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# The Canadian Journal.

TORONTO, JANUARY, 1854.


## Variations in the Level of the Lakes.

The annual fluctuations in the level of the water of Lake Ontario appear nearly simultaneous and commensurate with the fluctuations which have been observed to take place in the Upper Lakes. Whatever conclusions are deduced from this phenomenon in Lake Ontario, the same will evidently hold good with respect to Lakes Erie and Huron. Mr. Hall, in his Geology of the 4th District of the State of New York says, that a single individual informed him that about the year 1788 or 1790, the Lakes were as high as in 1838; associating this fact with the observations which have been recorded on pages 26 and 62 of this Journal, in the absence of more detailed information, we obtain the following table:

| Maximum Level. | Minimum Level. |
|---|---|
| 1788 or 90 | 1819 |
| 1838 | 1848 |
| 1853 | |

| | |
|---|---|
| Or from Maximum to Minimum | 31 years. |
| " " | 10 |
| From Minimum to Maximum | 19 |
| " " | 7 |

It seems scarcely possible to discover any relation between these figures which would indicate periodicity in the occurrence of the fluctuations, or in any recorded phenomena of the kind beyond the rise of the Lakes in the Spring and their fall in the Autumn of the year. We are therefore thrown back upon those enquiries which would lead us to imagine that the annual variations in the levels of the Lakes are due to an unequal amount of rain-fall, and an inconstant degree of evaporation. Whatever apparent regularity may be deduced from observed phenomena appears to be altogether dependent upon those climatic changes which distinguish, in a greater or less degree, every extensive region.

The chief source of supply is the Niagara River, which joins Lake Ontario with Erie. The quantity of water flowing down this stupendous cataract has been estimated, by Mr. Barrett, at Black-rock. The result of three separate observations, made during the high water of 1838 and 1839, gave 19,500,000 cubic feet, or nearly 600,000 tons per minute.* If we assume 20,000,000 cubic feet per minute to represent the maximum quantity passing into Lake Ontario from Lake Erie, the whole volume from that source alone would be sufficient to raise the waters of Lake Ontario 62 feet during one year, or about 2 inches in one day, if there were no outlet, and no waste by evaporation. At the same rate of discharge, Lake Erie would be drained in about two years and four months. The elevation of the waters of the Lakes above their present mean level cannot have taken place to an extent beyond a few feet *during the last geological era.* A curious confirmation of this physical fact is given by the Provincial Geologist in his Report for the years 1845-6. "Lake Ontario is stated to be about nine feet above the St. Lawrence at the Gallops; so that any stoppage in the river below the Gallops, which would raise the surface of Ontario beyond twenty-one feet over its present level, would send a broad sheet of its waters, with a violent current, down the valley of the Petite Nation, an accident which, judging from the apparently undisturbed condition of its clay banks, has not happened since the country *rose from beneath a tertiary ocean.*"

There is no reason to suppose that the level of Lake Ontario has risen many inches even, above its present high elevation, for many ages. The existence of an occasional sand bank, supporting a growth of heavy timber on the shores of both the Upper and Lower Lakes, sufficiently confirm this fact. It is, however, to be remarked that the inroads made by the waters during the last two years have far exceeded those made in 1838. It has been found, as was previously stated, (page 25) that on the Eastern shores of Lake Simcoe, many hundred acres of land are now submerged, and in part denuded of their forest growth by the waters which have covered them during the past summer. Lake Simcoe, an inland body of water, 128 feet above Lake Huron has exhibited precisely the same phenomena as the larger Lakes into which its waters ultimately flow. The same rapid breaking down of its banks and cliffs have constantly occurred during the memory of the oldest settlers on its eastern shores, as are universally witnessed on the clay cliff shores of Lakes Erie and Ontario. This denuding action, coupled with the detritus of rivers, cannot fail to exercise an influence upon the general level of the bottom of the Lakes during the lapse of years.

It is well known that a very large portion of the water which falls to the earth in the form of rain or dew becomes again dissipated by the process of evaporation. Accurate experiments have been made by competent persons with a view to ascertain the relation existing between rainfall and evaporation, not only from the surface of the soil under different circumstances, but also from the surface of water.

The following table* shows that the quantity annually passing off from the surface of water may often equal, and occasionally exceed, the precipitation even in temperate climates. The clear skies and hot sun of Canada West would favor the supposition that the annual results of evaporation from the surface of its great lakes really exceed, in general, those of precipitation.

| *Name of place.* | *Evaporation in In.* | *No. of years ob.* |
|---|---|---|
| London | 23.98 | 3 |
| Kendal | 25.75 | 3 |
| Tottenham | 30.47 | 8½ |
| Glasgow | 32.41 | 2 |
| Liverpool | 36.73 | 3 |
| Paris | 38 | |
| Boston, U. S.† | 56 | |
| Ogdensburgh‡ | 49.30 | 1 |

The amount of evaporation from open plains varies from one half to one-third of the rainfall in this climate. In forest-clad regions a much greater proportion escapes as drainage.

The month of May of this year was distinguished not only by the large quantity of rain which fell, but also on account of the number of rainy days, and hence the cloudiness of the sky. In a note attached to the Monthly Meteorological Register of the Provincial Observatory for May, we find the following:—"The depth of rain for this month is much above the average and has been exceeded only in two years, 1844–49; but the number of rainy days is the greatest that has been known throughout the whole series of years, being only equalled in August in 1844." It must be borne in mind that a cloudy sky of a few days longer duration than usual during the warm months of the year, will arrest evaporation to such a degree from the surface of water, as

* Hall's Geology of the State of New York.

* Thompson, Introduction to Meteorology. † Dr. Hale. ‡ J. H. Coffin.

very soon to cause a marked difference in the levels of lakes embracing an area of upwards of 50,000 square miles, and draining a country more than four times as large again.

A glance at the seasons preceding the high water of 1836 and 1852, which differed only by 8 inches in Lake Ontario, will perhaps enable us to recognize the influence of climatic changes upon our lake levels.

The winter of 1835-6 may be said to have commenced on Nov. 23rd. On Dec. 1, the Bay was frozen over, being about a fortnight earlier than usual. The temperature of December was as follows:—3 days below zero; 9 between 10° and 20°; 15 between 20° and 32°; and 4 between 32° and 40°. January, 1836, was not remarkable for severity, the minimum being only 2° and the maximum 45°. This mildness was compensated by the rigour of the succeeding month, in which there were *no less than* seven days below zero, and only one above the freezing point at 8 A. M. March was likewise unusually severe, and the Bay was not clear of ice until the 25th of April. This winter may be said to have continued 155 days. During the whole period there fell no more than 1¾ inches of rain; the number of days of snow was *thirty-four*.* In an admirable paper on the winter of 1851-2, Capt. Lefroy states that, "The winter of 1835-6, which is said, however, to have been the most severe in North America since 1779-80, was decidedly more severe than that of 1851-2. But the winter of 1851-2, was the most severe of any since 1835-6."

"So far, therefore, that winter, taken in its popular extent maintains its character for severity, but this results chiefly from our having excluded October, and included April. October, 1851, was unusually warm and genial, having had a mean temperature of 47°.8, which is 3°.3 higher than the mean for the same series of years, while April, 1852, has been one of the coldest in it."

It seems remarkable that during the year 1852, the quantity of rain which fell at Albany, was less in that year than since 1826. The greatest fall in any one year was in 1850, which amounted to 50.97 inches. The least fall during a period of 26 years was in 1852, which amounted to 31.79 inches, or not less than 8.85 inches *below* the mean of 26 years.† At Toronto, the rainfall in 1852 was also below the mean by rather more than one inch.

In continuation of the tables given on pages 26 and 53 we add the following:

**Observations made at Gerrie's Wharf, by Mr. G. A. Stewart.**

1853.

OCTOBER.

| *Day.* | *Hour.* | *Height of Water.* | *Wind.* |
|---|---|---|---|
| 15 | 3 P. M. | 2.98 | ---- |
| 18 | 10 A. M. | 2.90 | ---- |
| 20 | 10 A. M. | 2.93 | ---- |
| 26 | 2 P. M. | 2.90 | West. |
| 28 | 12 Noon. | 2.90 | ---- |
| 30 | 12 Noon. | 2.93 | ---- |

NOVEMBER.

| *Day.* | *Hour.* | *Height of Water.* | *Wind.* |
|---|---|---|---|
| 1 | 2 P. M. | 2.88 | ---- |
| 2 | 4 P. M. | 2.78 | ---- |
| 4 | 4 P. M. | 2.72 | ---- |
| 5 | 11 A. M. | 2.72 | ---- |
| 7 | 4 P. M. | 2.70 | ---- |
| 10 | 10 A. M. | 2.79 | ---- |
| 12 | 10½ A. M. | 2.76 | ---- |
| 14 | 3 P. M. | 2.68 | ---- |
| 15 | 2 P. M. | 2.77 | ---- |
| 19 | 2 P. M. | 2.75 | ---- |
| 21 | 10 A. M. | 2.82 | ---- |
| 22 | 9 A. M. | 2.81 | ---- |
| 25 | 12 Noon. | 2.76 | ---- |
| 29 | 11 A. M. | 2.82 | ---- |

DECEMBER.

| *Day.* | *Hour.* | *Height of Water.* | *Wind.* |
|---|---|---|---|
| 1 | 1 P. M. | 2.58 | ---- |
| 5 | 11 A. M. | 2.62 | ---- |
| 8 | 12 Noon. | 2.65 | ---- |
| 13 | 11 A. M. | 2.60 | ---- |
| 15 | 11 A. M. | 2.60 | ---- |
| 16 | 11½ A. M. | 2.62 | ---- |
| 17 | 11½ A. M. | 2.58 | ---- |

The maximum altitude registered by Mr. Stewart occurred on the first day of June, 1853. The difference between the water level on that day and on December 17th is 2 feet 1 inch, which represents the fall of the water during a period of six and a half months. During the last two months, it has fallen only five inches, and the probability is that its minimum for this winter has already very nearly been attained.

It is, perhaps, worthy of note that Mr. Murray, the Assistant Provincial Geologist, in his report for 1848, states that there were indications in the water marks of both Lake Huron and Lake Nipissing that they have "sunk considerably below their ancient levels," and that a corresponding fall could be traced in each successive lake of the chain between them. Lake Nipissing is 69 feet above Lake Huron, into which it empties itself. The difference between the level of Lake Huron in 1848 and the "ancient level," as indicated by water marks on the beach and rocks, was 4.10 feet. In Lake Ontario, the low water mark of 1848 was 3 feet 6½ inches below the maximum level of 1852, and 4 feet 2½ inches below the minimum level of 1853, as will be seen by comparing the data given in the September number of the *Journal.* It will also be remembered that the maximum level of Ontario in 1853, was exactly equal to the maximum level in 1836, may not therefore the "ancient level" which Mr. Murray observed registered on the rocks of Lake Huron be that of 1836, or 1838, which appears to have been the year of maximum level for Lake Michigan, as recorded by Dr. Houghton, who gives the difference between the levels of 1819 and 1838, at 5 feet 3 inches. The level of Ontario in 1838 we have not been able to ascertain,—probably it was higher than in 1836. With regard to Lake Nipissing, the connection appears even more probable; Mr. Murray, in 1848, made the following measurements against a vertical rock:

| | FT. | IN. |
|---|---|---|
| Spring mark of 1848, over existing summer level of 1848 | 2 | 0 |
| Old mark, above the spring mark | 3 | 9 |
| Old mark above existing level | 5 | 9 |

The difference between the maximum level of Lake Michigan in 1838, and the old water-mark of Lake Nipissing, being only 6 inches, renders it highly probable that the height of the water of the year 1838 is registered on the rocks of Lake Nipissing—as it is not to be supposed that so easily obliterated an object as a natural water-mark, on a perpendicular rock forming the shore of a lake would be of very ancient date,—without

* From observations by the Rev. C. Dade.—*Vide* Scobie's Almanac, for 1851.

† Regent's Report for 1853.

it possessed characteristics which have not been alluded to by Mr. Murray.

In concluding these imperfect notes on the interesting phenomena of the lakes, we have merely to express our entire concurrence in the views which are entertained by many, that the annual variations are the result of climatic irregularities, and consequently, entirely dependant upon waste and supply. The local variations are unquestionably due chiefly to the influence of winds, and in a far less degree to sudden variations in atmospheric pressure, which produce the phenomena of *seiches*, as described by Col. Jackson, on page 27 of this *Journal*. The violent and local convulsions which have been witnessed near Cobourg, and elsewhere, appear to result from causes far more obscure, but yet not altogether inexplicable. We shall return to the consideration of these remarkable phenomena at some future period. The very great difficulty of obtaining authentic information respecting "lake convulsions," or any phenomena of a local character which may have been observed and recorded, induces us warmly to solicit from the members of the Institute, or the readers of this journal, the communication of any facts or information which they may think worthy of transmission.

The following paper, from the rural economy of J. B. Boussingault, on 'the Influence of Agriculture on Climate in lessening Streams,' contains matter of much interest, which can already be appreciated in many ways by the people of Canada, and of the shores of the great lakes.

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### The Influence of Agriculture on Climate in Lessening Streams, etc.

(FROM THE "RURAL ECONOMY" OF J. B. BOUSSINGAULT.)

A question of great importance, and that is frequently agitated at this time, is, as to whether the agricultural labors of man are influential in modifying the climate of a country or not? Do extensive clearings of woods, the draining and drying up of great swamps, which certainly influence the distribution of heat during the different seasons of the year, also exert an influence on the quantity of running water of a country, whether by lessening the quantity of rain which falls, or by promoting the more speedy evaporation of that which has fallen?

In some districts it has been held, that the streams which had been used as moving powers, have very sensibly diminished. In other places, the rivers are said to have shrunk visibly; and in others, springs that were formerly abundant, have almost dried up. Observations to this effect appear to have been principally made in valleys, surmounted by mountains; and it is generally asserted, that the falling off in the springs and streams had followed close upon the period at which the woods, scattered over the surface of the country, were cleared away without any kind of reserve.

The lakes which are met with in plains, and at different levels in mountain ranges, seem to me peculiarly calculated to throw light on this subject. Lakes may, in fact, be received as natural gauges of the running waters of a country. If the mass of the water contained in the lakes undergo change in one direction or another, it is obvious that this change, and the direction in which it has occurred, will be proclaimed by the s...e or mean level of the lake or lakes, which will differ for the same reason that it does at different seasons of the year, viz. as drought or rain prevails. The mean level of the lake or lakes of a district will, therefore, fall, if the quantity of water which flows through that district diminishes; the level, on the contrary, will rise, if its streams increase; and it will remain stationary if the afflux and efflux of the lake continue unchanged. In the following remarks, I shall attach myself particularly to observations upon lakes which have no outlet, by reason of the facility with which any, even slight, change in the level of these must be discovered. I shall not, however, neglect those lakes which have an exit by a stream or canal, because I believe that the study of these may also lead to accurate enough results; the only point requiring preliminary remark is the sense in which the words, change of level, are to be taken.

One of the most interesting portions of Venezuela is, undoubtedly, the valley d'Aragua. Situated at a short distance from the seaboard, possessed of a warm climate, and of a soil fertile beyond example, it combines within itself all the varieties of agriculture that belong in peculiar to tropical regions; on the hillocks, which rise in the bottom of the valley, are seen fields which bring to mind the agriculture of Europe. Wheat succeeds pretty well upon the heights which surround La Vittoria. Bounded on the north by a chain of hills, which run parallel with the sea-board, and to the south by the range which separates it from Llanos, the Aragua Valley is limited on the east and west by a series of lesser elevations, which shut it in completely. In consequence of this peculiar configuration of country, the rivers which rise in its interior have no outlet to the ocean; their waters accumulate in the lowest part of the valley, and form the beautiful lake Valentia. This lake, which M. de Humboldt says exceeds the lake Neufchatel in size, is raised about 1300 feet above the level of the sea; it is about ten leagues in length, and about two leagues and a half where it is widest.

At the time when M. de Humboldt visited the Aragua Valley, the inhabitants were struck with the gradual diminution which had been going on in the waters of the lake during the last thirty years. It was enough to compare the statements of older writers with its condition at this time, to obtain conviction that the waters had, in fact, very much diminished. Oviedo, for instance, who visited the valley frequently towards the end of the sixteenth century, says, that the town of New Valencia was founded in 1555, at a distance of half a league from the lake; in 1800, M. de Humboldt ascertained that the lake was upwards of 4549 yards, or upwards of 3¼ miles, instead of about 1½ mile from its banks.

The appearance of the surface also gives new proof of the fac. of the recession of the water; certain hillocks which rise in the plain still preserve the title of islands, which, undoubtedly, they formerly received with propriety, when they were surrounded by water. The land which had been left by the retreat of the lake, soon became transformed into beautiful plantations of cotton-trees, bananas, and sugar-canes. Buildings, which had been erected on the banks, were left, year after year, further and further from them. In 1796, new islets made their appearance. An important military position, a fortress built in 1740, in the Isle de la Cabrera, was then upon a peninsula. Finally, in two islets of granite, M. de Humboldt discovered, several yards above the level of the lake, a bed of fine sand mixed with fresh water shells. These facts, so certain, so unquestionable, did not pass without numerous explanations from the wise men of the country, who, as if by common consent, fixed upon a subterranean exit for the waters of the lake. M. de Humboldt, after the most careful examination of all the circumstances, did not hesitate to ascribe the diminution of the waters of the lake Valencia, to the extensive clearings which had been effected in the course of half a century in the Aragua Valley. "*In felling the trees which covered the crowns and slopes of the mountains,*" says this celebrated traveller, "*men in all climates seem to be bringing upon future generations two calamities at once—a want of fuel and a scarcity of water.*"*

* Humboldt, vol. v. p. 173.

Twenty-five years after M. de Humboldt, I explored in my turn the valley d'Aragua, having fixed my residence in the little town of Maracaibo. The inhabitants had now remarked, that for several years, not only had the lake ceased to diminish, but that it had even risen very perceptibly. Some fields that were formerly covered with cotton plantations were now submerged. The Isles de las Nuevas Aparacidas, which had risen from the waters in 1796, had again become shoals dangerous to navigation; the tongue of earth de la Cabrera, on the north side of the valley, had become so narrow that the slightest rise in the water of the lake covered it completely; a continuous N. E. wind was sufficient to flood the road which led from Maracaibo to New Valencia; in short, the fears which the inhabitants of the lake had entertained for so long a period had entirely changed their nature; they were now no longer afraid of the lake drying up; they saw with dismay that, if the water continued to rise as it had done lately, it would, in no long space of time, have drowned some of the most valuable estates, &c. Those who had explained the diminution of the lake by supposing subterraneous canals, now hastened to close them up in order to find a cause for the rise in the level of the water.

In the course of the last twenty-two years important political events had transpired. Venezuela no longer belonged to Spain; the peaceful valley d'Aragua had been the theatre of many a bloody contest; war to the knife had desolated this beautiful country and decimated its inhabitants. On the first cry of independence raised, a great number of slaves found freedom by enlisting under the banners of the new republic; agricultural operations of any extent were abandoned, and the forest, which makes such rapid progress in the tropics, had soon regained possession of the surface which man had won from it by something like a century of sustained and painful toil. With the increasing prosperity of the valley, many of the principal tributaries to the lake had been turned aside to serve as a means of irrigation, so that the beds of some of the rivers were absolutely dry for more than six months in the year. At the period which I now refer to, the water was no longer used in this way, and the beds of the rivers were full. Thus with the growth of agricultural industry in the Valley d'Aragua, when the extent of cleared surface was continually on the increase, and when great farming establishments were multiplied, the level of the water sunk; but by and by, during a period of disasters, happily passing in their nature, the process of clearing is arrested, the lands formerly won from the forest are in part restored to it, and then the waters first cease to fall in their level, and by and by show an unequivocal disposition to rise.

In crossing the steppe of Baraba, in his way from Tobolsk to Baraoul, M. de Humboldt perceived everywhere that the drying up of waters increases rapidly under the influence of the cultivation of the soil.

Europe also possesses its lakes; and we have still to examine them from the particular point of view which engages us. M. de Saussure, in his first inquiries in regard to the temperature of the lakes of Switzerland, examined those which are situated at the foot of the first line of the Jura. The Lake of Neufchatel is eight leagues in length, and its greatest breadth does not exceed two leagues. On visiting it, Saussure was struck with the extent which this lake must formerly have possessed; for, as he says, the extensive level and marshy meadows which terminate it on the south-west, had unquestionably been covered with water at a former period.

The effect of forests, considered in this point of view, would therefore, be to keep up the amount of the waters which are destined for mills and canals; and, next, to prevent the rain water from collecting, and flowing away with too great rapidity. That a soil covered with trees is further less favourable to evaporation than ground that has been cleared, is a truth that all will probably admit without discussion. To be aware that it is so, it is enough to have travelled, a short time after the rainy season, upon a road which traverses in succession a country that is free from forests, and one that is thickly wooded. Those parts of the road that pass through the unencumbered country are found hard and dry, while those that traverse the wooded districts are wet, muddy, and often scarcely passable. In South America, more, perhaps, than anywhere else, does the obstacle to evaporation from a soil thickly shaded with forests, strike the traveller. In the forests the humidity is constant,—it exists long after the rainy season has passed; and the roads that are opened through them, remain through the whole year deeply covered with mire;—the only means known of keeping forests-ways dry, is to give them a width of from 260 to 330 feet, that is to say to clear the country in their course.

If once the fact is admitted, that running streams are diminished in size by the effect of felling the forests and the extension of agriculture, it imports us to examine whether this diminution proceeds from a less quantity of rain, or from a greater amount of evaporation, or whether perchance it may be owing to the practice of irrigation.

I set out with the principle that it must be next to impossible to specify the precise share which each of these different causes has in the general result. I shall, nevertheless, endeavour to appreciate them in a summary way. The discussion will have gained something, if it be proved that there may be diminution of running streams in consequence of clearing off the forests alone, without the whole of the causes being presumed to act simultaneously.

With regard to irrigation, it is necessary to distinguish between that case in which an extensive farm has been substituted for an impenetrable forest, and that in which an arid soil, which never supported wood, has been rendered productive by the industry of man. In the first case, it is very probable that irrigation will have contributed but little to the diminution in the mass of running water; it may readily be imagined that the quantity of water used up by a dense forest, will equal, at all events, if not exceed, that which will be required by any of the vegetables which human industry substitutes for it. In the second case, that is to say, where a great extent of waste country has been brought under cultivation, there will evidently be consumption of water by the vegetation which has been fostered upon the surface; agricultural industry will thus tend to diminish the quantity of water which irrigates a country. It is extremely probable that it is to a circumstance of this kind that we must ascribe the diminution of the lakes which receive so large a proportion of the running streams in the north of Asia. It is almost unnecessary to add, that in circumstances of this kind the effect which is due to the simple evaporation of rain water is not increased; the loss by this means must be rather less, because from a surface covered with plants evaporation takes place more slowly than from one that is devoid of vegetation.

In the considerations which I have presented upon the lakes of Venezuela, of New Granada, and of Switzerland, the diminution may be directly ascribed to a less mean annual quantity of rain; but it may, with equal reason, be maintained to be a simple consequence of more rapid evaporation.

There are, in fact, a variety of circumstances, under the influence of which the diminution of running streams can be shown to be connected with more active evaporation. I shall confine myself to the mention of two particular instances, one noticed by

M. Desbassyns de Richemond, in the Island of Ascension; the other is from observations by myself, and is among the number of facts which I registered during my residence of several years at the mines of Marmato.

In the Island of Ascension there was an excellent spring, situated at the foot of a mountain originally covered with wood; this spring became scanty and dried up, after the trees which covered the mountain had been felled. The loss of the spring was rightly ascribed to the cutting down of the timber. The mountain was, therefore, planted anew, and a few years afterwards the spring reäppeared by degrees, and by and by flowed with its former abundance.

* * * * * * * *

We have still to inquire, whether extensive clearings of the forest—clearings which embrace a whole country—cause any diminution in the quantity of rain that falls. Unfortunately, the observations which we have upon the quantity of rain which falls in particular districts, are only of sufficient antiquity and accuracy in Europe, to be worthy of any confidence, and there the soil was cleared, before observation, in the generality of instances, began.

The United States of America, where the forests are disappearing with such rapidity, will probably one day afford elements for the complete and satisfactory solution of the question, whether or not the cutting down of forests causes any diminution in the quantity of rain which falls in the course of the year.

In studying the phenomena accompanying the fall of rain in the tropics, I have come to a conclusion which I have already made known to many observers My own opinion is, that the felling of forests over a large extent of country has always the effect of lessening the mean annual quantity of rain.

It has long been said, that in equinoctial countries the rainy season returns each year with astonishing regularity. There can be no doubt of the general accuracy of this observation, but the meteorological fact must not be announced as universal and admitting of no exception; the regular alternation of the dry and rainy season is as perfect as possible in countries which present an extreme variety of territory. Thus, in a country whose surface is covered with forests, and rivers, and lakes, with mountains, and plains, and table lands, the periodical seasons are quite distinct. But it is by no means so where the surface is more uniform in its character. The return of the rainy season will be much less regular if the soil be in general dry and naked; or if extensive agricultural operations take the place of the primeval forest; if rivers are less common, and lakes less frequent. The rains will then be less abundant; and such countries will be exposed, from time to time, to droughts of long continuance. If on the contrary, thick forests cover almost the whole of the territory, if its rivulets and rivers be numerous, and agriculture be limited in extent, irregularity in the seasons will then take place, but in a different way; the rains will prevail, and in some seasons they will become as it were incessant.

The facts which have now been laid before the reader seem to authorize me to infer—

1st.—That extensive destruction of forests lessens the quantity of running water in a country.

2nd—That it is impossible to say precisely whether this diminution is due to a less mean annual quantity of rain, or to more active evaporation, or to these two effects combined.

3d.—That the quantity of running water does not appear to have suffered any diminution or change in countries which have known nothing of agricultural improvement.

4th.—That independently of preserving running streams, by opposing an obstacle to evaporation, forests economize and regulate their flow.

5th—That agriculture established in a dry country, not covered with forests, dissipates an additional portion of its running water.

6th.—That clearings of forest land of limited extent may cause the disappearance of particular springs, without our being therefore authorized to conclude that the mean annual quantity of rain has been diminished.

7th. and lastly.—That in assuming the meteorological data collected in intertropical countries, it may be presumed that clearing off the forests does actually diminish the mean annual quantity of rain which falls.

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## Investigation of the Specific Heats of Elastic Fluids.

BY M. V. REGNAULT.

I have been employed for more than twelve years in collecting the elements necessary for the solution of the following general problem:—

"A certain quantity of heat being given, what is theoretically the moving force which can be obtained from it by applying it to the developement and dilatation of different elastic fluids, in the various circumstances which can be realised in practice?"

The complete solution of this problem would give the true theory, not only of the steam engines now in use, but also that of engines in which the vapour of water was replaced by other vapours, or even by a permanent elastic fluid, whose elastic force should be augmented by the heat.

At the time I began these researches, the question appeared to be more simple than it does at present. Starting from ideas then admitted in science, it was easy to define clearly the different elements which compose it, and I imagined processes by aid of which I hoped to succeed, in finding in succession their laws, and fixing their numerical data. But, as usually happens in the sciences of observation, as I proceeded in my studies, the circle continually augmented; the questions which, at first, seemed to me most simple, became quite complicated, and, perhaps, I should not have had the courage to attack the subject, if, at the beginning, I had understood all the difficulties.

It has been admitted, until lately, that the quantities of heat disengaged or absorbed by the same elastic fluid were equal, when the fluid passed from the same initial to an identical final state, in whichever direction the transition took place; in a word, it was admitted that the quantities of heat depended only on the initial and final conditions of temperature and pressure, and were independent of the intermediate circumstances through which the fluid passed. S. Carnot published, in 1834, under the title of *Reflections on the Motive Power of Fire*, a work, which did not at first excite much attention, and in which he admits, as a principle, that the motive force produced in a fire engine is due to the passage of the heat from the more heated calorific source which emits the heat, to the cooler condenser which finally collects it.

Mr. Chapeyron has developed mathematically the hypothesis of Carnot; and he has shown that, the quantities of heat gained or lost by the same gas, then, do not depend solely upon its initial and final state, but also upon the intermediate state through which it is made to pass.

The mechanical theory of heat has regained favour within a few years, and it now employs a great number of mathematicians. But the principle of Carnot has undergone an important modification—it has been admitted that heat may be transformed into mechanical work, and that, reciprocally, mechanical work may be transformed into heat. In the theory of Carnot, the quantity of heat possessed by the elastic fluid at its entrance into the engine is found entirely in the elastic fluid which issues from it, or in the condenser; the work is done merely by the passage of the heat from the boiler into the condenser, while it traverses the engine. In the new theory, this quantity of heat is not entirely preserved in the form of heat; a portion disappears during its passage through the machine, and the work done is in every case proportional to the quantity of heat lost. Thus, in a steam engine with or without condensation, with or without cut-off, the work done by the machine is proportional to the difference between the quantity of heat which the vapour has at its entrance into the machine, and that which it keeps at the moment of its exit or condensation. In this theory, to obtain the maximum mechanical effect from a given quantity of heat, we must make this loss of heat the greatest possible; that is to say, the elastic force which the expanded steam keeps at the moment of its entrance into the condenser must be as small as possible. But in every case, in the steam engine, the quantity of heat utilised in mechanical work will be but a very small portion of that which we have been obliged to give to the boiler.

In a steam engine in which the steam is expanded, but not condensed, the steam entering under a pressure of five atmospheres, and discharged at atmospheric pressure, the quantity of heat which the steam has, when it enters the machine, is, according to my experiments, about 653 units; that which it retains at its discharge, 637. According to the theory of which I am speaking, the quantity of heat utilised in mechanical work is 653—637=16 units; that is, only $\frac{1}{40}$th of the quantity of heat given to the boiler. In a condensing engine, receiving its steam at five atmospheres, and the condenser keeping, constantly, an elastic force of 55 mm. of mercury, the quantity of heat in the entering steam will be 653 units, and that which it has at the moment of its condensation 619; the heat utilised will be 34 units, or a little more than $\frac{1}{20}$th of the heat given to the boiler.

A larger portion of the heat may be utilised in mechanical work, either by overheating the steam before its entrance into the machine, or by lowering as much as possible the temperature of the condenser. But this latter means is hard to realise in practice; it would, moreover, require a considerable increase in the quantity of cold water necessary for effecting the condensation, which wastes power, and the boiler can only be fed by water which is but little heated. We shall attain the same end more easily by expanding the steam to a less degree in the machine, and condensing the steam by the injection of a very volatile liquid, such as chloroform or ether. The heat which the steam has at the moment of this condensation, and of which but a very small part would have been transformed into mechanical work, passes into the more volatile liquid, which it transforms into vapour of high pressure. By passing this vapour into a second machine, where it expands to the elastic force to which the injection water can practically reduce the condenser, a part of the heat is transformed into mechanical work; and a calculation founded on the numerical data of my experiments, shows that this quantity is much greater than could have been obtained by the further expansion of steam in the first machine. In this way can be perfectly explained the economical result obtained from two connected machines, the one working with water, the other with ether or chloroform, on which experiments have been recently made.

In the air engines, where the motive force is produced by the dilatation which heat produces upon the gas in the machine, or by the increase which it produces in its elastic force, the work done at each stroke of the piston will always be proportional to the difference of the quantities of heat in the air entering and leaving; that is, to the loss of heat by the air in traversing the machine. But as, in the Ericsson system, the heat which the air gives out is given up to bodies from which the entering air takes it again, and brings it back to the machine, we see that, theoretically, all the heat expended is utilised for mechanical work; whilst, in the best steam engine, the heat utilised in mechanical work is not the $\frac{1}{20}$th part of the heat expended. Be it observed here, that I neglect all the extraneous sources of loss, as well as the mechanical or practical obstacles which may present themselves in the application of the principle.

MM. Joule, Thomson, and Rankine, in England, and MM. Mayer and Clausius, in Germany, starting frequently from different points of view, have developed analytically this mechanical theory of heat, and have sought to deduce from it the laws of all the phenomena relative to elastic fluids. For my part, I have for a long time expressed, in my courses of lectures, analogous ideas, to which I have been led by my experimental labours upon elastic fluids. In these researches I, in fact, met anomalies which appeared to me inexplicable in the theories before admitted. To give an idea of them, I will cite some of the most simple examples.

*First example.*—1st, A mass of gas, under a pressure of ten atmospheres, enclosed in a space the capacity of which is suddenly doubled, the pressure descends to five atmospheres.

2nd. Two reservoirs of equal capacity are placed in the same calorimeter; the one is filled with a gas under ten atmospheres, the second has a complete vacuum; the communication between the two reservoirs is suddenly opened; the gas expands into double its volume, and the pressure is also reduced to five atmospheres.

Thus, in the two experiments, the initial and final conditions of the gas are the same; but this identity of conditions is accompanied by very different caloric results; for, whilst in the first case a considerable cooling is observed, in the second the calorimeter shows not the least change of temperature.

*Second example.*—1st. A mass of gas traverses, under atmospheric pressure, a worm, in which it is heated to 100° cent; then, a calorimeter, whose initial temperature is 0°. It raises the temperature of the calorimeter $t°$.

2nd. The same mass of gas traverses, under the pressure of ten atmospheres, the worm, in which it is heated to 100°, then the calorimeter at 0° under the same pressure; it raises the temperature of the calorimeter $t'°$, and experiment shows that $t$ and $t'$ are but slightly different.

3rd. The same mass of gas, under the pressure of ten atmospheres, traverses the worm, in which it is heated to 100°; but when it arrives at the orifice of the calorimeter at 0°, or to any point of its course, the gas dilates, and descends to the pressure of the atmosphere; so that it issues from the calorimeter in equilibrium of temperature with it, and in equilibrium of pressure with the surrounding atmosphere. An elevation of temperature, $t''$, is observed in the calorimeter.

According to the theories formerly admitted, the quantity of heat abandoned by the gas in experiment No. 3, ought to be equal to that of No. 2, diminished by the quantity of heat which has been absorbed by the gas during the enormous dilatation which it has undergone. On the contrary, experiment shows a higher value for $t''$ than for $t'$ and $t$. I might multiply these citations, but I should anticipate what I have hereafter to say. I reserve the farther elucidation until I shall publish together the experiments which I have made on the compression and dilatation of gases.

However, the examples which I have just cited suffice to show

how careful we must be in the conclusions to be drawn from the experiments in which elastic fluids that are in motion, undergo changes of elasticity, and perform mechanical work often difficult to appreciate; for the calorific effects produced depend, in great part, upon the order and manner in which these changes have taken place.

Unhappily, if it is easy to announce vaguely a physical theory, it is very difficult to specify it with precision, so as not only to connect with it all the facts known to science, but also to deduce from it those which have heretofore escaped observation. The theory of luminous undulations, as it was established heretofore by Fresnel, presents the only example heretofore known in physics. The expression in equations of the problems of heat, looked upon in a mechanical point of view, leads, like all analagous problems, to an equation of partial differences of the second order, between several variables which are unknown functions of each other. These functions represent the true elementary physical laws, which must be known, in order to have the complete solution of the problem. The integration of the equation introduces arbitrary functions, the nature of which we must seek to discover by preparing the results given by the equation with those which direct experiments give, and with the laws derived from those experiments. Unhappily, in experiments on heat, direct experiments are rarely applicable to simple phenomena; generally, they attack complex questions, which depend on several of these laws at a time, and most frequently it is difficult to assign the part which belongs to each of them. The experimenter must then endeavour to modify the circumstances under which he operates, so as to vary as far as possible, in the respective experiments, the parts which belong to each of the elementary phenomena, and to the law which expresses it. He will thus obtain equations of condition which may be of great aid for the discovery of a general theory; for this, whatever it may be, must always satisfy these equations.

This is the manner in which I have directed my researches; and I have always endeavored to define, in the most precise way, the conditions under which I was working, so that my experiments might be of service, whatever theory might finally prevail.

I published, in 1847, the first part of my researches; they compose the second volume of the *Memoirs of the Academy* (*of Sciences of Paris*). Since that date I have not ceased to pursue them; but the experiments which they required were so numerous, the numerical calculations so long and troublesome, that it would have been impossible for me to have executed them, if I had been left to my own individual efforts. I have been powerfully seconded by M. Izarn, who had already lent me his assistance for the first part of my work, and by a young engineer of mines, M. Descos, whom the minister of public works has kindly appointed my assistant for the last two years, in order to hasten the conclusion of my work. Let me be permitted thus publicly to express my thanks for the indefatigable zeal with which they have seconded me.

The subjects to which my new experiments have been directed are the following :—

1st. The relations which exist between the temperatures and the elastic forces of a great number of saturated vapours, from the feeblest pressures up to twelve atmospheres.

2nd. The elastic forces of these same vapours, saturated or not, in the gases.

3rd. The elastic forces, at saturation, of the vapours produced by mixed liquids.

4th. The latent heat of these vapours, under different pressures, from the feeblest up to those of eight or ten atmospheres.

5th. The latent heats of vaporization of the same substances, in gases.

6th. The specific heats of permanent gases and vapours, under different pressures.

7th. The quantities of heat absorbed and disengaged by the compression and dilitation of gases, whether this dilatation takes place in a space whose capacity is augmented, or whether it takes place through a capillary opening in a thin wall, or by a long capillary tube.

8th. The quantities of heat absorbed by the gas, when it produces, during its expansion, a motive force which is altogether consumed in the interior of the calorimeter, or is principally utilised elsewhere.

9th. And, finally, the densities of saturated vapours under different pressures.

The experiments which have reference to these different questions, with the exception of the last one, are now nearly finished. But, as much time will still be required to put them in order, and discuss them with the proper care, I propose to present the general results, successively, to the academy, while awaiting the time when I can publish them together.

I will present at present my researches on the calorific capacities of elastic fluids.

*The capacities for heat of elastic fluids.*—The specific heat of elastic fluids may be defined in two different ways; in the first, the specific heat of an elastic fluid is the quantity of heat which must be given to a gas to raise its temperature from 0° to 1° cent., allowing it to dilate freely, so as to preserve a constant elasticity; in the second, it is the quantity of heat which must be given to it, to raise its temperature from 0° to 1°, forcing it to keep its volume, its elastic force increasing.

The first of these has been called the specific heat of a gas under constant pressure. The second, specific heat of a gas under constant volume. The first definition only, coincides with that which has been admitted for the capacity for heat of solid and liquid bodies; it is also the only one which has heretofore lent itself to direct experimental demonstration.

A great number of physicists have employed themselves during the last century, in the examination of the specific heats of elastic fluids; Crawford, Lavoisier and Laplace, Dalton, Clement and Desormes, De la Roche and Berard, Haycrafft, Gay-Lussac, Dulong, De la Rive, and Marcet, have successively published researches on this subject. The greater part of these physicists have sought to demonstrate experimentally certain laws to which they had been led by the ideas which they had formed *à priori* as to the constitution of elastic fluids. They have applied themselves to determine the numerical values of the caloric capacities of the different gases in relation to that of liquid water generally taken as unity, than to look for the simple relations which they supposed must exist among themselves. The conclusions to which they have come are generally very erroneous.

The work of De la Roche and Berard, which was crowned by the Academy in 1813, is still the most complete on this subject, and the one whose results differ the least from the truth. This superiority is caused not only by the extreme care which these skilful experimenters exercised in their experiments, but also by the direct method which they followed; whilst the greater part of the other physicists had recourse to indirect methods, in which the element they sought exercised frequently but a very feeble influence.

The general conclusions which De la Roche and Berard drew from their labours were as follows:—

1. The specific heats of the gases are not the same for all,

whether we consider them in reference to volumes or to weights.

2. The capacity for heat of atmosphere air (that of water=1) is 0·2669; that of the vapour of water 0·8470.

3. The specific heat of equal volumes of atmospheric air increases with the density, but in a less rapid progression. The ratio of the pressures being

$$\frac{1}{1{\cdot}3583}\text{, that of the specific heat is }\frac{1}{1{\cdot}2396}.$$

4. De la Roche and Berard admit, on theoretic considerations, and resting, moreover, on direct experiments of Gay-Lussac, that the specific heat of the gas increases rapidly with the temperature.

These are the most precise notions on the specific heat of gases which we at present possess, and which are generally admitted by physicists. The limits within which I am obliged to confine myself, in the present extract, prevent me from discussing the methods which have been adopted by my predecessors, or to explain those which I have myself followed. I will merely say, that I have met, in this kind of researches, great difficulties, not only in the experiments, but also in point of theory; the considerations which I have mentioned at the commencement of this article will render them easily understood. Thus, although my first experiments are fifteen years old, and although I announced them at that epoch in the *Memoirs on the Specific Heats of Solids and Liquids*, it is only after using the most various methods, and after having forced the elements of their correction in opposite directions, that I now, with confidence, present my results to the Academy.

According to my experiments, the specific heat of air, compared with that of water, is

| | | | |
|---|---|---|---|
| Between — 30° and 10° cent. | | | 0·2377 |
| " + 10° " 100° | .. | | 0·2379 |
| " 100° " 225° | .. | | 0·2376 |

Thus, contrary to the experiments of Gay-Lussac, the specific heat of air does not vary sensibly with the temperature. Experiments made upon some other permanent gases led to a similar conclusion.

In experiments made upon atmospheric air, under pressures varying from 1 to 10 atmospheres, I found no sensible difference between the quantities of heat which the same mass of gas abandons in cooling, through the same number of degrees. Thus, in contradiction to the experiments of De la Roche and Berard, who found a very notable difference for pressures varying only from 1 to 1·3 atmospheres, the specific heat of the same mass of gas is independent of its density. Experiments made upon several other gases led me to analogous conclusions. I, nevertheless, present this law with some reserve; I cannot yet decide whether the capacity for heat under different pressures is absolutely constant, or whether it undergoes a very slight variation; because my experiments, perhaps, require a slight correction for the state of motion in which the gas was.

The specific heat 0·237 of the air, compared with water, is notably smaller than the number 0·2669, admitted by De la Roche and Berard; it is derived from more than a hundred determinations made under different conditions.

The other elastic fluids whose specific heat I have determined are—

| | Specific heats. | | |
|---|---|---|---|
| Simple gases. | By weight. | By volume. | Densities. |
| Oxygen | 0·2182 | 0·2412 | 1·1056 |
| Azote (nitrogen) | 0·2440 | 0·2370 | 0·9713 |
| Hydrogen | 3·4046 | 0·2356 | 0·0692 |
| Chlorine | 0·1214 | 0.2962 | 2·44 |
| Bromine | 0·05518 | 0·2992 | 5·39 |

In casting the eyes over this table, it is immediately remarked that the specific heats of equal volumes of oxygen, azote, and hydrogen, differ very little from each other; so that we would be led to admit that the specific heat of the simple gases is the same, when these gases are taken under the same volume and at the same pressure. But for chlorine and bromine, numbers have been found nearly equal to each other, but much greater than those which were obtained for the other simple gases.

| | Specific heats. | | |
|---|---|---|---|
| Compound gases. | By weight. | By volume. | Densities. |
| Protoxide of azote | 0·2238 | 0·3413 | 1·5250 |
| Deutoxide | 0·2315 | 0·2406 | 1.0390 |
| Oxide of carbon | 0·2479 | 0·2399 | 0·9674 |
| Carbonic acid | 0·2164 | 0·3308 | 1.5290 |
| Sulphuret of carbon | 0·1575 | 0·4146 | 2·6325 |
| Sulphurous acid | 0·1553 | 0.3489 | 2·2470 |
| Chlorhydric " | 0.1845 | 0·2302 | 1·2474 |
| Sulphydric " | 0·2423 | 0·2886 | 1·1912 |
| Ammonia (gas) | 0·5080 | 0·2994 | 0·5894 |
| Protocarburet of hydrogen | 0·5929 | 0·3277 | 0·5527 |
| Bicarburet of hydrogen | 0·3694 | 0·3572 | 0·9672 |
| Vapour of water | 0·4750 | 0.2950 | 0.6210 |
| " Alcohol | 0·4513 | 0·7171 | 1·5890 |
| " Ether | 0·4810 | 1·2296 | 2·5563 |
| " Chlorhydric ether | 0·2737 | 0·6117 | 2·2350 |
| " Bromhydric " | 0·1816 | 0·6777 | 3·7316 |
| " Sulphydric " | 0·4005 | 1·2568 | 3·1380 |
| " Cyanhydric " | 0·4255 | 0·8293 | 1.9021 |
| " Chloroform | 0·1568 | 0·8310 | 5·30 |
| " Dutch liquid | 0·2293 | 0.7911 | 3·45 |
| " Acetic ether | 0·4008 | 1.2184 | 3·04 |
| " Acetone | 0·4125 | 0·8341 | 2 022 |
| " Benzine | 0·3754 | 1·0114 | 2·6943 |
| " Essence of turpentine | 0·5061 | 2·3776 | 4·6978 |
| " Chloride of phospho's | 0·1346 | 0·6386 | 4·7445 |
| " Arsenic | 0.1122 | 0·7013 | 6·2510 |
| " Silicium | 0·1329 | 0·7788 | 5·86 |
| " Tin | 0·0939 | 0·8639 | 9·2 |
| " Titanium | 0·1263 | 0·8634 | 6·836 |

The specific heat which I have determined for the vapour of water, by a great number of experiments, is 0·475; it is only about one-half of that found by De la Roche and Berard. It is very remarkable, that the specific heat of the vapour of water is very nearly equal to that of ice, or solid water, and only one-half of that of liquid water.

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**Researches on the Developement of the Viviparous Aphides. By Dr. W. J. Burnett.**

"With every inquiring mind there is a deep interest connected with the developement of animal life. To watch the origin and rise of new forms, to trace the successive phases through which they pass, as the ideas on which they are formed become more and more definitely expressed, until finally they have their full incarnation in perfect animals: these, from the earliest times, have been favorite studies with some of the most genial minds, and over which they were accustomed to dwell with the profoundest delight.

"With a subject naturally so enticing, it is not surprising that the Old Fathers of our science soon learned many of the more general conditions which wait upon the introduction into life of new beings. In these studies, the class of insects has always been quite prominent for the materials it furnished; the commonness of these animals, and the readiness with which they are at all times obtained, render them easy objects of inquiry in all their conditions of life, and there can be no doubt that many of these fine old naturalists who have long passed away, owe the basis of their high eminence to Entomological studies of this kind, into which they were seductively drawn in their earlier days.

Every naturalist is aware of the remarkable phenomena connected with viviparous reproduction of Aphides or plant-lice, for their singularity has led them to be recounted in works other than those of natural science, and, from the earlier observers, they have been a kind of wonder-stories in Zoology and Physiology.

I need not here go over the historical relations of this subject. The queer experiments and the amusing writings of the old Entomologists are well known. The brief history of the general conditions of the developement of those insects are as follows: In the autumn the colonies of plant-lice are composed of both male and female individuals; they pair, the males then die and the females deposit their eggs, after which they die also.

Early in the ensuing spring, as soon as the sap begins to flow, these eggs are hatched, and the young lice immediately begin to pump up sap from the tender leaves and shoots, increase rapidly in size, and in a short time come to maturity. In this state it is found that the whole brood, without a single exception, consists solely of females, or rather and more properly of individuals which are capable of reproducing their own kind.

This reproduction takes place by a viviparous generation, there being formed in the individuals in question young lice, which, when capable of entering upon individual life, escape from their progenitor and form a new and greatly increased colony. This second generation pursues the same course as the first, the individuals of which it is composed being like those of the first, sexless, or at least without any trace of male sex throughout.

These same conditions are here repeated, and so almost indefinitely. Experiments having shown that this power of reproduction under such circumstances may be exercised, according to Bonnet, at least through nine generations, while Duvan obtained thus eleven generations in seven months, his experiments being here curtailed, not by a failure of reproductive power, but, by the approach of winter, which killed his specimens; and Keyber even observed that a colony of *Aphis dianthi*, which was brought into a constantly heated room, continued to propagate for four years in this manner without the intervention of males, and even in this instance it remains to be proved how much longer these phenomena might have been continued.

The singularity of these results led to much incredulity as to their authenticity, and on this account the experiments were often and carefully repeated; and there can now be no doubt that the virgin Aphis reproduces her kind—phenomena which are continued almost indefinitely, ending finally in the appearance of individuals of distinct male and female sex, which lay the foundation of new colonies in the manner just described.

The question arises, what interpretation is to be put upon this almost anomalous phenomenon? Many speculations have been offered by various naturalists and physiologists, but most of them have been as unsatisfactory as they have been forced, and were admissible only by the acceptance in physiology of quite new features.

As the criticism I intend to offer upon some of these opinions will be the better understood after the detail of my own researches, I will reserve this further notice until the concluding part of this paper.

My observations were made upon one of the largest species of Aphis with which I am acquainted, the *Aphis Caryœ* of Harris.

While in Georgia this last spring, it was my good fortune that myriads of these destroyers appeared on a hickory which grew near the house in which I lived. The number of broods on this tree did not exceed three, for with the third series their source of subsistence failed and they gradually disappeared from starvation. The individuals of each brood were throughout of the producing kind, no males were to be found, upon the closest search; they were all, moreover, winged, and those few which were seen without those appendages appeared to have lost them by accident. I mention this fact, especially since it has been supposed by naturalists that the females were always wingless, and therefore that the winged individuals or the males appeared only in autumn.

The first brood, upon their appearance from their winter hiding place, were of mature size, and I found in them the developing forms of the second brood quite far advanced. On this account it was the embryology of the third series or brood alone, that I was able to trace in these observations. In a few days after the appearance of these insects, the second brood (B), still within its parent (A), had reached two-thirds its natural size. At this time the arches of the segments had begun to close on the back, and the various external appendages of the insect to appear prominently. The alimentary canal had been more or less completely formed, although distinct abdominal organs of any kind belonging to the digestive system were not very prominent. At this period, and while the individuals of generation B are not only inside of their parent A, but are also enclosed each in its primitive egg like capsule,—at this time I repeat, appear the first traces of the germs of the third brood (C).

These first traces consist of small egg-like bodies, arranged two, three or four in a row, and attached to the locality where are situated the ovaries in the oviparous forms of these animals. These egg-like bodies were either single nucleated cells of 1-3000 of an inch in diameter, or a small number of such cells inclosed in a single sac. These are the germs of the third generation; they increase with the developement of the embryo, in which they have been formed, and this increase of size takes place not by an augmentation of the primitive cells, but by the endogenous formation of new cells. After this increase has gone on for a certain time, they appear like little oval bags of cells—all these component cells being of the same size and shape, there being no one which is longer and more prominent than the rest, and which could be comparable to a germination vesicle. While germs are thus constituted, the formation of new ones is continually taking place. This occurs by a kind of constriction process of the first germs, one of their ends being pinched off, as it were, and thus what was a single sac becomes two, which are attached in a moniliform manner. This new germ, thus formed, may consist of only a single cell, as I have often seen, but it soon attains a more uniform size by the endogenous formation of new cells within the sac by which it is inclosed. In this way the germs are multiplied to a considerable number, the nutritive material for their growth being apparently a sort of liquid with which they are bathed, contained in the abdomen, and which is here derived from the abdomen of the first parent. When these germs have reached the size of 1-300th of an inch in diameter, there appears on each, near one side, a yellowish, vitellus-looking mass of spots, which in size and general aspect are different from those constituting the germ proper. This yellowish mass increases *pari passu* with the germ, and at last lies like a cloud over and conceals one of its poles.

I would also insist on the point that it does not extend itself gradually over the whole given mass, and is therefore quite unlike a true germinative vesicle or a proligerous disc. When the egg-like germs have attained the size of 1-50th of an inch, then appears distinctly the sketching or marking out of the future animal. This sketching consists at first of delicately marked retreatings of the cells, here and there, but which soon become prominent from furrows, and at last the whole form stands boldly out.

After proceeding with this subject in an able manner and to some considerable length, the learned author says:

If, in this discussion of some of the highest relations of physiology, we have not wandered too far from our subject proper, which we have thereby sought to illustrate, indirectly, we will revert to the thread of its discourse for a few concluding remarks:

The final question now is, what is the legitimate interpretation of these reproductive phenomena of the Aphides we have described? My answer to this has been anticipated in the foregoing remarks. I regard it as nothing but a rather anomalous form of gemmiparity. As already shown, the viviparous aphides are sexless; they are not females, for they have no proper female organs, no ovaries and oviducts. These viviparous individuals, therefore, are simply gemmiparous, and the building is internal instead of external, as with the Polyps and Acalephs; it, moreover, takes on some of the morphological peculiarities of oviparity, but all these similar conditions are economized and extrinsic, and do not touch the intrinsic nature of the processes concerned therein."
—*Proceedings of the American Association—Annals of Science*

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## On the parallelism of the lower Silurian groups of Middle Tennessee with those of New York.*

BY PROF. J. M. SAFFORD.

The Lower Silurian rocks of Middle Tennessee are divided into two natural, and well characterized groups. The Lower division, which has been named the *Stones River Group*, is a series of bluish and dove-colored limestones from 250 to 300 feet thick. These rocks are the lowest visible in this part of the State.

The Upper division, named the Nashville Group, is, in great part, dark bluish limestone, about 400 feet in thickness. We are acquainted with 200 species from these rocks, of which one half are new, the others being identical with New York species.

The Tennessee strata, under consideration, are the equivalents, generally, of the following New York groups: first, the Black River group (including the Chazy, Birdseye and Black River limestones); secondly, the Trenton limestone; and thirdly, the Hudson River group (including the Utica slate.)

This general parallelism is very clear and satisfactory. When we come, however, to search, in Tennessee, for the Trenton limestone, separated, as a distinct group, from the Black River rocks below, and from the Hudson River above, we are entirely lost.

The difficulties are these: First, many of the species, belonging exclusively to the Trenton limestone in New York, occur, in Middle Tennessee, mingled in the same strata with Black River fossils; in fact, many of them occur in a lower position than some of the Black River species, for instance the following group, *Stromatocerium rugosum*, *Streptoplasma profunda*, and *Columnaria alveolata*, is highly characteristic of the uppermost member of the Stones River Group; notwithstanding this the central part of the same group affords such Trenton fossils as the following: *Retepora fenestrata*, *Subulites elongata*, *Cyrtolites compressus*, *Bucania bidorsata*, *Bucania expansa*, &c., &c. In the second place, if we take the Nashville group, and study its Trenton, and Hudson River fossils, we find the same blending of species, some of the Trenton running up to the very top of the group, and some of the Hudson River appearing at its base.

* Proceedings of the American Association—Annals of Science.

The Trenton species thus appear to lose their value in Middle Tennessee, as characteristic of a subdivision of the Lower Silurian rocks.

It is very different, however, with the species of the ot[her] New York groups. The Stones River group has through[out] (excluding the Trenton species) a well marked Black R[iver] fauna; and so the Nashville group, which succeeds it [h]as a decided Hudson River fauna, while at the same time there is no blending of these characteristic species.

To illustrate these remarks, I have constructed the table on the following page, using all the described species common to the two States, excepting those found, either in both the Tennessee groups, or, in both the Black River and Hudson River groups of New York, for these do not bear upon the points before us; this excludes such species as *Orthis testudinia*, *Pleurotomasia umbilicata*, *Leptæna sericea*, *L. alternata*, *Chætetes columnaris*, *Murchisonia bicincta*, &c., &c. Several *doubtful* species have also been excluded.

This table illustrates the blending in Tennessee, of Trenton with Black River species below, and Hudson River species above; and, also, the fact, that the characteristic Black River species are confined to the Stones River Group, while those characteristic of the Hudson River rock, are confined to the Nashville Group.

| | New York. | | | | | | Tennessee. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | *Stones R. Group.* | | | *Nas'vill Group.* | | |
| | Chazy. | B. & B. R. | Low. Tren. | Cen. Tren. | Up. Tren. | U. S. H. R. | Low. | Cen. | Up. | Low. | Cen. | Up. |
| 1. Maclurea Magna | • | • | | | | | | • | | | | |
| 2. Columnaria alveolata | | • | | | | | | | • | | | |
| 3. Streptoplasma profunda | | • | | | | | | | • | | | |
| 4. Stromatocerium rugosum | | • | | | | | • | | • | | | |
| 5. Gonioceras anceps | | • | | | | | • | • | | | | |
| 6. Lituites undatus | | • | | | | | | • | | | | |
| 7. Orthoceras fusiforme | | • | | | | | • | • | • | | | |
| 8. Buthotrephis* caespitosa | | | • | | | | | • | | | | |
| 9. Retepora fenestrata | | | • | | | | | • | | | | |
| 10. Leptaena filitexta | | | • | | | | | • | • | | | |
| 11. Orthis tricenaria | | | • | | | | | • | | | | |
| 12. Bucania bidorsata | | | • | | | | | • | | | | |
| 13. Bucania expansa | | | • | | | | | • | | | | |
| 21. Pleurotomaria rotuloides | | | • | | | | | | • | | | |
| 15. Cyrtolites compressus | | | • | | • | | | • | | | | |
| 16. Phacops callicephalus | | | • | | • | | | • | | | | |
| 17. Edmondia ventricosa | | | | • | • | | | • | | | | |
| 18. Ambonychia amygdalina | | | | | • | | | • | | | | |
| 19. Endoceras proteiforme | | | | • | • | | | • | | | | |
| 20. Subulites elongata | | | | | • | | | • | | | | |
| 21. Spirifer lynx | | | • | • | • | | | | • | • | • | |
| 22. Orthis pectinella | | | • | • | • | | | | | | • | |
| 23. Murchisonia bellacincta | | | • | | • | | | | | | • | |
| 24. M. subfusiformis | | | | | • | | | | | | • | |
| 25. Atrypa modesta | | | | | • | • | | | | | • | • |
| 26. Modiolopsis anodontoides | | | | | | • | | | | • | | |
| 27. Favistella stellata | | | | | | • | | | | | • | • |
| 28. Ambonychia radiata | | | | | | • | | | | | • | • |
| 29. Avicula demissa | | | | | | • | | | | | • | |
| 30. Cyrtolites ornatus | | | | | | • | | | | • | | |

In view of all these facts it follows; First, that the Trenton limestone, as a distinct group, cannot be recognised in Middle Tennessee; and, Secondly, that the Nashville and Stones River groups are, respectively, the representatives of the Hudson River, and Black River groups of New York, and that the former rests directly upon the latter.

It may be added too, that the facts, thus developed in Tennessee, show that it will hardly be satisfactory to unite, as has been suggested, the Trenton limestone, as a group, with the Hudson River rocks, for the blending of species takes place downwards as well as upwards in as great, if not greater, proportion. So far as our Tennessee species are concerned, it would be a much more natural arrangement to unite the lower part of the Trenton limestone with the Black River rocks, and the central and upper portions with the Hudson River group. The Table, which has been constructed with reference to this view, illustrates this point sufficiently well. Most of the Trenton species in the Stones River group belong to the Lower division, and the few others may be found hereafter to belong to the same; while all of the Trenton species, in the Nashville group, belong to the Upper division, three of them being common.

If the New York species will admit of this classification, and we are inclined to think they will, the confusion, which has hitherto existed in regard to the parallelism of these groups, will in some measure, at least, be removed.

The parallelism will then be—

| | | |
|---|---|---|
| Nashville group. | Hudson River,<br>Utica State,<br>Cen. and Up. Trenton. | New group. |
| Stones R. group. | Lower Trenton,<br>Black R. G. | New group: say Black River. |

## Photography—The Wax-Paper Process.

May I be permitted to detail a process I have found very successful during a photographic tour I have taken this autumn? It combines the advantages of extreme sensitiveness (two minutes being as effectual as ten by the ordinary method), together with the faculty of the excited paper keeping good for several weeks; two properties which I consider invaluable while working at a distance from home, as the papers can all be excited ready for the camera before commencing the journey, while the development can be deferred until the return home, provided the time elapsed after exciting be not more than about three weeks. By this means the necessity for carrying about a quantity of dishes, chemicals. etc., is avoided, the only requisites being the camera and stand, paper holders and prepared paper.

My method is a modification of Le Gray's process, in which the pores of the paper are saturated with wax previous to the formation of the surface. This is undoubtedly the best, both as regards the brilliancy of the finished picture, and the ease and convenience of manipulation; but there are several circumstances which tend to impair the beauty of the result, foremost of which may be mentioned the spots, one or two being generally to be met with even on the best paper, By the following slight modification I have succeeded in removing the impurities which cause the spots, and also in diminishing the time of exposure in the camera.

The paper I employ is the thin variety made by Canson, Frères. The first operation consists in waxing it: the sheets, cut to the proper size and marked on the smooth side, are to be soaked in melted wax, and afterwards separately ironed between blotting paper until there are no shining particles of wax to be seen on the surface.

The next operation consists in iodizing the sheets; the bath is composed of

| | |
|---|---|
| Iodide of potassium | 15 grains. |
| Water | 1 pint imp. |

with the addition of as much free iodine as will give it a sherry color. This removes the iron and brass, of which the spots generally consist: it will require renewing now and then. The sheets are to be completely immersed in this bath for at least two hours, taking care to avoid air bubbles, and then hung up to dry: they will be of a deep purple color, owing partly to the union of the iodine with the starch in the paper, and will keep good any length of time.

The solution for rendering these iodized sheets sensitive consists of

| | |
|---|---|
| Nitrate of silver | 15 grains |
| Glacial acetic acid | 15 " |
| Water | 1 ounce. |

The marked side of the paper is to be laid carefully on this solution, and kept there for about half a minute longer than necessary to completely decolorize it (from seven to ten minutes), and then floated on distilled water for a few minutes. It must then be dried between blotting-paper, and kept in perfect darkness in a portfolio until required. With only one washing in distilled water, as above, it will not keep good longer than six days; but if washed sufficiently it will keep good for weeks.

It is hardly possible to state any definite time for the exposure in the camera, as this of course must vary with the intensity of the light; but with a lens of twelve inches focal length, with a half inch aperture in front of it, from one to two minutes will suffice on a bright day with the sun out; while on a dark gloomy day, from seven to ten minutes may be requisite.

For developing the picture, I employ four parts of a nearly saturated solution of gallic acid, and one part of the solution previously employed for exciting the paper; these are well mixed, and the marked side of the paper floated on it. The picture will soon begin to appear, and should be completely out in less than an hour, and before the gallo-nitrate is decomposed; it must then be washed, soaked in tolerably strong hyposulphite of soda until all the yellow iodide is removed, washed again several times, and then dried, and either ironed over, or held before a fire to melt the wax. The greatest care must be taken to have the dish perfectly clean to contain the gallo-nitrate; it ought to be rubbed with strong nitric acid now and then, to remove the stains from a previous operation; unless this precaution be taken to avoid the presence of dirt the picture will be covered with stains similar to marbling in book-binding. The gallic acid and nitrate of silver must also be filtered before mixing.

By adhering to these directions, any person who has a little experience in manipulation may be sure of getting excellent results, with a far less number of failures than by any other process. I have endeavored to state everything as explicitly as possible, but should I not have rendered myself sufficiently intelligible in any part of the process, I shall be happy to give any information that lays in my power.

William Crookes.

Hammersmith.

P. S.—I have seen several inquiries respecting the price that ought to be paid for a good lens, the general idea seeming to be that they are very expensive. The lens I always employ cost me fifteen shillings; it was made at Slater's, and is 1⅝ inch in diameter, and 12 inches focus. The picture I forward as an illustration of the process will show what can be done with it: it was taken in one minute with a half inch aperture in f... the lens.—*Notes and Q...*

## The Earl of Rosse's Telescopes, and their Revelations in the Sidereal Heavens.

BY REV. W. SCORESBY, D. D., F. R. S., S. L. & E., etc.*

In a second lecture on these interesting subjects, recently delivered at Torquay, much and important consideration was given to the inquiry,—What has the gigantic telescope done?

The lecturer having himself had the privilege of observing on different visits, and for considerable periods, with both the instruments, was enabled to reply, he hoped in a satisfactory manner, to this inquiry. His opportunites of observing, he said, notwithstanding interruptions from clouds and disturbed atmosphere, had been somewhat numerous, and, not unfrequently, highly instructive and delightful. Of these observations he had made records of nearly 60, on the moon, planets, double stars, clusters, and nebulæ. He had been permitted also to have free access to, and examination of, all the observatory records and drawings, so that he was enabled on the best grounds, he believed, to say, that there had been no disappointment in the performance of the instruments; and that the great instrument, in its peculiar qualities of superiority, possesses a marvellous power in collecting light and penetrating into regions of previously untouched space. In what may be called the domestic regions of our planet—the objects in the solar system—all that other instruments may reveal is within its grasp or more, though by the prodigious flood of light from the brighter planets, the eye is dazzled unless a large portion is shut out.

But in its application to the distant heavens and exploration of the nebulous systems there, its peculiar powers have, with a steady atmosphere, their highest developments and noblest triumphs. In this department—that to which the instrument has been particularly directed—every known object it touches, when the air is favorable, is, as a general fact, exhibited under some new aspect. It pierces into the indefinite or diffuse nebulous forms shewn by other instruments in a general manner, and either exhibits configurations altogether unimagined, or resolves perhaps the nebulous patches of light into clusters of stars. Guided in the general researches by the works of the talented and laborious Herschels—to whom astronomy and science owe a deep debt of gratitude—time has been economized, and the interests of the results vastly enhanced. So that many objects in which the fine instruments of other observers could discern only some vague indefinite patch of light, have been brought out in striking, definite, and marvellous configurations.

Among these peculiar revelations is that of the *spiral* form—the most striking and appreciable of all—which we may venture to designate "*The Rossean Configuration.*" Its discovery was at once novel and splendid; and in reference to the dynamical principles on which these vast aggregations of remote suns are whirled about within their respective systems and sustained against interferences, promises to be of the greatest importance.

One of the most splendid nebulæ of this class—the *great spiral* or *whirlpool*—has been figured in the Philosophical Transactions for 1850. It may be considered as the grand type and example of a class; for near 40 more, with spiral characteristics, have been observed, and about 20 of them carefully figured. Dr. Scoresby had the pleasure of being present at the discovery of this particular form in a nebula of the planetary denomination, in which two portions following spiral forms were detected. Its color was peculiar,—pale blue. He had the privilege, too, of being present on another interesting occasion, when the examination of the great nebula in Orion was first seen to yield decisive tokens of resolution.

In these departments of research, the examination of the configurations of nebulæ, and the resolution of nebulæ into stars, the six-feet speculum has had its grandest triumphs, and the noble artificer and observer the highest rewards of his talents and enterprise. Altogether, the quantity of work done, during a period of about seven years,—including a winter when a noble philanthropy for a starving population absorbed the keenest interests of science,—has been decidedly great, and the new knowledge acquired, concerning the handiwork of the Great Creator, amply satisfying of even sanguine anticipations.

Dr. Scoresby found, in September last, that about 700 catalogued nebulæ had been already examined, and transferred to the ledger records from the journals of the Observatory, (comprising only a selection from the general observations,) and the *new nebulæ*, or nebulous knots, discovered merely incidentally, amounted to 140 or more. The number of observations, involving separate sets of the instrument, recorded in the ledger, (exclusive of very many hundreds, possibly thousands, on the moon and planets,) amount to nearly 1700, involving several hundreds of determinations of position and angular measurements with the micrometer on the far distant stars. The carefully drawn configurations, eliciting *new characteristics*, exceed 90, and the rough or less finished sketches amount to above 200. Of the 700 catalogued nebulæ already examined, it should be observed, that in full one-half or more, something new has been elicited.

In speaking of the effects of the flood of light accumulated by the six-feet speculum of the Earl of Rosse, Dr. Scoresby remarked, that this peculiarity of the instrument (connected as it is with due length of focus and admirable definition) enabled it to reach distances in space far beyond the powers of any other instrument. This was its peculiar province; and in this, as to existing instruments, there was not, nor, as he hoped to shew, could there be, any competition. For comparing the space-penetrating power of the six-feet speculum with one of two feet (which has rarely been exceeded) we find it three to one in favor of the largest, with an accumulation of *light* in the ratio of $6^2$ to $2^2$, or 9 to 1. On comparing the powers of this magnificent instrument with those of a refractor of two feet aperture, the largest hitherto attempted, we have a *superiority*—making a due allowance for the loss of light by reflection from two mirrors, and assuming an equal degree of perfectness, figure, and other optical requirements in the refractor, and *no* allowance for absorption of light—in the ratio of about 4·5 to 1, as to light, and as 2·12 to 1, as to the capability of penetrating space, or detecting nebulous or sidereal objects at the extreme distance of visibility. Hence, whilst the range of telescopic vision in a refractor of two feet aperture would embrace a *sphere* in space represented by a diameter of 2; the six-feet speculum (assuming both instruments to be of equal optical perfection, magnifying equally, and allowing fifty per cent. for loss of light for two reflections in the one case, and none (?) in the other) would comprehend a sphere of about 4·24 diameter,—the outer shell of which, 1·12 in thickness, being the province of the great instrument alone. But let us reduce those proportions to *sections* of equal spaces, that we may judge more accurately of the relative powers. Now, the solid contents of different spheres, we know, are in the ratio of their diameters. Hence the comparative spheres, penetrated by the two instruments referred to, should be $4{\cdot}24^3$ to $2^3$; that is, as 9·5 to 1. Deducting, then, from this vast grasp of space the inner sphere, capable of being explored by other instruments, we find that, out of nearly ten sections of space reached by this telescope, there are nearly nine sections which the six feet speculum may embrace as peculiarly its own!

What its revelations yet may prove, then, we can have no idea. Several thousands of nebulæ have been catalogued: the great

* An abstract of a lecture delivered at Torquay, November 15, 1852.—From the Edinburgh New Philosophical Journal for January, 1853.—Sill. Jour.

reflector might add to these tens of thousands more. But this, seeing how few nights in a year are favorable for the highest powers, must be the work of years of perseverance. It would be a worthy undertaking for the government of a great country, to afford the means of multiplying such gigantic instruments. Application is to be made, in this direction, for a six-feet reflector at the Cape of Good Hope, for the examination of the heavens towards the southern pole. Lord Rosse, with his usual nobleness of liberality, will yield up his laboratory, machinery, and men, to the service of government, and is willing, moreover, to give the direction and guidance of his master-mind. Will the British nation be content with a refusal?

The range opened to us by the great telescope at Birr Castle, is best, perhaps, apprehended by the now usual measurement—not of distances in miles, or million of miles, or diameters of the earth's orbit, but—of the progress of light in free space. The determination, within, no doubt, a small proportion of error, of the parallax of a considerable number of the fixed stars, yields, according to M. Peters, a space betwixt us and the fixed stars of the smallest magnitude, the sixth, ordinarily visible to the naked eye, of 130 years in the flight of light. This information enables us, on the principles of *sounding the heavens*, suggested by Sir W. Herschel, with the photometrical researches on the stars of Dr. Wollaston and others, to carry the estimation of distances, and that by no means on vague assumption, to the limits of space opened by the most effective telescopes. And from the guidance thus afforded us, as to the comparative power of the six feet speculum in the penetration of space, as already elucidated, we might fairly assume the fact, that if any other telescope now in use could follow the sun if removed to the remotest visible position, or till its light would require 10,000 years to reach us, the grand instrument at Parsonstown would follow it so far, that from 20,000 to 25,000 years would be spent in the transmission of its light to the earth. But in the cases of clusters of stars, and of nebulæ exhibiting a mere speck of misty luminosity, from the combined light perhaps of hundreds of thousands of suns, the *penetration* into space, compared with the results of ordinary vision, must be enormous; so that it would not be difficult to shew the *probability* that a million of years, in flight of light, would be requisite, in regard to the most distant, to trace the enormous interval.

But after all, what is all this, vast as the attainment may seem, in the exploration of the extent of the works of the Almighty? For in this attempt to look into space, as the great reflector enables us, we see but a *mere speck*—for SPACE IS INFINITE. Could we take, therefore, not the tardy wings of the morning, with the speed of the mere spread of day, nor flee as with the leaden wings of light, which would require years to reach the nearest star, but, like unhampered *thought*, could we speed to the farthest visible nebula at a bound,—there, doubtless, we should have a continuance of revelations; and if bound after bound were taken, and new spheres of space for ten thousand repetitions explored, should we not probably find each additional sphere of telescopic vision garnished with suns and nebulous configurations rich and marvellous as our own? If these views serve to enlarge our conception of creative wonders, and of the glory and power of the Great Architect of the heavens, should they not deeply impress us in respect to the Divine condescension in regarding so graciously this little, inferior world of ours? Animated with the spirit of the Psalmist, we shall each one, surely, be disposed appropriately to join in his emphatic saying—"When I *consider* thy heavens, the work of thy fingers, the moon and the stars which thou hast ordained: what is man, that thou art mindful of him? or the son of man, that thou visitest him?"

## On the Rising of Waters in Springs immediately before Rain. By Prof. J. Brocklesby.*

My attention was particularly called to this phenomenon during the close of the summer of 1852, while residing a few weeks in Rutland, amid the highlands of Vermont. In the western portion of the town is a lofty hill, rising to the height of about four hundred feet above the Otter Creek valley. Near the summit of the hill a small spring bursts forth whose waters are conveyed in wooden pipes to the barnyards of two farm houses situated on the slope of the hill; the first being about one-fourth of a mile distant from the spring, and the second nearly one-third of a mile. At the latter house I resided. The waters of the spring are not abundant, and during the summer months frequently fail to supply the aqueduct. Such was the state of the spring when I arrived at Rutland; for the summer had been extremely dry, and the brooks were unusually low, and the drought had prevailed so long that even the famed Green Mountains had, in many places, began to wear a russet livery. The drought continued, not a drop of rain falling, when one morning a servant, coming in from the barnyard, affirmed that we should soon have rain, as the water was now flowing in the aqueduct, the spring having risen several inches. The prediction was verified, for within two or three days rain fell to a considerable depth.

In a short time the spring again sunk low, and ceased to supply the aqeduct; but one cloudless morning, when there were no visible indications of rain, its waters once more rose, flowing through the entire length of the aqueduct, and ere twenty-four hours had elapsed, another rain was pouring down. On inquiry it was ascertained from the residents in the vicinity, that the phenomenon was one of ordinary occurrence, and that for the last twenty years the approach of rain was expected by the rising of the spring.

Interested by these facts, I sought for others of a like nature, and requested through the public prints information on the subject from all who happened to possess it, and also upon collateral points which were conceived to have important relations to this phenomenon. I was rewarded by the knowledge of only one additional instance, existing in Concord, Massachusetts, where a spring that supplies a certain brook is said to rise perceptibly before a storm. Mr. Wm. Munroe, who lives near the stream, kindly offered the following information, which is given below in nearly his own words:—"Although I have frequently been informed that the Dodge's brook, (so called,) after a dry time, and when no water had run for some days, would begin again to run when the clouds threatened rain, but before a drop had fallen; yet I cannot say that I have ever taken much pains to investigate the fact. However, I perfectly recollect being at one time near the brook when there had been a long drought. The clouds threatened rain very soon—not a drop of water had run into the brook for some days—not a drop had fallen from the clouds, and no rain had occurred in the vicinity. The course of the brook is across the road, I was standing in the road watching the brook, and then saw a small stream in its bed flowing towards the river, which is about fifteen rods distant from the road; the spring that supplies the brook is situated about half a mile from the river, and is sometimes so powerful that I have known the brook to overflow the road for the space of several rods; I cannot say that it is an established fact that the river always rises before a rain, but I have good reason to suppose that it does." The preceding statements in respect to Dodge's brook are corroborated by the son of Mr. Munroe, who writes thus:—The subject has

* Proceedings of the American Association at Cleveland—Annals of Science.

not so far as we are aware, fallen under the notice of any close observer of the facts you enquire about, the most that is known being this—that the bed of the brook, during a long drought, having become dry, the stream is known to start again before a rain, and the belief is that rain is to be looked for immediately on the appearance of Dodge's brook." The cause of the phenomenon has been attributed by some to the fall of rain at the distant sources of the spring, a short time previous to their descent in the vicinity of the spring itself; but this view is doubtless erroneous, since it is altogether improbable that rain should fall at two different localities year after year with the same constant period of time between them, and that this interval should be such as to insure that water falling at the first locality should always arrive through subterranean channels at the second before the rain commenced. I have not been able to ascertain the state of the barometer, either at Rutland or Concord, at the times when the phenomenon in question occurs; nevertheless, I believe that the true solution will be found in the diminished atmospheric pressure which exists before a rain. The waters of a spring remain at any given level, because the atmospheric and hydrostatic pressures combined exactly counterbalance the upward force of the jet.—The spring will therefore rise, either when the force of the jet is increased while the atmospheric pressure continues the same, or when the latter is diminished while the former remains constant; and the elevation is greatest of all when the decrease in the pressure of the atmosphere occurs simultaneously with an increase in the strength of the jet. The rising of the water in the instances related, cannot, I think, in view of the facts detailed, be fairly attributed to any sudden augmentation of force in the current of the spring, but it is to be regarded as the result of diminished atmospheric pressure occurring at the particular times, in perfect accordance with known meteorological laws. I am not aware that it has yet been ascertained whether this phenomenon is local or general. If the latter should be found true, and the explanation given correct, we arrive at the curious discovery that the springs and fountains of the earth are natural barometers, whose indications may, perhaps, be worthy of notice in future physical investigations.


**INCORPORATED BY ROYAL CHARTER.**

**Canadian Institute.**

Third ordinary meeting, Jan. 7, 1854.

The names of the following Candidates for Membership were read:

Lucius O'Brien, C. E., .................. Toronto.
F. A. Whitney, .................. Toronto.
J. W. G. Whitney, .................. "
C. H. Jervis, .................. "
Rev. E. St. John Parry .................. "
Capt. C. R. Scholefield, .................. "
J. Small, M. D., .................. "
J. E. Small, .................. "

The following gentlemen were elected Members:—

G. B. Holland, .................. Toronto.
C. Hampden Turner, .................. Rooks Nest, Surrey, Eng.
H. Bennett, .................. Toronto.
E. Billings, .................. Bytown.

The following pamphlets were presented to the Society by Mr. Henning:

Report and proceedings of the Standing Committee on Railroads, Canals and Telegraph Lines, Quebec, 1852.

Reports on the Sea and River Fisheries of New Brunswick.

Return of Sums paid by Government and correspondence relative to Railroads, 1853.

Geological Survey of Canada, 1852-'53.

Report of Special Committee on the Magdalen Islands, and Western part of this Province above Lake Huron, 1853.

The thanks of the Institute were given to Mr. Henning for his donation.

The annual address was then delivered by the President, after which Dr. Bovell read a paper, entitled 'Original Views on the Renal Circulation.

## The President's Address.

*Gentlemen of the Canadian Institute,*

The duty which, by your appointment, falls at this time upon me, of saying something of the condition, objects, and prospects of this Association, is rendered much more agreeable than it might otherwise have been, by the prosperous state of its affairs as exhibited in the last report of the council.

The liberal spirit in which the Legislature has patronised your efforts at so early a stage; the ready and kind attention of the Executive Government to such requests and suggestions as have been made to them in connection with the objects of the Institute;—the great accession within the last year of new members, many of them gentlemen who from their position, public spirit, and scientific attainments may be expected to render you important service; the growing circulation of the useful and highly interesting Journal published by the Association; and the many valuable gifts of books, and of minerals, and other objects of interest in various departments of Natural History,—these circumstances have all combined to place the Institute, even at the present moment, in a position most gratifying to its members, while they afford grounds for very encouraging hopes as to its future usefulness.

But in venturing to draw from the past these flattering presages of the future, we must not forget to make allowance for the advantages which we have lost in the departure from the Province of our late President, whose active and zealous services in behalf of the Association, have been so instrumental in bringing it to its present state.

It is not merely that his familiarity with rather a wide range of scientific subjects qualified him for taking much more than an ordinary part in the proceedings of the Institute; but his eager thirst for knowledge, his ardent devotion to the interests of science, his indefatigable industry, his strong religious sense of the obligation which we all lie under to the common family of mankind; and as much as all these, his hopeful turn of mind which made it always difficult for him to believe that any thing would be found to be impracticable by which a great public good might be attained;—these all made him an invaluable fellow-worker with you, especially in laying the foundation for your future system of proceeding. Some portion of his spirit inevitably communicated itself to those with whom he was associated, and thoroughly unselfish, and disinterested as he was seen to be in all his aims, he proved to be an efficient applicant on behalf of the Association whenever an occasion offered, being a suitor whom all were reluctant to disappoint, and all willing to oblige.

I need offer you no excuse, I am persuaded, for not suffering myself to be restrained by the domestic tie which exists between Capt. Lefroy and myself from paying this just tribute to his services—That circumstance has but given me a better opportunity than I should otherwise have had of appreciating his disposition and exertions. It can hardly, I believe, lead me to take a more affectionate interest in his reputation than will always be felt by those whom I am addressing.

It is abundantly evident, gentlemen, that the Canadian Institute, from the zealous efforts of several able and efficient supporters, is occupying at this moment a more considerable place in public estimation than it could have been expected to attain so early; but if we stop for a moment on the vantage ground that has been gained—to look round us, and to glance at the past as well as at the future, I believe we may come satisfactorily to the conclusion that if it shall be the good fortune of this Association to work out any important good for Canada, it still need not be seriously regretted by us that it did not begin its work sooner, or rather that such an Association was not sooner formed.

Many things seem to have occurred to render the time chosen for its commencement an auspicious starting point, and it will be more favorable perhaps to its future success that the Institute has had from the first a vigorous growth, and has occupied early a position recommending it to public countenance and favor, than that it should have been forced into existence before it could have found adequate support. It could only then have lingered in a sickly state, not attracting much attention nor giving rise to any sanguine hopes;—and it would have been more difficult to have infused life and energy into such an Institution, than at a fitting time to create a new one. Less competent, as I am, in other respects to form an opinion upon this point than many others who are present, I have the advantage of being able to judge perhaps more clearly, from actual observation, of the past condition of Upper Canada; and I do not believe that much time has really been lost, (if any has been,) in making this kind of effort for the advancement of science.

This is pretty well proved, I think, from the small success which was found to attend some exertions of a similar description, though less comprehensive in their character, which have, from time to time, been made in Upper Canada.

And here we may naturally ask ourselves whether it is, or is not, to the discredit of this country that up to this period more has not been done by voluntary efforts for the promotion of science, and more distinction gained in its pursuit? I should be glad to be able to prove, quite satisfactorily, that we lie under no peculiar reproach in that respect. At all events let the facts be fairly stated.

Two generations have passed away since a civilized people began to occupy Upper Canada;—our own Journal, in a late article full of interesting matter, informs us that for twenty years of that time we have had a population over 300,000—for ten years exceeding 500,000, and we may be certain that at present our numbers are beyond a million.—Upon the first impression it would seem, on a comparison with other countries, that, under such circumstances and in all this time, some native Canadian might have been expected to start from the canvas more distinctly than any has done;—that some one gifted with peculiar powers would have gained for himself a name likely to endure, and would have conferred celebrity upon the country of his birth, by some striking discovery in art or science, or at least by a proficiency in some liberal pursuit, that would have attracted general attention, and established even abroad a deference to his name as an authority.

We might refer to some other countries, particularly in the North of Europe, where, in communities not so populous, there have, from time to time, arisen men so distinguished by the gifts of genius, and by the use they made of them, that their names have been handed down from age to age, and are regarded now with a veneration scarcely diminished by the splendid modern discoveries which have disproved some of their theories, and rendered useless many of their inventions.

But we must consider, on the other hand, that these men have generally flourished in older communities than ours; that the discoveries made, and the distinction obtained by many of them, were the fruits of a "learned leisure," which in Upper Canada hitherto scarcely any have enjoyed; and, besides, that these shining lights have commonly appeared at distant intervals in the course of centuries, with larger spaces of time perhaps between them than would cover our whole history as a people.

The more rapid and general spread of knowledge, too, has had the effect in our time of placing educated men upon more equal ground in regard to their attainments; so that a striking elevation is not so easily gained. And there has been another more formidable impediment peculiar to our condition as a new country, for Upper Canada may still be called such, though it is fast losing any claim to particular allowance upon that score—I refer here to the fact that among the million who now inhabit this upper portion of the Province, even those who came hither in mature years from other countries, with minds highly cultivated, have, with very few exceptions, been unavoidably engaged like the multitude around them, in the anxious labor of some profession or employment, by which their daily subsistence was to be earned. Those born in the country have had their time and their thoughts equally engaged by efforts to gain for themselves a competency which few have had the fortune to inherit from their fathers. And *so* it has happened, (though I think not entirely *so*) that Upper Canada, if I may assert this without seeming to disparage any just claim to excellence, and distinction, can not yet be pointed to as the birth place of any who have won for themselves the celebrity that waits on genius successfully cultivated, nor perhaps even of any who have greatly signalized themselves by an enthusiastic devotion to art or science. When I hesitate to say that we can wholly and clearly ascribe this want, which I think we must acknowledge, to the influence of any or all of the causes that I have mentioned, it is because I can not forget that in other countries we do see, every now and then, starting up, as if to relieve the monotony of life, poets, philosophers, mathematicians, mechanics, linguists, artists, whose very existence has seemed bound up in some one particular pursuit, who, under every disadvantage of position—oppressed by want—disheartened at times by neglect—unaided by instruction, and having access to no advantages which may not be enjoyed here, have worked their way to eminence, and have made their names like house-hold words, likely to endure to the end of time—men

> Whose honors with increase of ages grow
> As streams roll down, enlarging as they flow.

I suppose after all, the solution is that we must look upon these prodigies as the gifts of God vouchsafed to a Country when he thinks fit; and that in the order of Providence, the day of Upper Canada has not yet come—for we must say of genius, as the Poet has said of taste,—

> --This nor gems, nor stores of gold
> Nor purple state, nor *culture* can bestow
> But God alone, when first His active hand
> Imprints the secret bias of the soul.

It will not, however, I trust be long before Canada will have her sons whom future generations will have a pride in remembering, for as respects her political condition, and the public provision made for instruction, such is her actual state, and such the prospects of the future which are opening upon us that we can scarcely name a country of which it can be said that those who are to be born in it will have fairer opportunity and freer scope, for the cultivation and use of their intellectual faculties.

We can not, it is true, hope for many years, or, should I not rather say, for many ages, to possess seats of learning which can rival the time-honored universities of the United Kingdoms; but in what portion of the British Empire is instruction more accessible to all?—I mean instruction to such an extent as is necessary for developing and cherishing any latent spark of genius, or discovering the germ of any peculiar talent, and for facilitating the early progress of youth in the pursuit of any science to which their nature may particularly incline them.

Throughout a large portion of Upper Canada, and in many entire Counties, the difficulties of a first settlement in a thickly wooded Country have been overcome by the patient though tedious and toilsome labour of the axe-man, for which the inventions of science have not yet provided a substitute. The second and third generations of farmers are now occupying fertile lands, cleared by the toil of those who have gone before them. Very many of these are in comfortable circumstances, able to appreciate and enjoy the advantages of education, and not without the ambition to improve them, and to ascend to positions among their fellow-men, which, in Canada, as in other portions of the British Empire, are open to all. Our commerce, too, expanding with the rapid and enormous increase of our productions is accumulating wealth—and wealth brings leisure. We shall soon have a larger class of men among us who, having succeeded to something more than a bare competency, or having secured an independence by their own exertions will be exempt from the daily toil which is the common lot; and some of these we may hope will be inclined to devote themselves to the pursuits of Science, and to encourage and assist the efforts of others.

The current literature of the day now circulates as freely and almost as cheaply in Upper Canada as it can do any where. The system of education in the Common Schools, extended as it is to the remotest parts of the Province, brings instruction within the reach of almost every household. The formation of public Libraries in connection with this system; the multiplication of grammar schools; the establishment of Colleges fully adequate in number to the wants of the Province; and the formation in most of our large towns of Mechanics' Institutes, all show a population alive to the importance of intellectual culture; and I believe those who have acquired experience in Europe and in Canada in the business of instruction, will not hesitate to declare that there is no want of good natural capacity in the Canadian youth.

What useful part may be taken by this Association in encouraging a taste for Scientific pursuits, is in some measure foreshadowed in the numbers of the Canadian Journal.

Besides the papers read and discussed here by members, which form, properly speaking, the proceedings of the Institute, we find collected in the Journal, and presented in a convenient form, notices of important discoveries in the Arts and Sciences, and discussions of various scientific questions, which have engaged the attention of learned bodies, or of individuals possessing a profound knowledge of the several subjects, and the advantage of every aid which the most favorable circumstances could supply.

Some of these discussions relate to questions which are not of a nature to be affected by any peculiarities of situation or climate, but have an universal interest, so that the truths which may be ascertained, and the results arrived at, are useful in one country as well as in another. Others may turn upon particular diversities, arising from local causes, and may from that very circumstance furnish grounds for useful comparison. It is a great advantage to have such facts, and the reasoning upon them collected and presented in a convenient form, unmixed with political and other controversies of a merely temporary interest, and unincumbered with the crowd of advertisements which swell the bulk of daily and weekly newspapers. In a Country, too, which is advancing by such rapid strides in population and wealth, and which is making such remarkable exertions to procure for itself those advantages which till lately were confined to older and more opulent communities, it is deeply interesting to collect and preserve for future comparison and reference, the history of its developement. Those who come after us will feel that no light obligation has been conferred upon them by the Association which has taken the trouble of recording the first movements made in our great public enterprises, thus enabling them to see the time and manner of originating them, and to compare the predictions of their promoters with the results which have followed. Again, the early history of our settlements; the gradual growth of our towns and cities; the increased and improved quality and the varying proportions of our agricultural productions;—the unforseen turns which the trade of Canada will have taken under the freedom of intercourse permitted to her; the extension and improvement of our navigation; the stupendous railway undertakings; the introduction and growth of manufactures; and what is really more important than all, the developement of civil and religious institutions; upon all, or most of these points, the pages of the *Canadian Journal* may be made the means of disseminating and preserving much valuable information,—as I think we may say they have already done, in regard to several of the subjects which I have alluded to. Some of these, though they refer to facts and topics of great public interest, may not (except in their bearing upon questions of political economy) be considered to come within the range of Science, which has been defined to be "Art, attained by precepts, or built on principles," and they may not come directly within any of the objects specified in the first section of the regulations of the Canadian Institute, yet information upon them cannot but be useful and welcome to the public, and in disseminating such information by the circulation of the Journal, the Institute will be felt to be rendering a valuable service, and a service to science, in that wider sense by which it may be understood to comprehend every species of knowledge. For valuable papers relating to several of the physical sciences, we shall, I hope, continue to be indebted to a class of gentlemen who made, indeed, the first movement towards the establishment of the Institute. I mean the Civil Engineers, whose profession compels them, in the study and practice of it, to look below the surface of things; to devise new applications of mathematical principles, and mechanical powers, and to consider and make allowance for the great laws of Nature: for it is upon her mysterious and unerring laws that many of their operations are founded. We may expect too, that their opportunities of research, and their habits of observation, will lead to valuable contributions being made to our museum of mineralogy, and to the study of geology among us. We can not indeed, presume to say what description of physiological researches may not receive some assistance from the cause I allude to, for there is such an affinity between the several branches of natural Science, that there is always a prospect of good, especially in a large and imperfectly explored country like this, from any circumstance which sends abroad among the works of Nature a number of men whose minds have been turned and trained to the observation of her laws, and who have been accustomed to reason and to act upon what is known concerning them.

In connection with some of the speculations and studies of natural philosophers, Canada will always present a very interesting field from the circumstance that a large portion of it to the northward, while it is even now easily accessible by means of its numerous chains of lakes and rivers, and is becoming every year more so from the nearer approaches of railways, yet from its inaptitude for cultivation, continues, and is likely to continue in its primitive state, exhibiting to the lover of nature, and to the inquirer into her works, her romantic woods, rocks and rivers, her shrubs, mosses, insects, and all her wonders, animate and inanimate in their aboriginal state, undisturbed and unaffected by the operations of man.

It will be felt, I think, in future times, to be a great charm of this country that nature, on so vast a scale, can be seen in all her majesty and freshness, by so ready and easy a transition from a contiguous territory, populous and fertile, and abounding in all the comforts and advantages of civilized life.

It is, perhaps, no disadvantage that I have little space left, without wearying you, to say any thing of the future prospects of the Canadian Institute, for in speaking of the future we must be dealing, more or less, in uncertain speculation.

The degree of success which has been obtained in so short a period of time, gives at least good encouragement; and as I have already stated, the attempt for gaining some foot-hold for scientific discussion, seems to have been made at a juncture very favorable.

The public mind is at present little distracted by angry political discussions—there has been a long period of tranquility which may create stronger confidence in the stability of our Colonial relation. The greater activity of trade, and greater abundance of capital arising from various causes, occasion Canada to be more looked to than formerly as a country presenting advantages for the profitable investment of money.

The progress which is being made in the construction of railways (there being now, in Upper Canada, nearly 400 miles of rail-way in use, where ten months ago there was not one mile completed,) must inevitably give to the Province a very different position in the estimation of other countries, and cannot fail to have a great effect in attracting to it men of liberal minds and means. There must be many, no doubt, who not having been under any absolute necessity of emigrating, are yet very sensible that they might find it to their advantage in doing so—but have been deterred from taking the step so long as they must have submitted to the many discomforts and disadvantages inseparable from bad roads and the consequent difficulty of access to market. Men of cultivated minds, and accustomed to social comforts and enjoyments, will, in future, hesitate less to disperse themselves freely over all portions of this new country, when a few hours travelling, unattended by fatigue or discomfort, will transport them to and from the large towns. Such persons will soon be able, without subjecting themselves to any severe privation, to make their choice of a place of residence in Canada, according to their preferences of climate or soil, or proximity to lakes or rivers, or guided by the price of land, or by the description of settlers whom they would choose for neighbors, or by any other predilections—for it will be in their power to consult their peculiar tastes—without condemning themselves to exclusion from what others are enjoying.

The tendency of this great change, to people Upper Canada more generally, and in more equal proportion, with a class of educated men, is an advantage by which such an institution as this can hardly fail to profit. And I believe, without meaning to disparage any advantages which other colonies may present that we may expect to gain no inconsiderable degree of wealth and intelligence from a re-action which seems inevitable, of that movement which of late years has been carrying such multitudes to the Australian Colonies. It has seemed as if the sacrifice of the lives, and health and fortunes of thousands were necessary to produce a conviction of the rather obvious truth that the circumstance of gold being among the natural productions of a country, does not ensure the acquisition of wealth, nor even of independence to all who can make their way to it,—but that, on the contrary, it has a tendency to place many, if not most, of those in a false and distressing position, who rush thither in the eager spirit of adventure.

Now that so many are returning with disappointed hopes, many more must be warned by their example not to run so perilous a hazard; and of those who have rational motives for seeking new homes, but may hesitate hereafter to wander to countries so remote, upon very doubtful prospects, we may expect to have the pleasure of receiving our fair proportion; and whatever may be the accession of intelligence that may accrue to the country from this cause, some portion of that gain, I trust, will be felt by the Canadian Institute.

In contemplating any extension of the labors and objects of this Association, and considering in what additional manner or degree it may be made to contribute to the advantage and enjoyment of those who have leisure and inclination to indulge in scientific pursuits, we must find ourselves at once embarrassed by the want of a suitable building belonging to the Institute in which its proceedings can be carried on, and its library and museum accommodated and arranged with a due regard to order and convenience. This want, too, we must apprehend, may soon press with greater force than at present, since it is uncertain how long we can be permitted, by the kind consideration of the government, to occupy the spacious, and, in some respects, convenient building which we are now in. Perhaps a careful examination of what we might reasonably hope to be able to accomplish, might convince us that we need not long delay taking measures for providing for the Institute a permanent home of its own.

There are many reasons which should stimulate us to make such an effort; but it may be safely left to the Council to consider the proper time and manner of proposing it.

I owe it to myself, gentlemen, not to conclude without assuring you that if due credit had been given to my earnest protestations of unfitness, I should not now have been found inadequately filling a place, of which the duties could be much better discharged by many whom I see about me. I beg, therefore, that you will be just enough to make this allowance for me; that I am here by no fault of mine; for I am but too conscious that I have the least possible pretensions to Science, excepting whatever knowledge I may have gathered in the course of a long application to one particular science which I apprehend may not be universally in favor. In the regulations first promulgated by the Council, I saw it stated "that there were three classes of persons who might with propriety join the Institute." In the first of these I was well aware that I could not claim a place. In the second class, which was stated to consist of "those who may reasonably expect *to derive some share of instruction* from the publication of your proceedings in the Journal," it seemed to me that I might be included;—and perhaps also in the third, which was defined as consisting of "those who, although they may neither have time nor *opportunity* for contributing much information, may yet have an ardent desire to countenance a laudable, and, to say the least, a patriotic undertaking." I confess I was amused by observing the delicate tact with which the framer of these regulations substituted in his description of the third class the word "opportunity" for "*ability*," which was plainly in his mind, but being willing to understand and accept the word in its hidden sense, I ventured to enter by a door so widely and considerately opened, but I entered it only for the purpose of receiving instruction, not with any idea of communicating it.

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### Original Views on the Renal Circulation.

Dr. Bovell commenced by showing the unanimity of opinion on the injurious consequences resulting from detention of the solid elements of the urinary secretion, and the readiness of the conversion of those bodies into other compounds, such as urea, ammonia and oxalic acid, &c. The experiments of Dr. Lethby on the passage of arsenious acid through the renal circulation, and the detection of the poison in the urine, were next dwelt on, as well as the recent experiments of M. C. Bernard, these latter specially going to prove a ready exit for watery portions of the blood through the kidney. Finally, Dr. Bovell brought forward several cases of Bright's disease, to support the opinion advanced in the paper, viz: that the malphigian tufts, said by Mr. Bowman and others to secrete the water of the urine, were the true renal secerning apparatus, and that the water of the urine was supplied by the venous plexus of the tubuli uriniferi. We are very glad to be able to state that Dr. Bovell's views on this most important subject will shortly be printed for the use of the Members of the Institute in pamphlet form.

### Alphabetical List of the Members of the Canadian Institute.

| *Names.* | *Residence.* |
|---|---|
| Adamson, Rev. W. A., D.D. | Quebec, C. F. |
| Allan, G. W. | Toronto, C. W., |
| Ambrose, Alex. P. | Grimsby, " |
| Armour, A. H. | Toronto, " King street. |
| Armstrong, W. | " " Queen " |
| Arnold, John | " " Peter " |
| Badgley, Prof. F. | " " Bay " |
| Baker, Hugh C. | Hamilton " |
| Baldwin, Hon. Robt. | } Spadina, near Toronto, C. W. |
| Baldwin, W. W. | } Spadina, near Toronto, C. W. |
| Baldwin, Robt., Junr., | } Spadina, near Toronto, C. W. |
| Baldwin, W. A. | " " |
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| Barclay, Rev. J. | " " Wellington street. |
| Barron, F. W. | " " U. C. College. |
| Bartlett, Rev. T, H.M. | Kingston, " |
| Barwell, Lewis | Brantford, " |
| Beaven, T. F. | Toronto, " Spadina Avenue. |
| Beaven, E. W. | " " Trinity College. |
| Beard, Chas. | Woodstock " |
| Becher, H. C. R. | London, " |
| Bell, Rev. Andrew | L'Original, " |
| Bell, Rev. George | Simcoe, " |
| Bethune, Prof. N. | Toronto, " Richmond street. |
| Bird, James | Peterboro, " |
| Blackie, John | Danville, C. E. |
| Black, James | Ayr, C. W. |
| Bleasdell, Rev. W. | Trenton, " |
| Bogert, J. J. | Toronto, " Trinity College. |
| Boomer, A. K. | " " King street. |
| Boulton, W. S. | London, " |
| Boulton, Hon. H. J. | Toronto, C. W., Wellington street. |
| Bovell, Prof. James | " " King street. |
| Bristow, Arthur | Weston, " |
| Brondgeest, J. T. | Toronto, " |
| Brown, Geo., (M. P. P.) | " " |
| Browne, George | Montreal, C. E, |
| Brown, John | Thorold, C. W. |
| Browne, J. O. | Toronto, " York street. |
| Brunel, Alfred | " " Bond " |
| Buckland, Prof. G. | " " |
| Burke, J. N. | Stanfold, C. E. |
| Cameron, Peter | Toronto, C. W. |
| Cameron, J. M. A. | " " |
| Cameron, Hon. Malcolm | Quebec, C. E. |
| Cameron, John | Toronto, C.W., Com. B'k., Willam st. |
| Cameron, Angus | " " Mon't. Bank, Yonge st. |
| Cameron, Col. K. | Beaverton, C. W. |
| Campbell, Major T. E. | St. Hilaire, C. E. |
| Campbell, Judge E. C. | Niagara, C. W. |
| Carruthers, F. F. | Toronto, " |
| Cayley, F. M. | " " |
| Chapman, Prof. E. | " " |
| Cherriman, Prof. J. B. | " " Observatory. |
| Clark, John | Port Dalhousie, C. W. |
| Connor, Skeffington, L.L.D. | Toronto. " Bay street. |
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| Cotton, James | Toronto, " Church street. |
| Craigie, Doctor W. | Hamilton, " |
| Crawford, D. | Toronto, " Jarvis street. |
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| Crease, G. | Toronto, C. W. |
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| Crombie, E. M. | " " George " |
| Cronyn, Rev. B. | London, " |
| Crooks, Adam | Toronto, " |
| Cull, E. L. | " " |
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| Dartnell, G. H. | } Toronto, C. W., Peter street. |
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| Dennis, J. S. | Weston, " |
| Deslandes, P. F. C. | Toronto, " Pine Hurst. |
| Devine, Thomas | Quebec, C. E. |

Dexter, Armory ........ Cobourg, C. W.
Dick, Capt. T ........ Toronto, " Queen street, W.
Donaldson, Capt., W ........ St. Catharines, C. W.
Draper, Hon. Justice ........ Toronto, " York street.
Drummond, A ........ " "
Duggan, Geo. (Junr.) ........ " " Adelaide st.
Duggan, John ........ " " Bay street.

Ellis, Joseph ........ Toronto, C. W., Queen street.
Ellis, John ........ " " King street.
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Esten, J. H ........ Toronto, " St George's Sqr.
Ewart, John, Junr ........ " " Yonge street.

Feehan, D. K ........ " " Front street.
Ferrie, Robert ........ Doon "
Fitzgerald, W. W ........ Toronto, "
Fitzgerald, W. J ........ " "
Fleming, S ........ " " Richmond st.
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Forrest, J. W ........ Hamilton, "
Fowler, Henry ........ Toronto, " Yonge street.
Freeland, Patrick ........ " " Church street.
Fripp, H. G. R ........ " " Yonge street.

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Hallan, S. W ........ Toronto, "
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Herrick, Doctor George ........ Toronto, C. W., Church street.
Henning, Thomas ........ " " " "
Heyden, L ........ " "
Heyden, L. Junior ........ " "
Hind, Prof., H. Y ........ " "
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Hincks, Rev. Prof. W ........ Toronto, C. W.,
Hirschfilder. J ........ Yorkville, "
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Hodgins, Thos ........ }
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Houghton, E ........ Port Stanley, C. W.
Howard, J. G ........ Toronto, " King street.
Howard, J. S ........ " "
Hutcheson, John ........ " " Church street.

Jacques, John ........ " " King street.
Jameson, Hon. R. S ........ " " " "
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Jones, W ........ Port Stanley, C. W.
Jones, E. R ........ Chatham. "
Irving, Rev., Prof. G. C ........ Toronto, " Trin. College.
Joseph, J. G ........ " " King street.

Keefer, Samuel ........ Montreal, C. E.

Lachlan, Major R ........ " "
Langton, John, (M. P. P.) ........ Peterborough, C. W.
Lawson, Walter ........ Sarnia, "
Lefroy, Capt. J. H.; R. Artillery ........ Woolwich, England.
Logan, W. E ........ Montreal, C. E.
Lowe, F. C ........ Toronto, C. W., Wellington street.
Lyons, James ........ Hamilton, C. W.

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Macklem, Doctor Thomas C ........ Chippewa.
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Maxwell, J ........ Hamilton, "
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Moberly, Walter ........ " "
Moffatt, Lewis ........ " " " "
Morrison, J C., M. P. P ........ " "
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Moyle, Henry ........ Brantford, "
Murney, Edward H ........ Bellville, "

McCallum, A ........ Toronto, " Model School.
McCallum, James, Jr. ........ Uxbridge, "
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McClary, William ........ London, "
McCutcheon, P. McG ........ Toronto, " King street.
McDonald, Don ........ " " Queen street.
McDonald, Don. Jr ........ " "
McDonnell, Alex ........ Hamilton, "
McGill, Hon. P ........ Montreal, C. E.
McGregor, C. J. - - - - - - Toronto, C W., York street.
McPhillips, G. - - - - - - Richmond Hill, C. W.
McQueen, Thos. - - - - - - Hamilton, "

Nicol, Doctor W. B. - - - - - Toronto, " Adelaide st.
Noble, A. Lieut. R. Artillery - Quebec, C. E.
Northcote, Henry - - - - - Toronto, C. W., King street.

O'Brien, E. G. - - - - - - - Toronto, C. W, Toronto street.
O'Brien, W. - - - - - - - Barrie, "
O'Brien, R. L. - - - - - - - Toronto, "

Palmer, E J. - - - - - - - " "
Pardey, W. H. - - - - - - - " "
Parker, David - - - - - - Sarnia, "
Parkes, Vincent - - - - - - Toronto, "
Parr, Richard - - - - - - Chatham, "
Passmore, F. F. - - - - - - Toronto, " King street.
Patrick, Alfred - - - - - - " " John street.
Pell, J. E. - - - - - - - " " King street.
Perram, J. - - - - - - - Tecumseth, "
Perkins, Frederick - - - - Toronto, " Peter street.
Philbrick, Prof., C. J. - - - Yorkville, "
Phillips, T. D. - - - - - - Toronto, " Trinity College.
Primrose, Doctor Francis - - - " " Richmond street.
Prosser, T. C. - - - - - - Bolton, Albion, C W.
Pyper, W. - - - - - - - Toronto, C W., C'l B'k., William st.

Rahn, C. - - - - - - - Toronto, C. W., Melinda street.
Reekie, James - - - - - - Quebec, C. E.
Richardson, Prof. J. H. - - - Toronto, C. W., Bay street.
Richards, Hon. Justice - - - " "
Ridout, Thomas - - - - - - " " Bay street.
Ridout, G. P., (M. P. P.) - - - " " King street.
Ridout, Charles - - - - - - " " Maria street.
Ridout, Charles - - - - - - " " B'k. of Upper Canada
Robarts, T. P ........ Toronto, C. W., William Street
Roberts, D ........ " " Peter Street.
Roberts, J. G ........ " " Ellah's Hotel.
Robertson, T. J ........ " " Normal School.
Robins, S. P ........ " " Model School.
Robinson, Hon. W. B. (M.P.P.) ........
Robinson, Hon. Chief Justice ........ " " Beverly House.
Robinson, W ........ Norwich, C. W.
Robinson, Christopher ........ Toronto, " Beverly House.
Robinson, J. Lukin ........ " " Peter Street.
Rothwell, Richard ........ " " Trinity College
Rowsell, Henry ........ " " King Street.
Rubidge, F. P ........ Quebec, C. E.
Rutherford, E. H ........ Toronto, C. W., Bay Street.
Ruttan, Henry ........ Cobourg, "
Ryerson, Rev. Doctor E ........ Toronto, " Bay Street
Rykert, G. Z ........ St Catharines, C. W.
Rykert A. E ........ Toronto, " Trinity College

Sabine, Col. E. R. Artillery ........ Woolwich England
Salter, A. P ........ Chatham, C. W.
St. George, H. Q ........ Whitchurch, "

Sangster, John..................Hamilton, "
Savigny, H. P....................Barrie, "
Scadding, Rev. Doctor H.........Toronto, " U. Can. College
Schoefield, W. A................Bentick, "
Sears, S. B.....................Chatham, " Or Buffalo.
Shanly, Walter..................Toronto, " Wellington Stree
Shanly, Francis.................. " " Bay Street.
Shier, John.....................Whitby, "
Simons, T. M....................Hamilton, "
Simpson, A. W...................Cobourg, "
Sladden, W......................Toronto, "
Small, Rev. J. W................ " " York Street.
Smallwood, Doctor...............Isle Jesus, C. E.
Smith, William..................Glanford, C. W.
Sootheram, G. H.................Toronto, C.W., B.B N.A., Yonge St.
Spragge, Hon. J. G. (Vice Chan'r.) " " Portland Street.
Spratt, Robert.................. " "
Spreull, Samuel................. " " 61½ Yonge Street.
Stark, David....................Montreal, C. E.
Stephenson, Robert (M.P.).......England.
Stevenson, James Jr.............Hamilton, C. W.
Stewart, G. A...................Toronto, "
Storm, W. G..................... " "
Stratford, Doctor S............. " " Yonge Street.
Strathy, G. W. - - - - - - - " " Bond Street.
Street, R P. - - - - - - - -Gore Bank, Hamilton, C. W.
Street, T. E. - - - - - - - -Niagara Falls, "
The Right Rev. Lord Bishop of Toronto, " Front street.
Thomas, W. - - - - - - -Toronto, C. W., Church Street.
Thomas, C P. - - - - - - - " " "
Thomson, E. W. - - - - - - - " "
Thomson, C. E. - - - - - - - " " Trinity College.
Torney, Hugh - - - - - - - " "

Unwin, Charles - - - - - -Toronto, C. W.

Valentine, J S. - - - - - -Niagara, "
Vidal, Capt. Alex. - - - - -Sarnia, "

Walsh, F. L. - - - - - - -Simcoe, "
Walsh, Robert - - - - - - -Lloydtown, "
Walker, E. A. - - - - - - -Barrie, "
Weller, W. H. - - - - - - -Cobourg, "
Wells, Robert - - - - - - -Toronto, "
Wells, R. M. - - - - - - - " "
Wheeler, Thomas - - - - - - " " King Street.
Whittemore, E. F. - - - - - " " Bay Street.
Whitwell, Rev. R. - - - - -Phillipsburg, C. E.
Widder, Fred'k. - - - - - -Toronto, C. W.
Willis, Rev. M., D D. - - - - " "
Wilkinson, J. A. - - - - - -Sandwich, "
Wilson, Prof. Daniel - - - - -Toronto, "
Woodruff, S. D - - - - - -St. Catharines, C. W.
Worthington, Thomas - - - -Wellington, P. E. District, C. W.
Worthington, John - - - - -Toronto, C. W., Temperance Street.
Worts, J. G. - - - - - - - " "
Wright, James - - - - - - " " City B'k. Church St.
Wyllie, G. B. - - - - - - - " " King Street.

HONORARY MEMBERS—FOUR.

| | |
|---|---|
| Lefroy, Capt. J. H.; R.A., F R.S. | Sabine, Col. E., R.A., F.R.S., &c. |
| Logan, W. E.; F.R S. and G S. | Stephenson, Robert (M.P.) |

LIFE MEMBERS—EIGHT.

| | |
|---|---|
| Cotton, James | Hincks, Hon. F. |
| Duggan. George Junr. | Hutcheson, John |
| Duggan, John | Jamieson, Hon. R. S. |
| Herrick Doctor G. | Parkes, Vincent. |

JUNIOR MEMBERS—TWENTY-NINE.

| | |
|---|---|
| Baldwin, Robert | McGregor, C. J. |
| Baldwin, M. S. | Northcote, Henry. |
| Beavin, T. F. | O'Brien, L. R. |
| Beavin, E W. | Ridout, Charles |
| Bogert, J. J. | Ridout, Charles |
| Crease, G. | Rothwell Richard |
| Crumbie, E M, | Rykert, A. E. |
| Dartnell, G. H. | Simpson, A. W. |
| Davies, H. | Thomas, C P. |
| Esten, J H | Thomson, C. E. |
| Fitzgerald, W. W. | Torney, Hugh |
| Hallen, H. S. | Wells, R. M. |
| Heyden L (Junior) | Wright, James |
| Moberley, W. | Phillips, T. D. |
| Murney, E. H. | |

| | |
|---|---|
| Honorary Members, - - | 4 |
| Life Members, - - - | 8 |
| Junior Members, - - - | 31 |
| Members, - - - - | 239 |
| Total, - - - | 282 |

JAMES JOHNSTON,

*Assistant Secretary,*

CANADIAN INSTITUTE

12 December, 1853.

Ordered by the Council to be presented to the Annual General Meeting, Dec. 17th, 1853.

ELECTED ON THE 7TH JANUARY, 1854.

Bennett, Henry - - - - - -Toronto. C. W.
Billings, Elkanah - - - - -Bytown, C. W.
Holland, G B. - - - - - - -Toronto. C. W.
Turner, C. H. - - - - - - - -Rooks nest, Surry, England.

ELECTED ON THE 14TH JANUARY, 1854.

Whitney, F. A. - - - - - -Toronto.
O'Brien, L. R. - - - - - - "
Whitney, J W. G. - - - - - "
Jervis, C. H - - - - - - - "
Parry, Rev. E St. John - - - "
Scholefield, Capt. C R. - - - "
Small, J., M. D, - - - - - - "
Small, J. C, - - - - - - - "
Total Members, - - - - "282+12=294

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ERRATA.—Page 119—After F. W. Cumberland, last line from the bottom of the page, insert:—The gentlemen whose names are given in the above certificate were balloted for, and duly elected, Dec. 3d, 1853

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**Correspondence.**

The following is the letter of Dr. Wilson, which accompanied his donation of Minerals to the Institute—recorded in the November number of the Journal.

PERTH, 6th Nov, 1853.

SIR,—

On account of professional duties I have not been able to send a few minerals for the museum of the Canadian Institute before this time; I have packed a small box with specimens for this purpose, addressed to you, paid the freight, and sent it off to day by way of Brockville, and trust it will reach you in good order. The specimens are not of such a character as will attract the attention of those who collect minerals for the sake of their beauty; but they may be of some little use to the scientific enquirer. The specimens are all numbered, with which the following list will agree, and also give their names and localities:—

| No. | | | *Locality.* | | | | |
|---|---|---|---|---|---|---|---|
| No. 1. | Raphelite - - - - | Tp. of | Lanark, | 3d Con. | part | lot, | No. 7 |
| " 2 | Perthite - - - - | " | N. Burgess, | 6th Con. | | lot | No. 3. |
| " 3. | Peristorite, - - - | " | Bathurst, | 9th | " | " | 19. |
| " 4. | Bytownite, - - - | " | Drummond, | 6th | " | " | 2. |
| " 5. | An unknown mineral | " | North Burgess, | 9th | " | " | 2. |
| " 6. | Tremolite, - - - - | " | Bathurst, | 12th | " | | |
| " 7. | Labradorite, - - - | " | " | 9th | " | " | 19. |
| " 8. | Anthophylite and Satin Spar - - - - | " | North Burgess, | 6th | " | " | 4. |
| " 9. | Asbestos, - - - - | " | Dalhousie, | 3rd | " | " | 15. |
| " 10. | Sphene, Pyroxene, &c. | " | Elmsley, | 8th | " | " | |
| " 11. | Short, - - - - - | " | Bathurst, | 4th | " | " | 18. |
| " 12. | Black Spinell - - | " | Bathurst, | 1st | " | " | 10. |
| " 13 | Compact, Dolomite, | Town line bet. N. Sherbrook and Palmerston opposite No. 18 and 19 in N. Sherbrook. | | | | | |
| " 14. | Granular Dolomite. | Tp. of | Dalhousie, | 10th Con., | | lot | No. 8. |

| | | | |
|---|---|---|---|
| " 15. Ferruginous Silicate of Manganese - - | " Lanark, | 2nd Con., lot No. 2 town lot. | |
| No. 16. Copper Ore, - - - | " N. Burgess | 9th Con., lot No. 2. | |
| " 17. Serpentine, containing Corundum - | " N. Burgess, | 8th " | " 2. |
| " 18 Magnetic Iron Ore, | " S. Sherbrook, | 3rd " | " 18 & 16. |
| " 19. Graphite - - - - | " S. Burgess, | 2nd " | " 3. |
| " 20. An unknown mineral | " Dalhousie, | 5nd " | |
| " 21. Weathered specimens of Perthite - - | " N. Burgess, | 6th Con., lot No. 3. | |

The specimens marked 1, 2, 3, 4 have been characterized by the late Dr. Thomas Thomson, Professor of Chemistry in the University of Glasgow, as new species. Although the Doctor has been a powerful leader and contributor to chemical science for more than forty years, yet his decisions concerning these minerals have been denounced by Mr. Hunt, Chemist to the Geological survey of this province, as altogether erroneous. In the Geological report for 1847 and 1848, Mr. Hunt says that the Perthite of Dr. Thomson is "nothing more than a reddish felspar;" that from the Doctor's analysis it would appear that this mineral, unlike other felspars, contains no potassium, which is, according to him, replaced by calcium; and it was upon this chemical difference, principally, that he predicated its distinctness as a species. It has, however, been analyzed by my pupil, Mr. Hartly, in the laboratory of the survey, and the results shew that it contains both potassium and sodium, and is indeed quite similar in composition to other felspars." I have no apparatus fit for delicate analysis; but if I had and were ever so capable, would feel no small reluctance in venturing to dispute Mr. Hartley's investigations, but would be inclined to put more confidence in Doctor Thomson's statements than in Mr. Hunt's pupil. In October, 1849, I was favored with a letter and special messenger from B. Silliman, Junr., in which he says, "I propose to make some new analyses of the minerals described by Dr. Thomson as new species, and will feel particularly indebted to you for authentic specimens of them" I sent the Professor the specimens he wanted and begged that he would favor me with the results of his analysis. In his reply he says: "I am unable at present to give you my own opinions of the species; I have, however, put them into the hands of my brother-in-law, Mr. Dana, who is now preparing for the third edition of his mineralogy, to be issued next spring, and they will get justice done them" It is only lately I got a chance of seeing the third edition of Dana's Mineralogy, and do not observe that it gives any new analysis of these minerals—it refers the reader to the Canada authorities, Mr. Hartley and Mr. Hunt, for information I am sorry to observe in this book that even the localities of the minerals are not correct—it gives the locality of Perthite and Bytownite as being in Bathurst, and they are several miles distant from the township. Since my correspondence with Professor Silliman, I have got Mr. Logan's report for 1850 and 1851, wherein Mr. Hunt again declares Dr. Thomson's decisions incorrect, and when speaking of the Perthite, he says: *The colors of this felspar become much darker by exposure to the action of the weather,* the analytical results which follow were obtained from freshly broken *light colored fragments*, and the mineral rendered, &c., &c. Mr. Hunt was with me at the locality of the Perthite, examined the surface of the rock and the mineral in situ with apparent attention, and, after having done this, how he can state that this mineral becomes darker by exposure to the action of the weather is very extraordinary. Whenever the mineral is exposed to the weather, it becomes of a light color, and, in some places, bleached almost white; such light colored specimens, must be partially decomposed, and therefore unfit for giving by analysis, the several constituents of the mineral. The specimens marked 21 were taken by me from the surface of the rock where they were exposed, to the weather, and will speak for themselves. Mr. Hunt further observes that "the quantity of Potash present in, and the extensive deposit of this felspar, are such as make it worthy of attention, as an economical source of this alkali, which in proportion as wood becomes scarce, is increasing in value so much as to make its extraction from its mineral constituents a source of profit." Now, as this mineral is only to be found mixed up with a kind of granite which occupies a bit of surface no more (the proprietor of the land informs me) than four acres, these four acres must afford a very great quantity of potash indeed, or the demand must be very small, if it will yield a sufficient supply when our woods are all gone—the process of extracting the alkali, too, from the rocks, must be less expensive and less laborious than it is at present. Possibly this is not the only locality of the felspar; but I have yet to learn whether this mineral has been found in any other place. The external characters of the Perthite differ from those of other felspars, and Mr. Hunt gives it no credit for being new on this account; yet says that a mineral he found in 1847, at the grand Calumet on the Ottawa, gives by analysis the same constitution as chlorite, the principle difference being in the proportion of water, and "that the hardness completely distinguishes it from chlorite, and constitutes it a new and distinct species." Thus it seems hardness, and other external or physical characters (independent of chemical analysis) are quite sufficient to confer on this mineral the dignity of a new species; whilst the Perthite (notwithstanding its peculiar external and physical characters) gets no credit for these, but is condemned to the plebeian rank of common falspar. Much can be said about Mr. Hunt's treatment of the other three minerals, but I feel I am encroaching on your time and patience. You will much oblige me by giving me your opinion of the red colored mineral, No. 5, and also of No. 20.

I am, Sir, your ob'dt. servant,

JAMES WILSON.

PROF. H. CROFT,
Corresponding Sec. Canadian Institute,
Toronto.

## Notices of Books.

*Letters from Egypt, Ethiopia and the peninsula of Sinai, by Dr. Richard Lepsius, with extracts from his chronology of the Egyptians, with reference to the Exodus of the Israelites. Revised by the Author; Translated by Leonora and Johanna B. Horner: p.p. 578, London, Henry G. Bohn,* 1853.

Egypt and Ethiopia, still lands of mystery, notwithstanding all that has been thought, said and written respecting them, are partially unveiled to us in these interesting and erudite letters, coupled with the startling fact that the discoveries of Dr. Lepsius add not less than TWO THOUSAND YEARS to the generally assumed period of man's existence on earth, and place the period of the first Manethonic Dynasty between three and four thousand years before Christ. Not less interesting is the discovery of the true position of SINAI, which has been for so many centuries hidden as it were behind a cloud.

The origin of these letters is too interesting to be passed over without recognition, and before offering any illustrations of their varied contents, we will give the account of Dr. Lepsius's object of the expedition, and the means by which it was accomplished.

The object of the scientific expedition, which the King of Prussia sent to Egypt in the year 1842, was to investigate and collect, with an historical and antiquarian view, the ancient Egyptian monuments in the Nile Valley and upon the peninsula of Sinai.—It was fitted out and sustained for more than three years by the munificence of the King, and enjoyed uninterruptedly his gracious favour and sympathy—as well as the most active and kind attention from Alexander Von Humboldt, and by a rare union of fortunate circumstances—it attained the purposes they had in view as completely as could be expected.

We shall probably find space to give a more complete account of the results attained by this expedition in future numbers of the journal—let it suffice at present to present a few of the most striking.

The most important results we obtained, therefore, were in chronology and history. The Pyramid-fields of Memphis gave us a notion of the civilization of Egypt in those primitive times, which is pictorially presented to us in 400 large drawings, and will be considered in future as the first section in that portion of the history of man, capable of investigation, and must be regarded with the greatest interest.

Those earliest Dynasties of Egyptian dominion, now afford us more than a barren series of empty, lost, and doubtful names. They are not only free from every real doubt and arranged in the order and the epochs of time, which have been determined by a critical examination, but by showing us the flourishing condition of the people in those times, both in the affairs of the state, civil affairs, and in the arts they have received an intellectual and frequently a very individual historical reality. We have already mentioned the discovery of five different burial-places of the 6th Dynasty in central Egypt, and what we obtained from them. The prosperous times of the new monarchy, viz.: the period of splendour in the Thebaid as well as the Dynasties which followed, were necessarily more or less completed and verified. Even the Ptolemies, with whom we appear to be perfectly acquainted in the clear narratives of Grecian history, have come forward in a new light through the Egyptian representations and inscriptions, and their deficiences have been filled up by persons who were hitherto considered doubtful, and were hardly mentioned by the Greeks. Lastly, on the Egyptian monuments we beheld the Roman Emperors in still greater and almost unbroken series, in their capacity of Egyptian governors, and they have been carried down since Carracalla who had hitherto been considered as the last name written in heroglyphics, through two additional later Emperors as far as Decius, by which means the whole Egyptian monumental history has been extended for a series of years in the other direction.

The following description, of a spectacle not uncommon in tropical seas, but one of which the eye never becomes wearied, will be read with interest. It occurred on the outward voyage of the expedition from Southampton, off the Spanish coast.

Page 37—"But now the most splendid spectacle presented itself that I have ever seen at sea. The ocean began to lighten up, all the crests of the breaking waves glowed with an emerald-green fire, and a brilliant greenish-white waterfall fell from the paddle-wheels of the vessel, which left in its long wake a broad light streak in the dark sea. The sides of the vessel, and our downward gazing faces, were lighted up as bright as moonlight, and I was able to read print without any difficulty by this water-fire. When the illuminating matter, which, according to Ehrenberg's researches, proceeds from infusorial animalculæ, was most intense, we saw flames dancing over the sea, as far as the coast, so that it seemed as if we were sailing through a more richly starred sky than that which was above us. I have frequently observed this illuminatton of the sea on the Mediterranean also, but never with such extraordinory brilliancy as on this occasion. The spectacle was quite like enchantment. Suddenly I observed between the waves new living streaks of fire, which radiated from the vessel like two gigantic serpents, and, judging by the proportions of the ship, were at least from sixty to eighty feet long; they moved in a deceptive manner, in large windings beside the vessel, crossed the waves, dipped into the foam of the paddle-wheels, re-appeared, retreated, hurried forward, and finally vanished in the distance. For a long time I could not explain this phenomenon. I thought of the old tales, so frequently repeated, of the huge sea serpents which have been seen from time to time. Nothing could more closely resemble what was here before us. At length it occurred to me that it might however, only be fishes running a race with the vessel, and, by their rapid movements, brushing the surface of the luminous sea, they might produce the long streaks of light behind them. Nevertheless, the ocular demonstration remained as deceptive as before; I could discover nothing of the dark fishes, nor determine their size; but I at length consoled myself by my own conjecture."

Thebes, the city of a hundred gates, the half explored and half understood wonder of the past, is described with much minuteness. A short extract we subjoin.

"We have now been inhabiting our Thebian Acropolis, on the hill of Qurna, above a quarter of a year, every one busily employed in his own way from morning to evening, in investigating, describing, and drawing the most valuable monuments, taking paper impressions of the inscriptions, and in making plans of the buildings; we have not yet been able to complete the Libyan side alone, where there are at least twelve temples, five-and-twenty tombs of Kings, fifteen belonging to the royal wives or daughters, and a countless number belonging to private persons still to be examined. The eastern side, with its six-and-twenty sanctuaries, in a certain degree of preservation, will however demand no less time, and yet, more has been done by previous travellers and expeditions in Thebes itself, especially by the French-Tuscan expedition, than in any other spot, and we have every where only compared and oompleted their labours, and not repeated them. We are also far from imagining that we have now by any means exhausted the infinite number of monuments; whoever follows us with new information, and with the results of more advanced science, will also find fresh treasures, and gain fresh instruction from the same monuments. I have always had a historical aim in view, and this has especially determined my selection of the monuments. Whenever I believed that I had attained what was most essential for this end I was satisfied."

"The royal temple of KARNAK, which was dedicated to the King of the Gods, embraces in itself the whole history of the Egyptian Monarchy. "All Dynasties emulated in the glory of having contributed their share to the enlargement, embellishment or restoration of this national sanctuary." It was founded by their first king, Sesurtesen I, under the 1st Theban Royal Dynasty, the 12th of Manetho, between 2600 and 2700 before Christ, and even now exhibits some ruins in the centre of the building, from that period, bearing the name of this King."

"But a far more splendid enlargement of the temple was executed in the fifteenth and fourteenth centuries, B.C., by the great Pharohs of the 19th Dynasty; for Sethos 1st, the father of Rames Miamun, added in the original axis of the temple, the most magnificent hall of pillars that was ever seen in Egypt or elsewhere. The stone roof, supported by 134 columns, covers a space of 164 feet in depth, and 320 feet in breadth. Each of the twelve central columns is 36 feet in circumference, and 66 feet high beneath the architrave; the other columns, 40 feet high, are 27 feet in circumference. It is impossible to describe the overwhelming impression which is experienced upon entering for the first time into this forest of columns, and wandering from one range into the other, between the lofty figures of gods and kings on every side represented on them, projecting sometimes entirely, sometimes only in part.

"Every surface is covered with various sculptures, now in relief, now sunk, which were, however, only completed under the successors of the builder; most of them, indeed, by his son Ramses Miamun. In front of this hypostyle hall was placed at a later period, a great hypæthral court, 270 by 320 feet in extent, decorated on the sides only with colonades, and entered by a magnificent pylon. The principle part of the temple terminated here, comprising a length of 1170 feet, not including the row of sphinxes in front of its external pylon, nor the peculiar sanctuary which was placed by Ramses Miamun directly beside the wall farthest back in the temple, and with the same axis, but turned in such a manner that its entrance was on the opposite side. Including these enlargements, the entire length must have amounted to nearly 2000 feet, reckoning to the most southern gate of the external wall which surrounded the whole space, which was of nearly equal breadth. The later Dynasties who now found the principle temples completed on all sides, but who also were desirous of contributing their share to the embellishment of this centre of the Theban worship, began partly to erect separate small temples on the large level space which was surrounded by the above mentioned enclosure wall, partly to extend these temples also externally."

We shall conclude this notice with the description of the climate of Upper Egypt, and some of its curious results.

"In Upper Egypt, where it scarcely ever rains, it is totally different, especially with respect to all the monuments which are situated on the borders of the desert, out of reach of the annual inundation, and this is uniformly the case with the tombs, the richest storehouses for our knowledge of ancient Egyptian life, which in this country alone really fulfil their true destination by serving as an asylum against distruction and decay. The narrow district of the Nile annually recreated borders in its whole length on the wide, rocky, and petrifying desert. The towns and temples were therefore chiefly built on the boundary between the two, partly not to intrench upon the fertile ground, partly in order that the buildings should be upon a drier and more secure foundation. And thus in fact, we find the numerous temples and palaces in wonderful preservation, so far as they are not mutilated by the hand of man. Even the bricks made of Nile mud, and dried in the sun, apparently the most perishable material, have not unfrequently been preserved in the open air for thousands of years, in the form in which they were built up, and with their coating of plaster. A row of great vaulted halls, built entirely of Nile bricks, and partly covered in the inside with stucco, stands about the celebrated temple of the great Ramses, in Thebes. They date from the same period as the temple itself, the beginning of the thirteenth century before Christ. This is not alone testified by the architectonic plan of the building, but most irrefutably by the bricks themselves, which bear the name of Ramses Miamun stamped upon them as a mark of the royal manufacture. At that time, and earlier, during the whole of the 18th and 19th Dynasties, it was a very common practice to line the excavated rock-tombs with Nile bricks, and afterwards to paint upon the stucco, especially wherever the rock was friable, and was therefore hewn into a vaulted roof. But the same custom is sometimes found even in the earliest period of the Pyramids of Memphis. In enclosed places, not only the building material, but the colours, both upon the stone and the plaster covering, have almost without exception retained their original freshness and perfection; and also, very frequently, where they have been exposed to the open air. The peculiar incorruptibility of vegetable and even of animal matter is, however, still more astonishing. Our museums are filled with such remains. In the most ancient tombs of Memphis, a multitude of objects are found made of wood, such as sarcophagi chests, and boxes of all kinds, chairs, instruments, small ships, likewise grains of corn, and dried fruits, such as pomegranates, dates, the fruit of the Doum Palm, nuts, almonds, beans, grapes; also bread, and other food: besides cloth made of bast, a texture of reeds, papyrus, and an incredible quantity of linen. The countless number of mummies, also, are well known, which, though taken out of their tombs, still last for centuries with their skin and hair; also all mummified bodies of animals, with their furs and feathers; even the internal parts of the human body could there be embalmed for ever, and are still found in vases expressly designed for that purpose. This wonderful conservative property belonging to all ancient Egyptian objects, depends therefore chiefly upon the sky being without rain and the dry soil of the non-irrigated desert. But the country offered another marked advantage above other lands—namely, the greatest abundance of materials, especially adapted for all kinds of monuments.

### The Canadian Journal Postage Free.

The Members of the Canadian Institute and the Subscribers to the Journal, will be glad to be informed that for the future no charge will be made for the transmission of the Canadian Journal through the Post to any part of Canada. We believe we are correct in stating that this boon has been obtained through the instrumentality of the Hon. Malcolm Cameron. Such an encouraging instance of the desire of the members of the Government to favour by every legitimate means the claims of Science and Literature, will surely induce increasing exertions on the part of those who wish to witness the progress of Canada in scientific and practical knowledge, keep pace with the increase of its commercial wealth and the extension of its political importance.

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### Second Trial of Newall's Railway Break.

The second trial trip on the East Lancashire Railway, for testing the efficiency of this break was more systematically conducted, and its results have been ascertained with greater accuracy.

A much larger train was used than on the present occasion, consisting of 10 carriages, besides the locomotive and tender, eight of which had breaks attached. Length of train, 86 yards; weight, 88 tons, exclusive of the passengers. Order of carriages attached to engine and tender:—1, Van with break; 2, second-class carriage with break; 3, composite carriage with break; 4, composite with break; 5, second-class carriage with break; 6 and 7, first and second-class carriages without break; 8 and 9, two composites, each with breaks; van with break. Of the nature of the apparatus it is only necessary to repeat that a shafting with connecting rods stretches along over the top of the entire train, from the elbow of the engine driver to the hand of the guard behind (with flexible joints and sockets to accommodate curves, expansions, or contractions of the train), and that it is in the power of either of these, or of any one servant on the train, whichever may have the greatest presence of mind, on the alarm of danger, to apply the whole of the breaks in a moment. The trial ground extended over the 30 miles of rail between Manchester and Blackburn; the experiments being seven with the new breaks, and two with the old breaks, for the sake of comparison.

First Experiment.—On a slight curve on a down incline of 1 in 532 at Within's-lane, between Ratcliffe and Bury, the speed attained when the fog signal for putting on breaks exploded, being 38 miles per hour —the train was brought to a complete stand in 218 yards. Rails rather slippery, owing to a fog.

Second Experiment.—On a level at the station at Bury. Speed 40 miles per hour. Train brought up in 100 yards: in other words, the train ran only 14 yards beyond its own length after the signal was given to put on the breaks.

Third Experiment.—On a descending gradient of 1 in 38, down the first part of the Accrington-bank, 21 miles north of Manchester. Speed 40 miles per hour. Train pulled up in 450 yards.

Fourth Experiment.—On lower portion of Accrington-bank, with a descending gradient of 1 in 40, speed 48 miles per hour. Train brought up in 371 yards. This experiment was regarded as highly satisfactory. The rails were rather slippery, and the weight of the engine was unfavourable to the experiment, the locomotive being a ponderous one, made for goods trains, and not having breakage power to the tender sufficient to stop itself on such an incline, a fact showing how much the engine had dragged at the train after the patent breaks had exerted force enough to have stopped it, was seen in the draw-bars of most of the foremost carriages being drawn out from 10 to 20 inches. It was a matter of surprise to some of the old servants accustomed to work trains down this bank that a train at such a speed could be stopped by any possible means.

Fifth Experiment.—On the straight and level run at the Blackburn station. Speed 48 miles per hour; rails dry. Train stopped in 172 yards.

To witness the last and following experiments the company had alighted and stood on the station platform. The train was taken a few miles back each time towards Accrington, in order that a very high speed might be attained. A fog signal on the rails at the middle of the station was the notice to apply the breaks.

Sixth Experiment.—Speed 40 miles per hour. Stopped in 138 yards, or about 14 seconds of time.

Seventh Experiment.—Speed 56 miles per hour. Stopped in 310 yards. (The actual distance run by this train was 328 yards; but, as the last 128 yards were on a decline of 1 in 110, the 18 yards were deducted for the sake of a comparison with the previous experiments, to allow for extra gravitation.)

Eight Experiment.—For this experiment two of the patent break wheel carriages were taken off, and two other carriages were substituted with the old or ordinary breaks. The train then came into the station at a speed of 42 miles per hour. There were two guards, and each applying a break, and the driver applying the break to the tender, the stoppage of the train was entrusted to these three. The train went a distance of 663 yards before a stoppage could be effected. Allowing 43 yards for the disadvantage of the slight incline, over the last 463 yards, the distance was agreed to be taken at 620. By a calculation made on the spot, it was held that, comparing the speed of this train with the previous one, it ought to have been stopped in 180 yards instead of 683. In other words, the balance in favour of the new break train, as compared with a train having ordinary breaks, was the difference between 180 and 620.

Ninth Experiment.—This was the last trial made, and it was agreed to try the train with one ordinary break in addition to the engine driver's break. Speed 40 miles per hour. Stopped in 861 yards; or, allowing 61 yards for extra gravitation after reaching the incline, the distance was taken at 800 yards.

Taking the last experiment in comparison with the sixth, we have two trains at equal speed (40 miles), and the one is brought to a stand by a single person with the new apparatus in 138 yards, while the other runs 800 yards before it is stopped by the exertions of two persons, the guard and driver. The scientific and practical men present, without exception, expressed themselves highly gratified with the results. Mr. Fairbairn said, without pledging himself after an inspection such as had now been afforded to an approval of every detail of the invention, he would say that, so far as he could see, it was a very successful one, and he thought it was likely to lead to a change that was not important to this company alone, but to the locomotion of the whole kingdom. It had one important feature—that it could throw the whole weight of compression by the breaks on every carriage and every wheel of the train at once.

It was stated that a train with the new apparatus had been on this line from the 15th September, travelling a total of 5,874 miles, and making 2,856 stoppages, without the machinery once getting deranged or requiring repair, and that the wheels of the carriages in the time were little worn, while those with the ordinary breaks would have been worn flat in places to an extent requiring 3-8ths of an inch turning off by the lathe, in diameter, to bring them round, or into shape again. The power of the breaks has been known on a level line to bring a train to a stand, in spite of the tractile power of the engine with full steam on. Another advantage observed was, that the new apparatus gives perfect communication between guard and driver, as the break need only be applied in a modified degree to attract the notice of either; or, if this was not enough, a bell attached would render the communication more complete. It has been suggested that, as there are periodical meetings of all the great railway authorities in London, their attention should be called to the new agent, and that the train might be sent up the London and North-Western line to enable them to test it.

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### Obituary.

Died, at his residence on Ann Street, December 7, Hugh Scobie, Esq.

The loss which Canada has sustained by the untimely death of this enterprising man, will be better understood if we enumerate a few of his works: He was Editor and Proprietor of the *Daily Colonist;* the *British Colonist;* the *News of the Week;* the *Canadian Almanac* (an edition of 40,000 copies); Publisher of the *Canadian Journal;* the *Municipal Manual* for Upper Canada; of numerous Charts of the Great Lakes; Plans of Cities and Towns; Maps of the Districts of Canada; Maps of the Western and Eastern Divisions of Upper Canada; and a large number of Educational Works. He was the third son of Captain James Scobie, of the 83rd Highlanders, and, at the time of his death, was only in his 43rd year. The citizens of Toronto manifested the well-merited esteem they entertained for the deceased when living, and their painful regret at his death, by closing their places of business during the progress of a very numerous procession, which attended his remains to the grave.

# Monthly Meteorological Register, St. Martin, at Isle Jesus, Canada East October, 1853.

*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 ft.**

| Day. | Barom: corrected and reduced to 32° Fahr. | | | Temp. of the Air. | | | Tension of Vapour. | | | Humi'y of the 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. | 10P.M. | 6 A. M. | 2 P. M. | 10P.M. | 6 A. M. | 2 P. M. | 10P.M. | 6 A. M. | 2 P. M. | 10 P. M. | 6 A. M. | 2 P. M. | 10P.M. | | | 6 A. M. | 2 P. M. | 10 P. M. |
| 1 | 29·626 | 29·447 | 29·423 | 42.5 | 59 0 | 46.6 | .263 | .338 | .303 | .92 | .66 | .93 | S W b W | S S W | S W b S | 4.51 | 0.50 | Calm. | | | Cir. Str. 8. | Cum Str. 5. | Overcast. |
| 2 | ·348 | ·346 | ·424 | 45.4 | 45.0 | 41.0 | .292 | .290 | .253 | .93 | .93 | .92 | N E b E | N b W | W N W | 0.87 | 7.67 | 9.37 | 0.606 | | Str. 10. | Rain c. 7.40 a.m | Rain. |
| 3 | ·443 | ·405 | ·615 | 38.0 | 45.0 | 36.1 | .232 | .241 | .210 | .94 | .76 | .91 | W N W | W N W | W b N | 16.30 | 15.00 | 15.00 | 0.666 | | Rain. | Cir. Str. 5. | Clear. |
| 4 | ·574 | ·537 | ·483 | 38.0 | 52.7 | 47.8 | .236 | .326 | .313 | .94 | .81 | .93 | S W b W | S W b W | S W | 2.61 | 2.25 | 3.25 | 0.444 | | Light rain. | Str. 10. | Light Showers. |
| 5 | ·423 | ·261 | ·186 | 51.0 | 53.0 | 51.0 | .337 | .341 | .374 | .87 | .83 | .96 | S | S | S W b W | 5.00 | 9.19 | 5.16 | 0.366 | | Cum. Str. 10. | Cum. Str. 10. | Rain. |
| 6 | ·518 | ·435 | ·540 | 40.0 | 41.0 | 36.1 | .250 | .201 | .205 | .95 | .73 | .86 | W N W | W N W | W N W | 15.64 | 24.16 | 25.81 | | | Rain. | Str. 9. | Cir. Str. 10. |
| 7 | ·679 | ·658 | ·672 | 34.0 | 47.7 | 41.1 | .178 | .212 | .217 | .83 | .69 | .79 | W N W | W N W | W b N | 19.84 | 14.81 | 6 25 | | | Str. 2. | Clear. | Str. 10. |
| 8 | ·542 | ·542 | 508 | 42.2 | 62.2 | 49.0 | .243 | .421 | .312 | .85 | .75 | .86 | S S W | S W | S | Calm. | 1.17 | Calm. | | | Clear. | Clear. | Str. 10. |
| 9 | ·222 | ·240 | ·266 | 51.7 | 69.5 | 53.1 | .361 | .414 | .315 | .92 | .58 | .76 | W b S | S S W | W S W | 1.65 | 4.62 | 3.72 | 0.100 | | Cum. Str. 2. | Clear. | Cir. 2; Th. storm |
| 10 | ·377 | ·358 | ·395 | 39.1 | 50.8 | 37.1 | .225 | .274 | .199 | .79 | .70 | .83 | W | W N W | W b N | 3.17 | 5.37 | 0.53 | | | Clear. | Str. 2. [& hail | Str. 6. [at 4.45 |
| 11 | ·473 | ·469 | ·520 | 38.0 | 42.5 | 38.1 | .226 | .263 | .226 | .91 | .92 | .91 | W b N | W N W | W b N | 1.39 | 13.14 | 18.05 | Inap. | | Clear. | Str. 4; Shower | Str. 9. |
| 12 | ·488 | ·410 | ·420 | 37.0 | 45 6 | 42.6 | .201 | .253 | .243 | .86 | .80 | .85 | W b N | W | W | 14.40 | 12.06 | 15.00 | | | Str. 8. | Cir. Str. 2. | Hazy. |
| 13 | ·395 | ·386 | ·549 | 40.5 | 45.8 | 40.8 | .245 | .253 | .227 | .92 | .80 | .85 | W N W | N W | N W | 21.73 | 9.98 | 8.45 | Inap. | | Rain. | Cir. Str. 2. | Str. 8. |
| 14 | ·663 | ·632 | ·765 | 36.7 | 51 5 | 35.5 | .210 | 274 | .203 | .91 | .70 | .91 | N W | N W bW | W | 0.38 | 0.67 | 2.12 | | | Clear. | Str. 2. | Clear. |
| 15 | ·740 | ·621 | ·654 | 36.0 | 59 2 | 47.0 | .210 | .358 | .291 | .91 | .70 | .86 | S W b S | S W b W | W S W | 0.22 | 8 21 | 2.51 | | | Clear; hoar fr. | Cir. Str. 7. | Clear. |
| 16 | ·736 | ·662 | ·561 | 38.0 | 63.6 | 47.0 | .218 | .411 | .291 | .87 | .71 | .86 | W b S | W S W | S S W | 0.25 | 1.37 | 1.02 | | | Clear. | Clear. | Clear. |
| 17 | ·581 | ·543 | ·650 | 44.6 | 55.9 | 41 0 | .282 | .385 | .235 | .92 | .84 | .85 | W S W | W N W | N W | 2.62 | 6.75 | 2.71 | | | Clear. | Cir. St. 4. | Clear. |
| 18 | ·746 | ·679 | ·685 | 32.0 | 55.4 | 43.0 | .182 | .295 | .233 | .91 | .66 | .79 | N W b N | W N W | W b S | 0.67 | 5.06 | 3.05 | | | Clear. | Clear. | Light Cir. |
| 19 | ·690 | ·611 | ·651 | 37.2 | 63.7 | 50.0 | .218 | .366 | .283 | .91 | .63 | .75 | W b N | W S W | W b S | 5.31 | 4.08 | 6.25 | | | Clear. | Clear. | Clear. |
| 20 | ·651 | ·621 | ·586 | 43.6 | 67.0 | 50.8 | .252 | .480 | .326 | .85 | .72 | .87 | W b S | S W | S W | 7.81 | 2.00 | 1.75 | | | Clear. | Clear. | Clear. |
| 21 | ·577 | ·491 | ·439 | 44.6 | 55.9 | 54.2 | .282 | .418 | .373 | .92 | .87 | .94 | E | E N E | E b N | Calm. | 0.91 | 3.52 | | | Clear. | Clear. | Str. 10. |
| 22 | ·372 | ·211 | ·128 | 49.0 | 66.2 | 63.2 | .336 | ·605 | .546 | .93 | .94 | .94 | E | S b E | S b E | 2.95 | 1.95 | 9.00 | 1.126 | | Rain c. 3.4 a.m. | Cum. Str. 9. | Rain at 7 p.m. |
| 23 | ·207 | ·292 | ·388 | 51.0 | 57.5 | 44.0 | .315 | .316 | .241 | .81 | .66 | .79 | S W | W b S | W b S | 5.21 | 17.50 | 7.65 | 0.433 | | Str. 4. | Cir. Str. 5. | Clear; Aur. Bor. |
| 24 | ·247 | ·428 | ·248 | 38 8 | 41.8 | 32.2 | .196 | .235 | .182 | .76 | ·85 | .91 | W b N | N E b E | N N E | 1.78 | 0.62 | 7.50 | 0.430 | 2.00 | Str. 9. | Str. 10; Rain at | Snow at 6.30p.m |
| 25 | ·113 | ·115 | ·391 | 33.0 | 40.5 | 32.7 | .187 | .210 | .187 | .90 | .79 | .90 | W b N | W b S | W | 17.75 | 17.03 | 17.00 | 0.286 | | Cir. Str. 8. | Clear. [2 25 p.m | Clear. |
| 26 | ·610 | ·415 | ·498 | 33.0 | 45.3 | 41.0 | .161 | .272 | .235 | .78 | .86 | .85 | S S W | S S W | S | 9.61 | 4.25 | 7.07 | | | Overcast. | Str. 10. | Str, 10. |
| 27 | ·357 | ·359 | 526 | 41.0 | 48.0 | 39.0 | .262 | .302 | .214 | .96 | .86 | .84 | S | W b S | N W bW | 6.68 | 5.87 | 3.88 | 1.006 | | Rain. | Str. 10. | Clear. |
| 28 | ·465 | ·455 | ·563 | 35.0 | 41.5 | 29.5 | .203 | .201 | .131 | .91 | .73 | .70 | N N E | N | N W | 1.01 | 2.63 | 3.93 | | | Str. 9. | Cir. Str. 4. | Clear. |
| 29 | ·724 | ·730 | ·786 | 26.5 | 40.9 | 28.5 | .108 | .210 | .117 | .66 | .79 | .65 | N W | W b N | W b N | 3.32 | 9.30 | 2.85 | | | Cear. | Clear. | Clear. |
| 30 | ·853 | ·805 | ·720 | 24.1 | 42.0 | 32.0 | .115 | .178 | .153 | .76 | .63 | .76 | W b N | W S W | S b E | Calm. | 0.76 | 0.12 | | | Clear. | Str. 2. | Overcast. |
| 31 | ·629 | ·504 | ·463 | 31.5 | 52.2 | 40.0 | .171 | .283 | .210 | .89 | .70 | .79 | S | S | S b W | 0.92 | 3.85 | 6.25 | | | Clear. | Cir. Str. 2. | Clear. |

Barometer.
- Highest, the 30th day - - - - - 29.853
- Lowest, the 25th day - - - - - 29.113
- Monthly Mean, - - - - - - - 29.500
- " Range - - - - - - - 0.740

Thermometer
- Highest, the 9th day - - - - - 69.°5
- Lowest, the 30th day - - - - - 23.°0
- Monthly Mean - - - - - - 43.°37
- " Range - - - - - - 46.°5

Greatest Intensity of the Sun's Rays—138.°0

Lowest point of Terrestial Radiation 21.°0

Mean of Humi·.ity, 855.

Amount of Evaporation, 2.31 inches.

Rain fell on 11 days amounting to 5.463 inches, and was accompanied by thunder and lightning on 2 days.

Thunder and lightning on 2 days.

Snow fell on the 24th day, amounting to 2.00 inches.

Most Prevalent wind—W. N. W.

Least do. do. E.

Most Windy Day—the 6th day—mean miles per hour 21.87.

Least Windy Day—1st day—mean miles per hour 0.456.

Aurora Borealis visible on 1 night, and might have been seen on 17 nights.

The electrical state of the atmosphere has been marked by moderate intensity of a positive character, and during the storm of the 9th day, indicated a High Tension of the same character.

* *This Table was accidentally omitted in the November number. The Tables for Toronto, and St. Martin, and Quebec, will appear as usual in the next issue.*