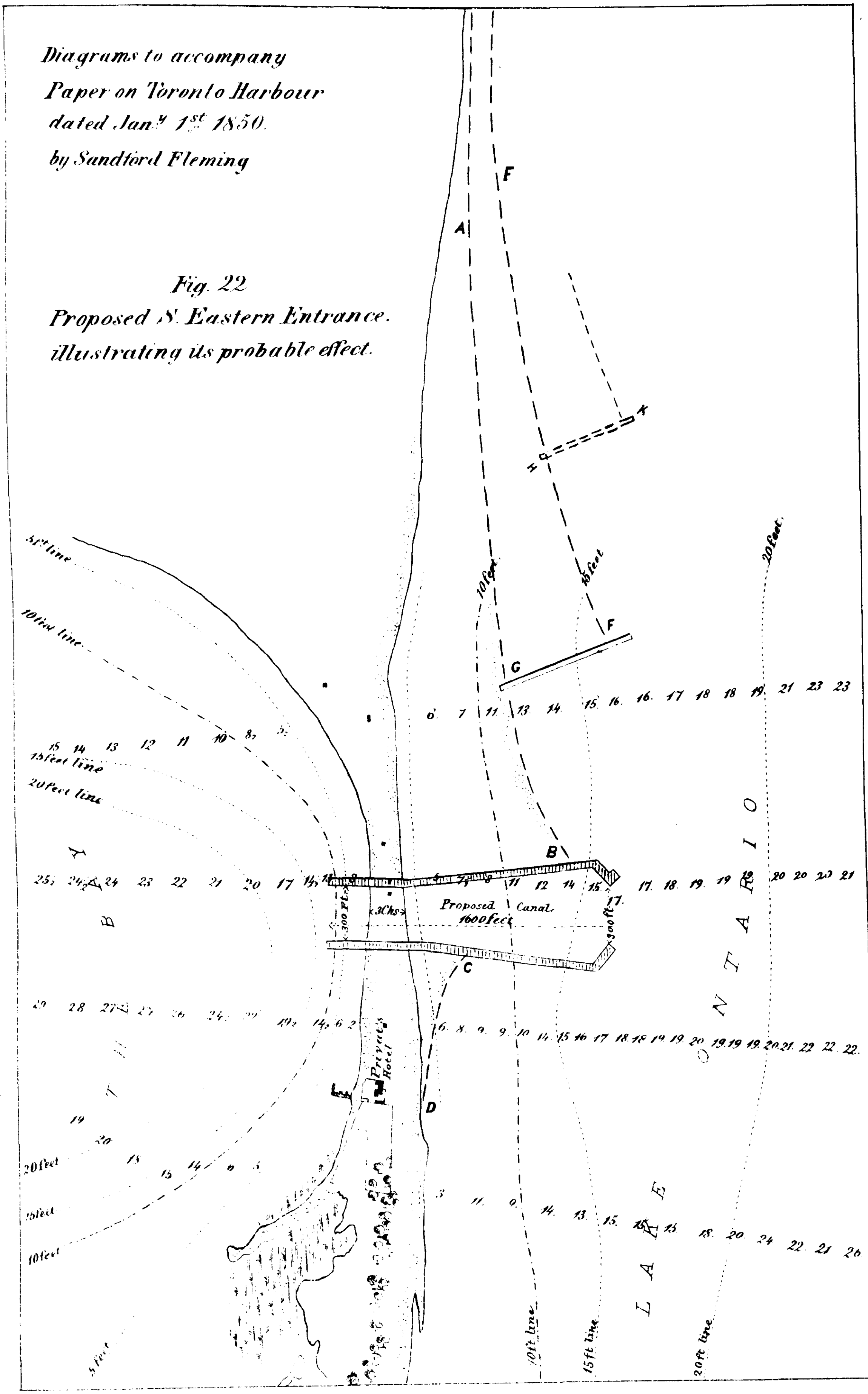


To illustrate a Paper
ON THE
FORMATION OF TORONTO HARBOUR
by San Fleming
Page 223

The dotted lines in Figs 9, 10, 11, 12, 13, indicate the present outline of the Peninsula and Shore
The lines A B &c in Fig. 14 are the lines of Sections A, B &c Fig 16, 17, &c.
The dotted lines Fig. 14 & 15 are Contours shewing depth of 10, 20, 30, 40, 50 & 60 feet of water respectively.



Diagrams to accompany Paper on Toronto Harbour dated Jany 1st 1850. by Sandford Fleming

Fig. 22
Proposed S. Eastern Entrance. illustrating its probable effect.

For the Canadian Journal

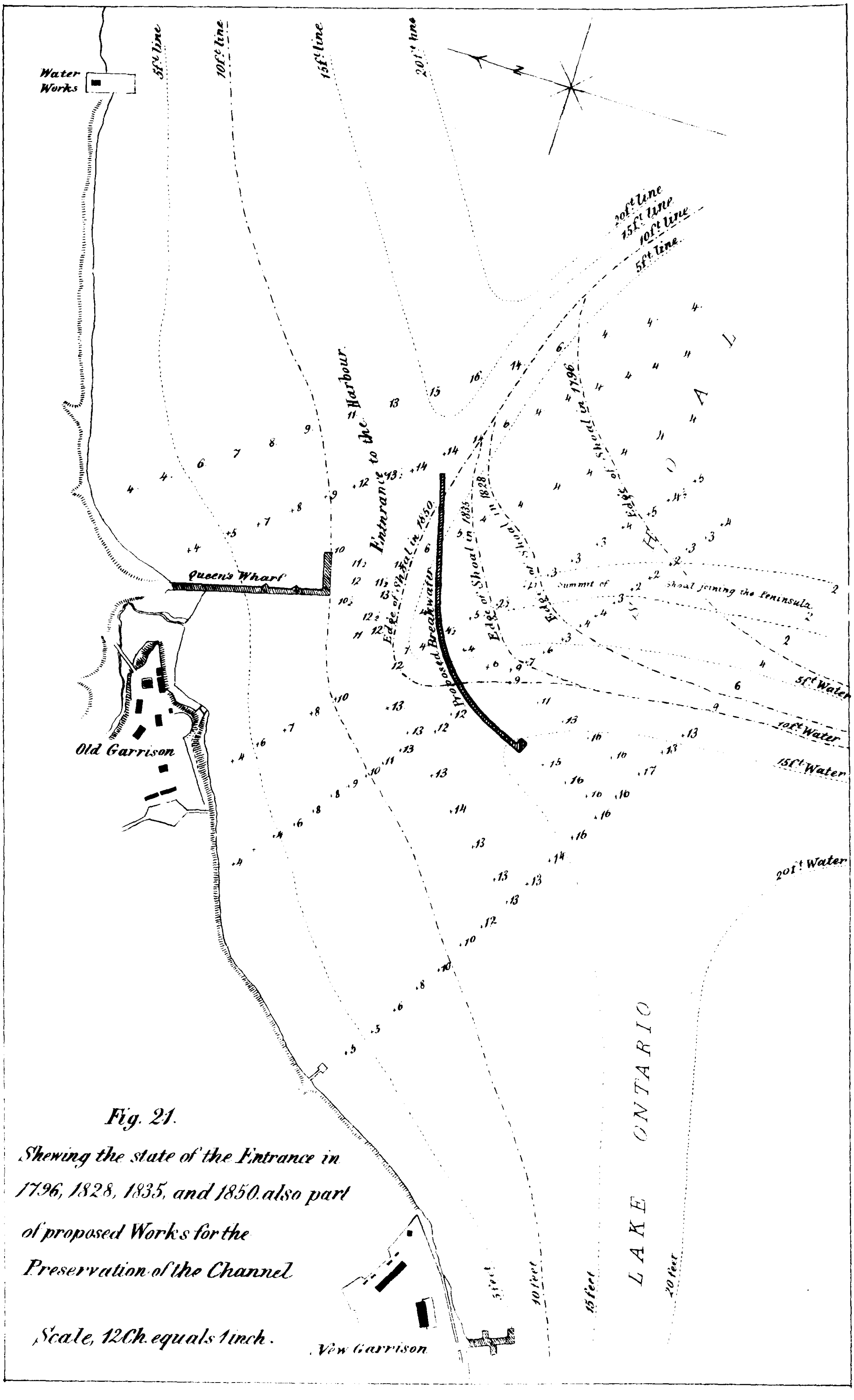


Fig. 21.

Shewing the state of the Entrance in 1796, 1828, 1835, and 1850 also part of proposed Works for the Preservation of the Channel

Scale, 12 Ch. equals 1 inch.

FIG. 20

Section on line A. B. Fig. 14.

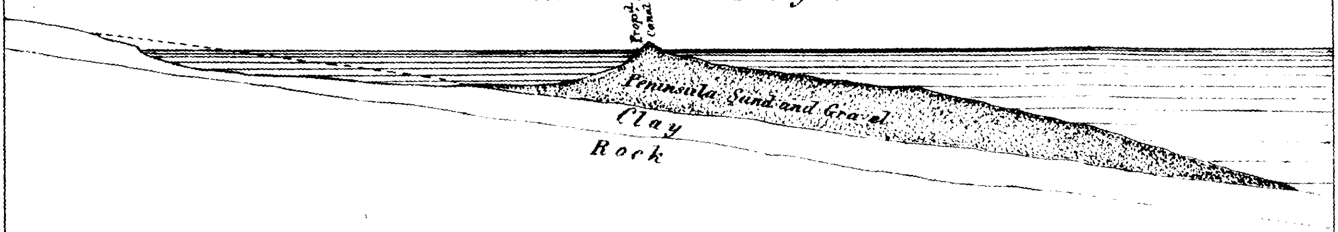


FIG. 19

Section on line C. D. Fig. 14.

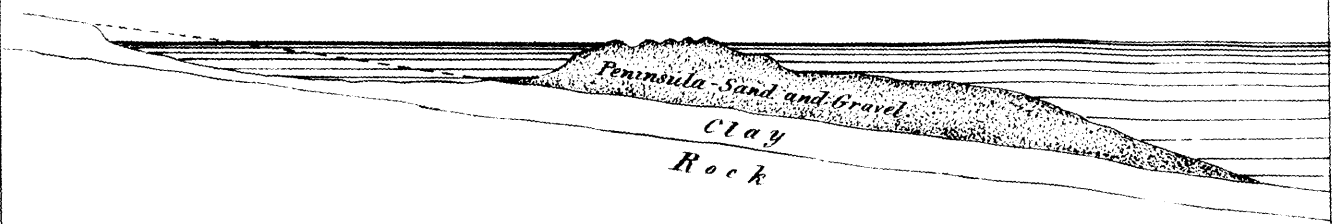


FIG. 18

Section on line E. F. Fig. 14.

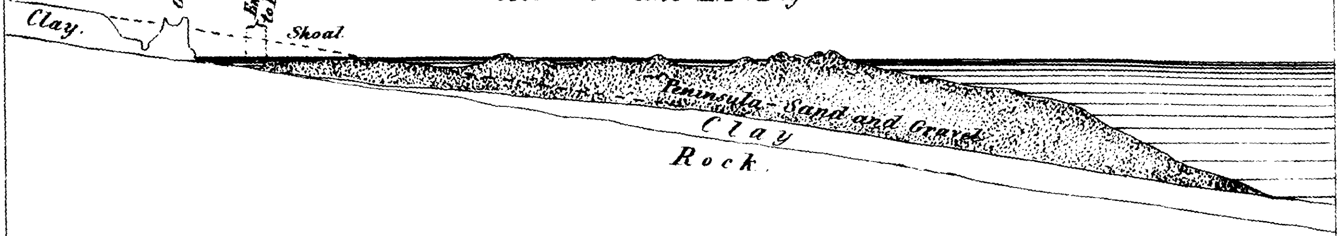


FIG. 17.

Section on line G. H. Fig. 14.

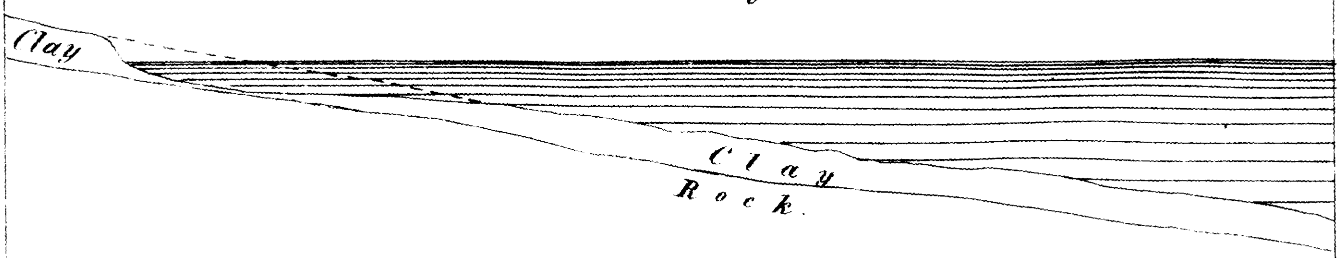
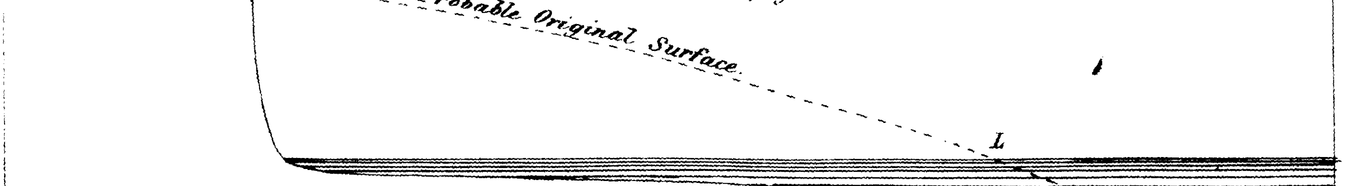


FIG. 16

Sectionl Sketch from Scarboro Heights Lakewards.
on line K.L, Fig 9.



Scales { *Figs. 17, 18, 19, and 20, Horl. 48 Chs. Vertl. 160 ft. to an inch*
Fig. 16............ Horl. 48 Chs. Vertl. 320 ft. to an inch.

Maclear & Co. Lith. Toronto

The Canadian Journal.

TORONTO, APRIL, 1854.

Meteors and Falling-Stars.

*Read before the Canadian Institute, February 4th, by T. Henning, Esq.**

SHOOTING-STARS.

The more important questions relating to shooting-stars, are the smaller size of the meteors, their infinitely greater frequency, the arcs they describe, their divergence or point of departure, their frequent occurrence in showers, and the periodicity of certain of these phenomena. We can touch but very slightly upon any of these interesting points. Falling-stars are distinguished by most observers into those that fall separately and in small numbers, and those that come in swarms or showers of many thousands. The former are said to fall *eporadically;* the latter which the Arabian writers compare to swarms of locusts, are periodic in their visits and move in streams, generally in a parallel direction, proceeding from one or more points of divergence. Olbers gives five or six as the mean number of meteors which can be reckoned hourly in the range of vision of one person on ordinary occasions; Quetelet gives eight. Julius Schmidt, of the Bonn Observatory, an observer long accustomed to astronomical accuracy, states in a letter lately written to Humboldt, that the mean number of *sporadic* shooting-stars observed in an hour on ordinary occasions is from *four* to *five*. Of the *periodic* meteors, there may be expected on the average in each hour *above* thirteen or fifteen. The most remarkable of the *periodic* falls are those which occur from the 12th to the 14th November, and on the 10th August, the festival of St. Lawrence, "whose 'fiery tears' were noticed in former times in a Church Calendar of England, no less than in old traditionary legends, as a meteorological event of constant occurrence." Although several remarkable falls on the night between the 12th and 13th November had been noted, such as the splendid one in 1799, described by Humboldt, and which had been seen in America from the equator to New Herrnhut in Greenland (*Cosmos*, vol. iv., p. 216), also in 1818, 1822, 1823, 1831, and 1832, still, the connection existing between these falls and the recurrence of certain days was unthought of. The magnificent shower of 1833, when the stars fell "like flakes of snow," 240,000 having fallen during a period of nine hours, and was visible from Jamaica to Boston. Similar streams, of somewhat less intensity, were observed in the United States in 1834, 1835, and 1836, of which very interesting accounts are given in the 27th, 29th, and 31st volumes of *Silliman's Journal*, by Olmsted and Palmer, of Yale College, who were perhaps the first to detect the periodical character of this fall. The next most celebrated fall is that of the 10th of August. The frequency of meteors in the month of August was noticed by Muschenbroek as early as 1762, but their periodic return about St. Lawrence's Day was first shown by Quetelet, Olbers, and Beuzenberg. Several other periods, however, have since been added to this number, making the list stand thus:—

JANUARY: between the 1st and 3rd. (Somewhat doubtful.)

APRIL: 18th or 20th. (?) (Arago was the first to call attention to this as a recurring phase. Great streams: 25th April, 1095; 22nd April, 1800; 20th April, 1803.—*Cosmos*, vol. i., p. 125–6.)

MAY: 26th. (?)

JULY: 26th to 30th. (Quetelet: maximum properly between the 27th and 29th July.)

AUGUST: 10th. (Muschenbroek and Brandes.)

OCTOBER: 16th to 18th, according to Professor Lowe; 19th, and the days about the 26th, says Quetelet.

NOVEMBER: 12th to 14th; very seldom the 8th or 10th.

DECEMBER: 9th to 12th; but in 1798, according to Brandes' observation, the 6th and 7th; Herrick, in New Haven, 1838, the 7th to 8th; Heis (Aix la Chapelle), 1847, the 8th and 10th.

Eight or nine epochs of periodic meteoric streams are thus recommended to the attention of observers.

The *hourly variation* in the number of stars observed to fall during the night is a very remarkable thing, and one very difficult to account for. A very important paper upon this point was presented lately to the Institute at Paris, by M. de Coulvier Gravier, a plain country gentleman, who has devoted thirteen years to the study of falling stars, with the view principally of being able to predict therefrom the changes in the atmosphere. By the advice of M. Arago, he commenced in 1840 to keep a journal, which, by the personal co-operation of the celebrated astronomer Saigney, has been rendered a valuable acquisition to astronomical science. From 1841 to 1845, 5312 shooting-stars were observed in 1034 hours. An analysis of these observations prove that they appeared, with slight exceptions, in increased numbers as the night advanced towards morning. The number seen hourly stand thus:

From	6 to 7	o'clock,	p. m	3·1
"	7 to 8	"	"	4·5
"	8 to 9	"	"	3·7
"	9 to 10	"	"	4·10
"	10 to 11	"	"	4·5
"	11 to 12	"	"	5·0
"	12 to 1	"	a.m.	5·8
"	1 to 2	"	"	6·4
"	2 to 3	"	"	7·1
"	3 to 4	"	"	7·6
"	4 to 5	"	"	6·0
"	5 to 6	"	"	8·2

His observations between the 10th and 11th August, 1853, correspond with this. The hourly number of stars seen by him on the 9th was 49, and on the 10th 56. Between 9 and 10 o'clock p.m. on the 9th he saw 36, but between 1 and 2 a.m. 56. Between 12 and 1 o'clock on the night of the 10th–11th, 78 were seen, and 88 from 1 to 2. The direction was quite uniform, the radiant being near Cassiopeia. Mr. Herrick, at New Haven, on 10th August, 1853, saw from 12 to 3¼ o'clock, 388 stars, being 110 from 12 to 1, 115 from 2 to 3, and 44 from 3 to 3·25. Apparent radiant place did not change its position among the stars. Another result of M. Gravier's tables is the fact that the light of the moon does not efface more than three-fifths of the aggregate number of the stars thus seen. Again: while shooting stars appearing in the north of the hemisphere are not so numerous as those from the south, it is the same with the stars from the west as compared with the abundance of their appearance in the east. M. Gravier also ascertained that those stars comprised between the N.N.E. and the N.E. make the longer mean course, viz., 11°3′, while those between the S.W. and W.S.W. take the shortest mean course, viz., 11° 30′.

With regard to the point of divergence it may be necessary to state a few facts, as on this has been grounded an argument for

* Continued from page 191.

their being luminous bodies which present themselves independently of the earth's rotation, and penetrate into our atmosphere *from without*—from space. The observations of Olmsted proved that in the case of the November falls in 1833, 1834, and 1837, the stars proceeded from the star γ Leonis, but in the August fall in 1839, Algol in Perseus, or a point between Perseus and Taurus, was the centre of divergence. According to the accurate observations of Heis, at Aix la Chapelle, as quoted in Vol. I. of the *Cosmos*, "The falling-stars of the *November period* present the peculiarity that their paths are more dispersed than those of the *August period.* In each of the two periods there were simultaneously several points of departure, by no means always proceeding *from the same constellation*, as there was too great a tendency to assume since the year 1833." After investigating the paths of 407 stars, he found that 171 came from Perseus, 83 from Leo, 35 from Cassiopeia, 40 from the Dragon's Head, but full 78 from undetermined points. Schmidt, of Bonn, in a letter to Humboldt (July, 1851), says: "If I deduct from the abundant falls of shooting-stars in November 1833 and 1834, as well as from subsequent ones, that kind in which the point in Leo sent out whole swarms of meteors, I am at present inclined to consider the *Perseus point* as that point of divergence which presents not only in August, but throughout the *whole year*, the most meteors. This point is situated in Right Ascension 50·3°, and Declension 51·5° (holding good for 1844–6.") He adds, "If the directions of the meteor-paths are considered in their full complication and periodical recurrence, it is found that there are certain *points of divergence* which are always represented, others which appear only sporadically and changeably."

THEORIES REGARDING THE ORIGIN OF METEORITES AND FALLING-STARS.

Passing over the opinions of those who attributed *meteorites* to the effect of lightning in tearing up the earth and converting it into a compact mass, of Aristotle, who considered them masses of stone carried by a hurricane from one locality to another, and of those who have supplied that mysterious region, the North Pole, with an enormous volcano, hurling its eruptions to the distance of many hundred miles, the hypotheses regarding their origin may be reduced to three: 1st. that which makes them of atmospheric origin; 2nd. that which gives to them a lunar or planetary origin; and lastly, that which is now generally received as the true one, viz., that they are of cosmical origin.

The hypotheses respecting the atmospheric origin of these bodies are now generally exploded; and yet a great deal can be said in their favour. The ablest and most satisfactory paper upon this subject that I have been able to procure, is one written by F. G. Fischer, Esq., in the Berlin *Memoirs.* It is too long, and discusses too many points, to admit of the compression suitable to a paper like this. He lays down his positions something to this effect: Owing to the many gases and exhalations which are continually evolving at the surface of the earth, many matters exist in the atmosphere which escape chemical investigation, either from the want of tests to denote their presence, from their extreme rarity, or from their accumulating only in the higher regions of the atmosphere, where no experiments can be made. Owing to their extreme lightness, these exhalations ascend with the rapidity of lightning immediately on being disengaged, commingling only when they reach a stratum of air of equal rarity. What becomes of these vapours and gases, which, in the lapse of ages, must be greatly augmented? "Perhaps," says Mr. Fischer, "falling-stars, fire-balls, northern lights, and meteoric stones are the means by which Nature either transforms them into her own essence or returns them directly to the earth." In the reduction of these gases to solids, he has recourse to the agency of electricity, but the *modus operandi* he attempts not to explain. Kepler held somewhat similar views, and describes fire-balls and shooting-stars as "meteors arising from the exhalations of the earth, and blending with the higher ether." Sir William Hamilton, while giving an account of the great eruption of Vesuvius, in August, 1799, ascribes such phenomena to local electrical agency, developed by volcanic ejections. "This kind of electrical fire," says he, "seems to be harmless, and never to reach the ground." (On the improbability that meteoric masses are formed from metal-dissolving gases, which, according to Fusimeri and others, may exist in the highest strata of our atmosphere, and, previously diffused through an almost boundless space, may suddenly assume a solid condition, and on the penetration and misceability of gases, Humboldt treats largely in his *Relation Historique*, vol. i., p. 525.)

ORIGIN IN LUNAR VOLCANOES.

Another opinion is, that aerolites derive their origin from volcanoes in the moon. Chladni states that an Italian, Paolo Terzago, was the first to surmise (1664) that these bodies were of selenic origin. In 1795 Olbers commenced an investigation into the amount of the initial tangential force that would be requisite to bring to the earth masses projected from the moon; and the mathematical possibility of a sufficient force existing, together with the then prevalent opinion of there being active volcanoes in the moon, led to the belief in some minds of the physical probability of such an origin. La Place, Biot, Brandes, and Poisson all gave considerable attention to this *ballistic* problem, as Humboldt designates it. Olbers, Brandes, and Chladni thought "that the velocity of 16 to 32 miles, with which fire-balls and shooting-stars entered our atmosphere," furnished a refutation to the view of their selenic origin. Setting aside the resistance of the air, an initial velocity of 8292 feet in a second would be required, according to Olbers; to La Place, 7862; to Biot, 8282; and to Poisson, 7595. Olbers has shown "that, with an initial velocity of 8000 feet in a second, meteoric stones would arrive at the surface of the earth with a velocity of only 35,000 feet. But the measured velocity of meteoric stones averages five times that amount, or upward of 114,000 feet to a second, and, consequently, the original velocity of projection from the moon must be almost 110,000 feet, or fourteen times greater than La Place asserted." —(*Cosmos*, vol. i., p. 121.)

La Place, in one portion of his great book, cautiously observes that aerolites, "in all probability, come from the depths of space," but elsewhere inclines to the hypothesis of their lunar origin—assuming, however, that the stones projected from the moon "become satellites of our earth, describing around it more or less eccentric orbits, and thus not reaching its atmosphere until several, or even many revolutions have been accomplished." The distinguished chemist Berzelius has examined this hypothesis at great length, and adopts it on grounds which he finds in the chemical constitution and mineralogical character of these bodies. His arguments, which are copied in the Edinburgh new *Philosophical Journal*, are exceedingly ingenious, but still they are built on hypothetical conjectures which can be met and answered. Von Ende Beuzenberg and others coincide in his general views. The great velocity of these bodies, however, as well as the direction of their orbits, which is often opposite to that of the earth, are now regarded as conclusive arguments against this hypothesis. In connection with this, I may just name the opinion of Olbers and those who consider these meteoric bodies the *debris* or fragments of a large planet which had burst, and of which the *asteroids* are the remaining portions. The smaller fragments continue to circulate about the sun in orbits of great eccentricity, and when they approach the regions of space through which the earth is moving, they enter the atmosphere with great velocity, and in consequence of the great resistance and friction which follow, are rendered incandescent, and emit a light as long as they remain in it. As there have thus been believers in the planetary origin of meteorites, so some of the Greek philosophers thought they came from the sun. This was the opinion of Diogenes Laertius regarding the origin of the Aegos Potamos stone, about which Aristotle held such an absurd idea.

COSMICAL ORIGIN OF AEROLITES, ETC.

The more general opinion now is that the greater portion of meteors are of *cosmical* origin—that is, bodies revolving in space, independent of the earth's rotation, and subject to the same laws as the other celestial bodies. "Shooting-stars, fire-balls, and meteoric stones are," says Humboldt, "with great probability, regarded as small bodies moving with planetary velocity, and revolving, in obedience to the laws of general gravity, in conic sections round the sun. When these masses meet the earth in their course, and are attracted by it, they enter within the limits of our atmosphere in a luminous condition, and frequently let fall more or less strongly heated stony fragments, covered with a shining black crust; but the formative power, and the nature of the physical and chemical processes involved in these phenomena, are questions all equally shrouded in mystery."

The great argument in favor of this view of the character of these bodies is derived from the divergence or point of departure being generally stationary, and secondly, from their entirely planetary velocity. These facts led Sir John Herschell to decide "that a zone or zones of these bodies revolve about the sun, and are intersected by the earth in its annual revolution." Capocci, of Naples, regards the Aurora Borealis, shooting-stars, aerolites, and comets as all having the same origin, and as resulting from the aggregation of cosmical atoms, brought into union by magnetic attraction. He supposes that in the planetary spaces there exist bands or zones of nebulous particles, more or less fine, and endued with magnetic forces, which the earth traverses in its annual revolution; that the smallest and most impalpable of these particles are occasionally precipitated on the magnetic poles of our globe, and form polar Auroras; that the particles a degree larger, in which the force of gravitation begins to be manifested, are attracted by the earth, and appear as shooting-stars; that the particles in a more advanced state of concretion give rise in like manner to the phenomena of fire balls, aerolites, etc.; that the comets which are known to have very small masses are nothing else than the largest of the aerolites, or rather uranolites, which, in course of time, collect a sufficient quantity of matter to be visible from the earth.

After the great shower of stars in 1833, and the observed periodicity of its character, Professor Olmsted, collecting all the facts within reach, deduced from them the existence of a nebulous cloud or mass of meteoric stars, approaching the earth at particular periods of its revolution, under conditions as to time, direction, and physical changes from proximity, which he has fully detailed in Silliman's *Journal of Science* for 1834 and 1836. His speculation that this meteoric cloud might be part of the solar nebula known as the Zodiacal Light, was taken up and enlarged upon by Biot in a Memoir read by him in 1836. He shows that on the 13th November the earth is in such a relative position that it must necessarily act by attraction or contact upon the material particles of which this nebula is composed, producing phenomena which we may reasonably consider to be represented by these meteoric showers. He brings the same theory to explain the sporadic shooting-stars of ordinary nights. He supposes that the habitual passage of Mercury and Venus across the more central regions of this nebula must have dispersed innumerable particles in orbits very little inclined to the ecliptic, and so variously directed that the earth may encumber, attract, and render them luminous in every part of its revolution. Supposing, then, we admit that these meteors compose a closed ring or zone, within which they all pursue one common orbit, how is it that we so seldom witness such splendid spectacles as those exhibited in the November showers of 1799 and 1833? "If," says Humboldt, "in one of these rings, which we regard as the orbit of a periodical stream, the asteroids should be so irregularly distributed as to consist of but few groups sufficiently dense to give rise to these phenomena, we may easily account for the unfrequency of such glorious sights." Olbers has predicted, but I know not upon what data, that the next appearance of the phenomenon of shooting stars and fire-balls intermixed, falling like flakes of snow, will not occur until between the 12th and 14th November, 1867.—(*Cosmos*, vol. i., p. 127.) Again: the enormous swarm of falling-stars in November, 1799, was almost exclusively seen in America—the swarms of 1831 and 1832 were visible only in Europe, and those of 1833 and 1834 only in the United States, and occasionally the November stream has been visible in but a small portion of the earth. A very splendid meteoric shower was seen in England in 1837, while a most attentive and skillful observer at Braunzberg, in Prussia, only saw on the same night, which was uninterruptedly clear, a few sporadic shooting-stars, between 7 o'clock p. m. and sunrise the next morning. Bessel explains, "that a dense group of the bodies comprising the great ring may have reached that part of the earth in which England is situated, while the more eastern districts of the earth might be passing at the time through a part of the meteoric ring proportionally less densely studded with bodies." In the same way Humboldt accounts for the non-appearance, during certain years, in any portion of the earth, of the two great streams of August and November, to intervals occurring between the asteroid groups. Poisson's account of this is somewhat different. "If," says he, "the group of falling-stars form an annulus around the sun, its velocity of circulation may be very different from that of our earth; and the displacements it may experience in space, in consequence of the actions of the various planets, may render the phenomenon of its intersecting the planes of the ecliptic possible at some epochs, and altogether impossible at others." The latest form of this hypothesis is that adopted by M.M. Saigney and Gravier, in France, viz., that meteors and their substances have their original abode in infinite space; that large groups of shooting-stars are situated in portions of the heavens visited by our earth; that, when our globe arrives in the vicinity of these corpuscules, they are attracted by the earth, and, bursting, leave the material of which they are composed to fall upon the surface of our globe.

Whilst this is now generally regarded as the most probable hypothesis yet framed to account for the origin of these mysterious appearances, still, even by it, many things regarding meteors are left unsolved. Many questions there are yet awaiting the possible solution of the future, and this solution can only be the result of more extended observation and experiment. It is the duty, therefore, of all who desire the advancement of science, to aid in adding at least to the number of recorded observations, and thus to broaden the basis on which the astronomer and the man of science are to build their hypotheses and their theories.

In conclusion, it is remarkable to find that the opinions of some of the Greek natural philosophers, particularly those of the Ionian school, early assumed the *cosmical* origin of meteoric stones.

"Falling-stars," says Plutarch, in his life of Lysander, "are not emanations or detached parts of the elementary fire, that go out the moment they are kindled, nor yet a quantity of air bursting out from some compression, and taking fire in the upper regions; but they are really heavenly bodies, which, from some relaxation of the rapidity of their motion, or by some irregular concussion, are loosened, and fall." And Diogenes, of Apollonia, says: "*Invisible* (dark) masses of stone move with the visible stars, and remain, on that account, unknown. The former sometimes fall upon the earth, and are extinguished, as happened with the *stony star* which fell near Aegos Potamos."

The utilitarian spirit of the present age is apt to enquire after the practical uses to be attained by the observation of these celestial phenomena. On this point but little can be said. So far as I have been able to learn, the geographical determination of degrees of longitude is the only practical purpose which well-observed falls of shooting-stars have yet been made to subserve. Beuzenberg published a paper on this subject in 1802, but Dr. Maskelyne had pointed to this application of the phenomena some twenty years previously. In a letter dated Greenwich, Nov. 6, 1783, he writes: "If the exact time could be had at different places, the absolute velocity of the meteor, the velocity of the sound propagated to us from the higher regions of the atmosphere, and the *longitude of places* might be determined." (On this point, see *Silliman's Journal* for Oct., 1840.) But apart from this view of the matter, what deep interest attaches to meteoric phenomena, if we admit the connection that is now believed to exist between them and other planetary systems! "He who is penetrated with a sense of this mysterious connection (to adopt the fine sentiments of Humboldt), and whose mind is open to deep impressions of Nature, will feel himself moved by the deepest and most solemn unction at the sight of every star that shoots across the vault of heaven, no less than at the glorious spectacle of meteoric swarms in the November phenomenon, or on St. Lawrence's Day. Here motion is suddenly revealed in the midst of nocturnal rest. The still radiance of the vault of heaven is for a moment animated with life and movement. In the mild radiance left on the track of the shooting-star, imagination pictures the lengthened path of the meteor through the vault of heaven, while, everywhere around, the luminous asteroids proclaim the existence of one common material universe. Accustomed to gain our knowledge of what is not telluric solely through measurement, calculations, and the deductions of reason, we experience a sentiment of astonishment at finding that we may examine, weigh, and analyze bodies that appertain to the outer world. This awakens, by the power of the imagination, a meditative, spiritual train of thought, where the untutored mind perceives only scintillations of light in the firmament, and sees in the blackened stone that falls from the exploded cloud nothing beyond the rough product of a powerful natural force."

A few Rough Notes on some of the Canadian Saturniæ, and Suggestions on the Possibility of using their Silk for Textile Purposes.

Read before the Canadian Institute, March 11th, by Thomas Cottle, M.D. of Woodstock.

To the student of Nature, the delight which his investigations of the different kingdoms create is very much enhanced if, during his researches, he can discover among the natural productions of the country he inhabits any which may be usefully employed in adding to the necessaries or luxuries of life.

In the following trifling sketch, it is the wish to call attention to a genus of Lepidopterous insects whose products may possibly be as usefully employed as some of the coarser varieties of silk now used in India, and which, being indigenous, would not be liable to the failure that occurred some years ago in the attempt to introduce the true silk worm into the neighbouring States of the Union. Should this expectation not be realized when tested by experiment, yet, if the hint now given should induce others to turn their attention to the as yet comparatively unexplored productions of this Province, they will not have been written in vain.

To the family Bombycidæ belong those moths the enveloping tissues of whose cocoons have been used for textile purposes. The member of this family the products of whose labour have been most used by man, and to whose silk it is generally thought we are entirely dependant for our silken fabrics, is the well-known silk-worm *par excellence* (Bombyx mori), with which all are too cognisant to require further mention; but in India the web of other insects of this family are so employed. On this subject, Cuvier, or rather Latreille, in the Regne Animal, writing of the genus Saturnia, says: "They have employed from time immemorial in Bengal two other species of the same division, the Bombyx Mylitta, of Fabricius, and the Phalæna Cynthia, of Drury, and I am convinced, after the communication made me by M. Huzard of a Chinese manuscript on this subject, that the caterpillars of these Bombyces were the wild silk-worms of China, and I think that a part of the silks which the ancients procured by their maritime commerce with the Indies was produced from the silk of these worms." Both the insects above mentioned belong to the genus Saturnia as now constituted. Some of the Canadian species are very fine specimens of the genus, and spin large cocoons; and is it unreasonable to imagine that one or other of the species might be made as available for manufacturing purposes as their Indian congeners? An obstacle to be overcome is the difficulty of dissolving the animal cements with which the caterpillar glues together the threads; but as the perfect insect has the power of dissolving this glue when about to escape from its cocoon (for it has no jaws to tear open the walls of its prison), could not the chemist, by analyzing this fluid there secreted, provide us with an efficient solvent? The natives of India for one species use a lye made of the ashes of the plantain.

The first is Saturnia Polyphemus, one of the princes of the Canadian Lepidoptera: This fine insect expands five inches, is of a yellowish brown; both wings with a hyaline spot. The anterior wing is marked with two curved lines near the base, a waved line on the border, and a dark spot on the apex. The hyaline spot is encircled by a yellow margin. On the posterior wing the hyaline spot is larger, with a bluish grey iris, shading into black, and the marginal band is darker. The colours of the male are the same as those of the female, but more decided. The caterpillar is described by Gosse "as of a most brilliant light green, nearly transparent, each segment of the body rising into two roundish humps, each ending in a little bright yellow tubercle, bearing two or three short hairs; two rows of similar tubercles run down each side, which are joined by a diagonal yellow line on each segment, just behind which are the spiracles, which are scarlet. The head and legs are light brown, the last segment terminated by a line of purplish brown. It is rather inactive, and slow of motion. Its length, when crawling, is two inches and a half, and its diameter about half an inch." He gives it as feeding on the choke cherry (Prunus Serotina), and probably any species of Prunus will serve it for nourishment. The cocoon is oblong, rounded at the ends, and very firm, capable of resisting considerable pressure, and in all those examined, with the leaves of one or other species of Prunus firmly attached. Its weight is about eleven grains. This insect bears considerable resemblance to the Saturnia Mylitta of India, one of those species which are there cultivated for their silk, and which goes there by the name of Tusseh silk. The natives are unable to rear these in confinement, and trust to the eggs of wild individuals for their annual supply of caterpillars. We may probably have the same difficulty with the Canadian species. The writer, during the last summer, raised a female, which, soon after leaving the cocoon, began laying unimpregnated eggs. He procured a male, which he placed in the same box, but, though left together for three or four days, no connection took place. Whether the female was exhausted before the introduction of the male (though it still continued to lay a few eggs), or whether, like the Indian species, they will not breed in confinement, requires further experiment. The silk of this species is of a lighter colour than either of the two following, not very much darker than that of the Bombyx Mori.

The Saturnia Cecropia is another of the silk-spinning moths. This is the largest of the Canadian Lepidoptera, and in fact is inferio· in size to but few of the family. It varies from six to seven inches in width. Its head is red, with a white collar between it and the thorax, which, with the abdomen, is red. The latter is marked with white transverse lines; the ground colour of the wings is greyish brown; the base of the anterior pair same colour as the thorax, bounded anteriorly by a whitish band; disk oblong, rusty brown, with a kidney-shaped white spot margined with black; beyond this, a brown wavy band bordered with black, the rest of the wing shading down to light brown, with indented black line. Near the tip is a black spot, with a crescentic line of light blue; the colour of the posterior wing the same; the oblong disk larger, and marked with the same white spot. The feruginous band is broader, bordered with white, before which is a transverse row of black spots, and a black transverse line. The caterpillar is green, with several projecting points, which, as well as the head and legs, are yellow. On each segment are two small blue spots. It does not confine itself to one species of plant for food. Abbot says it feeds on the wild American plum (Prunus Pennsylvanica). Here the apple seems its favourite food. It also feeds on a species of Spiræa, common on the borders of swamps. The writer has taken a cocoon from a common garden plum, and from a bitter nut (Carya Amara); but finding an occasional cocoon on a tree is not a proof that on that tree the insect has fed, for the caterpillar will crawl some distance occasionally for a convenient situation. An individual which, for the case of observation, was fed on one of the above mentioned low shrubby Spiræas, when about to change into the pupa, ascended a maple ten or fifteen feet from the plant on which it was nourished. The cocoon is firmly attached to the under side of a twig. It is three inches in length, and of a brown colour. The outer layer is coarse and strong; the inner finer. It weighs about seventeen grains.

Saturnia Promethea is much more common than the preceding two. The male insect is of a dark, chocolate brown, nearly black. The margins of both wings are light brown, with a deeply indented wavy black line. Near the apex of the anterior wing is a black spot, with a semicircular blue margin on the posterior wing. Within the black line are several black spots. The female differs very much from the male, so much so as to be hardly recognizable as the same insect. The wings are not falcate, but rounded; the whole body of a reddish brown; the colour of both wings is the same; the interior half is a dark brown, the remainder much lighter, with minute black specks, looking as if powdered, and a dark buff margin. On the anterior wing is an angular white spot. The spot on the apex like that in the male. On the posterior wing is a lunated white mark; on the hinder margin a wavy line, within which are reddish brown spots.

Peale describes the caterpillar as of a delicate green, with yellow feet. Each segment of the body, except the posterior, is marked with six blue spots, from which arise small black tubercles. In the second and third segments however, the two central tubercles are replaced by club-like projections of a third of an inch in length, and of a bright coral-red colour. The last segment is furnished with but few tubercles, the central one of which is of the same clavate form as those on the anterior segments, but of a yellow colour. When about to change into the pupa state, it selects a leaf, the sides of which it draws together by means of its silk, which it continues over the peticle to the branch, round which it firmly fastens it. Within the leaf it then spins its cocoon, and retires for the winter, during which time the leaf and its footstalk wither, and are carried away by the blast, leaving the cocoon hanging by its peduncle, and, to a casual glance, looking like a withered leaf. On tearing off the outer layer which originally lined the leaf, and which is very strong, an oblong cocoon remains, about the size of that of the silk-worm, of a dark brown colour, and very firm. The perfect insect appears in June. This insect seems as indifferent in the choice of its food as the last species. Abbot figures it on the Halesia Tetraptera. It feeds on the spice-wood (Laurus Benzoin), the sassafras (Laurus Sassafras), and the common wild cherry. In this part of Canada the last is the favourite food.

Another species, the Saturnia Luna, the most beautiful, though not the largest of our native Saturniæ, judging by analogy, would also furnish silk; but from its rarity, none of its cocoons have come under observation.

Of the insects above mentioned, their usefulness will probably be in the order of their enumeration. The Saturnia Polyphemus, though rarer, spins a considerable quantity of silk, and will be most easily unwound. The Saturnia Cecropia, although the largest and more frequent, at least in this locality, has coarse silk, which will probably require to be torn in shreds and carded as cotton or wool. Saturnia Promethea is by far the most common, but will probably be the most difficult to use, the cocoon being very firmly glued together.

Remarks on some Coincidences between the Primitive Antiquities of the Old and New World.

By Professor Wilson, LL.D. University College, Toronto.

In introducing this subject to the members of the Canadian Institute, Professor Wilson ol erved:—

It is well known to the students of antiquities, in so far as such relics of the past are valuable to us for the purposes of historical illustration, that the archæologists of Europe have of late years devoted much of their study to those remains which pertain to epochs older than the classic ages, and to areas lying beyond the ancient limits of Greece and Rome. In this study of the primitive antiquities of Europe, Scandinavian and British archæologists have taken the foremost place, and the result has been the disclosure of traces, throughout the North of Europe and the British Isles, of the extremely rude and primitive arts and sepulchral rites of a people occupying these areas long prior to the dawn of history, or to the intrusion of even the oldest of the historic races on regions from which they were being displaced, or had already disappeared, at the early dates when the first glimpses of transalpine Europe are met with in the pages of Greek or Roman historians. The recent investigations of the archæologist and philologist, though pursued on entirely different grounds, and with little concurrent aim or purpose, alike disclose the fact that there have existed on the Continent of Europe races entirely distinct from the great historic group to whom the Indo-Germanic languages pertain; and while the philological investigations of Dr. Pritchard have extended this group so as to embrace the Celtic languages, and convert the whole into a more comprehensive Indo-European classification, the researches of Nilsson, Retzius, Worsaae, and their British coadjutors, appear no less conclusively to establish the fact that the ancient Keltai were intruders on still older Allophylian races.

It is probable that some of the results of such investigations are already familiar to members of the Canadian Institute, especially as the labours of Scandinavian antiquaries, to whose researches some of the most valuable results are due, have acquired a special interest for the colonists of this Western World since the recent publication of the "*Antiquitates Americanæ*" has by the Society of Antiquaries of Copenhagen, added upwards of three centuries to the historic era of the continent re-discovered by Columbus. To others, however, a reference to such archæological investigations may not be without novelty as well as interest. It had long been known to antiquaries that, along with the relics of classic art, there were also to be found throughout Europe monolithic structures, fictile ware, and weapons and implements of stone, copper, and bronze, the manifest productions of ruder artificers than even the legionary artizans of Imperial Rome. These, when they attracted any attention, were loosely designated as "aboriginal" or "Celtic," and were supposed to receive a sufficient classification by being thus set apart from the classic remains, which were alone thought worthy of careful study. During the present century, however, the archæologists of Northern Europe have devoted special attention to such traces of aboriginal arts and primitive civilization, and the result has been the classification of their various sub-divisions on principles of scientific chronological order and logical analogies, akin to those by which the palæontologist has reduced to order and method the older chaos of unsystematized and uninterpreted geology.

The first class in this system of primitive archæology is designated "*the Stone Period*," as embracing the European era of rudest aboriginal arts, during which the necessities of war and the chase, and of the simple domestic economy of its ancient people, were supplied by weapons and implements constructed entirely of such ready natural materials as stone, horn, bone, etc.

After referring to the abundant evidence of the existence and duration of such an era of primitive savage arts in Europe, as is proved by collections including many thousand specimens in European Museums, Professor Wilson next proceeded to show the remoteness of the era to which they belong, as demonstrated by the circumstances under which some of them have been found. In proof of this he referred, among other examples, to the discovery in the alluvial valley of the River Forth, in Scotland, at different periods from 1819 to 1824, of gigantic fossil balænopteræ, at heights varying from twenty to nearly forty feet above the present level of the sea; and while the situation of such cetaceous fossils manifestly proved a gain of dry land from the sea, and that not by the filling up of the ancient estuary, but by the upheaval of the whole area, the discovery along with them, in more than one instance, of the rude bone lance or harpoon by which it may be presumed they had been assailed by some hardy Caledonian whaler of the remote era which they reveal, no less conclusively establishes the fact that such changes must have occurred since the British Islands were occupied by a human population. He then drew attention to the well ascertained examples of the upheaval of large areas within the historic period, apart from such instances of active volcanic action as Puzzuoli and other parts of the Bay of Baiæ, in Italy, exhibit. Special reference was made to the ascertained rate of upheaval still going on over a large portion of the Scandinavian peninsula, extending from Gothenburg to the head of the Gulf of Bothnia, if not indeed to the North Cape, and from this he inferred that the evidence of the colonization of the British Isles pointed to a date, at the very lowest computation, of some fifteen centuries before the Christian era.

At a period thus approximately defined, the primitive races of Northern Europe and the British Isles were practising arts precisely analogous to those with which we are familiar on this continent, as still pursued among its rude aboriginal tribes. At a later period, as appears from the investigations of European archæologists, the metallurgic arts were introduced among the primitive tribes of the Old World, and implements and weapons of copper and of bronze gradually displaced their ruder stone predecessors. Such would appear to have been the common experience of the untutored races of mankind, for no primitive and barbarous people has been met with in modern times, cut off from intercourse with civilized nations, among whom any knowledge of the metallurgic arts existed; and no partially civilized people, when similarly isolated, appears to have acquired the art of smelting and working the iron ore. The Esquimaux, and the whole natives of the Polynesian Islands, were, when first discovered, in precisely the same condition as the Allophylian races of Europe during its Stone Period. They were without any knowledge of the metals, and supplied all their wants by means of implements of stone, shell, bone, and wood. Such also was the condition of the Indians of North America when first brought into contact with Europeans. Nor is this conclusion affected by such discoveries of mining operations as those referred to in Mr. Whittlesey's paper on the Ancient Mines of Lake Superior.* In so far as any traces of the employment of their products, either by the Indians or by the mound-builders of an older era, have been recovered, they prove the extremely primitive and untutored arts of both races, while amply bearing out the justice of that writer's observations that "the copper is apparently *cold wrought*, and does not show that it has been melted. It must, therefore, have been found by the mound-builders in its native state, and there are no mines in North America known at this time from which native metal can be had except those of Lake Superior."

Such a process of working the malleable ores has already been recognised as far too partial a manifestation of any knowledge of the properties of metals to be accepted in proof of the introduction of the metallurgic arts among a people. It has been remarked, in reference to similar specimens of "*cold wrought*" metallic relics:—"It is not impossible that the working in gold may have preceded even the age of bronze. If metal could be found capable of being wrought and fashioned without smelting or moulding, its use was perfectly compatible with the simple arts of the Stone Period. Of such use masses of native gold, such as have been often found both in the Old and the New

* *Canadian Journal*, Vol. I., p. 132.

World, are peculiarly susceptible; and some of the examples of Scottish gold personal ornaments fully correspond with the probable results of such an anticipatory use of the metals."*

The metallurgic arts were, however, introduced into Northern Europe at a period prior to the dawn of authentic history, but now designated, from the remains of its novel arts, "*the Bronze Period;*" and America had its corresponding ante-historic era, during which the metallurgic arts of Mexico and Yucatan were developed among a people to all appearance of the same race as the mound-builders of the Mississippi Valley, and, like them, totally ignorant of the more laborious and difficult art of smelting and forging the iron ore.

Professor Wilson having pointed out, somewhat in detail, the great similarity observable between the stone, bone, and horn implements and weapons of the American Indians and those found in the ancient sepulchral barrows of Northern Europe, and also the analogies between the copper tools and weapons of the mounds of the Mississippi Valley and the copper and bronze relics of Europe's pre-historic period: concluded by remarking that it must be regarded as a subject of just interest thus to perceive that aboriginal races, had been displaced by the historic races from the ancient area of Europe, equally rude in their arts, and low in the scale of civilization, with those whom the philanthropist and the scientific observer now watch with a common regret disappearing before the advances of the European on this great continent, like the dews of morning before the rising sun.

On some New Genera and Species of Cystidea from the Trenton Limestone.

Read before the Canadian Institute, February 11th, by E. Billings, *Barrister at Law, Bytown, Canada West.*

The Cystidea were first set apart as a separate order of the Echinodermata by the late illustrious geologist, Leopold Von Buch, in a memoir which appeared in 1845 in the Transactions of the Royal Academy of Sciences of Berlin, and afterwards in 1846 translated and published in the Journal of the Geological Society of London. From the latter publication the following definition of the order is extracted:

"The Cystidea were natural bodies supported on a stem or pedicle, which was attached to the ground; their surface, more or less spherical, was covered by a great number of polyhedral plates, accurately fitted to one another, and between these plates were certain openings, necessary for the performance of the animal functions.

"With regard to the openings on the surface, we find in all the Cystidea, 1st, that the mouth was planted in the central part of the upper surface, generally in a moveable proboscis covered with minute plates; 2nd, that besides this mouth, and close to it, there is generally, if not always, a small anal orifice penetrating the plate, but not itself surrounded with any plates peculiar to it; 3rd, that further towards the middle, but almost invariably on the upper half of the body on which the mouth is placed, there rises a round or oval aperture, not connected with the mouth, and often covered by a five or six-sided pyramid, which seems to be composed of as many little valves. This probably forms the ovarial orifice of the animal."—*Quarterly Journal, Geological Society*, vol. ii., p. 29.

Von Buch also supposed that the Cystidea were not provided with arms similar to those of the Crinoidea, but since the date of his monograph several species have been brought to light furnished with appendages which may be called arms. These, together with certain other organs supposed to be peculiar to this group, will be referred to hereafter.

The Cystidea are rare fossils, and as yet but imperfectly understood in some respects. Von Buch, in the article above quoted, describes seven species known in 1845 on the continent of Europe, and in 1848 Professor E. Forbes, in the Memoirs of the Geological Survey of England, gave an account of twenty-one species discovered in the Silurian rocks of Great Britain. Of these, two were found to be identical with *Spheronites aurantium* and *Caryocystites granatum*, also described by Von Buch, while several others were mere fragments, recognised to be portions of Cystideans. It is probable that in all Europe not more than thirty species had been clearly established in 1848.

The American species already made known are only seven. They are the following:

1st. A fossil found at Bytown many years ago by Dr. Bigsby, and described by Mr. G. B. Sowerby in Vol. II. of the Zoological Journal, p. 318. Professor E. Forbes refers this curious organism to the genus *Agelacrinites* of Vanuxem.

2nd. *Echino-encrinites anatiformis*, in Vol. I. of Hall's Palæontology of New York. This species and the former are the only Cystidea yet described as having been discovered in the Trenton limestone. It has been found by Mr. Logan in Lower Canada, and in Owen's Report on the Geology of Wisconsin, p. 505, it is said to have been met with in the upper magnesian limestone of that region, a formation classified as the equivalent of the Trenton limestone.

3rd. *Callocystites Jewettii.*

4th. *Apiocystites Elegans.*

5th. *Hemicystites Parasitica.* The three last are from the Niagara shale, and described in Vol. II. of the Palæontology of New York.

6th. *Lepadocrinites Gebhardii*, from the Pentamerus limestone, figured but not described at p. 346 in Mather's Report on the Geology of the First District of New York.

7th. *Agelacrinites Hamiltonensis*, from the Hamilton group, noticed in Vanuxem's Report on the Geology of the Third District at p. 158, and figured at the end of the volume.

I now propose to add to the above list of American Cystidea several new species discovered by me within the last two years in the Trenton limestone at Bytown and in the immediate vicinity. The first of these, as it constitutes a new genus, may be called Glyptocystites, on account of the profusion of sculpture with which its surface is ornamented. Its description is as follows:

GENUS GLYPTOCYSTITES. (*Nov. gen.*)

[Greek, *γλυπτος, sculptilis*, and *κυστις, vesica.*]

Body oblong, composed of four horizontal, irregular series of plates, so disposed as to form five nearly vertical pillars, each of which supports an arm; pelvic plates, four; second, third, and fourth series of five plates each, summit closed by several small pieces; arms originating from the top of the fourth series, deflected downwards, and attached to the sides throughout their whole length; a sinuated groove, terminating upwards in the mouth, occupies the centre of each arm; a row of tentacles on each side of each groove, mouth situated in the apex, and closed by a valvu-

*Wilson's Pre-historic Annals of Scotland, p. 214.

lar apparatus of small plates; anal orifice on the left side, near the mouth; ovarian aperture in the lower half of the body, *without valves;* column short, and tapering to a point downwards; pectinated rhombs on many parts of the body.

But one species is known, which is the following:

Glyptocystites Multipora.

DIAGRAMS OF THE STRUCTURE AND ARRANGEMENT OF THE PARTS.*

Fig. 1. *Left side.* Fig. 2. *Posteal side.* Fig. 3. *Right side.* Fig. 4. *Anteal side.*

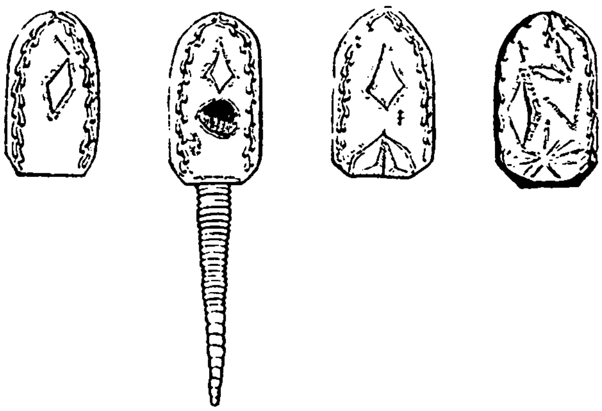
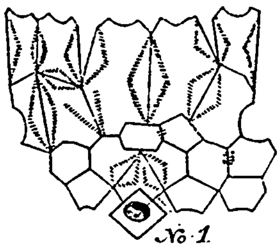
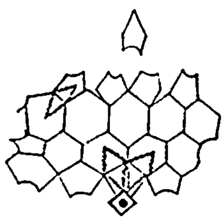


Fig. 5.



Development of the plates and pores of of *Glyptocystites multipora.*

Fig. 6.



Development of the plates and pores of *Sycocystites* (Echino-encrinites) *angulosus*, as drawn by Von Buch.

—*Quarterly Journal, Geographical Society, Vol. II., Plate 4.*

This beautiful little fossil is about one inch long, and five-eighths of an inch in its greatest diameter. Some of the specimens are larger, but these appear to be the average dimensions. The body is of an oblong and slightly conical shape, most obtuse at the base. It is also obscurely five-sided, the arms being situated upon the angles. Its covering consists of a number of polyhedral plates, firmly united at their edges, and forming a strong calcareous shell, which, if fissured down from the top to the bottom, and unfolded on a plane surface, would present the arrangement seen in Fig 5.

In the several other genera of Cystideans allied to this, the rows of plates extend in uninterrupted bands horizontally round the body, but here the second and third rows are broken through by the extension of the plates in the series below and above.

In the basal series there are four plates resting upon the upper joint of the pedicle, one of them hexagonal, and three pentagonal. The hexagonal plate occupies the base on the posterior side, and supports that plate on which rests the ovarian aperture; and the pentagonal plate, immediately opposite on the front side of the fossil, is remarkable for being twice the height of the others. As allusion will be frequently made to it in the course of the following description, it is marked No. 1 in the diagram Fig. 5, for convenience of reference.

The second series consists of five plates, three hexagonal, and two slightly heptagonal. This row is divided in front by the great extension upwards of No. 1. The ovarian aperture rests in a concave notch excavated out of the upper side of the plate in this series, which is supported by the hexagonal pelvic plate. These two rows enclose the lower one-third part of the body. In the third series a small but conspicuous hexagonal plate occupies the front, resting on the apex of No. 1, and having a small pentagonal plate on its right, or on the left side of the fossil. On the right side is a large rhomboidal plate, made heptagonal by being notched on its lower side to fit upon the angles of the two plates below, one of which it covers in part, the others entirely. This plate is easily recognised by the large pectinated rhomb between it and the ovarian aperture, and by the diagonally-placed rhomb, which lies partly across the fossil at the upper side of the plate in question. It is separated from the small hexagonal plate by a projection of one of the plates of the fourth series, which here rests upon a plate of the second. Two other partly rhomboidal plates of this series enclose the sides of the ovarian aperture, and meet over it.

The three last-mentioned plates of the third series are each in height about one-third of the total length of the fossil, and resting upon them are three plates of the fourth series of nearly the same size and shape, which extend to the line of the origin of the arms. The other two plates of the fourth series are more than half the whole length of the body. One of them stands upon the small hexagonal and pentagonal plates, and the other in part upon the small hexagonal plate, and in part upon a plate of the second series. All the plates of the fourth series are excavated on their summits where the five arms originate from them. They do not close the fossil at the top. The circular space surrounded by their upper extremities is closed over by a dome, in the top of which is the elongated mouth.

The five plates in the second series, and in some of the specimens the two small ones in the third, are ornamented by strong rounded ridges, which radiate from the elevated centre of the plates to the corners, or cross the sides at right angles. There are also generally one or two short ridges between the rays, while sometimes several concentric lines of growth may be observed.

The principal characters upon which the genera of Cystidea and Crinoidea have been established, are derived from the number and arrangement of the plates between the base and those points near the summit whence the arms arise. Many Crinoids, among which may be mentioned, as affording good examples, the very ancient *Heterocrinus*, several species of which abound in the same strata along with the Cystidea now under examination, and also the recent species, *Pentacrinus Caput Medusæ*, living in the Caribbean Sea, are formed simply of five vertical pillars of plates, which stand upon the pelvis, and proceed straight up the sides of the cup to the top, where each supports an arm. These, with many others that could be cited, might be properly arranged into a family, in which the distinctive feature would consist in the presence of those arm-bearing pillars of more or less quadrangular plates, placed one above the other. This structure appears, with some slight irregularities, in the unfolded calcareous shell of *Glyptocystites*, as represented in Fig. 5.

As the arms may be considered simply as continuations upwards of those pillars, and as the base of the fossil whence they arise is the back of the animal, they (the arms) are said to be developed

* The side containing the large ovarian aperture may be considered as the posterior side of the animal, and consequently the right and left sides will correspond with the right and left hands of the observer, while the anterior side will be directly opposite or in front.

from the dorsal pole of the cuticular skeleton. Volborth, an eminent palæontologist, contends that it is so in the Cystidea, and that they are true Crinoids, while several other writers upon the science maintain an opposite opinion, and regard the arms of the Cystidea as springing from the ventral aspect, and being developed downwards. Upon this curious question I do not feel myself authorized to venture an opinion, and shall content myself with directing attention to the fact that this new genus appears to be constructed very nearly upon the same plan as the Crinoids above mentioned.

The small cup of an Encrinite, figured at the end of this paper for another purpose, is formed upon a different principle. The plates of the second row alternate with those of the pelvis, and those which bear the arms do not rest immediately upon single plates below, but in the angles formed by the sloping sides of the plates of the second series. There is no trace of the arm-bearing pillars, as in *Heterocrinus* and *Pentacrinus*. It is a member of a different family, in which the genera *Cyathocrinus*, *Poteriocrinus*, *Homocrinus*, and others of similar structure may be placed.

In Fig. 6 is represented the structure of the Cystidean *Echino-encrinites*, which is the same in principle as this family of Crinoids, with alternating plates. This genus, and four others, *Pseudocrinites*, *Prunocystites*, *Apiocystites*, and *Lepadocrinites*, are all constructed exactly alike so far as regards the plates below the arms; and as they are the only Cystideans yet known to which *Glyptocystites* exhibits anything like a near approach, it must for this reason alone be considered a new genus.

The arms are five, four of them in perfect specimens extending from the summits of the plates of the fourth series to the base, and the fifth being only about three lines in length. They divide the surface into four compartments, seen in Figs. 1, 2, 3, and 4. The right side, Fig. 3, is nearly twice as wide as any one of the others. It is divided at the upper part by the short arm. The two arms on the ovarian side, Fig. 3, unite near the summit, and the grooves which occupy their centres here unite, and cross over the apex in a single furrow to the other side, where they separate, and follow down the front pair of arms. A short groove also from the apex extends to the lower end of the short arm. On each side of each groove there is a row of seven or eight protuberances, which are the bases of the tentacles.

On none of the Cystidea heretofore discovered are there more than three of those organs called *pectinated rhombs* or *ambulacral openings*, while this species displays the extraordinary number of thirteen. The office performed by them in the animal economy has not yet been explained. They consist of spaces of small extent, perforated by elongated pores, which pierce the plates to the interior. They are generally of a rhomboidal shape, and each is situated upon two plates, one half being upon each. In *Glyptocystites* they differ somewhat in external appearance from those described as belonging to the English and American Cystidea already known, but correspond in form very nearly with those of the Russian species of *Echino-encrinites*. In the Geology of Russia, as quoted by Mr. Hall in Vol. I. Palæontology of New York, p. 88, it is stated: "The *Echino-encrinites* is further distinguished by the presence of pores, not disseminated over the entire surface, as in *Echino-sphærites*, but occupying a determinate place, and bordering three small rhomboidal areas." This is their form in *Glyptocystites*. There is in each a smooth rhomboidal space, the length of which is twice the breadth, and completely surrounding it is a row of elongated pores. The suture between the two plates, upon which each of those organs is situated, forms the greatest diagonal of the rhomb. These pores do not terminate at the border of the smooth space in the centre, but are extended beneath it, and cross over to the other side. I ascertained this fact by grinding down the surface of a specimen. When the unperforated space in the centre is thus removed, these rhombs are precisely similar to those of one of the species of *Pleurocystites*, presently to be described in this paper.

The several positions of these rhombs are as follows:

On the left side of the fossil, Fig. 1, there are two, one of which extends from the centre about half way to the summit, inclining towards the rear as it ascends, with a very small one immediately above it, and inclining to the front. It must here be noticed that, in all the large rhombs of this species, there is an elevated border along one side of the unperforated area in the centre. In this compartment the border is on that side of the large rhomb which corresponds with the left hand of the observer.

On the ovarian side, Fig. 2, two are visible, a small one under the left side of the aperture, and a large one, with the border on the left, standing perpendicularly above it.

On the right side, Fig. 3, there are five: 1st. A large one upright along the left side of the division, in length one half that of the fossil, and with the border on the right: 2nd. A small one perpendicularly above the upper end of the last: 3rd. A third lies across the fossil from the top of the large one, but inclining downwards, and with its border on the lower side: 4th. The fourth extends from the lower end of the third nearly to the summit; its border is on the right: 5th. The remaining rhomb on this side appears to be half of a large one. It consists of two rows of pores, united a little below the centre on the right side of the division, and spreading apart from each other in the direction of the point above, where the two last mentioned touch each other at their lower extremities.

On the front side of the fossil, Fig. 4, there are four of those rhombs, two of which occupy precisely the same position as two of those on the Russian species of *Echino-encrinites*. Referring again to the Geology of Russia, we find it stated: "Two of these poriferous rhombs are situated near the base, and have their greatest diagonals united upon one of the angles of the opening where the stem is inserted, while the third is found on the opposite side between the mouth and the great lateral opening, and directly above the pentagonal basal plate. The two first are mounted upon plates of the two inferior ranges, and the last upon those of the two superior ranges." In *Glyptocystites* one half of each of these two rhombs is situated on the elevated basal plate No. 1, and the other halves on the plates of the second range, which lean against its long, sloping sides. In each the border is on the upper side. By referring to Fig. 6, it will be seen that Von Buch has figured them in the same position, with the exception that there the greatest diagonal is at right angles to the suture between the plates. In this fossil, the greatest diagonal in all the rhombs follows the suture, and the lesser diagonal crosses it. In the English species of *Echino-encrinites* there is but one rhomb below and two above, while in the Russian fossils the reverse is the case. The true form and disposition of those organs, as described by Von Buch, and by the authors of the Geology of Russia, although alluded to, have evidently been overlooked in the English and American works before referred to. On the right side of the small hexagonal plate in front there is a very small rhomb, and, with its greatest diagonal running perpendicularly upwards from the centre of the upper side of this plate to the top of the plates of the fourth series, there is a very large one with the border on the left side.

The whole of the lower part of this fossil to the top of the second series is exactly like *Echino-encrinites angulosus*, as described by Von Buch, with the exception of the great height of the basal plate No. 1. He says: "The stem is very slender at its further (lower) extremity, and is provided with articulations, whose length is three or four times greater than their diameter. Towards the cup the diameter, however, increases, the articulations approach one another and become rings, and at length, when they reach the basal plate and pass into it, this diameter is as much as one-third of the whole diameter of the cup.

"The base of the cup into which the stem passes is nearly a perfect square, which may become changed into a rhomb, the angles of which are blunted by compression of the entire form. The basal plates are deeply depressed near where the stem is attached."

This description applies so nearly, that no other is necessary for the base of the fossil now under examination. On looking at the bottom, four sharp, straight ridges will be seen, forming a perfectly square inclosure, round the opening into which the stem is inserted, and upon one of the angles of this square the lesser diagonals of the two basal rhombs are united. In *Echino-encrinites*, however, as described by Von Buch, and as is mentioned in the passage from the Geology of Russia above quoted, it is the greatest diagonal of each rhomb that points to the corner of the square.

It has been already stated that a deep groove passes over the summit, and sends down branches to the extremities of the arms. Exactly on the apex of the fossil, and in the bottom of this groove, there is an elongated oval opening to the interior, one-eighth of an inch in average length, and of the width of the groove. In this aperture all the grooves of the arms terminate as in one common centre. This is probably the mouth of the animal, and as affording an analogy in support of this view, it may be here observed that with few, if any exceptions, the grooves on the under sides of the rays of the star-fishes, the ambulacra of the sea-urchins, and the pseudambulacra of the pentremites all terminate in the mouth. In all the armless Cystideæ, the buccal orifice occupies the centre of the apex, and in the four-armed species of *Pseudocrinites*, figured in the Memoirs of the Geological Survey of England, this aperture is placed in the same position in the central point from which the arms radiate. The only other orifice on or near the top of the fossil is a minute pore upon the left side, indistinctly visible to the naked eye, which appears to be altogether too small to be considered the mouth, when we compare the great size of that organ in *Echino-encrinites*, as figured by Von Buch and Professor E. Forbes. It appears probable that, in all those Cystidea with sulcated arms radiating from the summit, the mouth will be found in the centre, where all the grooves meet.

In well-preserved specimens, the groove across the summit is filled with two rows of small oblong plates, which project upwards and lean against each other above, but do not interlock. If the apical orifice be the mouth, then, without doubt, these rows of plates formed a peculiar valvular apparatus by which it was opened and shut. They also fill the groove down to and past those points where it branches into the arms; and it is difficult to conceive what their office could be here, unless to form a covered way for certain vessels passing from the mouth to the extremities.

Figs. 7 and 8 show this part of the fossil with and without those

Fig. 7.

Fig. 8.

plates, and I also forward herewith two specimens which are in the same condition. There are other specimens in my possession exhibiting these and other parts in greater perfection, some of which I hope to place in the Museum of the Canadian Institute during the approaching season of navigation, when parcels of fossils can be sent with safety.

The ovarian aperture is in form like a spherical triangle, with very obtusely-rounded angles, one of which usually forms the lowest corner of this organ on the right side. It rests wholly upon that plate of the second series which stands upon the hexagonal pelvic plate, a position somewhat different from that occupied by it in the other allied genera of Cystidea. It is generally supported by this plate and the next on the left in the same series in the species heretofore made public. It is altogether in the lower half of the body, its upper margin being about half way between the summit and the base. I have found many specimens of this fossil under such circumstances as to leave but little doubt that it was unprovided with the valves by which the ovarian aperture was opened and closed in several species. In this respect it resembles also the *Echino-encrinites* of Pulcowa, so often referred to in this paper. Many of the European geologists are of the opinion that this latter had not an ovarian pyramid, while others maintain an opposite view, supposing that, in being rolled about the bottom by the waves and currents after death, the plates became detached, and thus they have never been seen; but in one locality I disinterred many specimens from a bed of shale between two strata of limestone, where it was perfectly evident that they could not have suffered any other violence than such pressure as might result from the accumulation of the deposit above them. They had evidently lived and died in this spot. The lower stratum of limestone was partly formed of their plates and disjointed columns to the depth of an inch of its upper surface, and it may be inferred from this circumstance that they had flourished here for a great length of time undisturbed. In the shale, which varied in thickness from one to three inches, were imbedded a number of perfect specimens, some of them standing nearly upright, and with the pedicle apparently still attached to the rock below. The delicate little tentacula on the arms were preserved with all the plates still occupying the grooves. It was easy to read with one glance the whole history of the catastrophe which fell upon them and occasioned their destruction. They had been buried alive by a deposit showered down upon them from a superficial current passing far above, while at the bottom it was still water. If, after death, they had not been subjected to a sufficient amount of violence to remove the tentacula, it is highly probable that, had they been provided with ovarian valves, these would also remain; but in upwards of sixty specimens discovered here and in other localities, not a trace of a valve is to be seen.

(To be continued.)

ERRATA.—On page 215, for "A. Elegans," read "A. elegans," and for "H. Parasitica," read "H. parasitica."

On some Points connected with the Early History of Rome.*

By the Rev. E. St. John Parry, M.A., Professor of Classics in the University of Trinity College.

"Ancient History," it has been well said, "is the biography of the dead, while Modern History is the biography of the living." "And it must therefore necessarily follow," as the same author says, "that Modern History must be especially interesting to

* The following paper originally formed the substance of a Lecture delivered before the Canadian Institute. It has subsequently undergone some alteration and modification. The Author feels bound to acknowledge the suggestions of Professor Wilson, whose view he has carefully considered, although he still inclines to Niebuhr's Theory of the Etrurian race in preference to that of Dennis.

ourselves, inasmuch as it treats only of national existence not yet extinct: it contains, so to speak, the first acts of a great drama now actually in the process of being represented, and of which the catastrophe is still future." And to carry on the idea of this great historical writer, if we may speak of the history now enacting, and in progress since the dismemberment of the Western Empire as one great Drama; we may also compare Ancient History to the Prologue of that Drama, or rather, perhaps, to the mass of presupposed action and interest, of which the Drama itself takes no account but in so far as its own colour and incidents are derived from it. It is in this point of view that Ancient History interests us so deeply, as containing not only the type of what follows, but in many cases the actual germ from which our own institutions, our own political forms, are primarily derived. This is true of the Early History of Rome to a greater extent perhaps than of any other History. From the Roman Empire we have derived many of our distinguishing national institutions, as well as a large element of our language. In its early History we find these institutions embedded, as it were, amid a mass of heterogeneous matter: from which it requires much labour and discrimination to detach them. Some of the greatest geniuses of Modern times have been employed in investigating this subject. Glareanus, Perizonius, Beaufort, and Vico, are some of the names which every Scholar reveres for their services done to the cause of critical historical enquiry; and if we give Niebuhr the precedence above them all, it is because he has brought to bear upon a subject which they had previously touched upon, the full strength of modern criticism, aided by a commanding and practical genius; carrying with him to the investigation of early Roman History the experience of the diplomatist and financier, and above all, the unbending patience of the Teutonic character, he has reproduced so faithfully before the present generation the genuine form and features of the old Republic, that we are tempted to pay him an almost undivided homage, and to recognize in him the Second Founder of early Rome.

Within the limits of this paper, it is impossible to give a general account either of modern discoveries, or of the early history which they illustrate. It will be sufficient to endeavour to illustrate one or two subjects; and we may confine our aims to some few notes on the Ethnology and Languages of Ancient Italy.

I. ETHNOLOGY.

1. *Pelasgians.* The greater part of Italy appears in very early times, to have been inhabited by the Pelasgians, whether under the name of *Siculians, Aborigines, Œnotrians, or Tyrrhenians.* Under one or other of these names, they occupied the southern part at least of Etruria; the district round Reate in the Sabine territory, and the west and east of Southern Italy. It is generally allowed that these Pelasgi, were part of that extensive and wide spread family, which many centuries before our era occupied all the countries situated on the Mediterranean, from Etruria to the Bosporus. We find their monuments—commonly known as the Cyclopean masonry, in Arcadia, Argolis, and Attica, in Greece; in Etruria, and Latium, in Italy.* These walls formed of enormous blocks, raised as it were by the hands of Giants, have defied the lapse of time, and still remain to us as unaccountable monuments, whether of the skill or of the strength of the extinct race. The general family of the Pelasgi is found at Dodona, worshipping the mystic vo[illegible] of the prophetic dove; at Lemnos, Imbros and Samothrace, successors of the Cabiri, deriving their rites from the religion of the East. Theirs was Troy,† the great Pelasgic town, whose founder, Dardanus, was fabled in various legends to have come from Arcadia, from Samothrace, or from Cortona; all historical centres of the early Pelasgic race.

The Pelasgians are generally reported by writers of antiquity to have formed settlements on the coasts of Italy; and in the various legends of the foundation of Italian towns by the race, we perceive that they are traced to two centres, the Arcadian and Argive Pelasgi, and the Lydian or Tyrrhenian Pelasgi. It cannot be doubted that the Pelasgians, as an unsettled and seafaring race, may have occupied simultaneously many points on the coast of Italy. As a commercial and industrial race, they would naturally establish themselves on the sea coast, and at the mouths or on the banks of the larger rivers. Thus we find them, according to tradition, occupying twelve cities on the banks of the Po, twelve in Etruria, and twelve to the south of the Tiber; corresponding to the same Pelasgic number of twelve townships in Attica, twelve towns forming the Amphictyonic League in Greece, the Æolian and Ionian Leagues in Asia Minor. If we remember what has just been noticed, viz:—the dispersion and industrial character of the Pelasgic nation, we are at no loss to account for their disappearance from history: they are indeed branded in Grecian story as blood-thirsty marauders; of their race is told the tragedy of Lemnos, the inhuman murder of Phocæan prisoners at Agylla. Nor can we doubt that these tales arose from the hatred of the warlike Greeks to an agricultural and industrial population, distinct from the heroic tribes who afterwards peopled both Greece and Italy, in their possession of a knowledge of nature which inspired their enemies with fear and with hatred. The Telchines of Rhodes, the wizards of ancient fable; the Cyclopes of Peloponnesus and Sicily, who penetrated the depths of the earth with lamps fixed on their foreheads, the one-eyed miners of antiquity; the Cabiri of Lemnos and the Eastern Pelasgic races—workmen as well as Gods, who were worshipped under the image of earthern jars, the emblems of the mystery of the potter's art: all these teach us that the genius of the Pelasgic race was one of industry and skill, both undervalued by their ruder contemporaries. So the Pelasgi in Italy were made subject to various conquerors; those of the North to the Gothic Rasena; those of Centre Italy (the Siculians inhabiting Latium) to the Oscans, who drove them into the island which has ever since retained their name; those of the South (the Œnotrians and Peucetians) when the invading Hellenes subjugated their old seats in Lucania and Apulia, were reduced to serfdom, as their kinsmen were in Etruria; while a portion of them, the Bruttii, retained for ever the name as well as the condition of slaves.

The consideration of the history of this Pelasgic race, and its settlement in Italy, is so intimately connected with the after condition of their chief territory (that of Etruria), that we may here anticipate a little the course of events, and advert to the conquest of Etruria by the Etruscans.

* The force of this argument for the identity of the Italian and Greek Pelasgi has been questioned; but although some such works may be found of a much later date, yet we must accept the existence of such monuments as are unquestionably of ancient date, appearing contemporaneously in Greece and Italy, as a strong evidence of some connection between the tribes that at that period occupied those two countries.

† Professor Newman, while rejecting much of Niebuhr's speculations concerning the Pelasgi, thinks that "we may well accept his conjecture that the migrations of the Pelasgians by sea from the coast of Troas to Sicily and Italy, carrying with them their Penates and religious worship, generated the poetical legends concerning Æneas and others; indeed it can hardly be doubted, that the worship of the Penates, and Palladium of Lavinium, which Æneas was supposed to have conveyed thither, was strikingly similar to ceremonies practiced on the north and north-east coast of Ægean." (Newman's Regal Rome, p. 8.)

The early inhabitants of Etruria were Tyrrhenians, a branch of the Pelasgic race. That they were at any rate closely connected with the early inhabitants of Greece, if not belonging to the same great family, is clear from several considerations. These Tyrrhenians appear by the preponderating evidence of antiquity to have migrated from Greece and Asia Minor. Succeeding and conquering them we find a race which is referred to Lydia as its mother country on the testimony of Herodotus, as well as of many other ancient authors. This theory of their origin has been supported by Mr. Dennis, and quite lately by Professor Newman. On the contrary we have the absence of any corroborating testimony in Xanthus, the annalist of Lydia, as noticed by Dionysius; and the fact that the language, religion, and institutions of these Etruscans did not correspond with those of Lydia. This negative objection is overruled by Newman on these grounds:

1. That the positive testimony of Herodotus is worth far more than the omission of Xanthus.

2. That the tendency of fiction in nations is to remodel the past, not the future. "They feign forefathers," he says, "not children: so that this belief of the Lydians is a weighty circumstance."

3. That the native population of Etrusia was then *Umbro-Pelasgian;* and that the language and institutions of the Etrurians would naturally undergo a sensible change from their proximity to the old population, just as the language of the Lydians themselves had undergone a sensible change during the vicissitudes which befel them in the growth of the Persian Empire.

Niebuhr, as is well known, combats this view; and would derive the Etruscans from the country north of Italy, supposing them to have conquered the Tyrrhenians and Umbrians, and occupied Etruria proper and the country about the Po. This view is that which, after all that Professor Newman urges against it, seems nevertheless to rest on the surest ground. I will, before proceeding to state the accepted theory of the Etruscan History and their invasion of Central Italy, offer one or two remarks on the arguments by which Mr. Newman has endeavoured to set aside that theory.

1st. As to the positive testimony of Herodotus. His account of the story may be freely translated as follows :—

"The Lydians say of themselves, that the common games which are now in use in Greece are their invention; and that, besides inventing these games, they moreover sent a colony to Tyrsenia. The following is their story:—In the days of Atys, the son of Manes, their king, there was a sore famine throughout all Lydia. And for a time the Lydians lived in distress, but afterwards, when the famine stayed not, they sought for remedies against it. It was then they say that they invented dice, and knuckle-bones, and ball, and all other kinds of games except draughts. * * * * For one whole day then they played games that they might not want food: and the next day they took their turn to eat, and rested from their games. Thus they lived for eighteen years. But when the evil abated not, but rather grew worse and pressed them sore, then at last their king divided all the Lydians into two parts, and drew lots for the one to remain at home, and the other to leave the country. And with the lot that drew to remain at home the king joined himself; but with that which was to depart from the country, he joined his own son, whose name was Tyrsenus. Now the party who were appointed by lot to depart out of the land went down to Smyrna, and built ships for themselves, and put in them all their moveable property, and sailed away to look for a livelihood and a home: and they passed by many nations, until they came to the Ombrici. And there they built cities in the land, where they live even unto this day. But they changed their name from Lydians after the name of their king's son, who had led them out, and were called Tyrsenians." (Hdt. I. 94).

I think that no one who reads this paragraph can fail to observe that Herodotus tells this tale merely as a tale, and does not attach to it any great importance. We have no words of criticism, or of assent, such as he so often appends to stories in themselves far more probable. He seems to class it with the invention of games, and to give the Lydians credit for one as lightly as for the others. At any rate, the amount of credit which Herodotus gives to this story can hardly be characterized as positive testimony, or be set against the omission of any such account in Xanthus, who, more perhaps than any one, would have endeavoured to raise the historical importance of his country by recording this legend, if he had regarded it as entitled to credit. I confess that it seems to me to belong too clearly to the *a posteriori* class of fictions, where the name of the hero is represented as descending to the people and the country, where the national life is traced fondly back to some semi-heroic *eponymus*—to some god, or child of a god, who had left Olympus and walked among men, and founded for himself a city and a people in the golden age. This tendency is illustrated by many familiar instances, which we need not recall to our readers' minds; but it may be interesting to observe how such a fiction may arise, not only in an early and credulous age, but at a cultivated and critical period—nay, how even the critic may show undue credulity, misled by this name-parentage of early fiction. Let us take as our instance Tacitus, the historian, the sceptic; a man of all others the most likely, we should think, to have entertained that "*wise disbelief*" which "is our first grand requisite in dealing with materials of mixed worth." And yet, when treating of the history and institutions of the Jews, he shows not only ignorance and prejudice, both of which we can easily account for, but he gives us a remarkable instance of the tendency of eponymising (if we may coin an expressive word) which we have noticed above. Among various theories which he mentions, these two are to the point: "Quidam (memorant) regnante Iside, exundantem per Ægyptum multitudinem, ducibus *Hierosolymo* ac *Juda*, proximas in terras exoneratam;" and again: "Alii, Judæorum initia, *Solymos*, carminibus Homeri celebratam gentem, conditam urbem *Hierosolyma* nomine suo fecisse."—(*Tac. Hist.*, V. 2, cf. also, 3-8.)

2. Professor Newman's second argument does not appear conclusive. Although the fabulous tendency in nations looks to the future rather than to the past; although "they feign forefathers," as he says, "not children," yet we cannot allow that this belief of the Lydians is in itself a circumstance of any great weight; for we must distinguish between the art of inventing a posterity gratuitously, so to speak, and the art of claiming the parentage of a nation already existing, and presenting sufficient marks of a family likeness to render the claim feasible. This we conceive to have been the case with the Lydians. They found a nation existing in Italy in whom they recognized some marks of a common stock. This nation they claimed as their offspring. Their claim must be modified or rejected according to one of two alternatives. We may suppose that the nation whom they wished to claim was merely one branch of that Pelasgic family which has its seats in Lydia as well as in Italy. In that case, they may have had a real connection with that western outpost of their family, but with the Tyrrheno-Pelasgic inhabitants of Etruria, not the Etrurians proper. Or, secondly, if we consider this legend as referring to the strict Etrurian race, we feel bound to

reject it—to class it among other national claims to an illustrious progeny, placing it in the same category with the claim of the Jews to the colonization of America,* or with the rival claim of the ancient Welch to a discoverer and colonizer of the New World in the person of their fabulous Prince Madoc.

3. The change of language is equally explicable on either theory. Whatever were the respective languages of the original inhabitants of the country and of its later conquerors, it is very probable that both underwent considerable modification, so that we can easily account for the appearance of a new composite tongue, equally distinct from Pelasgian and from pure Etrurian. Thus much we may say here, in anticipation of what will fall into its place more properly when we come to consider the Languages of Ancient Italy.

These considerations appear to my mind feasible enough to incline us to agree with Niebuhr rather than with Dennis, to look for the Etruscans rather to the north of the Italian Peninsula than to the east. So far we agree with Dennis that in Etruria are found many traces of the influence of Eastern customs and religion; but we hesitate to make the introduction of these customs contemporary with the incursion of the Rasena or pure Etruscans. The monuments discovered in Etruria only increase our difficulty. Not only do they present us with an unintelligible language, but they further perplex us by the strange medley of religions which appears in them. As Michelet describes them:—"These men, with large arms and large heads, remind one of the statues found in the Mexican ruins of Palanque. * * * * * This eagle-horse carries me to Persia; these personages who cover their mouths as they address a superior seem to have been detached from the bas-reliefs at Persepolis. At their side I see the man-wolf of Egypt, the Scandinavian dwarfs, and perhaps the mallet of Thor." Without following out all the fanciful resemblances perceived by this author, we yet clearly perceive enough uncertainty to forbid our basing upon these remains any very important theory.

How, then, are we to explain the history of Etruria?

I. We must remember that there was existing in the country from the earliest times of which any record remains, a population which may be described as Tyrrheno-Pelasgian, composed of a mixture of the distinguishing Italian with the Greek element. This race perhaps supplanted an old Umbrian population, probably existed side by side with it. At all events, it is found in Etruria in the middle of the sixth century B.C., at which time Agylla is mentioned by Herodotus as a town consulting the oracle at Delphi, in which temple it had a chapel or storeroom—an evidence of Pelasgian origin.

* The question of the probable locality of the Jews of the Dispersion has excited much curiosity since the time that Alexander the Great, followed by birds who spoke Greek, attempted to find the Rechabites in the dark mountains. Penn, we know, fancied he had discovered the Jews in America, and supposed them to have passed over from the eastern extremity of Asia to the western extremity of America. Others have discovered them beyond the Corderillas, have even traced the route by which the tribe of Reuben reached the West Indies, or have bridged over Behring's Straits to make the migration more probable. Nay, we are told that Noah spent the last 350 years of his life in colonizing various parts of the earth. Others have traced the Americans from the Canaanites who fled before Joshua, from the Carthaginians, or from the nations who would not embrace Christianity. The migration of Madoc is placed A.D. 1170, and has been made the theme of poets and historians. We may spare ourselves the trouble of refuting these opinions, for they refute each other. They are brought forward here as an instance of the contradiction and difficulty which attends these national traditions, and of the large share which national pride or religious bias may have in their construction.

II. Against this nation (a peaceful industrial population, as we have noticed above) there came from their fastnesses in the Rhaetian Alps the warlike *Rasena*, known to the Romans by the name of Etrusci. Livy (v. 35.) considers the Etruscans to have been Rhaetians; although, as he observes, their language had been greatly modified by the circumstances of their local position. However this may be, yet we have every reason to conceive that the race which now infested Italy was neither Umbrian, nor Lydian or Pelasgic, but Gothic; that they swept from the Alps, like their successors the Gauls, in an overwhelming torrent, conquered Lombardy, and thence, passing down the western side of the Appeninnes and forcing, perhaps the Umbrians who still inhabited Northern Etruria, to cross the mountains and confine themselves to the Eastern coast, they spread down from Lake Trasimenus along the valley of the Tiber, and flooding the country to the sea coast, established within those limits the empire of the Rasena.

This period may be marked by the date 523 B. C., at the latest: for we know that between that date and 533 B. C., Agylla (afterwards Caere) was still a Pelasgo-Tyrrhenian town in communication with Delphi. From that date to about 470 B. C. is the probable period of Etruscan conquest: and during this half century they must have overrun Central Italy and received the submission of Latium, and, among the Latin towns, of Rome herself.* In the year 470 they are said to have founded Capua; and were about that time at the height of their power. Hiero broke their naval power at the battle of Cuma, and about the same time, in all probability, a rising of Latium took place, when they were beaten back with loss from under the walls of Aricia. From that period their power declined. The Romans, after shaking off their temporary yoke, rose steadily. The Etruscans were henceforth confined within the Tiber as their southern border. About the middle of the 4th century of Rome the Gauls deprived them of their possessions in Lombardy. In B. C. 280, they are admitted to terms of lasting friendship with Rome; and continue the faithful allies of Rome for two centuries till in the year 88, they, together with the Umbrians, received the Roman franchise.

More has been said of this branch of Italian ethnology than would have been necessary, and more perhaps than may seem compatible with the restricted limits of this paper, because I found it necessary to disagree with the views put forth by Professor Newman, and was unwilling to do so without assigning my reasons more at length. We may pass on more briefly to a notice of the remaining nations who may be classed among the early inhabitants of Italy.

The *Umbrians and Oscans* seem to have occupied large portions of Italy to the north and south of Latium. Under this class of nations were included the hardiest and most warlike of Italian nations. The hardy Samnites, who maintained many bloody wars against the power of Rome and Latium; the Volscians, those eternal enemies of the Roman name; the Sabellians, the mountain shepherds, distinguished from the less hardy Osci, who cultivated the plains. The former worshipping Mavus, Mamers, or Mars, adored under the form of a lance; the same deity, whose name was derived from the Sabine *quiris*, a spear, and worshipped as Quirinus in early Rome. The latter worshipping a kind of Hercules, known by the names Sabus, Semo, Sancus, Fidius, the same deity whose name, we know, inscribed "Semoni Sanco" on a stone found on the island in the

* This fact, though disguised by Livy, as he followed the old poetical story, is expressly admitted by Tacitus, (Hist. III. 72.) and proved at large by Niebuhr. (Hist., Vol. I., p. 511-551, &c., Eng. Tr.)

Tiber, gave rise to the tradition mentioned by Justin Martyr, (Apol. I., 26) that Simon Magus was worshipped as a god at Rome, and that a statue in his honor had been erected by Claudius Cæsar.

This family of nations inhabited the districts known by the names of Umbria, Picenum, Sabinum, Samnium, and Lucania.

The chief element of Italian population which we have hitherto left unnoticed is the Greek, purely derived from Latin Greece, and distinguished from the Pelasgic population which had settled in Italy long previously. The earliest Greek colony in Italy was Cumæ, in Campagnia, which is referred to a fabulous date. There were, no doubt, many other towns of which there is no distinct record. Even in Southern Etruria we can trace in the legend of Tarquinius, and the story of the arrival of Demaratus from Corinth with the artists Euchir and Eugrammus, a link between the sea-board of Etruria and the maritime cities of Peloponnesus. In Magna Græcia the Greek element was most firmly planted, and there, both in religion and in philosophy, it gave rise to a school as distinguished as any in old Greece itself.

(To be continued.)

List of Indigenous Plants found in the neighbourhood of Hamilton, with the dates of their being found in Flower and Examined.

By Dr. Craigie and Mr. W. Craigie.

APRIL 21*st*.
Symplocarpus fœtidus.
28*th*.
Sanguinaira Canadensis.
Hepatica triloba.
Claytonia Virginica.
Erythronium Americanum.
MAY 4*th*.
Viola ovata.
" pubescens.
Leontice thalictroides.
Trillium erectum.
8*th*.
Thalictrum anemonoides.
Viola cucullata.
" blanda.
" Canadensis.
Dicentra Canadensis.
" Cucullaria.
Chrysosplenium Americanum.
Uvularia perfoliata.
Trillium grandiflorum.
" cernuum.
10*th*.
Caltha palustris.
Dentaria diphylla.
Panax trifolium.
Anemone nemorosa.
Fragaria Virginiana.
11*th*.
Cardamine rhomboidea.
Dentaria laciniata.
Ranunculus abortivus.

MAY 12*th*.
Asarum Canadense.
Waldsteinia fragarioides.
Amelanchier Canadensis.
14*th*.
Mitella diphylla.
Saxifraga Virginiensis.
Phlox divaricata.
Ranunculus sceleratus.
16*th*.
Xanthoxylum Americanum.
Lonicera ciliata.
Atragene Americana.
21*st*.
Thalictrum dioicum.
Viola sagittaria.
Tiarella cordifolia.
Arum triphyllum.
22*nd*.
Zizia aurea.
Sassafras officinale.
Sambucus pubens.
Benzoin odoriferum.
23*rd*.
Platanthera bracteata.
Actæa rubra.
" Americana.
Cornus Canadensis.
Lithospermum arvense.
24*th*.
Trientalis Americana.
Ribes hirtellum.
27*th*.
Smilacina stellata.

MAY 27*th*.
Osmorhiza brevistylis.
Geranium maculatum.
Cerasus Pennsylvanica.
Zizia integerrima.
28*th*.
Streptopus roseus.
Orchis spectabilis.
Prunus Americana.
Ribes floridum.
Pedicularis Canadensis.
Castilleja coccinea.
Cardamine hirsuta.
29*th*.
Polygonatum pubescens.
Podophyllum peltatum.
Rubus triflorus.
30*th*.
Prosartes lanuginosa.
Staphylea trifolia.
Veronica peregrina.

JUNE 4*th*.
Cornus Florida.
Cratægus coccinea.
Cerasus Virginiana.
Geranium Robertianum.
Cerastium hirsutum.
Cypripedium pubescens.
Acer spicatum.
Veronica Americana.
5*th*.
Potentilla Canadensis.
Cratægus punctata.
Aquilegia Canadensis.
Hydrophyllum Virginicum.
Sanicula Marilandica.
Platanthera Hookeri.
7*th*.
Lathyrus ochroleucus.
Comandra umbellata.
Smilacina bifolia.
Erigeron bellidifolium.
9*th*.
Triosteum perfoliatum.
Aralia nudicaulis.
Cornus circinata.
Smilacina racemosa.
10*th*.
Cerasus serotina.
Cornus alternifolia.
12*th*.
Cornus stolonifera.
Viburnum Lentago.
Rubus villosus.
Pyrola rotundifolia.
16*th*.
Linnæa borealis.
Calla palustris.
Celastrus scandens.
18*th*.
Leucanthemum vulgare.
Euonymus Americanus.
19*th*.
Aphyllon uniflorum.

JUNE 21*st*.
Stellaria longifolia.
Circæa alpina.
Specularia perfoliata.
Potentilla Norvegica.
Osmunda cinnamomea.
" interrupta.
23*rd*.
Viburnum acerifolium.
Diervilla trifida.
Veronica officinalis.
Myosotis laxa.
24*th*.
Lilium Philadelphicum.
Pentstemon pubescens.
Campanula rotundifolia.
Polygala Senega.
Hypericum perforatum.
Rosa lucida.
Liriodendron tulipifera.
Gillenia trifoliata.
Ranunculus fascicularis.
25*th*.
Sagittaria variabilis.
Pyrola elliptica.
Cynoglossum officinale.
Euphorbia platyphylla.
Frasera Caroliniensis.
Oxalis stricta.
Lysimachia quadrifolia.
30*th*.
Iris versicolor.
Utricularia vulgaris.
Nuphar advena.
Nymphœa odorata.
Asclepias incarnata.
" debilis.
Apocynum cannabinum.
Lathyrus maritimus.
Geum Virginianum.
Archangelica atropurpurea.
31*st*.
Prunella vulgaris.
Sisyrinchium anceps.
Galium triflorum.
" lanceolatum.
Botrychium Virginicum.
Hypoxis erecta.
Medeola Virginica.
Mitchella repens.
Silene noctiflora.
JULY 2*nd*.
Asclepias phytolaccoides.
" Syriaca.
Cornus paniculata.
Moneses uniflora.
3*rd*.
Hydrophyllum Canadense.
Rhus typhina.
Sparganium ramosum.
Allium tricoccum.
Lathyrus palustris.
Vicia Americana.
Lathyrus myrtifolia.
Stachys aspera.

JULY 4*th.*
Trifolium procumbens.
" arvense.
Galium boreale.
Malva rotundifolia.
Euphorbia polygonifolia.
Verbascum Blattaria.
Lepidium Virginicum.
Polygonum convolvulus.
11*th.*
Epilobium augustifolium.
" coloratum.
Thalictrum Cornuti.
Ranunculus acris.
Rubus odoratus.
Pyrola secunda.
" asarifolia.
Sambucus Canadensis.
Anemone Virginica.
12*th.*
Ceanothus Americana.
Apocynum androsœmifolium.
Geum strictum.
Anemone Pennsylvanica.
Rudbeckia hirta.
14*th.*
Lilium superbum.
Lysimachia ciliata.
15*th.*
Hydrocotyle Americana.
Orchis hyperborea.
16*th.*
Solanum dulcamara.
Ranunculus aquatilis.
Circæa Lutetiana.
Galium asprellum.
Helianthus trachelifolius.
Cnicus arvensis.
Agrimonia Eupatoria.
Aspidium acrostichoides.
Monarda fistulosa.
Lysimachia stricta.
Tilia Americana.
Physalis viscosa.
Sium lineare.
Eupatorium perfoliatum.
18*th.*
Scutellaria galericulata.
Œnothera biennis.
Antennaria margaritacea.
19*th.*
Corallorhiza multiflora.
Chimaphila umbellata.
Ampelopsis quinquefolia.
Hypericum corymbosum.
Campanula Americana.
Monarda didyma.
20*th.*
Gerardia flava.
Lobelia puberula.
Halenia deflexa.
21*st.*
Melissa clinopodium.
Teucrium Canadense.
Gaultheria procumbens.

JULY 22*nd.*
Polygonum Persicaria.
Mimulus ringens.
Erigeron Canadense.
Barbarea vulgaris.
Arctium lappa.
24*th.*
Lobelia spicata.
Phryma leptostachya.
Cicuta maculata.
Desmodium acuminatum.
Euphorbia corollata.
Asclepias tuberosa.
Astragalus Canadensis.
Melampyrum Americanum.
26*th.*
Polanisia graveolens.
Solidago Canadensis.
" odora.
Datura stramonium.
Potentilla Anserina.
Cicuta bulbifera.
Bidens connata.
Phytolacca decandra.
Clematis Virginiana.
Verbena hastata.
Calystegia sepium.
Eupatorium ageratoides.
Impatiens fulva.
" pallida.
Mentha Canadensis.
Saponaria officinalis.
Eupatorium purpureum.
Polymnia Canadensis.
Urtica divaricata.
Aspidium marginale.
Polypodium vulgare.
Polygonum aviculare.
30*th.*
Scrophularia Marilandica.
Aralia racemosa.
Leonurus cardiaca.
Cnicus lanceolatus.
31*st.*
Aster miser.
" corymbosus.
Inula Helenium.
Desmodium Canadense.
" cuspidatum.
Cynoglossum Morisoni.
Platanthera psycodes.
Struthiopteris Pennsylvanica.
Spiræa salicifolia.
Penthorum sedoides.
Chimaphila maculata.
Goodyera pubescens.
Lobelia inflata.
Desmodium nudiflorum.
Veronica anagallis.
Hypopitys lanuginosa.
Sonchus oleraceus.
Heracleum lanatum.
AUGUST 4*th.*
Gerardia quercifolia.
" pedicularia.

AUGUST 4*th.*
Solanum nigrum.
Decodon verticillatum.
Aster Tradescanti.
Desmodium paniculatum.
Lespedeza frutescens.
Desmodium Dillenii.
Circium discolor.
Polygonum Pennsylvanicum
" amphibium aquaticum.
Aster macrophyllus.
" simplex.
Dryopteris thelypteris.
Camptosorus rhizophyllus.
Lactuca elongata.
Solidago altissima.
5*th.*
Chenopodium urbicum.
Hieracium longipilum.
" Canadense.
Nabalus albus.
Baptisia tinctoria.
Lobelia syphilitica.
Epilobium palustre.
Acalypha Virginica.
9*th.*
Scutellaria lateriflora.
Collinsonia Canadensis.
15*th.*
Rumex hydrolapathum.
" Cuscuta Americana.
Pontederia cordata.
Diplopappus albus.
Helianthus strumosus.
" giganteus.
Phaca neglecta.
Liatris cylindracea.
17*th.*
Polygala fastigiata.
Tofieldia pubens.
Lobelia cardinalis.
18*th.*
Bidens frondosa.
Solidago squarrosa.
" bicolor.
" latifolia.
Polygonum hydropiper.
Erigeron strigosum.
Lespedeza hirta.
Pycnanthemum incanum.

AUGUST 18*th.*
Hedeoma pulegioides.
20*th.*
Apios tuberosa.
Polygonum amphibium terrestre.
Gerardia tenuifolia.
Hieracium paniculatum.
Phaseolus helvolus.
Scutellaria parvula.
Artemisia Canadensis.
" gnaphalodes.
Bidens chrysanthemoides.
" cernua.
Polygonum Orientale.
28*th.*
Parnassia Caroliniana.
Spiranthes cernua.
Gentiana Andrewsii.
Abutilon avicennæ.
Chelone glabra.
Senecio vulgaris.
Cirsium muticum.
Solidago cæsia.
" puberula.
" patula.
" Muhlenbergii.
" altissima.
Aster multiflorus.
" longifolius.
" puniceus.
" novæ Angliæ.
" acuminatus.
SEPTEMBER 1*st.*
Amphicarpœa monoica.
13*th.*
Polygonum arifolium.
" sagittatum.
" lapathifolium.
Solidago nemoralis.
" latifolia.
Lechea minor.
Aster amplexicaulis.
" dumosus.
" prenanthoides.
" azureus.
" cordifolius.
" patens.
25*th.*
Gentiana quinqueflora.
" crinita.

Toronto Harbour.—Its Formation and Preservation.

Read before the Canadian Institute, by Sandford Fleming, C. E., June 1, 1850.

(*Continued from page* 107.)

Second, That the Peninsula proper has been formed solely by the mechanical action of the waves, that the sand and gravel of which it is composed have been by this action gradually transported from the eastward and deposited on the deltaic shoal of the Don, and that the delta has thus been raised above the surface of the water and extended westward far beyond its original limits.

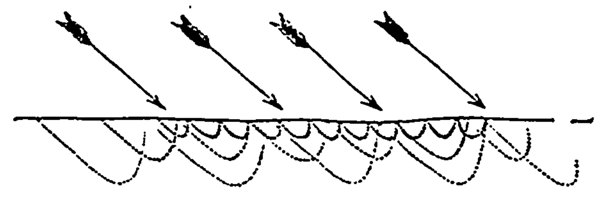
The effects produced by waves on a shore exposed to their action are of various kinds, depending in a great measure on the nature of the beach, the direction of the waves, and their mechanical force: if the shore be of clay the action is entirely destructive, the banks are undermined and continually caving in, the fine argillaceous particles are taken up by the water, carried out and deposited after a time at depths unaffected by the motion at the surface; if the shore be of sand or gravel the effects produced are quite different. When the direction of the waves is not at right angles to the beach a progressive action results, and when the waves break point blank on the shore line with sufficient force the action is destructive, in which case the banks are broken down and the spent wave returns loaded with sand to be deposited outside of the breakers in the form of a shoal generally parallel to the coast; if the soil of which the banks are composed be a mixture of clay and sand the action is both destructive and progressive, the clayey particles are washed out and deposited in still water, while the sand, gravel, and stones are left behind to be moved forward either in one direction or another, and at a rate depending solely on the strength of the impinging waves, and the gravity of the materials themselves. On a rocky shore the effects produced are precisely similar, although of course to a much more limited extent; by continual exposure to the wearing action of water and weather a mass is undermined and tumbles down, a portion of the debris is put in progressive motion during every storm when the waves impinge otherwise than at right angles to the shore line, and is moved, according to the locality, in a certain prevailing direction, until meeting a projecting point or other hindrance to its onward progress; thus forming those shingle beaches seen at many places on all rocky shores.

The effects of the destructive action on banks of clay can be traced wherever the shore is entirely of that material; the owners of property along many parts of Lake Ontario can bear testimony to its annual encroachments; and, to come nearer home, many citizens of Toronto must have witnessed the gradual alteration in the form and recession of the clay banks between the old and new garrisons.

The effects of the progressive action can also be witnessed at many points on all the lakes; but at none in a more remarkable degree than at Toronto, although at other places to even a much greater extent. And since to the peculiar motion of sand and gravel beaches will be attributed not only the extraordinary changes the Peninsula is at present undergoing, but even the greater part of the entire formation, it will be necessary to explain fully the nature of it, and give the reasons why the beach should have a tendency to move in one direction in preference to another.

Let us take an example when the direction of the wind forms an acute angle with the shore, a particle of sand resting on the surface is driven forward up the inclined plane of the beach in the direction in which the wave itself moves, the particle either remains at its now elevated position or (as is more usual) sweeps along in a small curve and rolls downwards with the expended wave to a new position, the distance of which from the first will be in proportion to the mechanical force of the wave and its direction; another and each successive wave drives the particle forward in a similar manner, unless by accident it finds a resting place behind some obstruction or be buried by other particles on the same mission as itself. If we take instead of a grain of sand, a small pebble, we find that the same wave, or a wave having the same force, moves it a less distance than it does the sand, that larger pebbles being heavier make proportionately less progress, and that stones still heavier are moved only when the waves have considerable power. All of these bodies, however, when within the impelling force of the wave and placed in positions fairly exposed to its direct action, seem to be governed by the same law, and are moved forward a less or greater distance according to their weight and gravity.

Fig. 2.

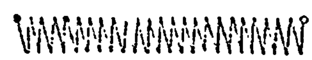


The arrows denote the direction of the waves; the dotted lines show the paths of grains of sand and pebbles.

The zig-zag direction taken by the sand and gravel on the beach is indicated by the various dotted lines on Fig 2, the smallest one is intended to show the course of a grain of sand, and the two largest lines that of pebbles varying in size. The progressive motion is slightly suspended between each wave, but although intermittent is continued so long as the sea breaks on the shore from the same quarter, and until the moving mass meets with an obstruction, or by reason of a sudden bend or other peculiarity of the shore line is deposited in a position beyond the influence of the waves.

When the waves impinge at right angles to the shore the progressive motion of the beach is theoretically nothing, the various particles of sand are rolled upwards and downwards, changing position only laterally or in the line of direction of the waves; when the waves impinge somewhat less than a right angle the grains of sand move along in a sharp zig-zag line, as

Fig. 3.



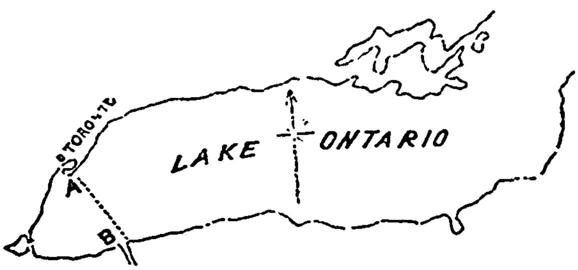
in Fig. 3, when much less than a right angle the particles move onward in a long undulatory line as in Fig. 4. The distance between the points of each indentation being in proportion to the cosine of the angle formed by the direction of the waves and the line of the shore.

Fig. 4.

Granting that the direction of the waves is governed by that of the wind, it follows that whenever the wind blows from a quarter to the right of a perpendicular to the shore, the beach sand is moved to the left, and *vice versa*. If, therefore, the wind blew with equal strength and during equal times from all points of the compass throughout the year, and the waves also had at all times the same mechanical force, the sand would at one time move to the right, and at another time an equal distance to the left; but, to speak in general terms, the beach would remain ever as it was (excepting the effects of the destructive action). Since the forces never could act simultaneously, we would have, it is true, a constant repetition of complicated motions, zig-zag, undulatory, lateral, progressive, and retrograde; but, from their assumed equality and the equal times of their application, there could be no resultant. The mean velocity of the wind may properly enough be taken as equal throughout the year from all points of the compass, since the actual difference, as obtained by observations, will effect the results inappreciably; but the mean force of the waves will not in consequence be equal, as this is greatly influenced by the locality. It is found that the mechanical force of a wave depends chiefly on the strength of the wind and the extent of open water traversed; allowing then that the wind blows equally from all points, it will follow that the resultant of the aggregate forces of the waves impinging at any particular place, will be a line lying in a direction opposite to the largest area of open water.

In applying this conclusion to the beach in front of Toronto we find that the greatest extent of Lake Ontario passed over by winds blowing from any point westward of the perpendicular A B, Fig. 5, does not exceed forty miles, nor is the area of water over twelve hundred square miles, while to the East of A the

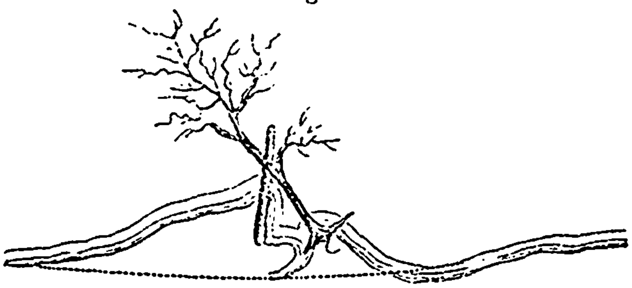
Fig. 5.



waves have a fetch of as much as a hundred and eighty miles over an expanse of water measuring nearly nine thousand square miles; hence then (the duration of the action being taken as equal in both cases) the intensity of the collective forces of waves impinging at A from the eastward is many times greater than that of those from the westward, and the motion of the beach at A must therefore be westerly; it must of course move with a variable velocity because the forces are not constant; its path, or rather the path of each particle, undulatory, since the forces act impulsively on the plane of the beach in combination with gravitation; it must sometimes retrograde since the direction of the forces is ever changing, and they never act simultaneously; but aggregately, the beach sand, subject to many complicated motions, and acted on by innumerable and incalculable forces, must move absolutely from east to west, and (taking the forces on each side of line A B respectively as positive and negative) with a velocity proportionate to their algebraic sum.

On that portion of the beach successively washed by the waves only, can the progressive motion be proved ocularly, yet doubtless a similar action must be produced between the breakers and the main land all along the shore, and when we consider that the lake is seldom or never entirely at rest, that even during perfect calms, unless continued for several days, a gentle ripple capable of moving sand is found on the shore, throughout the whole year, therefore, must the materials composing the beach be continually changing place, and although sometimes moving easterly, yet generally, as proved above, in the contrary direction.

Fig. 6.



The accompanying drawings of natural groynes very strongly confirm the conclusion here come to. They are copied from sketches recently taken (1850) on the spot, between Privat's Hotel and the Scarboro' Heights. Fig. 6 was formed by the falling of a tree opposite a fisherman's hut east of the Narrows on a passing log: the outer end of the tree was supported by its branches: about one half of the log was floating, but kept stationary by the tree; the remaining half rested on the surface, and enabled the sand to accumulate at its easterly side. Figs. 7 and 8 appear also to have been formed in a similar manner. They were found on that part of the shore between Ashbridge's Bay and the Scarboro' Heights. The dotted lines indicate what

Fig. 7.

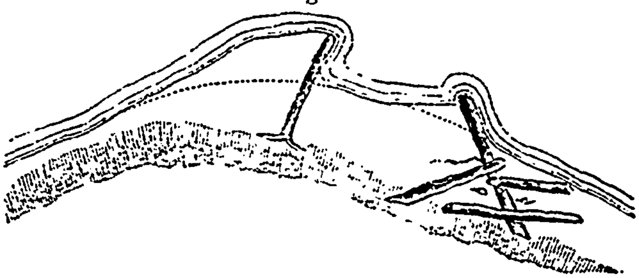
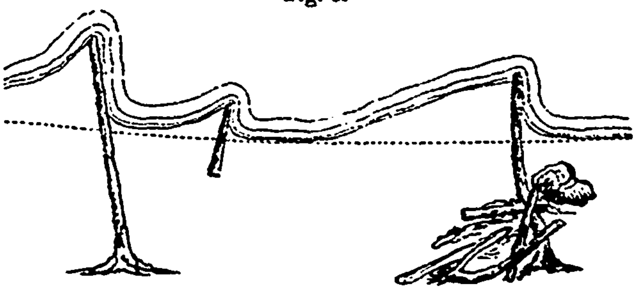


Fig. 8.



Sketches of natural Groynes.

was supposed to be the original water-mark. In all cases, the water was from one to two feet deep on the westerly side of the logs, and in several instances the sand was five or six inches above their upper surface on the easterly side. These groynes, formed by accident, show very clearly the results of the westward motion of the beach, and, although simple in the extreme, are natural models from which may be designed other contrivances for the retention of the moving sand, and will be referred to hereafter in treating of the preservation of the Harbour.

In addition to these indications of the westward motion of the beach, it may be observed that, on an examination of the mouth of several small streams discharging into the lake east of Ashbridge's Bay, it is found that, whatever be their general direction inland, so soon as they intersect the sand beach, their course is westward. In most cases they run parallel to the shore, separated from it by a small ridge of sand, and ultimately discharge into the Lake some distance west from the point where they leave the woods.

We have also palpable and positive proof of the westward motion of the beach in the extension of the Peninsula itself in that direction. Joseph Bouchette, late Surveyor-General of the Province, made a survey of Toronto Harbour in 1796, a reduced plan of which was published in 1815 along with his work on Canada. At the date of the survey, that part of the Peninsula on which the light-house is erected was then the margin of the lake. Since that time, one sand ridge after another has been washed up, until now, after a lapse of only fifty-four years, a tract measuring upwards of thirty acres has been added, and the Lake is now distant from the light-house about eighteen chains.

The general appearance of this recent addition to the Peninsula resembles so closely other older portions, and its geological character is so clearly identical not only with the adjacent parts, but also with the whole formation, that we may very properly infer they are each and all produced by the same causes. Admitting, then—and it is indisputable—that this enlargement of the light-house point is due to the progressive motion of the beach sand through the mechanical agency of the waves from the eastward, we come to the conclusion that the whole Peninsula is the result of the same action, continued through past ages, and traceable to the same eastward source.

Arrived at this conclusion, we are now naturally led to enquire whence has the abundant supply of material for so extensive a deposit been obtained. About five miles east of Toronto, a high bluff, known as the Scarboro' Heights, stretches along the shore for several miles. The bluff is about three hundred feet high, and is chiefly composed of sand, with at intervals a stratum of clay. It is known by the farmers residing in the neighbourhood to recede ten or twelve feet annually at the present day. Farther eastward, the coast has a low aspect, and is of a soil capable of providing but little of the substances of which sand and gravel beaches are composed. Moreover, by contouring the country bordering on this high cliff, it is found that the lines betoken a former great projection lakeward, of which Fig. 9 (see plates) is an ideal outline, and Fig. 16 a sectional sketch on the line K L, at right angles to the shore. For these reasons, then, we are induced to fix upon this point as the locality from whence has been drifted the materials forming the deposit in question.

Founded on demonstrative and probable evidence, here in part set forth, I will now venture to lay before you what I believe to be a correct theory of the gradual formation of that singular deposit which has provided for Toronto so good a harbour.

On the subsidence of Lake Ortario from a high to its present level, the land fell in easy slopes to the water's edge, and the gradual, descending surface-lines were continued outward under water; the abrupt terminations of the land along the boundary of the lake having been formed by its encroachments through a long course of ages, the promontories which formerly projected have been rounded off by the destructive influence of the elements. The sand and clay of which they consisted, and which lay between the ancient and present margins of the water, having been removed to other parts, the clay carried out and stratified at the bottom of the lake, and the sand formed into new deposits, kindred to the one under discussion.

Referring to Fig. 16, we have an illustration of this as applied to the Scarboro' Heights. K represents the present position of the cliff, and L the supposed former shore of the lake, the point of land extending from K to L, Fig. 9, having been removed by the waves.

Figs. 9, 10, 11, 12, and 13 are sketches of the deposit at several periods prior to and during its formation. The first shows the supposed original outline of the lake immediately after its subsidence, prior to any encroachments or changes of the shore line; the second, a small spit running westerly from the Scarboro' promontory; the third and fourth, farther extensions of this spit, and wearing away of the promontory. At this period (Fig. 12) the River Don has brought down a large quantity of drift from its valley, as explained in the first part of this paper, and the lake deposit is now going on over the shoal water. Only a small portion of the spit thrown up at this period now exists, the remainder having been encroached on and moved westerly as the heights at Scarboro' receded. The portion referred to is a narrow ridge running landward to the west of the Don. It may now be seen stretching from near the wind-mill outward, and separating the marsh from the harbour.

Fig. 13 shows still farther encroachments on the land at Scarboro', the almost entire removal of the spit shown by Fig. 12, and the advancement of the Peninsula westward.

Fig. 14 represents the present state of the deposit. The dotted lines are contours (explained on the plate) showing the rapid progress of the shoal landward at the western boundary of the Harbour. Its edge between the point of the Peninsula above water, and the mainland, at the Queen's Wharf, may be taken at the ten feet water-line, within which it immediately rises, and gives a depth of about four feet only along the eastern side, and from six to thirty inches along its western boundary.

Figs. 17, 18, 19, and 20 are sections across the Harbour and Peninsula, on the lines G H, E F, C D, and A B, drawn on Fig. 14. These show clearly, without unnecessary explanation, the nature and limits of the deposit. Fig. 20 runs from the foot of George Street southerly, through that point of the Narrows proposed for the eastern entrance to the harbour, hereafter mentioned; Fig. 19 on a line parallel to the first, from the Parliament Buildings southerly; Fig. 18 from near the Queen's Wharf directly across the shoal at the entrance: this, as well as the last, cuts several of the many ridges of sand, with long narrow ponds between, by which the upper surface of the formation is characterized. Fig. 17 runs from the old French fort parallel to the other sections, intersecting no portion of the deposit, but passing very close to its western limit at the Lighthouse point, in sixty feet water. The depth of water, increasing as the deposit was extended westerly, accounts very satisfactorily for its spreading so much towards the north. Although an equal amount of sand may annually have been brought forward, yet, as the deposit was forced out into increasing depths of water, this rate of extension westerly would in proportion be diminished, thus allowing the southerly waves more and more time to act in moving the deposit towards the north.

In the manner above explained, it is argued that the Peninsula has been formed, is still undergoing great changes, and is even now receiving large annual additions from the same source. It seems, too, from what will shortly be laid before you, that the same natural agents which have raised up a breakwater, and formed one of the most capacious harbours on the Lake, are as actively engaged in its destruction, by fencing in, as it were, the whole smooth water basin they have made, and justify the inference that, if left entirely to themselves, will at some future period unite the Peninsula to the mainland west of the Queen's Wharf, in the same manner as it was originally connected by the ridge from near Privat's to the Wind-mill. This stage of the deposit is illustrated by Fig. 15, at which period the surplus water of the Don would in all probability find egress over the bar by a shallow channel, fluctuating in position as well as depth during every southerly gale, or by such gaps as are occasionally opened in the narrow belt of sand separating Ashbridge's Bay from the main Lake.

The progressive motion of the beach, observable only on close examination, and apparently of little moment, is when continued during incalculable periods of time, thus proved to be productive of very extraordinary results. Nor is it confined to this neighbourhood, for we discover unmistakeable indications of its operations along the shores of all the great inland lakes.

Round Lake Ontario its effects can be traced at Burlington Beach, the mouth of the Niagara River, Presque Isle, Cobourg, Port Hope, Windsor Bay, and at innumerable points along the east and south boundaries of the Lake.

Round Lake Erie we see its results at Sandusky Bay, Point aux Pins, Long Point, Port Colborne, Buffalo, and at Erie.

At Saganaw Bay, Thunder Bay, Riviers Aux Sable, north and south, at Nottawasaga, and the Christian Islands, on Lake Huron.

Round Lake Superior we also have many examples of a like kind; at Fond du Lac, a gravel beach resembling in a marked degree, both in appearance and position, the Burlington beach near Hamilton. At the mouth of the Bad River, and at Point Iroquois, also, are found beach formations.

Many of these closely resemble in outline the Peninsula at Toronto. Some of them are kindred to the hypothetical stage denoted by Fig. 15; all of them are identical in geological character, and exemplify the workings of one of Nature's ever active agencies, co-existent and co-extensive with the lakes themselves. One fact which very strongly confirms the theory of the formation of the Peninsula here propounded, is worthy of notice: all the examples above mentioned invariably conform with the rule laid down—the trend of the deposits bearing in a direction opposite to the longest fetch of the waves, or the largest area of open water traversed. The entire absence of boulders is also very remarkable, and whenever gravel forms part of the drift, the largest sized is generally found nearest its source, the finest kinds being at the greatest distances. This circumstance is explained by Fig. 2, and the accompanying remarks, which show that small bodies are moved onwards with the greatest facility. Large boulders, in consequence of being able to resist the mechanical force of the waves remain at rest, and therefore can form no part of beach formations.

To arrive at a knowledge of those changes more particularly referred to, which have taken place on the shoal at the mouth of the harbour, I have with permission carefully examined the old maps and charts in the Surveyor-General and Ordnance Departments; many of them are wanting in detail, and in this respect of little service to the enquiry; others are of considerable value, the most reliable of which appear to be the charts of Bouchette, Bayfield, and Bonnycastle, dated respectively 1796, 1828, and 1835; for although they do not profess to much nicety of detail, yet emanating from these sources we have no reason to doubt their general accuracy. Fig. 2 shows the position of the shoal at the several dates of these charts, and as it now exists; the soundings have reference to its present state. I have much to regret being as yet unsuccessful in procuring a copy of one very old chart, the possession of which would be invaluable, seeing that it is without doubt the earliest record of Toronto Harbour in existence. This chart is said to have been made by a corps of engineers who accompanied the first pioneers from France nearly 200 years ago. A copy, perhaps the only one on the Continent, was unfortunately destroyed with the Parliament Buildings in Montreal, in 1847; the original is supposed to be deposited in a Jesuit College in Paris.

On comparing the charts of Bouchette, Bayfield, and Bonnycastle, with my own from a recent survey, showing the state of the Peninsula at the present time, we obtain results as follows:—

First, that the channel between ten feet water lines was,

In 1796	about	480 yards wide.
" 1828	"	310 "
" 1835	"	260 "
" 1850	"	120 "

Second, that the quantity of sand deposited at the south side of the entrance by an approximate estimate is as follows:—

From 1796 to 1849–50 nearly 660,000 cubic yards, being in 53 years about 12,400 yards per annum.

From 1828 to 1849 nearly 235,000 cubic yards, being in 21 years about 11,200 yards per annum.

From 1835 to 1849 nearly 155,000 cubic yards, being in 14 years about 11,000 yards per annum.

The alarming progress of the shoal landward is from these figures very apparent. Fifty-three years ago the entrance is shown to have been four times its present width, and fourteen years ago more than double, thus decreasing at the rate of from seven to ten yards annually, by the deposit of about 11,000 cubic yards.

If such be the case, and it is founded on the most authentic information relative to the past condition of the Harbour as yet in our possession, we have substantial reasons for believing that if left unheeded it will in ten or twelve years be inaccessible except to the smallest craft.

The extension of the shoal may be attributed to the same causes which are proved to have formed the whole Peninsula. The beach sand having reached the Light-house point cannot by reason of the great depth of water, as shown by the contour lines, Fig. 14, make much progress in extending the Peninsula from thence westerly; there is therefore nothing or at least not much to prevent the southerly waves from acting in full play, they having a fetch of forty miles in opposition to the northerly immediately off the land, and washing along the bar (scarcely under water) towards the north "dump," as it were periodically, large quantities of sand into the channel.

Certain outward and inward currents occasionally exist at the entrance, caused probably by gales slightly varying the level of portions of the lake, or, as it is also supposed, by local variations of the atmospheric pressure on its surface; these may assist to a limited extent in prolonging the existence of the channel, but from all the observations I have as yet been able to make, they appear to be surface currents only, having little or no appreciable effect five or six feet under water; even this supposition therefore is very problematical.

ITS PRESERVATION.

Having by sufficient evidence set forth the probability if not the certainty of an early destruction of the harbour by the damming up of its entrance, we may now proceed to the practical, and, so far as the commercial interests of Toronto are concerned, the vitally important part of the inquiry, and endeavour to obtain a satisfactory answer to the query—How can such a catastrophe be obviated or indefinitely postponed? A problem which becomes of comparative easy solution when the immediate cause of the evil is set beyond a doubt, and the nature of its operations clearly ascertained.

To keep those harbour channels subject to obstruction from moving sand-bars in a navigable condition, three expedients are generally resorted to: First, continuous or periodical dredging; second, the application of a scour to remove the bar as it is formed; third, the construction of such works as are calculated to prevent the deposition of the sand in the channels, by retaining it at a distance, when its source is known, or by diverting it to those points where depth of water is not essentially necessary.

The first is often applied as a temporary remedy, and as such may at times be viewed as a fit expedient, but to employ it as the lasting counteracter of a constantly increasing evil, is to adopt an indubitable source of unceasing attention and endless outlay; it should accordingly be dreaded as a permanent restorative, and employed only by compulsion from unusual difficulty in the application of other measures that are generally less costly and always more satisfactory.

The second is obtained at *marine* ports by taking advantage of the tidal fluctuations, and is generally produced twice each day by using the currents of rivers at low tide, or by holding up the sea water in large artificial basins at flood, then concentrating and guiding it to the bar at ebb. The impracticability of procuring a scour on Lake Ontario from tidal fluctuations must be admitted, since practically there are none; true it is we have a gradual rise and fall of about two feet annually, and at times successive oscillations in level to the extent of several inches, much resembling small tidal waves; but the latter, although they give to the surface water at the entrance of the harbour a perceptible current, are too rare and too feeble to be of any real value. Nor have we at Toronto a river sufficient for the service, for the Don has hitherto failed to keep open its own channel to a greater depth than two or three feet. Indeed I feel quite convinced that all attempts on these inland waters to keep permanently open those harbour channels much exposed to beach drifts by other than the largest class of rivers must sooner or later prove ineffectual. The currents of the Nottawasaga, of the Sable, and of the Saugeen, are unable to keep open to a sufficient depth or width the mouths of those rivers, and yet they are in volume from ten to twenty times greater than the Don.

The third remedy can always be advantageously employed in cases when the obstructions are the natural results of moving beaches, and when the works are located and executed with proper care they usually answer a good purpose; the second is often after great outlay under favourable circumstances of doubtful efficacy. In the case of Toronto, even if we had at command a current capable of removing the sand on its arrival at the point of the shoal, I question very much if it should be considered as more than an auxiliary, since it would of necessity tend to spread the deposit, and thus, although injuring the channel in a less degree, would impair the harbour generally by lessening in depth the approach to it. Without doubt the steps likely to confer the greatest security, and hence the most advisable to be taken, are those which are calculated to keep the drift at a distance from that point where it is not wanted.

I therefore beg leave to submit for your consideration the following preventive and remedial measures:—

1st. That a Groyne should be constructed at the Light-house point from the shore outward to 8 or 9 feet water for the retention of the moving sand, on the principle of those very simple natural ones shown by Figs. 6, 7, and 8.

2nd. That an auxiliary Groyne be run westerly across the outer edge of the shallows, a little to the south of Gibraltar point.

3rd. That a Pier or breakwater be built along the south side of the channel as shown on Fig. 21, increasing the navigable water to six hundred feet, by cutting off the point of the shoal north of the proposed line of pier.

The third alone would probably suffice for many years to keep the channel perfectly free from deposit; but the sand, if not retained at the Light-house point, would as at present be moved northward by the southerly waves, and would gradually accumulate to such an extent as to fill up the whole space along the south side of the pier until ultimately rounding its extremities. To effectually prevent this the first and second should also be constructed, the first would divert the drift westerly into deep water, where the navigation could never practically be obstructed; and the second groyne placed about midway between the first and third would have the effect of counteracting all progressive action along the west end of the Peninsula.

If the destruction of the Harbour entrance, and the formation of the Peninsula generally, be satisfactorily determined, I think it is equally conclusive that these works, or works of the same character, would, if established in due time, be exercised to a very beneficial result,—the preservation of the Harbour for an indefinitely long period.

There are other evils, which, if they affect the salubrity of the city more immediately than they prove detrimental to the Harbour, are not on that account of the less consequence. The Don annually transports even at this day considerable quantities of silt from the interior of the country to the Marsh, and, during freshets, a portion escapes from thence into the harbour through the openings in the beach between the Wind-mill and Privat's, tending of course, when deposited in the basin, to lessen its depth. All the drains and sewers empty into the bay, making it, in truth, the grand cess-pool for a population of probably 30,000 inhabitants, with their horses and cattle. The sewers of necessity bring down no inconsiderable portion of solid matter, impairing greatly the purity of the water in the Harbour, as well as gradually lessening its depth. This evil, increasing in a proportionate ratio to the growth of the city, might be greatly ameliorated, if not almost totally removed, by the construction of a main sewer along the whole city front eastward to the Marsh. Into this sewer all the lateral ones from the north, and the drainage of gas, chemical, and other such like works, should be made to discharge. The feculent mixtures produced would thus be collected and conveyed to a distant point, where, by similar operations to those now ripening in Britain, which will strip them not only of their noxious, but even of their offensive characters, might be profitably converted into a marketable commodity of the highest value to the farmer.

The prejudicial effect of the Don on the depth of the Harbour may also be destroyed by closing its present outlet, and forming an opening of sufficient capacity in the beach separating the main Lake from Ashbridge's Bay.

All proposed works relative to the improvement of the harbour should be carefully considered before any be proceeded with, lest some of them may interfere with preservative measures, or the general improvement of the whole. It may not be out of place, therefore, to consider briefly another proposition, which, for many years past, has engaged public attention perhaps more than any other in connection with the Harbour, viz., the forming of an eastern entrance.

Judging from the following paragraph, extracted from the *Courier* newspaper, dated 5th March, 1835, the project was seriously talked of fifteen years ago:

"CUT ACROSS THE PENINSULA.—A respectable meeting of the friends to this measure was held on Thursday evening at the Commercial Hotel, when a Select Committee was appointed to request the Governor to name an Engineer, and also to request the Mayor and Corporation to name another, to meet him for the purpose of reporting on the probable result of the cut. The Committee waited on His Excellency this morning, who very readily named Captain Bonnycastle, at the same time expressing a hope that a measure so adapted to promote the health of the city would be carried into effect. His Excellency also promised to do all in his power to put the entire Marsh at the disposal of a company, with a view to its being reclaimed as far as it is possible to do so. There is every reason to expect that the Corporation will take the same view of the case; and if the report of the Engineers shall be favourable, a number of wealthy merchants and others in the city have expressed their intention to take up a sufficient quantity of stock to complete the undertaking."

A few months thereafter, the following was gazetted amongst the Notices of Public Improvements:—

"TAKE NOTICE.—The Inhabitants of the City of Toronto will make application to the next session of the Provincial Parliament to incorporate them into a Company for the purpose of opening a Ship Navigation through the neck of the Peninsula between the Lake and the Bay of Toronto.

"Toronto, August 1st, 1835."

It is unnecessary to say that the contemplated improvement has not been carried out. The spirits of the projectors were probably damped, and their stock-book laid aside, after the opinions of the engineers appointed to examine were made public. I have only been able to obtain the perusal of one of these documents, but am informed that the report of the gentleman appointed by the Corporation was even less favourable.

Captain Bonnycastle says, relative to cutting a navigable canal through the Peninsula:

"If this should be done without due consideration, the barrier which Nature has interposed for the preservation of a Harbour formed probably by the cutting action of the Don when it was a larger river, which it only requires to look at its banks to convince one's self that it anciently was, will be thrown down, and the Harbour entirely destroyed.

"The reasons to be assigned for this opinion are as follows:

"The southern face of the Peninsula, a low ridge of sand, is bordered to some distance out, excepting near the Narrows, by large and fluctuating shoals, well known to the fishermen, who have so recently established a profitable trade on them.

"The force of the easterly and westerly gales on these shoals and the bounding shore is tremendous, as every person in Toronto has frequent opportunities of hearing, even at the great distance which the city is from them.

"Should a navigable canal, without due restrictions, be cut through the slender belt which divides the waters of the Lake from the basin, all the millions of tons of large shingle, small rounded and angular fragments of granite and other hard rocks which line the beach will be put in motion!—will break down by their erosive power any barrier opposed to them!—will carry before them the whole extent of the Narrows, and perhaps penetrate through the ponds, fill the basin, and convert it into a fresh sand bank." This he goes on to show might be produced by a current through the canal, and further states, "It might in fact tear away all the strip of beach along the western or bay shore of the great Marsh, and let the whole of that body of the mud of Ages into the Basin.

"It is argued that all this may be avoided by running out extensive piers into the Lake, and forming a strong embankment along the Ontario face of the Narrows. These, if placed in such situations as to break off the strength of the easterly or westerly swells, will do much towards it, but it will be also necessary to make the canal of stone, to puddle its sides to a considerable thickness or extent, to make it narrow, and to place gates both at its entrance and exit.

"With these precautions there can be no harm in trying the experiment."

Although entirely concurring with Captain Bonnycastle in the expediency of closing up the present outlets of the Don, and of conveying the whole sewage of the city to the Marsh; yet having already, with all due respect, expressed my reasons for differing from the view he takes of the formation of the Harbour, and since conclusions on this point affect directly and very materially the consideration of all works of improvement immediately connected with the Peninsula, I may also be permitted to entertain opinions not altogether coinciding with his as to the probable effects of the proposed south-eastern entrance, and its mode of construction.

Knowing the nature of the action of the beach at the proposed site of the canal, and I think it is established beyond a doubt, there can be no possible danger of any part of the Peninsula being torn away, or the basin within being filled up with sand, if proper steps be taken to counteract such action. This action is chiefly the progressive motion of the beach, which would effectually be suspended for many years by the piers of the canal themselves, constructed with crib work in the ordinary manner. The canal need neither be narrow, as suggested, nor provided with gates, since the former would increase the danger in entering, while the latter would add to the cost and inconvenience, and no benefit could result from either.

Fig. 22 shows the proposed position of the canal. Its extreme length, from 13 feet water in the bay to 17 feet in the Lake, is 1600 feet, with a width of 300 feet. The eastern pier, presenting an obstruction to the motion of the beach westward, would, acting as a groyne, retain it permanently at its eastern side; the western pier, on the other hand, would be exercised to a similar result in suspending the retrograde motion. The sand gradually accumulating in the space north of the lines A B and D C would thus strengthen the Peninsula at its weakest point, and remove any danger which may be feared from the destruction of the narrow separating ridge between the Lake and the Harbour. The entire destruction of the Isthmus, although hypothetical, is nevertheless a contingency advisable to guard against. Openings have repeatedly been forced through the ridge bounding Ashbridge's Bay by gales point blank on the beach: these, having a destructive action only, might produce a similar result here. If at the same period the base of the Scarboro' Heights became partially protected from the fury of the waves by the lodgment of an unusual number of trees, or the falling of boulders from the cliffs above, the supply of sand from the east would for a time be diminished, the gap would remain open, and liable to be widened by every southerly wind. The Peninsula would thus be converted into an island, resembling its kindred formation "Long Point" on Lake Erie.

Through course of time (roughly estimated at about 20 years) the sand accumulating east of the canal would reach the line A B and ultimately round the piers. Then it would be necessary to make another provision for its retention. A groyne on the line G F would effect this object, and retain the sand for another period, until it reached as far as the line E F. The canal might thus be kept open by repeating the construction of groynes like E F and H K, *ad infinitum*, from time to time as necessity required; or the same purpose may be effected by simply extending the eastern pier as the sand accumulated outward along its eastern side.

The canal, having thus the effect of widening the Isthmus and removing all probability of its destruction, would, besides being a great accommodation to sailing craft in adverse winds, and to *steam vessels at all times* likely enough prove of service in another respect. The purity of the water in the bay is ever liable to be impaired by the vessels in dock, and its close proximity to the city. The canal would provide an additional opening for the ingress and egress of the slight tidal waves formerly referred to, doubtless presenting greater facilities for the renewal of the water in the harbour on its occasional fluctuations in level.

From certain simple and well-established premises it has been my purpose to draw reasonable conclusions, which in recapitulation may briefly be stated as follows:—

First, That the foundation of the Peninsula enclosing the harbour may be attributed in its early stages to the debris of the country traversed by the Don, in conjunction with a drift from an ancient promontory at Scarboro'.

Second, That the drift from Scarboro' has supplied and gradually deposited the main part if not the whole of the materials composing the more recent portions of the formation.

Third, That the drift is in consequence of the singular progressive action given to sand and gravel beaches under certain circumstances by the waves.

Fourth, That the harbour is daily being impaired by its chief agent of formation, and that its only entrance is threatened with early destruction by the same cause.

Fifth, That its preservation may be permanently effected by the construction of groynes at well selected points.

Sixth, That the dangers to be feared from the silt of the Don and sewage of the city although remote, would, taken in conjunction with the increasing deleterious effects of the latter on the water of the harbour warrant their total exclusion.

Seventh, That the construction of a south-eastern entrance would be a great accommodation to the shipping, may improve the purity of the Bay water, and, if properly executed, have no effect in lessening its depth; but would only assist in the preservation of the harbour so far as its piers, acting as groynes might retard the sand, widen the narrows, and thus strengthen the weak point of the Peninsula.

Although the preventive and remedial measures are founded on what I believe to be correct deductions, yet, seeing that they differ materially from those advanced by others who have considered the subject, they are presented on that account with some degree of timidity. I purpose, however, with the view of either confirming or modifying the conclusions arrived at, to continue a series of observations, carefully noting the various changes going on; and will if deemed worthy, take much pleasure in laying the results of such observations before the Institute at a future time.

Mean results of Meteorological Observations, made at St. Martin, Isle Jesus, Canada East, (nine miles west of Montreal) for 1853.

BY CHARLES SMALLWOOD, M. D.

(*The geographical co-ordinates of the place are 45° 32′ N. Lat., and 73° 36′ W. Long. Height above the level of the sea, 118 feet.*)

Barometric Pressure.—The readings of the barometer are all corrected for capillarity, and reduced to 32° F. The means are obtained from the three daily observations, taken at 6 A.M., 2 P.M., and at 10 P.M.

The mean height of the barometer in January was 29·757 inches, in February 29·654, in March 29·584, in April 29·654, in May 29·644, in June 29·648, in July 29·479, in August 29.598, in September 29·325, in October 29·500, in November 29·637, and December 29·456 inches. The highest reading was on the 28th of January, and indicated 30·382 inches; the lowest was also in January, on the 24th day, and was 28·638 inches; the yearly mean was 29·578 inches, the mean yearly range was equal to 0·993 inches. The atmospheric wave of November was marked by its usual fluctuations, the final trough terminated on the 30th day.

Thermometer.—The mean temperature of the air, by the *standard* thermometer, was in January 16°·08, in February 16°·36, in March 29°·68, in April 41°·36, in May 56°·34, in June 68°·66, in July 68°·04, in August 68°·61, in September 58°·04, in October 43°·37, in November 31°·00, in December 16°·57. The highest reading of the *maximum* thermometer was on the 16th of June, and marked 99°·2; the lowest reading of the *minimum* thermometer was on the 27th of January, and was—28°·7 (below zero). The mean temperature of the quarterly periods was Winter 19°·22, Spring 42°·46, Summer 68°·43, Autumn 44°·10. The yearly mean was 42°·89, and the mean yearly range 59°·27. The greatest intensity of the sun's rays was in August, and indicated 143°·6, the least intensity was in January, and was 64°·0, and the lowest point of terrestrial radiations was—22°·1 (below zero) in December.

The mean humidity (staturation being 1·000) was, in January .909, in February ·906, in March ·881, in April ·858, in May ·895, in June ·739, in July ·727, in August ·741, in September ·834, in October, ·855, in November ·798, in December. ·759. The yearly mean was ·825.

Rain fell on 99 days, amounting to 44·201 inches and was accompanied by thunder and lightning on 17 days. The greatest amount of rain which I observed, fell in September; it commenced at 5·10 P.M., on the 14th, and continued until 5·40 P.M., on the 15th and amounted to 5·142 inches. I have only observed once, this year, a yellow matter fall with the rain, and that was on the 24th day of September. It was without thunder or lightning, but was accompanied by slight hail. *Snow* fell on 37 days, amounting to 116·81 inches on the surface. The first snow of the winter 1852–3 fell on the 17th day of October, 1852, and the last fell on the 14th day of April, 1853; the whole amount of snow in the winter 1852–3 amounted to 119.10 inches. The river Jesus was frozen on the 28th day of November. The last steamer left Montreal (on the St. Lawrence) on the 7th of December; the first steamer arrived at Montreal on the 15th day of April. The winter fairly set in on the 18th day of December.

The amount of evaporation was measured regularly from the 1st of April to the 31st of October, and amounted in

April to 1·80 inches, in May 2·51 inches, in June 3·41 inches, in July 3·98 inches, in August 3·16 inches, in September 2·23 inches, in October 2·31 inches. This period includes what I consider could be taken with anything approaching to accuracy, owing to frosty weather.

The most prevalent wind during the year was the W. S. W. least prevalent was the E; in the winter quarter the most prevalent wind was N. E. by E., and the least S.; in the spring quarter the most prevalent wind was N. E., and the least so S.; in the summer quarter the most prevalent wind was W. S. W., and the least N.; in the autumn quarter the most prevalent wind was W. N. W., and the least E. The greatest velocity of the wind was on the 14th day of March, and was 32·60 miles per hour. The yearly mean of the maximum velocity was 15·81 miles per hour, the yearly mean of the minimum velocity was 0.32 miles per hour. The quarterly means were as follows: winter, maximum velocity 17·93, minimum velocity 0·25; spring, maximum velocity 16·68, minimum velocity 0·81: summer, maximum velocity 11·23, minimum velocity 0·29; autumn, maximum velocity 16·13, minimum velocity 0·18 miles per hour.

Crows were first seen on the 7th day of March, wild geese *Anser Canadensis*, on the 30th day of March, swallows, *Hirundo rufa*, were first seen on the 1st of April; shad, *Alosa*, were first caught in this neighbourhood on the 30th of May; fire-flies, *Lampyris corusca*, were seen on the 10th day of June: frogs, *Rana*, were first heard on the 23rd of April.

The Aurora Borealis was visible on 39 nights as follows:

January 12th, 10 P.M. Faint auroral arch, dark segment underneath.—13th, 10 P.M. Idem, *Zodiacal light*, bright.

February 1st, 10 P.M. Faint auroral streamers.—8th, 4 A.M. Faint auroral light.—14th 10 P.M. to daylight. Bright auroral arch.—20th, 10 P.M. Faint auroral arch. *Lunar halos* were visible on two nights during this month.—*Zodiacal light* was very bright also on 5 nights.

March 8th 10 P.M. Faint auroral light to horizon, occasional streamers. *Zodiacal light* still visible and bright.

April 1st, 9 P.M. Low auroral arch, dark segment underneath; 10 P.M., streamers, segment vanished.—5th, 9 P.M. Zenith clear, N. W., horizon clouded with *strati*, Aurora Borealis faint; 9·30, auroral arch 40° high, dark segment underneath at the horizon.—6th, 8 P.M. Faint low arch; 9 P.M., arch 20° broad, dark segment underneath: 9·40, streamers in N. W., of a yellow green color; 10·30, streamers extending to the zenith.—10th, 9 P.M. Low faint auroral arch. *Zodiacal light* very bright on 5 nights during this month.

May 1st, 10 P.M. Faint auroral light.—2nd, 8·40 P.M. Splendid display of clouds of auroral light forming a distinct arch stretching from the Eastern to the Western horizon, apex of the arch passing the zenith, extending through the constellations *Bootes* and *Leo*; 9 P.M., auroral clouds in the N. W., low and very near the horizon, arch very faint; 9·5, arch resumed the same brilliant appearance as at 8·40; 9·10, the whole of the Eastern and Western heavens were lighted up with a splendid display of auroral clouds, assuming various shapes and colors from yellow to crimson, arch disappeared; 9·30, all vanished.—4th, 9·10 P.M. Low auroral arch, dark segment underneath, occasional streamers.—30th, 10 P.M. Low faint auroral light to the horizon. *Lunar halo* visible on the 20th, diameter 63°.

June 14th, 9 to 10 P.M. Auroral streamers, moderate brightness, dark segment underneath.—30th, 10 P.M. Faint auroral light.

July 10th, 9 P.M. Auroral light, dark segment, occasional streamers; 10 P.M., dark segment and streamers vanished.—11th, 11 P.M. Faint auroral light to the horizon.—12th, 10 to 11 P.M. Streamers to the zenith, extending from N. N. W. to E.—18th, 1 to 2 A.M. Low dark arch of auroral light, moderate brightness, occasional streamers.—23d, 10 P.M. Auroral streamers of moderate brightness.—26th, 10 P.M. Faint auroral arch.—27th, 10 P.M. Auroral light to the horizon, splendid streamers. Shooting stars numerous during the month.

August 7th, 10 P.M. Faint auroral streamers, dark segment in the North.—25th, 10 P.M. Faint streamers, of auroral light.—31st, 10 P.M. Faint auroral light. Shooting stars numerous from the 6th to the 13th. Comet first seen here on the evening of the 22d day, in the constellation *Leo*, at 8^h 20^m M. T., R. A. 11^h 30^m 10^s, Declination N. 20° 5.

September 1st, 8·50 P.M. Splendid display of auroral clouds, forming four distinct arches, of about 3° in width, with dark segments between, stretching from E. to W., from a point centered as it were in *Arcturus*. The most southern arch passing at its zenith through *Aquila*, the next through *Lyra*, the next through *Polaris*, under which was a dark segment, from which were sent up frequent streamers. These appearances continued with slight intermissions in intensity of color, from 8·50 till 9·50 P.M. The southern or superior arch remained the longest time visible. The northern horizon was lighted up for some time, but faint (until 10·5). Stars of low magnitude were visible through these appearances.—2d, 8·50 to 11·40 P.M. Much the same appearance as last night, but the arches not so well defined. The most southern arch was several degrees south of zenith. Many floating auroral clouds extending from E. to W.—3d, 7·30 P.M. Auroral arches again seen this evening, only two in number, the most southerly a little N. of *Polaris*, very dark segments in the N. to the horizon, occasional streamers.—12th, 10 P.M. Faint auroral light.—18th, 10 P.M. Faint auroral light.—24th, 10 P.M. Faint auroral arch, dark segment underneath.

October 23rd, 10 P.M. Faint auroral light.

November 9th, 10 P.M. Floating auroral clouds—very high wind.—27th, 10 P.M. Faint auroral light to the horizon. *Zodiacal light* very bright and well defined apex at *a Leonis*, (Regulus.) Base in East very extended.

December 4th, 8 P.M. auroral light bright to the horizon.—20th, 10 P.M. Auroral arch; no dark segment.—28th, 10 P.M. Low auroral light to the horizon.

Electrical state of the atmosphere.—The atmosphere has *daily* afforded indications of electricity varying in intensity, and kind: the highest tension has been *generally* noticed in the winter season; the tri-daily observations (which could not be condensed) would occupy too much space for the columns of this *Journal*.

Ozonometer.—Observations have been carefully registered twice daily, for some years, of the amount of ozone present in the atmosphere; the slips of iodized paper are carefully preserved in a dark place after having been exposed to the atmosphere, shaded from the sun, and rain. As a general rule, rain or snow shows an increase, and so far as my own observations go, a high electric state of the atmosphere *does not* show an increase in the amount of ozone.

St. Martin's January, 25, 1854.

INCORPORATED BY ROYAL CHARTER.

Eleventh Ordinary Meeting, March 4th, 1854.

David Buchan, of Toronto, was proposed for membership.

A donation from James Bovell, M.D., of various mineralogical specimens from Barbadoes, was announced.

A paper, written by Thos. Cottle, M.D., of Woodstock, was read by Professor Croft, the subject of the paper being "Canadian Saturniæ, with suggestions on the possibility of using their Silk for textile purposes." A number of fine specimens of Canadian Saturniæ from Professor Croft's private collection were on the table.

James Bovell, M.D., read a paper "On the Re-production of the Digestive Organs of the Holothuria." The paper was illustrated by dissected specimens of the Holothuria from Barbadoes.

A paper was laid on the table by the First Vice-President containing a list of indigenous plants found in the neighbourhood of Hamilton, with the dates of their being found in flower and examined, by W. Craigie, M.D., and Mr. W. Craigie, of Hamilton.

Twelfth Ordinary Meeting March 11th 1854.

The First Vice-President announced a further donation from the eminent publisher, H. G. Bohn, Esq., of London, of fourteen volumes of *Bohn's Standard Library*.

The thanks of the Institute were ordered to be presented to Mr. Bohn for his valuable donation.

John J. Macauley, of Toronto, was proposed for membership.

David Buchan, of Toronto, was elected member of the Institute.

A paper written by Elkanah Billings, Barrister-at-Law, of Bytown, C. W., "On some new Genera and Species of Cystidea from the Trenton Limestone," was read by Professor Hind.

The Rev. Dr. McCaul, who was to have read a paper "On some doubtful points in Grecian and Roman Antiquities," having been unavoidably prevented from attending the meeting, Professor Wilson delivered a very interesting Lecture on "Traces of the Practice of the Medical Art amongst the Early Romans." Professor Wilson exhibited some wax impressions of Roman medical stamps found in Scotland.

Thirteenth Ordinary Meeting March 18th 1854.

The names of the following candidates for membership were read:—

The Rev. H. J. Grasett	Toronto.
James Ross	Belleville.
Loftus Turner, Jun. Mem.	Toronto.
Thomas Brunskill	"
W. W. Copp	"
T. C. Orchard	"
John McNabb	"

John J. Macauley, of Toronto, was elected member of the Institute.

A paper written by Major Lachlan, of Montreal, "On the establishment of a system of simultaneous Meteorological Observations, etc., throughout the British American Provinces," was read by the Rev. Professor Irving.

At the conclusion of the paper, it was moved by Professor Cherriman, seconded by Professor Irving, "that the subject of Major Lachlan's paper be referred to the Council, and that a Committee be named by the Council in accordance with Major Lachlan's proposal."

Professor Hincks delivered a short Lecture on a peculiar vegetable parasitical production from South America.

Fourteenth Ordinary Meeting March 25th 1854.

The names of the following candidates for membership were read:

J. L. Wilkes	Brantford.
Thos. Maclear	Toronto.
Hiram Piper	"

The following gentlemen were elected members:

The Rev. H. J. Grasett	Toronto.
James Ross	Belleville.
Loftus Turner, Junior Member	Toronto.
Thomas Brunskill	"
W. W. Copp	"
T. C. Orchard	"
John McNabb	"

A communication from the Council was read by the Secretary, announcing that in accordance with the proposal contained in the paper by Major Lachlan, read at the last meeting of the Institute, they had nominated a Committee to take into consideration and report on the subject of Major Lachlan's suggestions.

The following gentlemen constitute the Committee: Professors Cherriman, Irving, Croft, Hind, Chapman, and Mr. S. Fleming.

A paper was read by the Rev. Henry Scadding, D.D., the subject being "Memoranda of Vesuvius and its neighbourhood."

Professor Chapman delivered a short Lecture on the tooth of the Elephas primigenius found in the River Credit.

The First Vice-President announced a second paper by Elkanah Billings, Esq., Barrister-at-Law, Bytown, "On some new Genera and Species of Cystidea from the Trenton Limestone," to be read at the next Ordinary Meeting of the Institute; also, a paper by Professor Wilson, entitled, "Some remarks on the intrusion of the Germanic races into the area of the older Keltic races of Europe."

Miscellaneous Intelligence.

Colonial Progress.—Official returns just published from the Province of Nova Scotia furnish another illustration of that extraordinary progress of the British colonies of North America which is rendered more striking from the little that has been said about it. Notwithstanding the losses sustained a few years back from the potato rot, all the great interests of the province exhibit revived activity; employment is general, and the revenue, under a tariff which is lower than any other on the American continent, yields a large surplus for educational purposes and internal improvements. Although in Nova Scotia the duty on imports is only 6¼ per cent., while in Canada it is 12½, and in New Brunswick from 7½ to 30 per cent., the receipts increased from 54,179*l.* in 1849 to 93,039*l.* in 1852, while the accounts for the past year, when made up, are expected to be equally favourable. The exports for 1852 amounted to 770,780*l.*, and the imports to 1,194,175*l.*; and, although an adverse balance is apparently thus exhibited, it is explained by the shipments being valued at home prices, and by no estimate being included of the gains from freight obtained by the vessels of the colony. The actual trade is therefore one of extensive profits, and the augmentation in the staple articles of production, as well as in the mercantile marine, is such as to show a vigour of growth unsurpassed in Canada or the United States, or, indeed, in any part of the world. The number of vessels registered and actually employed in the fisheries and trade of Nova Scotia is now 2,943, with a capacity of 189,083 tons, and the rate of progress is on a scale to denote that at no distant day she is destined to be one of the largest shipping countries in the world. "She owns now nearly one-third as much tonnage as France. She beats the Austrian empire by 2,400 vessels, and by 69,000 tons; and owns 116,000 tons of shipping more than Belgium. She beats the Two Sicilies by 38,449 tons; Prussia by 90,783. Holland, which once contested the supremacy of the seas with England, now owns but 72,640 tons of shipping more than this, one of the smallest of the British colonies; and Sweden, with a population of three millions, only beats Nova Scotia in shipping by 36,927 tons." At the same time, the comparison with the United States is also remarkable. Out of the 31 States which constitute the Union, there are only six (New York, Massachusetts, Maine, Pennsylvarnia, Louisiana, and Maryland) whose tonnage exceeds that of Nova Scotia, and the last three of these she is likely to outstrip in the course of a year or two. Considering that the colony is only 100 years old, and that her population does not exceed 300,000, these results are beyond anything ever before witnessed. But it is not alone as regards fisheries and shipping that the energies of the people are manifested. The agricultural capabilities of Nova Scotia are great, and are being turned to good account. "With the wheat-growing countries that surround the great lakes, whether on the British or American side, she is not," it is remarked, "to be compared. She does not raise her own bread, but while one barrel of her mackeral will purchase two barrels of flour she can always afford to buy what she requires. It is curious, however, to discover that even as a wheat-growing country she beats five of the New England States and 12 of the more recently settled States and territories." In the growth of rye she is far ahead of 16 of the States and territories of the Union; in oats she exceeds 13, in hay 21, in buckwheat and potatoes 23, and in barley every State and territory except Ohio and New York. Under these circumstances, coupled with the fact that the province enjoys, in common with Canada and New Brunswick, the full development of representative institutions, it is evident that the prospects of its prosperity are unlimited.—*Times.*

Purification of Gas.—At the City Court of Sewers, held yesterday, Mr. Deputy Peacock was unanimously elected chairman for the ensuing 12 months. The attention of the Court was for some time occupied with inquiries as to the supply and purification of gas. The subject was introduced by a report from the Committee on General Purposes, to whom was referred a statement made by Dr Letheby, that he had found 21 grains of oil of vitrol in 100 cubic feet of gas. The committee recommended that Dr. Letheby should be allowed to proceed with certain experiments, with a view to test the quality of the gas supplied to the city of London by the various gas companies, and also to promote its purification. This suggestion of the committee was adopted. A report was then read from Dr. Letheby respecting the power and quality of the gas supplied to the city by the Great Central Company. This report stated, that during the last three months the power of the gas had been nearly 22 per cent. greater than was required by act of Parliament, and that the result of various experiments was highly satisfactory. The report then congratulated the Court upon having directed public attention to the purification of gas as one of the most important sanitary and commercial questions of the day. Nearly 4,000,000,000 cubic feet of gas were now annually consumed, of which about 500,000,000 were supplied to the city of London. The consumption of gas in London was nearly trebled since 1837, but hitherto nothing had been done to control the companies engaged in its manufacture. Coal gas was liable to be contaminated with four impurities calculated to injure the atmosphere; but, as science could furnish a remedy, and render the gas pure, the report suggested that those in authority should pay attention to the subject, as the use of coal gas "might become either the greatest curse or the greatest boon of the 19th century."—*Times.*

A New Effect of the Magnetic Telegraph.—The various wires of telegraphs beginning to intersect so many sections of our country are said to have a decided effect upon electricity. That eminent scientific man, Prof. Olmstead, of Yale College, states, that as the storm comes up, and especially when over the wires, say fifty or a hundred miles distant, the lightning is attracted by the wires; which can be proved by any one remaining in a telegraph office for half an hour. About the time the storm is coming up, the wires are continually filled with electricity. It is my opinion, he says, that we should never have heavy thunder showers, or hear of lightning striking so long as we have telegraph wires spread over the earth.—*American Paper.*

Photographic Light.—A novel application of the combustion of zinc has just been discovered by Mr. Wenham. He takes fine zinc parings or shavings, and forms them into a pellet, which, when ignited, affords a brilliant, and it is said, a steady light for photographic purposes.

Claussen's Flax Works.—According to the statements of the parties interested, the recent fire at Claussen's Patent Flax-works at Broomley occurred at the time when the company had fully succeeded in establishing the process, and when large orders were in progress. A fresh manufactory is to be formed as soon as possible.

Extraordinary Diamond.—The extraordinary diamond recently deposited at the Bank of England from Rio was submitted this morning to the Queen by the consignees, Messrs. Devoy and Benjamin. It weighs 254½ carats, and is alleged to be likely, when polished, to exceed in size and brilliancy the Koh-i-noor.—*Times.*

Substitute for Coffee.—Asparagus, according to Liebig, contains, in common with tea and coffee, a principle which he calls "Taurine," and which, by the way, he considers essential to the health of all who do not take strong exercise. Reading this led me to think that asparagus might be made a good substitute for coffee. The young shoots which I at first prepared were not agreeable, having an alkaline flavour. I then tried the ripe seeds; these, roasted and ground, make a full-flavoured coffee, not easily distinguishable from a fine Mocha. The seeds are easily freed from the berries by drying them in a cool oven, and then rubbing them on a sieve.—*Correspondent of the Gardener's Chronicle.*

Monthly Meteorological Register, at the Provincial Magnetical Observatory, Toronto, Canada West.—February, 1854.

Latitude, 43 *deg.* 39.4 *min. North. Longitude,* 79 *deg.* 21. *min. West. Elevation above Lake Ontario,* 108 *feet.*

Magnet.	Day.	Barom. at tem. of 32 deg. 6 A.M.	2 P.M.	10 P.M	Mean.	Tem. of the Air. 6 A.M.	2 P.M.	10 P.M.	M'N.	Tension of Vapour. 6 A.M.	2 P.M.	10 P.M.	M'N	Humidity of Air. 6 A.M.	2 P.M.	10 P.M.	M'N.	Wind. 6 A.M.	2 P.M.	10 P.M.	Mean Vel'y	Rain in Inch.	Snow in Inch.
						°	°	°	°														
b	1	29·139	29·081	29·279	29·168	35·5	42·7	35·7	37·12	0·194	0·238	0·190	0·198	·94	·88	·91	·90	S W	W b S	Calm	3·92	Inap.	0·8
a	2	·450	·533	·714	·592	18·6	9·1	5·4	9·48	·094	·059	·049	·063	90	83	81	83	N N W	NE b N	N N W	10·03	...	1·5
c	3	·833	·732	·843	·805	-5·7	14·8	4·7	4·62	·029	·071	·045	·048	81	78	79	79	Calm	N E b N	NW b W	3·90	...	...
e	4	·953	·957	·902	·985	1·8	14·2	8·0	8·27	·045	·071	·054	·057	87	80	79	82	N W	W N W	Calm	1·97	...	1·0
b	5	·693	·512	—	—	16·9	19·5	—	—	·083	·092	—	—	84	83	—	—	S E b E	N E b N	—	6·77	...	1·0
a	6	30·037	30·082	30·093	30·079	-4·3	21·5	14·8	10·80	·028	·100	·074	·068	73	84	83	79	Calm	Calm	W S W	1·14	...	...
b	7	30·046	29·857	29·688	29·856	12·6	27·5	27·6	22·87	·071	·135	·120	·108	83	89	79	83	Calm	E b S	S E	6·28	...	3·2
a	8	29·382	·024	·077	·150	29·8	36·2	35·7	32·87	·154	·191	·190	·171	94	90	91	91	S E b E	E b S	W b N	6·53	0·465	...
b	9	·163	·140	·272	·199	31·6	21·4	30·9	28·55	·162	·097	·156	·138	92	81	91	87	W b S	W b S	W b N	8·30	...	0·2
d	10	·475	·743	·977	·761	18·3	19·3	7·9	15·07	·088	·081	·056	·076	85	75	83	82	W N W	N W	Calm	5·18	...	...
b	11	30·125	30·164	30·055	30·118	0·3	13·2	18·6	11·07	·045	·056	·092	·067	92	67	88	84	Calm	S E b F	E S E	5·27	...	Inap.
a	12	29·913	29·727	—	—	22·1	24·8	—	—	·108	·123	—	—	88	90	—	—	E S E	E	—	11·32	0·685	...
c	13	·433	·359	29·512	29·447	35·2	38·4	34·8	36·10	·203	·220	·185	·203	99	95	92	96	E	Calm	N N W	5·32	0·065	0·2
c	14	·677	·582	·259	·484	30·2	26·0	27·6	28·10	·158	·134	·135	.142	94	94	88	91	N E b N	E N E	E	9·69	Inap.	0·5
c	15	·274	·473	·593	·461	32·6	27·3	25·6	27·98	·179	·131	·125	·141	97	86	88	90	S S W	W	W S W	7·64	...	...
c	16	·634	·700	·847	·737	22·6	24·1	17·8	21·22	·112	·115	·085	·101	90	86	84	85	W b S	W b S	W N W	5·09	...	0·1
b	17	·974	·968	·819	·915	9·9	21·3	20·7	17·85	·060	·085	·100	·083	81	73	86	79	Calm	W b S	SW b W	7 82	...	...
b	18	·691	·435	·579	·568	24·9	39·1	29·4	31·28	·123	·197	·152	·161	89	83	94	90	S W b W	S W b W	N b W	8·87	...	0·2
b	19	·768	·836	—	—	16·2	23·6	—	—	·080	·098	—	—	84	75	—	—	N W b N	N b E	—	4·37	...	...
a	20	·715	·614	·559	·621	18·6	24·0	19·8	20·53	·088	·085	·094	·089	83	64	83	78	N E b E	E	N E b E	9·87	...	...
a	21	·625	·626	·576	·605	16·5	28·2	29·1	25·57	·087	·131	·129	·121	90	84	80	85	N N E	S S W	S W b S	3·97	...	0·1
a	22	·4 6	·251	·564	·412	33·4	35·7	10·8	26·60	·174	·187	·072	·145	92	89	96	92	S W b W	S W	N N W	13·24	...	2·5
a	23	·976	·985	·872	·941	0·4	13·2	15·9	10·55	·044	·053	·080	·061	90	64	84	79	N N W	N W	W S W	6·65	...	...
c	24	·763	·776	30·013	·860	22·0	34·5	21·5	25·28	·107	·172	·106	·124	88	86	89	87	W	W N W	N N E	8·15	...	0·2
c	25	30·129	30·007	29·870	·997	14·4	16·2	22·4	17·70	·076	·081	·110	·090	86	86	88	87	E b S	E b S	E b N	11·33	0·105	1·0
c	26	29·574	29·148	—	—	32·9	32·3	—	--	·176	·176	—	—	95	96	—	—	E b S	E	—	12·07	0·140	5·5
ca	27	·676	30·001	30·161	.972	16·2	22·4	8·0	15·37	·085	·109	·059	·083	90	87	87	87	N b E	N	N b E	7·48	...	...
a	28	30·121	29·967	29·908	·991	2·0	29·7	29·1	21·25	·042	·143	·142	·110	82	87	88	85	N b E	NW b W	S W b S	1·70	...	...
	M	29·697	29·669	29·710	29·695	17·39	25·00	20·91	21·09	0·102	0·118	0·108	0·110	89	83	86	86	Miles. 6·51	Miles. 7·08	Miles. 7·17	Miles 6·91	1·460	18·0

Highest Barometer...... 30·172, at 8 a.m. on 11th } Monthly range:
Lowest Barometer...... 29·002, at 4 p.m. on 8th } 1·170 inches.

Highest temperature.... 42°·8, at p.m. on 1st } Monthly range:
Lowest temperature..... –10°·8, at a.m. on 3rd } 53°·6.

Mean Maximum Thermometer.............. 29°·63 } Mean daily range:
Mean Minimum Thermometer............. 9°·15 } 20°·47.

Greatest daily range............... 37°·1, from p.m. 22nd to a.m. of 23rd.

Warmest day........ 1st. Mean temperature...... 37°·12 } Difference,
Coldest day.......... 3rd. Mean temperature...... 4°·62 } 32°·50.

Sum of the Atmospheric Current, in miles, resolved into the four Cardinal directions.

North.	West.	South.	East.
1743·79.	1577·85.	626·08.	1724·33.

Mean direction of Wind N 7° E.

Mean velocity of the Wind... 6·91 miles per hour.

Maximum velocity .... 22·9 miles per hour, from 9 to 10 p.m. on 22nd.

Most windy day...... 22nd; Mean velocity... 13·24 miles per hour.

Least windy day...... 6th; Mean velocity... 1.14 ditto.

Raining on 5 days. Raining 25·2 hours.

Snowing on 15 days. Snowing 60·8 hours.

Aurora observed on 4 days.

Possible to see Aurora on 12 days.

Impossible to see Aurora on 16 days.

The change of temperature from the 1st to the 2nd was very rema able, amounting to 27°·64 between the mean of the two days.

Comparative Table for February.

Year.	Temperature. Mean.	Max. obs'vd.	Min. obs'vd.	Range.	Rain. D's.	Inch.	Snow. D'ys	Inch.	Wind Mean Vel'y.	
	°	°	°	°						
1840	28·0	49·1	—8·3	57·4	8	1·475	6	Not Regis'd.	Not Regis'd.	
1841	22·4	43·4	—0·3	43·7	1	0·000	9			
1842	26·9	48·7	+2·5	46·2	8	3·625	9			
1843	14·5	37·5	—10·2	47·7	1	0·475	21	14·4	1·05	lb.
1844	26·0	47·1	—0·4	47·5	4	0·430	7	10·0	0·43	lb.
1845	26·0	46·6	—3·9	50·5	5	—	9	19·0	0·99	lb.
1846	20·4	41·4	—16·2	57·6	0	0·000	13	46·1	0·65	lb.
1847	21·5	42·2	—1·0	43·2	2	0·550	13	27·3	0·69	lb.
1848	26·6	46·9	—0·6	47·5	4	0·775	8	10·8	5·69	Miles.
1849	19·5	41·1	—9·2	50·3	2	0·240	13	19·2	6·58	Miles.
1850	26·0	49·2	+1·3	47·9	7	1·235	9	23·1	7·61	Miles.
1851	27·6	50·2	+1·3	48·9	7	2·600	4	2·4	6·94	Miles.
1852	23·4	41·2	—3·2	44·4	3	0·650	11	13·0	6·42	Miles.
1853	24·1	43·4	—0·6	44·0	4	1·030	15	12·6	7·29	Miles.
1854	21·1	42·7	—5·7	48·4	5	1·460	15	18·0	6·91	Miles.
									0·76	lb.
M'n.	23·60	44·71	—3·63	48·35	4·1	1·039	10.8	18·0	6·78	Miles.

Monthly Meteorological Register, St. Martin, Isle Jesus, Canada East.—February, 1854.

NINE MILES WEST OF MONTREAL.

BY CHARLES SMALLWOOD, M.D.

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

Day.	Barom. corrected and reduced to 32° Fahr.			Temp. of the Air.			Tension of Vapor.			Humidity of Air.			Direction of Wind.			Velocity in Miles per Hour.			Rain in Inch.	Snow in Inch.	Weather, &c. A cloudy sky is represented by 10; A cloudless sky by 0.		
	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10. P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.			6 A.M.	2 P.M.	10 P.M.
1	28·999	29·000	29·030	33·0	43·2	33·1	·197	·280	·191	·95	·94	·92	W b N	W b N	W S W	8·04	Calm	0·89		0·63	Str. 10.	Snow from 2 to	Str. 10.
2	29.305	·596	·489	19·0	21·2	18·0	117	086	099	91	58	82	N N E	E N E	N b E	Calm	10·12	2·28			Clear.	Str. 8. [6 p.m.	Do. 8.
3	·650	·596	·624	-16·1	7·8	-11·1	018	058	021	82	80	75	N N E	E N E	E b S	9·29	Calm	2·66			Do.	Clear.	Clear.
4	·796	·749	·764	-26·5	7·2	-12·0	009	058	021	70	82	75	W N W	E S E	S b W	0·26	Calm	0·87			Do.	Do.	Do. [at 5 p.m.
5	·810	·605	·657	-25·7	-3·7	-9·0	009	033	024	53	83	78	E	N E b E	N N E	Calm	4·20	7·92		Inapp	Do.	Do.	Str. 8. Snow
6	·821	·808	·836	-22·0	14·5	5·0	012	078	049	59	84	78	N N E	N W b W	W N W	1·90	Calm	8·19			Do.	Do.	Cir. Cum. 8.
7	·878	·807	·796	-11·2	15·0	6·5	021	089	059	75	89	92	W b N	N b W	N b E	0·22	Calm	0·82			Do.	Do.	Clear.
8	·561	·686	28·904	-3·1	12·2	18·5	051	090	113	94	94	93	N E b E	N E b E	N E b E	8·07	6·41	10·46		3·80	Snow.	Snow.	Snow.
9	28.960	29.010	29·023	17·5	38·2	30·0	096	217	160	83	80	86	N b W	N N W	N b W	5·02	1·92	15·32		0·10	Clear.	Slight Snow.	Cir. Str. 4.
10	29.174	·370	·622	20·1	14·5	5·0	107	087	049	82	80	78	W b N	N W b W	N W b W	15·87	16·25	12·19		Inapp	Cir. Str. 4.	Clear.	Clear A. Bo-
11	·760	·834	·854	-18·4	6·9	-6·0	014	052	030	66	79	81	N W b W	W	W b N	9·64	3·40	6·66			Clear.	Do.	Do. [realis.
12	·995	·867	·775	-22·5	6·5	0·5	015	048	042	88	63	84	W b N	N E b E	E N E	Calm	0·12	1·50			Do.	Do.	Cum. 8.
13	·538	·377	·366	8·5	31·2	32·7	065	164	198	93	94	96	N E b E	S b E	S S E	2·09	7·05	4·90	0·08	1.11	Snow at 7.30.	Cum. Str. 8.	Rain at 4.40 p.
14	·547	·534	·537	25·5	26·3	21·5	123	147	115	79	92	94	N b E	N E b N	N E b E	12·72	8·83	15·00	0·04		Rain.	Str. 10.	Str. 10. [m.
15	·260	·227	·331	22·8	33·2	27·0	120	187	146	95	90	88	E N E	N W	W S W	16·04	4·23	1·20	0·03	3·80	Snow.	Sleet.	Do. 10.
16	·401	·371	·462	22·1	22·5	14·0	115	108	088	82	77	83	W b S	W N W	W b N	7·62	9·07	10·37			Str. 10.	Cum. Cir. Str.	Clear Aurora
17	·575	·566	·553	11·0	20·0	14·0	077	083	091	83	63	87	W	W b N	W S W	11·70	9·31	9·33			Clear.	Clear. [6.	Do. [Borealis.
18	·408	·216	·308	20·0	31·0	28·7	107	178	161	82	92	89	S W b W	S W b W	W b S	8·14	12·85	6·28		Inapp	Str. 10.	Str. 10.	Str. 10.
19	·469	·665	·731	-4·0	10·0	-5·0	033	062	031	83	80	82	N b W	W b N	W b S	13·00	0·20	Calm			Clear.	Clear.	Clear. Zodiac.
20	·714	·673	·544	-16·9	10·0	-3·0	013	053	041	56	66	96	N E b N	N E b E	N E	Calm	0·02	1·68			Do.	Do.	Do. [Light.*
21	·456	·308	·392	-8·0	26·6	6·1	036	134	052	84	88	79	N E	S S E	S W b S	7·18	0·87	Calm			Do.	Light Cir. 4.	Do. Faint A.B
22	·278	·208	28·999	14·0	32·0	26·2	076	170	141	84	90	96	S E b S	N E	S b W	Calm	Calm	1·44		3·60	Str. 10.	Snow.	Snow c'd 11 40
23	·487	·579	29·645	-7·0	1·2	-6·0	028	040	036	80	75	90	W N W	W N W	W	14·70	15·00	6·82		0·82	Clear.	Clear.	Clear.† [p.m.
24	·609	·557	·757	-2·0	19·1	3·6	051	086	045	92	87	77	W	W	W	0·29	0·18	2·17		Inapp	Str. 10.	Do.	Do. Aur. Bo.‡
25	30·001	30·072	·969	-16·3	-0·7	-5·2	013	027	010	56	53	90	N E	N E b E	N E b E	1·75	0·08	15·14			Clear.	Do.	Str. 4. [night.
26	29·696	29·461	·044	6·3	15·0	20·5	059	081	110	92	84	90	N E b E	N E b E	N E b E	3·23	2·50	25·50		8·90	Str. 4.	Snow com. at	Snow c'd mid-
27	·462	·611	·659	13·2	34·5	7·2	074	166	054	83	87	79	N b E	N W b W	N W b W	19·00	0·23	0·37		1·20	Clear.	Clear. [10 a.m	Clear Aurora
28	·749	·654	·655	-8·8	34·3	13·1	026	178	088	76	83	87	N W	S W b S	S S W	Calm	Calm	Calm			Do.	Do.	Do. [Borealis.

Barometer	Highest, the 25th day	30·072
	Lowest, the 8th day	28·904
	Monthly Mean	29·520
	" Range	1·168
Thermometer.	Highest, the 1st day	44°·0
	Lowest, the 5th day	-27°·7
	Monthly Mean	12°·20
	" Range	71°·7
	Mean Humidity	·825
Greatest Intensity of the Sun's Rays		128°·0

The Mean Temperature of the Month was 4°·16 below that of last year.
Rain fell on 3 days amounting to 0·15 inches.
Snow fell on 13 days amounting to 23·96 inches.
Most prevalent Wind, N E b E. Least do., do., E.
Most Windy Day, the 10th day; mean miles per hour, 14·77.
Least Windy Day, the 28th day; mean miles per hour, 0·00.
Zodiacal Light was very bright during the month.
Aurora Borealis visible on 5 nights. Might have been seen on 10 nights.
The electrical state of the atmosphere has been marked *generally* by moderate intensity, and during the storms of the 22nd and 26th days indicated a very high tension of negative electricity.

* 19th and 20th. Very bright and well defined. † 23rd. Zodiacal Light bright. ‡ 24th. Very splendid.

Monthly Meteorological Register, Quebec, Canada East.—February, 1854.

BY LIEUT. A. NOBLE, R.A.

Latitude, 46 deg. 49·2 min. North; Longitude, 71 deg. 16 min. West. Elevation above the level of the Sea, — Feet.

Date.	Barometer corrected and reduced to 32 degrees, Fahr.				Temperature of Air.				Elasticity of Air.				Humidity of Air.				Direction of Wind.			Velocity of Miles.			Rain in inch.	Snow in inch.
	6 A.M.	2 P.M.	10 P.M.	MEAN.	6 A.M. °	2 P.M. °	10 P.M. °	MEAN. °	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.		
1	29·193	29·171	29·272	29·212	25·5	36·0	34·6	32·0	·124	·153	·176	·151	88	73	89	83	N W	N W	N W	8·8	8·0	7·2	...	0·2
2	·404	·582	·697	·561	15·4	12·5	5·7	11·2	066	068	046	060	71	80	76	76	N W	W	E	11·3	10·1	8·0	...	...
3	·875	·882	·953	·903	−4·6	4·5	−6·3	−2·1	027	045	023	032	71	77	63	70	E	E	E	8·0	8·8	8·0	...	...
4	·979	30·011	30·114	30·035	−21·8	−1·5	−9·4	−10·9	010	035	018	021	59	76	57	64	W N W	W N W	W N W	9·4	8·8	8·0	...	...
5	30·091	29·987	·068	·048	−23·0	0·0	−19·5	−14·2	008	030	000	013	48	63	00	37	W	Calm	Calm	3·8	...	...	...	...
6	·086	30·104	·175	·122	−11·6	−2·0	−7·5	−7·0	020	028	024	024	70	65	69	68	N N W	N b W	W b N	3·8	8·0	8·0	...	...
7	·179	·200	·165	·181	−16·7	+7·5	−9·8	−6·8	012	043	023	029	55	64	77	65	W	W b N	W	8·0	6·2	8·8	...	...
8	·101	29·813	29·341	29·751	−10·4	12·0	15·6	5·7	018	060	072	050	59	75	77	70	E	E	E	11·3	19·7	11·3	...	6·0
9	29·168	·205	·254	·209	18·3	28·0	29·4	25·2	079	138	141	119	76	89	87	84	E	E	E	10·1	8·0	8·0	...	1·0
10	·333	·469	·813	·538	20·6	27·4	3·4	17·1	092	121	044	089	81	80	78	80	W b S	W b N	W b N	7·2	6·2	6·2	...	...
11	30·052	30·083	30·222	30·119	−15·6	2·4	−6·0	−6·4	014	042	023	026	62	80	63	68	W	W	W	6·2	7·2	8·0	...	...
12	·250	·262	·247	·253	−16·2	6·5	−4·0	−4·6	009	045	026	027	42	70	65	59	W	E b S	E	8·0	8·0	13·4	...	...
13	·096	29·962	29·824	29·961	8·3	15·0	22·0	15·0	059	078	106	081	87	85	87	86	E	E	E	22·7	32·1	32·1	...	6·0
14	29·855	·963	30·005	·941	24·5	26·5	21·5	24·2	117	126	098	080	87	86	81	85	E	E	E	34·1	39·4	34·1	...	2·0
15	·866	·729	29·626	·740	22·5	24·5	26·6	24·5	101	117	134	117	81	87	95	88	E	E	E	27·8	16·0	11·3	...	5·0
16	·652	·608	·675	·645	22·5	30·0	15·5	22·6	101	150	072	108	81	90	77	83	N W	N W	W N W	10·1	13·9	10·9	...	0·2
17	·820	·810	·825	·818	10·5	23·4	13·5	15·8	077	114	071	087	55	88	82	75	N	W	W	8·8	10·1	10·9	...	...
18	·698	·518	·473	·563	15·4	31·0	25·5	23·9	076	150	119	115	83	85	85	84	N	W	W	13·3	19·5	16·0	...	3·0
19	·900	·947	30·066	·971	−8·6	3·8	−7·0	−4·1	022	039	024	028	67	71	67	68	W	W	W	10·9	8·0	7·2	...	...
20	30·116	30·051	29·983	30·050	−16·5	9·5	−1·8	−2·9	012	059	034	035	55	81	75	70	W	N W	Calm	8·0	3·8	...	...	...
21	29·882	29·781	·777	29·813	−8·0	17·0	3·3	4·1	022	075	046	048	66	77	82	75	E	E N E	E N E	8·8	9·4	8·0	...	...
22	·674	·438	·363	·492	5·0	26·0	21·5	17·5	047	128	098	091	79	88	81	83	E N E	E N E	E N E	8·0	8·0	8·0	...	5·5
23	·445	·616	·866	·642	14·0	18·0	−1·5	10·2	074	089	036	066	84	87	81	84	E N E	N W	N W	11·3	11·5	11·3	...	...
24	·854	·857	·962	·891	−8·6	9·5	−2·5	−0·5	021	057	025	034	65	79	56	67	W	W N W	W N W	10·1	9·4	8·8	...	...
25	30·391	30·496	30·468	30·451	−20·8	0·0	−8·0	−9·6	012	035	022	023	61	76	66	68	W b N	W b N	W b N	10·1	8·0	8·8	...	...
26	·252	29·974	29·401	29·876	4·0	18·5	24·4	15·6	045	086	121	084	79	82	91	84	E S E	E b S	E b S	8·0	7·2	10·9	...	14·0
27	29·522	·863	30·176	·854	17·6	28·7	11·5	17·6	094	098	058	083	92	75	75	81	W b S	W b N	W b N	10·9	13·9	6·2	...	...
28	30·380	30·194	·000	30·175	1·0	24·0	14·5	13·2	021	108	075	068	51	82	85	73	W b N	W	W	7·2	8·8	9·4	...	1·0
M	29·859	29·834	29·850	29·850	1·5	16·4	7·3	8·1	·049	·083	·063	·065	70	79	74	74				10·8	11·3	10·2		43·9

REMARKS.

5th. River St. Lawrence froze across opposite Quebec. The ice was, however, swept away by the tide.

6th. The St. Lawrence again frozen across, and the ice-bridge remained.

28th. Brilliant Aurora at 12. The whole of the northern horizon was of a pale, violet colour, and there was one patch of streamers in the N.E.

Highest Barometer, at 2 p.m. on the 25th .... 30·496 } Monthly Range, 1·325 in.
Lowest Barometer, at 2 p.m. on the 1st .... 29·171 }

Maximum Thermometer, on the 1st .... 36°·0 } Monthly Range, 60°·0
Minimum Thermometer, on the 5th .... −24°·0 }

Mean Maximum Thermometer .... 17°·0 } Mean Daily Range, 22°·4
Mean Minimum Thermometer .... −5°·4 }

Greatest Daily Range, on the 10th .... 43°·1
Least Daily Range, on the 15th .... 4°·0

Warmest Day, the 1st; mean temperature .... 32°·0 } Climatic Difference, 46°·2
Coldest Day, the 5th; mean temperature .... −14°·2 }

Possible to see Aurora on 13 nights.
Aurora visible on 9 nights.