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ON THE THEORY OF IGNEOUS ROCKS AND VOLCANOS.

BY T. STERRY HUNT,

OF THE GEOLOGICAL SURVEY OF CANADA.

Read before the Canadian Institute, 13*th March*, 1858.

In a note in the American Journal of Science for January, 1858, I have ventured to put forward some speculations upon the chemistry of a cooling globe, such as the igneous theory supposes our earth to have been at an early period. Considering only the crust with which geology makes us acquainted, and the liquid and gaseous elements which now surround it, I have endeavored to show that we may attain to some idea of the chemical conditions of the cooling mass by conceiving these materials to again re-act upon each other under the influence of an intense heat. The quartz, which is present in such a great proportion in many rocks, would decompose the carbonates and sulphates, and aided by the presence of water, the chlorids both of the rocky strata and the sea, while the organic matters and the fossil carbon would be burned by the atmospheric oxygen. From these reactions would result a fused mass of silicates of alumina, alkalies, lime, magnesia, iron, etc., while all the carbon, sulphur and chlorine, in the form of acid gases, mixed with watery vapour, azote, and a probable excess of oxygen; would form an exceedingly dense atmosphere. When the cooling permitted condensation, an acid rain would fall upon the heated crust of the earth, decomposing the silicates, and giving rise to chlorids and sulphates of the various bases, while the separated silica would probably take the form of crystalline quartz.

In the next stage, the portions of the primitive crust not covered by the ocean, undergo a decomposition under the influence of the hot moist atmosphere charged with carbonic acid, and the feldspathic silicates are converted into clays with separation of an alkaline silicate, which, decomposed by the carbonic acid, finds its way to the sea in the form of alkaline bicarbonate, where, having first precipitated any dissolved sesquioxyds, it changes the dissolved lime-salts into bicarbonate, which precipitated chemically or separated by organic agencies, gives rise to limestones, the chlorid of calcium being at the same time replaced by common salt. The separation from the water of the ocean, of gypsum and sea-salt, and of the salts of potash, by the agency of marine plants, and by the formation of glauconite, are considerations foreign to our present study.

In this way we obtain a notion of the processes by which, from a primitive fused mass, may be generated the silicious, calcareous and argillaceous rocks which make up the greater part of the earth's crust, and we also understand the source of the salts of the ocean. But the question here arises whether this primitive crystalline rock, which probably approached to dolerite in its composition, is now anywhere visible upon the earth's surface. It is certain that the oldest known rocks are stratified deposits of limestone, clay and sands, generally in a highly altered condition, but these, as well as more recent strata, are penetrated by various injected rocks, such as granites, trachytes, syenites, porphyries, dolerites, phonolites, etc. These offer, in their mode of occurrence, not less than their composition, so many analogies with the lavas of modern volcanos, that they are also universally supposed to be of igneous origin, and to owe their peculiarities to slow cooling under pressure. This conclusion being admitted, we proceed to inquire into the sources of these liquid masses, which, from the earliest known geological period up to the present day, have been from time to time ejected from below. They are generally regarded as evidences both of the igneous fusion of the interior of our planet, and of a direct communication between the surface and the fluid nucleus, which is supposed to be the source of the various ejected rocks.

These intrusive masses, however, offer very great diversities in their composition, from the highly silicious and felspathic granites, eurites, and trachytes, in which lime, magnesia and iron are present in very small quantities, and in which potash is the predominant alkali, to those denser basic rocks, dolorite, dierite, hyperite, melaphyre, euphotide, trap and basalt; in these, lime, magnesia and iron-oxyd are abundant, and soda prevails over the potash. To account for these differences in the composition of the injected rocks, Phillips, and after him Durocher, suppose the interior fluid mass to have separated into a denser stratum of the basic silicates, upon which a lighter and more silicious portion floats like oil upon water, and that these two liquids, occasionally more or less modified by a partial crystalization and eliquation, or by a refusion, give rise to the principal varieties of silicious and basic rocks, while from the mingling of the two zones of liquid matter, intermediate rocks are formed. (Phillips' *Manual of Geology*, p. 556, and Durocher, *Annales des Mines*, 1857, vol, 1, p. 217.)

An analogous view was suggested by Bunsen in his researches on the volcanic rocks of Iceland, and extended by Streng to similar rocks in Hungary and Armenia. These investigators suppose a trachytic and a pyroxenic magma of constant composition, representing respectively the two great divisions of rocks which we have just distinguished; and have endeavored to calculate from the amount of silica in any intermediate variety, the proportions in which these compounds must have been mingled to produce it, and consequently the proportions of alumina, lime, magnesia, iron-oxyd and alkalies which such a rock may be expected to contain. But the amounts thus calculated, as may be seen from Dr. Streng's results, do not always correspond with the results of analysis. (Streng, *Annales de Chimie et de Physique*, 3rd series, vol. 39, p. 52.) Besides there are varieties of intrusive rocks, such as the phonolites, which are highly basic, and yet contain but very small quantities of lime, magnesia and iron oxyd, being essentially silicates of alumina and alkalies in part hydrated.

We may here remark that many of the so-called igneous rocks are often of undoubted sedimentary origin. It will scarcely be questioned that this is true of many granites, and it is certain that all the feldspathic rocks coming under the categories of hyperite, labradorite, euphotide, diorite, amphibolite, which make such so large a part of the Laurentian system in North America, are of sedimentary origin. They are here interstratified with limestones, dolomites, serpentines, crystalline schists and quartzites, which are often conglomerate. The same thing is true of similar feldspathic rocks in the altered Silurian strata of the Green Mountains. These metamorphic strata have been exposed to conditions which have rendered some of them quasi-fluid or plastic. Thus for example, crystalline limestone may be seen in positions which have led many observers to regard it as intrusive rock, although its general mode of occurrence leaves no doubt as to its sedimentary origin. We find in the Laurentian system that the limestones sometimes envelope the broken and contorted fragments of the beds of quartzite, with which they are often interstratified, and penetrate like a veritable trap into fissures in the quartzite and gneiss. A rock of sedimentary origin may then assume the conditions of a so-called igneous rock, and who shall say that any of the intrusive granites, dolerites, euphotides, and serpentines, have an origin distinct from the metamorphic strata of the same kind, which make up such vast portions of the older stratified formation? To suppose that each of these sedimentary rocks has also its representative among the ejected products of the central fire, seems a hypothesis not only unnecessary, but when we consider their varying composition, untenable.

We are next led to consider the nature of the agencies which have produced this plastic condition in various crystalline rocks. Certain facts, such as the presence of graphite in contact with carbonate of lime, and oxyd of iron, not less than the presence of alkaliferous silicates, like the feldspars in crystalline limestones, forbid us to admit the ordinary notion of the intervention of an intense heat, such as would produce an igneous fusion, and lead us to consider the view first put forward by Poulett Scrope, * and since ably advocated by Scheerer and by Elie de Beaumont, of the intervention of water aided by fire, which they suppose may communicate a plasticity to rocks at a temperature far below that required for their igneous fusion. The presence of water in the lavas of modern volcanos led Mr. Scrope to speculate upon the effect which a small portion of this element might exert at an elevated temperature and under pressure, in giving liquidity to masses of rock, and he extended this idea from proper volcanic rocks to granites.

Scheerer in his inquiry into the origin of granite has appealed to the evidence afforded us by the structure of this rock, that the more fusible feldspars and mica crystallized before the almost infusible quartz. He also points to the existence in granite of what he has called pyrognomic minerals, such as allanite and gadolinite, which, when heated to low redness, undergo a peculiar and permanent molecular change, accompanied by an augmentation in density, and a change in chemical properties, a phenomenon completely analogous to that offered by titanic acid and chromic oxyd in their change by ignition from a soluble to an insoluble condition. These facts seem to exclude the idea of igneous fusion, and point to some other cause of liquidity. The presence of natrolite as an integral part of the zircon-syenites of Norway, and of talc and chlorite and other hydrous minerals in many granites show that water was not excluded from the original granitic paste.

Scheerer appeals to the influence of small portions of carbon and

* See Journal of Geol. Society of London, vol. xii., p. 326.

sulphur in greatly reducing the fusing point of iron. He alludes to the experiments of Schafhautl and Wöhler, which show that quartz and apophylite may be dissolved by heated water under pressure and recrystallized on cooling. He recalls the aqueous fusion of many hydrated salts, and finally suggests that the presence of a small amount of water, perhaps five or ten per cent., may suffice at a temperature which may approach that of redness, to give to a granitic mass a liquidity, partaking at once of the characters of an igneous and an aqueous fusion.

This ingenious hypothesis, sustained by Scheerer in his discussion with Durocher,* is strongly confirmed by the late experiments of Daubrée. He found that common glass, a silicate of lime and alkali, when exposed to a temperature of 400° C., in presence of its own volume of water, swelled up and was transformed into an aggregate of crystals of wollastonite, the alkali with the excess of silica separating, and a great part of the latter crystallizing in the form of quartz. When the glass contained oxyd of iron, the wollastonite was replaced by crystals of diopside. Obsidian in the same manner yielded crystals of feldspar, and was converted into a mass like trachyte. In these experiments upon vitreous alkaliferous matters, the process of nature in the metamorphosis of sediments is reversed, but Daubrée found still farther that kaolin, when exposed to a heat of 400° C. in the presence of a soluble alkaline silicate, is converted into crystalline feldspar, while the excess of silica separates in the form of quartz. He found natural feldspar and diopside to be extremely stable in the presence of alkaline solutions. These beautiful results were communicated to the French Academy of Sciences on the 16th of November last, and as the author well remarked, enable us to understand the part which water may play in giving origin to crystalline minerals in lavas and intrusive rocks. The swelling-up of the glass also shows that water gives a mobility to the particles of the glass at a temperature far below that of its igneous fusion.

I had already shown in the Report of the Geological Survey of Canada for 1856, p. 479, that the reaction between alkaline silicates and the carbonates of lime, magnesia and iron at a temperature of 100° C. gives rise to silicates of these bases, and enables us to explain their production from a mixture of carbonates and quartz, in the presence of a solution of alkaline carbonate. I there also suggested

* NOTE.—See for the arguments on the two sides, Bulletin of the Geol. Soc. of France, Second series, vol. iv., p. p. 468, 1018; vi., 644; vii., 276; viii., 500; also, Elie de Beaumont, Ibid. vol. iv., p. 1312. See also the recent microscopical observations of Mr. Sorby, confirming the theory of the aqueous-igneous origin of granite.—*L. E. & D. Phil. Mag.*, February, 1858.

that the silicates of alumina in sedimentary rocks may combine with alkaline silicates to form feldspars and mica, and that it would be possible to crystallize these minerals from hot alkaline solutions in sealed tubes. In this way I explained the occurrence of these silicates in altered fossilferous strata. My conjectures are now confirmed by the experiments of Daubrée, which serve to complete the demonstration of my theory of the normal metamorphism of sedimentary rocks by the interposition of heated alkaline solutions.

But to return to the question of intrusive rocks: Calculations based on the increasing temperature of the earth's crust as we descend, lead to the belief that at a depth of about twenty-five miles the heat must be sufficient for the igneous fusion of basalt. The recent observations of Hopkins, however, show that the melting points of various bodies, such as wax, sulphur and resin are greatly and progressively raised by pressure, so that from analogy we may conclude that the interior portions of the earth are, although ignited, solid from great pressure. This conclusion accords with the mathematical deductions of Mr. Hopkins, who, from the precession of the equinoxes, calculates the solid crust of the earth to have a thickness of 800 or 1,000 miles. Similar investigations by Mr. Hennessey however assign 600 miles as the maximum thickness of the crust. The region of liquid fire being thus removed so far from the earth's surface, Mr. Hopkins suggests the existence of lakes or limited basins of molten matter which serve to feed the volcanos.

Now the mode of formation of the primitive molten crust of the earth would naturally exclude all combined or intermingled water, while all the sedimentary rocks are necessarily permeated by this liquid, and consequently in a condition to be rendered semi-fluid by the application of heat as supposed in the theory of Scrope and Scheerer. If now we admit that all igneous rocks, ancient plutonic masses, as well as modern lavas, have their origin in the liquefaction of sedimentary strata, we at once explain the diversities in their composition. We can also understand why the products of volcanos in different regions are so unlike, and why the lavas of the same volcano vary at different periods. We find an explanation of the water and carbonic acid which are such constant accompaniments of volcanic action, as well as the hydrochloric acid, sulphuretted hydrogen and sulphuric acid, which are so abundantly evolved by certain volcanos. The reaction between silica and carbonates must give rise to carbonic acid, and the decomposition of sea-salt in saliferous strata by silica in the presence of water, will generate hydrochloric acid, while gypsum in the same way will evolve its sulphur in the form of sulphurous acid mixed with oxygen. The presence of fossil plants in the melting strata would generate carburetted hydrogen gases, whose reducing action would convert the sulphurous acid into sulphuretted hydrogen; or the reducing agency of the carbonaceous matters might give rise to sulphuret of calcium which would be in its turn decomposed by car bonic acid or otherwise. The intervention of carbonaceous matters in volcanic phenomenon is indicated by the recent investigations of Deville, who has found carburetted hydrogen in the gaseous emanations of the region of Etna and the lagoons of Tuscany. The ammonia and the nitrogen of volcanos are also in many cases probably derived from organic matters in the strata decomposed by subterranean heat. The carburetted hydrogen and bitumen evolved from mud volcanos, like those of the Crimea and of Bakou, and the carbonized remains of plants in the *moya* of Quito, and in the volcanic matters of the Island of Ascension, not less than the infusiorial remains found by Ehrenberg in the ejected matters of most volcanos, all go to show that fossiliferous sediments are very generally implicated in volcanic phenomena. It is to Sir John F. W. Herschel that we owe, so far as I am aware, the first suggestions of the theory of volcanic action which I have here brought forward. In a letter to Sir Charles Lyell, dated February 20, 1836, (Proceedings Geol. Soc. London, vol. II, p. 548), he maintains that with the accumulation of sediment the isothermal lines in the earth's crust must rise, so that strata buried deep enough will be crystallized and metamorphosed, and eventualy be raised, with their included water, to the melting point. This will give rise to evolutions of gases and vapours, earthquakes, volcanic explosions etc., all of which results must, according to known laws, follow from the fact of a high central temperature; while from the mèchanical subversion of the equilibrium of pressure, following upon the transfer of sediments, while the yielding surface reposes upon a mass of matter partly liquid and partly solid, we may explain the phenomena of elevation and subsidence. Such is a summary of the views put forward more than twenty years since by this eminent philosopher, which, although they have passed almost unnoticed by geologists, seem to me to furnish a simple and comprehensive explanation of several of the most difficult problems of chemical and dynamical geology.

To sum up in a few words the views here advanced. We conceive that the earth's solid crust of anhydrous and primitive igneous rock is everywhere deeply concealed beneath its own ruins, which form a great mass of sedimentary strata permeated by water. As heat from beneath invades these sediments, it produces in them that change which constitutes normal metamorphism. These rocks at a sufficient depth are necessarily in a state of igneo-aqueous fusion, and then in the event of fracture of the overlying strata, may rise among them, taking the form of eruptive rocks. Where the nature of the sediments is such as to generate great amounts of elastic fluids by their fusion, earthquakes and volcanic eruptions may result, and these, other things being equal, will be most likely to occur under the more recent formations.

ON THE ASSAYING OF COALS BY THE BLOWPIPE.

BY E. J. CHAPMAN,

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Read before the Canadian Institute, 16th January, 1858.

The blowpipe had been employed with great success for nearly a century in the examination of minerals and chemical products, with a view to distinguish these numerous bodies from one another, and also to ascertain their general composition, when Edward Harkort of Freiberg first applied it to the quantitative investigation of certain silver ores and furnace products. Plattner, who had worked with Harkort, subsequently extended this application to the assaying of various metallic substances, and added in no small degree to the utility of the instrument, by the invention of new methods of research and many new appliances, published collectively in his well-known *Probirkunst mit dem Löthrohre.** No one, however, has yet attempted to employ the blowpipe in the practical examination of coals, an application peculiarly fitted to it: since, in travelling, and at other times when only the blowpipe-apparatus can be conveniently made use of, determinations of the kind in question are often desirable. Having had some experience in the use of the instrument, I have attempted to supply this

* This work reached in 1853 its fourth edition. Harkort's earlier publication (1827), of which, however, merely the first part was issued, bore a similar title. For all that concerns the history and general application of the blowpipe, the reader may consult the fourth edition of the standard work by Berzelius, as translated by Whitney. A new edition of this work, incorporating the various tests and discoveries published since the death of its distinguished author, is much required.

deficiency; and, thinking the subject of sufficient interest to be brought before the Canadian Institute, I have embodied in the present paper, the results of my investigations. The subject may be conveniently considered under the following heads:—(1). Coal in its different aspects; (2). Instruments and appliances; (3). Operations.

§ 1. DIFFERENT VARIETIES OF COAL.

Without attending to minor distinctions or points of merely local value, we may arrange all varieties of coal, so far as regards practical purposes, under the following subdivisions:

1. Anthracites.
2. Anthracitic or Dry Coals.
3. Caking or Fat Coals.
4. Cannel or Gas Coals.
5. Brown Coals or Lignites.

These varieties pass by almost insensible transitions into one another. Thus, the cannel coals are related to the lignites by the different kinds of jet, some of which are referable to the one, and some to the other subdivision. Between the caking and the cannel coals there are also various links; whilst the anthracitic or dry coals, on the other hand—passing by excess of bitumen into the caking coals, and by a diminution of bituminous matter into the anthracites—serve to connect the first and third divisions. The typical or normal specimens of each of these five varieties, however, are sufficiently well marked.

1. *Anthracites.*—The true or normal anthracites possess a brilliant sub-metallic lustre, a degree of hardness varying from 3.0 to 3.25*, and a specific gravity of at least 1.33. A specimen from Pensylvania gave 1.51; another specimen, 1.44; one from the department of the Isère in France, 1.56; and three from Wales yielded respectively 1.33, 1.37, 1.34. It should be stated, however, that many of the Welsh specimens belong strictly to the division of anthracitic coals, rather than to that of the true anthracites. The normal anthracites exhibit also a black or grayish-black streak; and all are good conductors of electricity. The latter character may be conveniently shewn by the method first pointed out by VonKobell. A fragment placed in a solution of sulphate of copper (blue vitriol) in contact with a strip of zinc, will become quickly coated with a deposit of metallic copper: a phenomenon not exhibited in the case of common coal. Deducting ash and moisture, true anthracites present, as a mean, the following

* Hausmann in his *Handbuch der Mineralogie*, gives 2.5 as the extreme hardness of all coals; but this is evidently erroneous, as many specimens, not only of anthracite, but of common and cannel coals, scratch calcareous spar.

composition:—Carbon, 92½, Hydrogen 3½, Oxygen (with trace of Nitrogen) 4. All yield an amount of coke equal to or exceeding 89 per cent. The coke is frequently pulverulent, never agglutinated.

The comportment of anthracite before the blowpipe has not hitherto been given in detail. It is as follows:—*Per se*, the assay quickly loses its metallic brilliancy. After continued ignition, small white specks of ash appear on its edges. In borax it dissolves very slowly, with constant escape of bubbles. It is not attacked by salt of phosphorus; the assay works to the top of the bead and slowly burns away. In carbonate of soda, it effervesces, scintillates, and turns rapidly in the bead; and the soda is gradually absorbed. In the bulb tube a little water is always given off, but without any trace of bituminous matter.

As regards their geological position, the true anthracites belong chiefly to the middle portion of the Palæozoic series, below the Carboniferous formation; or otherwise, they constitute the under portion of the coal measures. Frequently also, anthracites occur in the vicinity of erupted rocks, and amongst metamorphic strata, as manifest alterations of ordinary coal.

2. *Anthracitic Coals.*—These are often confounded with the true anthracites, into which indeed, as already stated, they gradually merge. Normally, they differ from the true anthracites in being non-conductors of electricity, in burning more easily and with a very evident yellow flame, in yielding a small quantity of bituminous matter when heated in a tube closed at one end, and in furnishing an amount of coke below 80 per cent. The coke is also in general more or less agglutinated, although it never presents the fused, mamillated appearance of that obtained from caking coal. The mean composition, ash and moisture deducted, may be represented as follows:—Carbon 89½, Hydrogen 5, Oxygen (with trace of Nitrogen) 5½; or Carbon 89, Hydrogen 5, Oxygen (with trace of Nitrogen) 6.

3. *Caking Coals.*—These are often termed, technically, "Fat coals." They constitute the type-series of the coals, properly so called. All yield a fused and mamillated coke, varying in amount from 65 to 70 per cent. Sp. gr.=1.27–1.32. Commonly mixed with thin layers of strongly soiling "mineral charcoal" or fibrous anthracite. Mean composition (ash and moisture excluded): Carbon 87.9, Hydrogen 5.1, Oxygen (with nitrogen) 7.0.

4. *Cannel or Gas Coals.*—These coals, at least in normal specimens, do not fuse or "cake" in the fire. They give off a large amount of volatile matter, frequently more than half their weight; hence their

popular name of "gas coals." They soil very slightly, or not at all. The coke obtained from them is sometimes fritted, and partially agglutinated, but never fused into globular, mamillated masses, like that obtained from the caking coals. It varies in amount from 30 to 60, or, in typical specimens, from 55 to 58 per cent. Mean composition (normal cannel): Carbon 80–85, Hydrogen 5.5, Oxygen (with nitrogen) 9–12.5.

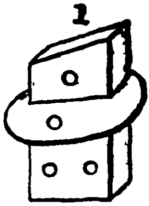
5. *Lignites or Brown Coals.*—These coals of Tertiary age, differ greatly from one another in external aspect. Some of the so-called jets—passing into the cannel coals—are black, lustrous, and non-soiling; whilst other varieties are brown, and of a ligniform or stratified structure; or, otherwise, earthy and loosely coherent. All, however, are partially soluble in caustic potash, communicating to it a dark brown colour. The coke—usually of a dull charcoal-like aspect, or in sharp-edged fragments retaining their original form—varies from 25 to 50 per cent. Its separate fragments are rarely agglutinated, except in the case of certain varieties (as the lignites of Cuba, and those from the fresh-water deposits of the Basse Alpes in France) which contain asphaltum. All the typical varieties of lignite, as pointed out by Cordier, continue to burn for some time, in the manner of "braise" or ignited wood, after the cessation of the flame occasioned by the combustion of their more volatile constituents; whereas with ordinary coal, ignition ceases on the flame going out. The mean composition of lignite may be represented by—Carbon 65–75; Hydrogen 5, Oxygen (with nitrogen) 20–30.

All the different kinds of coal, enumerated above, contain a variable amount of moisture, and of inorganic matter or "ash." The moisture rarely exceeds 3 or 4 per cent., although in some samples of coal it is as high as 6 or 7, and even reaches 15 or 20 per cent. in certain lignites. The amount of ash is also necessarily a variable element. In good coals it is under 5, frequently indeed, under 2 per cent. On the other hand, it sometimes exceeds 8 or 10, and in bad samples even 15 or 20 per cent. The ash may be either argillaceous, argillo-ferruginous, calcareous, or calcareo-ferruginous. The ferruginous ashes are always more or less red or tawny in color from the presence of sesqui-oxide of iron, derived from the iron pyrites ($Fe\,S^2$) originally present in the coal. If much pyrites be present, the coal is not available for furnace operations, gas making, engine use, &c., owing to the injurious effects of the disengaged sulphur. Calcareous ashes are more common in Secondary and Tertiary coals than in those of the Palæozoic Age. For methods of ascertaining the nature and amount of ash, pyrites, &c., see under § 3 below.

§ 2. INSTRUMENTS AND APPLIANCES.

The instruments, &c., employed in these examinations are the following: a blowpipe, blowpipe-lamp, and small spirit-lamp of the ordinary construction; together with the usual accessory instruments and re-agents which always accompany the blowpipe. These require no special description. The blowpipe may be of any form, but for the purpose of heating small platinum vessels in these experiments, it is convenient (although not absolutely necessary) to add to it an extra jet with an orifice rather larger than usual. The blowpipe-lamp should also be furnished with a broad wick-holder of the pattern recommended by Plattner (fig. 1), in place of the flat wick-holders formerly in use. In heating crucibles it is advisable to turn the wick-holder so as to make the upper surface slope towards the right hand instead of towards the left, the flame being then directed upwards, against and around the bottom of the crucible. Or, to avoid the trouble of changing the position of the wick-holder, the operator may turn the lamp itself, placing it with its fore part away from him.

1



In addition to the above, the following appliances, of more special use, are also needed:—(1). Two platinum capsules as thin as they can be obtained. One about half an inch in diameter, provided with a small ear or handle; and the other of somewhat smaller dimensions, and without any projecting ear. The smaller capsule, reversed, fits into the larger one, the two then constituting a closed vessel. Those which I employ, weigh together less than 42 grains. (2). A small platinum crucible with a lid. I make use of two small but deep platinum spoons; one with, and the other without a handle. The latter must be the larger of the two. Its edges must be bent slightly inwards so as to allow it when reversed to be fitted closely over the smaller spoon, and thus to constitute a lid. The long handle of the spoon crucible should be bent as shewn in figure 2. The object of this is to enable the crucible to retain an upright position when placed on the pan of the balance. The figure shews the exact size and form of the crucible employed by me. Its weight is a little under 36 grs. In some spoons a slight notch must be cut in the lid to admit the passing of the handle. (3). A pair of steel tongs or forceps to hold

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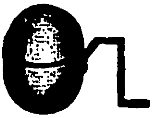
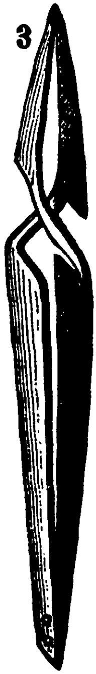


the platinum vessel during ignition. These tongs should be so constructed as to remain closed except when subjected to the pressure of the fingers. I give a figure of the kind that I employ, because it is much more convenient than the forceps commonly put up in blowpipe cases; or indeed, than any that I have found described in works on the blowpipe, or in the catalogues of the instrument makers. In using these tongs, the left hand need only be employed. They open by the pressure of the forefinger and thumb upon their sides. (4). A balance. The most convenient kind of balance for use in these operations, is that first contrived by Lingke of Freiburg, for Plattner's assaying experiments. It is figured and described in detail in the fourth edition of Plattner's "*Probirkunst mit dem Löthrohre.*" This balance takes to pieces, and packs with its weights, forceps, &c., into receptacles cut for it in a small box of pear-tree wood, the size of a thin octavo volume. It can be fitted up ready for use, in the course of a few minutes; and its delicacy is very great. That which I employ, when loaded with three grammes, a greater weight than it is ever required to carry, turns readily with less than half a milligramme, or the 0.0077th of a grain. It is convenient to have counterpoises for the platinum vessels described above, as the weights belonging to the balance only range from a gramme downwards. A small platinum capsule forms the best kind of counterpoise. It can be trimmed down by a knife or pair of scissors, until brought, after repeated trials, to the proper weight. In spare places in the box containing the balance that I use, I have cut out receptacles for the two platinum vessels and their counterpoises, and I recommend other operators to do the same; because these platinum vessels are of frequent use in various experiments unconnected with the present inquiry: as in ascertaining the amount of water in minerals, and so forth.

3



§ 3. Operations.

In the examination of Coals, the following operations are necessary: (1.) The estimation of the water or hygrometric moisture present in the coal; (2.) The estimation and examination of the coke yielded by the coal; (3.) The estimation and examination of the ash or inorganic matters present in the coal; and (4.) The estimation of the sulphur, chiefly contained in the coal as $Fe S^2$.

To these might be added, the determination of the heating powers of the coal; but this operation, at all times one of more or less uncertainty, cannot be performed by the blowpipe in a satisfactory manner. This, however, is really of little consequence, as apart from the doubtful character of the experiment even when conducted on the large scale, the relative heating powers of different samples of coal may generally be estimated sufficiently near for practical purposes by a comparison of the amount of coke, ash, and moisture. The litharge test commonly resorted to for the determination of the calorific power of coals, when properly considered, is of very little actual value. Take, for example, the respective results furnished by good wood-charcoal and ordinary coke. These results are closely alike or rather in favour of the charcoal; and yet experience abundantly proves the stronger heating powers of the coke. It is impossible to raise the temperature of a furnace with charcoal to anything like the same degree as that obtainable by the employment of coke. Besides which, in practice, it is not as a general rule, the absolute calorific powers of a coal that constitute its availability for ordinary operations, because a coal—such, for instance, as a brown coal rich in bitumen—may possess heating powers of considerable amount, but only of short duration: and in cases of this kind, the litharge test becomes again unsatisfactory. Thus the lignites of the department of the Basse Alpes, already alluded to, yield with litharge from 25 to 26 of lead; whilst many caking coals, practically of much higher heating powers, yield scarcely a greater amount. For these reasons, whilst seeking to discover a satisfactory method of ascertaining directly by the blowpipe the heating power of coals, I leave the subject out of consideration in the present paper.

Estimation of Moisture:—This operation is one of extreme simplicity. Some slight care, however, is required, to prevent other volatile matters from being driven off during the expulsion of the hygrometric moisture. Seven or eight small particles, weighing together from 100 to 150 milligrammes, are to be detached from the assay-specimen by means of the cutting pliers, and carefully weighed. They are then to be transferred to a porcelain capsule with thick bottom, and strongly heated for four or five minutes on the support attached to the blowpipe lamp: the unaided flame of the lamp being alone employed for this purpose. It is advisable to place in the capsule at the same time, a small strip of filtering or white blotting paper, the charring of which will give indications of the temperature becoming too high. The coal, whilst still warm, is then to be transferred to the little brass capsule in which the weighings are performed, and its weight ascertained. In transferring the coal from one vessel to the other, the larger pieces should be removed by a pair of fine brass forceps, and the little particles or dust afterwards swept into the weighing capsule by means of the camel's-hair pencil or small colour-brush belonging to the balance case. The weighing capsule should also be placed in the centre of a half-sheet of glazed writing paper, to prevent the risk of any accidental loss during the transference. After the weighing, the operation must always be repeated to ensure that no further loss of weight occur. In place of the blowpipe-lamp, the spirit-lamp may be employed for this operation, but with the former, there is less danger of the heat becoming too high. By holding a slip of glass for an instant, every now and then, over the capsule, it will soon be seen when the moisture ceases to be given off. It should be remarked, that some anthracites decrepitate slightly when thus treated, in which case the porcelain capsule must be covered with a small watch-glass.

Estimation, &c., of Coke:—In this operation, the small crucible is employed. Particles are detached from the assay specimen as before, by the cutting pliers, and about 100 or 150 milligrammes taken for the experiment. The weighing is performed in the crucible itself, this being placed in the little weighing-capsule, with its handle-support projecting over the side. The crucible, with its cover on, is then brought gradually before the blowpipe to a red heat. The escaping gases will take fire and burn for a few seconds on the outside of the vessel, and a small amount of carbonaceous matter may be deposited upon the cover. This, however, rapidly burns off on the heat being continued; and as soon as it disappears, the crucible is to be withdrawn from the flame, cooled quickly, and weighed always with its cover on. The loss, minus the weight of moisture as ascertained in a previous experiment, gives the amount of volatile or gaseous matter. The residue is the coke and its contained ash. The coke should be examined by a magnifying glass, and its general aspect and characters noted down. As already explained, some coals yield a swollen, semi-fused, and agglutinated coke, with a mamillated surface and metalloidal aspect. Others produce a slightly fritted and partially agglutinated coke; others again, an unfused coke retaining the form of the coal fragments subjected to the assay; others, a pulverulent, or a strongly-soiling coke, and so on. It is sometimes desirable to take the specific gravity of the coke.

Estimation of Ash:—The platinum capsule is employed for this operation. The coal must be reduced to a coarse powder, and about

150 milligrammes weighed out for the experiment. The weighing may be effected in the platinum capsule in which the experiment is to be performed. The weight ascertained, the platinum capsule is to be fixed in an inclined position above the spirit-lamp, and heated as strongly as possible. If the wick of the spirit-lamp be pulled up sufficiently, and a very thin capsule, as already directed, be employed, a temperature sufficiently high to burn off the carbon from most coals is in this manner attainable. The lid of the capsule must be placed above the coal-powder until combustion cease, that is to say, until the gaseous products be driven off, and only the uninflammable carbon and ash remain: as, otherwise, a portion of the powder might very easily be lost. Some of the anthracites, also, decrepitate on the first application of the flame; but even if decrepitation rarely ensue when the coal is in the form of powder, it is still advisable in all cases to keep the assay covered until the flame cease. During the after combustion, the powder or small particles must be gently stirred and carefully turned over, and if agglutinated, broken down by a light steel spatula, or, better still, by a small spatula of platinum, made by inserting a strip of stout platinum foil (an inch long) into one of the ivory or wooden handles intended to hold platinum spoons. These handles are quite useless for the latter purpose, or at least are far inferior to the steel forceps described above. With the forceps, for example, the spoons can be taken up and disengaged in an instant, and without the intervention of the right hand. Whilst the spoons also, are still red hot, the forceps may be laid down without the spoons coming in contact with the table. Figure 4 shews the form and size of the spatula that I employ. *A* is the ivory handle; *C* the piece of stout platinum foil fitting into a slit in A; and *B* the metal ring which keeps the two together. The platinum, it should be remarked, must be sufficiently stout to resist bending; and its point must be kept quite bright and smooth by occasional polishing on a smooth part of the agate mortar which always accompanies the blowpipe. If by the method of procedure just described, the carbonaceous matter be not finally burnt off, the flame of the blowpipe—using the oil-lamp, or spirit-lamp with the wick well up—may be employed to accelerate the process. The operator, however, must be careful to keep the capsule inclined away from the flame, in order to avoid the loss of

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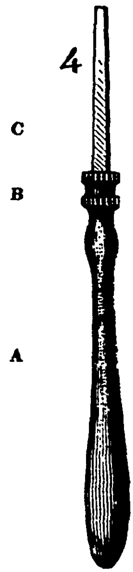

any portion of the fine light ash. Finally, when the ash ceases to exhibit in any of its parts a black colour, the lid of the capsule is to be cautiously replaced, and the whole cooled and weighed.*

Nature of the Ash:—As already remarked, the ash or inorganic portion of the coal, may be either argillaceous—consisting, in that case, essentially of a sub-silicate of alumina—or calcareous; and in either case, ferruginous also. If free from iron, the ash will be white or pale grey; but if iron be present, it will exhibit a yellowish, brown, or red colour, according to the amount of iron contained in it. The iron is, of course, in the state of sesqui-oxide, derived, except perhaps in a few rare instances, entirely from the iron pyrites or bi-sulphide of iron originally present in the coal. I have found, from numerous trials, that the well known salt of phosphorus test, so useful in general cases for the detection of siliceous compounds, cannot be safely resorted to for the purpose of distinguishing the nature of the coal ash obtained in these experiments. This is owing to the small quantity of ash, and to the extremely fine state of division in which it is obtained. Argillaceous ashes dissolve in salt of phosphorus with as much facility as as those of a calcareous nature, and without producing the characteristic silica-skeleton, or causing the opalization of the glass. With calcareous ashes also, the amount obtained is never sufficient to saturate even an exceedingly minute bead of borax or salt of phosphorus, and hence no opacity is obtained by the flaming process. The one kind of ash may be distinguished, however, from the other, by moistening it, and placing the moistened mass on a piece of reddened litmus paper. Calcareous ashes always contain a certain amount of caustic lime, and thus restore the blue colour of the paper. These calcareous ashes also, sometimes contain sulphate of lime.† For the detection of the latter, the following well known test may be resorted to. The ash is to be fused with carb. soda and a little borax on charcoal in a reducing flame, and the fused mass, thus obtained, is to be moistened and placed on a bright silver coin, or on a piece of glazed card: when, if sulphate of lime were present in the ash, a brown or black stain will be produced by the formation of sulphide of silver or of lead. In testing earthy sulphates generally by this process, a little borax should always be

* If the ash be very ferruginous, the results thus obtained, to be exact, will require correction: the original iron-pyrites of the coal being weighed as sesqui-oxide of iron. In ordinary cases, however,—*id est*, in assays as distinguished from analyses, this may be fairly neglected.

When also, the ash is calcareous, and in considerable quantity, it should be moistened with a drop of a solution of carbonate of ammonia, and gently re-heated, previous to weighing.

† The ashes of a lignite from Grosspreisen yielded Erdmann:—Carbonate of lime 30.93, sulphate of lime 36.42, lime 17.22, sesqui-oxide of iron 20.67, alumina 1.23, soda 1.86, potash 1.67.

added to the carbonate of soda, in order to promote the solution of the assay, and the more ready formation of an alkaline sulphide. If oxide of manganese be present in the ash, by fusion with carbonate of soda and a little borax, we obtain the well known bluish-green manganate of soda, technically termed a turquoise-enamel.

Estimation of Sulphur:—The method of detecting the presence of sulphur in coal, is the same as that just pointed out for the detection of sulphate of lime in the ash. The actual estimation of the sulphur is a much more troublesome operation. A process given by Berthier, in his *Traité des Essais par la voie sèche*, consists in boiling the ferruginous ash in hydrochloric acid, which dissolves out the sesqui-oxide of iron, and then calculating the sulphur from the loss. One hundred parts, for example, of sesqui-oxide of iron correspond to 70.03 of metallic iron; and hence to 150.24 of iron pyrites, or to 80.21 of sulphur. But this method, besides requiring a larger quantity of ash than can be conveniently prepared in these blowpipe examinations, exacts that the other portion of the ash be not attackable by the acid, a condition which of course does not obtain in the case of calcareous ashes. For this reason, the process recommended by Rose and other chemists is preferable, although somewhat beyond the range of blowpipe examinations. About 200 milligrammes of the coal in fine powder are to be intimately mixed with 8 parts of nitrate of potash, 4 of carbonate of potash, and 16 of common salt, and the mixture fused in a platinum crucible over the spirit-lamp, with the wick well pulled up, or, better still, over a double current or Berzeliu's lamp. The fused mass is then to be dissolved out in boiling water, to which a few drops of hydrochloric acid have been added, and the sulphuric acid thrown down by chloride of barium. By dividing the precipitate thus obtained (after filtration, careful washing, and ignition,) by 7.25, we get the amount of sulphur.

As the above process, although simple enough in the performance, is scarcely available when the operator is away from home, I have attempted to hit upon a more ready method, and one more properly within the legitimate pale of blowpipe experimentation, of ascertaining approximatively the amount of sulphur in coal samples. After various trials, I have found the following process sufficiently exact for all ordinary cases, because, as a general rule, we merely require to know here, if the coal under examination be slightly, moderately, or highly sulphurous. It consists essentially in comparing the intensity of the stain produced on silver foil by an alkaline sulphide of known composition, with that formed by an alkaline sulphide obtained from the assay-coal. For this purpose, mixtures must first be made of a coal free from sulphur, with such proportions of iron pyrites as correspond respectively to a per centage of 2, 4, 6, 8, and 10 parts of sulphur. These proportions are the following: Coal 96.26, pyrites 3.74= sulphur 2 per cent. Coal 92.50, pyrites 7.50=sulphur 4 per cent. Coal 88.76, pyrites 11.24=sulphur 6 per cent. Coal 85, pyrites 15= sulphur 8 per cent. Coal 81.27, pyrites 18.73=sulphur 10 per cent. Separate portions of each of these mixtures are to be fused in a platinum spoon with three parts of a mixture of five parts of carbonate of soda with one part of borax (mixed beforehand, and kept for these experiments in a receptacle of its own); and the fused mass is then to be dissolved out in a measured quantity of water. A single drop of the solution is afterwards to be placed on a piece of silver foil (formed for example by beating out a small coin), and suffered to remain upon it for thirty seconds. The silver, wiped dry, is finally to be marked on the back with the per centage of sulphur—2, 4, &c.—contained in the prepared coal. When employing this method for the estimation of sulphur, the coal under examination is to be treated in an exactly similar manner, and the stain produced by it on a piece of clean foil, compared with the test-stains on the separate silver plates.

Finally, when the iron pyrites in the coal is not in a state of semi-decomposition, the amount of pyrites, and consequently the amount of sulphur, may be arrived at far more nearly than might at first thought be supposed, by the simple process of washing in the agate mortar. Each single part of pyrites, it will be remembered, corresponds to 0.53 of sulphur. A large piece of the assay-coal should be taken, and broken up into powder; and a couple of trials should be made on separate portions of this. About 500 milligrammes may be taken for each trial, and washed in three or four portions. In the hands of one accustomed to the use of the mortar in reducing experiments, the results, owing to the lightness of the coal particles, and the consequent ease with which they are floated off, come out surprisingly near to the truth. In travelling, we may dispense with the washing bottle, by employing, in its place, a piece of straight tubing drawn out abruptly to a point. This is to be filled by suction, and the water expelled with the necessary force by blowing down the tube. A tube six inches long and the fourth of an inch in diameter will hold more than a sufficient quantity of water to be used between the separate grindings. The mortar should be very slightly inclined, and the stream of water must not be too strong, otherwise, and especially if the coal be ground up too fine, portions of the iron pyrites may be lost. The proper manipulation, however, is easily acquired by a little practice.

NOTES ON LATIN INSCRIPTIONS FOUND IN BRITAIN.

PART II.*

BY THE REV. JOHN M'CAUL, LL.D.,
PRESIDENT OF UNIVERSITY COLLEGE, TORONTO.

Read before the Canadian Institute, 30*th January,* 1858.

(4.) In article 3 of the preceding part, I cited an inscription on an altar found at Birrens, with the object of establishing the correct reading of the *nomen* of a Præfect of the second Cohort of the Tungrians. As doubts, however, exist, relative to the interpretation of parts of this inscription, I now propose directing special attention to it.

MARTI ET VICTO
RIAE· AVG· C· RAE
TIMILIT· IN COH
II TVNGR· CVI·
PRAEEST SILVIVS
AVSPEX· PRÆF·
V S L M

Dr. Wilson (Preh. Ann., p. 398) figures the altar, and renders the inscription thus:—"MARTI ET VICTORIÆ AVGVSTÆ CENTVRIÆ TIRONVM MILITVM IN COHORTE SECVNDA TVNGRORVM, CVI PRÆEST SILVIVS AVSPEX, VOTVM SOLVERVNT LVBENTES MERITO."

In the "Caledonia Romana," 2nd Ed., by Prof. Thomson, p. 128, we have the following translation of this rendering:

"To Mars and Victory, the Companies Augustæ of young soldiers in the second cohort of the Tungrians, commanded by Silvius Auspex, Præfect, most willingly have performed their vow."

As this interpretation is evidently unsatisfactory, Prof. Thomson suggests that "The letters C· RAETI probably refer to 100 Raeti, that is, soldiers drawn from the North of Italy and South East of Germany;

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* Since the publication of Part I. I have noticed an inscription, (Marini, Atti degli Arvali i, 212,) which favours my suggestion in Art. 1., that *delicta a medicis* was used for *derelicta a medicis*:

FELIX· PVBLICVS
ASINIANVS· PONTIFIC
DONAE· DEAE· AGRESTI FELIC
VOTVM· SOLVIT· IVNICEM· ALBA
LIBENS· ANIMO OB LVMINIBVS (sic)
RESTITVTIS· DERELICTVS· A MEDICIS POST
MENSES DECIM BENEFICIO DOMINAES MEDICINIS SANATVS PER
EAM RESTITVTA OMNIA MINISTERIO CARNIÆ FORTVNATÆ.

Vide also Orelli, n. 1518.

if so, the term Augustæ must be taken as an epithet of the Goddess Victory."

Mr. C. Roach Smith (Collect. Antiq. III. iv., p. 203):—"suggests the following reading, emending that given by Dr. Wilson only as regards the name of the person who erected the altar: *Marti et Victoriæ Augustæ C. Raetius militaris in cohorte secunda Tungrorum cui præest Silvius Auspex Præfectus votum solvit lubens merito.*"—but this reading of C. RAETI MILIT. seems to be very improbable.

AVG—for AVGVSTÆ—should unquestionably be joined with VICTORIÆ, as there are numerous similar examples; C I regard as standing for CIVES, as it is frequently used in inscriptions; Prof. Thomson's suggestion, in my judgment, gives the true reading, RAETI, the ethnic adjective of RAETIA: and MILIT is the ordinary abbreviation of MILITANTES. From this and a preceding inscription relative to the Tungrians, we learn that in addition to their own countrymen, Vellavians and citizens of Raetia were serving in their ranks. This is as might be expected, and agrees with the inference, which may be drawn from many sepulchral inscriptions, that the soldiers in the auxiliary wings or cohorts were sometimes of nations different from that which gave name to the wing or cohort. Vide Henzen, Annall. Inst. Arch. 1850, and Orell. Inscrip. n. 6838.

(5.) The following inscription, mentioning the same Præfect, is on an altar, also found at Birrens:

DEAE
MINERVAE
COH II TVN
GRORVM
MIL EQ CL
CVI PRAEEST CS L
AVSPEX PRAEF.

Dr. Wilson (Preh. Ann. p. 397) renders it thus:—DEÆ MINERVÆ, COHORTIS SECVNDÆ TVNGRORVM MILITIA EQVESTRIS CONSTANTINI LEGIONIS, CVI PRÆEST CAIVS LVCIVS AVSPEX PRÆFECTVS.

In the "Caledonia Romana," 2nd Ed., by Prof. Thomson, p. 129, we find the following translation of this rendering:—"'*To the Goddess Minerva, the Cavalry of the Second Cohort of Tungrians of the Constantine legion, commanded by Caius Lucius Auspex Præfect.*' The cohort was the tenth part of a legion, and hence the apparent *transposition* in this translation."

There are so many obvious objections to this interpretation, that it is plain that it cannot be received. COH II TVNGRORVM evidently stand for COHORS SECVNDA TVNGRORVM, and indicate that the altar was erected by the cohort V·S·L·M· or the verb *posuit, dedicavit,* or some similar term being omitted, as is of frequent occurrence. MIL EQ are for *Milliaria Equitata,* the well known designations of a cohort in which there were a thousand men, of whom a portion were cavalry. From Hyginus *de Castrametatione* (vide Græv. Antiq. X. 1093) we learn, that in such a cohort there were 760 infantry and 240 cavalry soldiers. COHORS SECVNDA TVNGRORVM was a cohort of this description, as appears from other inscriptions e. gr. the following given by Dr. Bruce (Roman Wall, p. 264.)—

IOM
COH II· TVNGR
* ∞ EQ·C·L·CVI
PRAEEST·ALB
SEVERVS PR
AEF· TVNG· IN
STA· VIC· SEVRO
PRINCIPI.

So far there is no doubt as to the true interpretation of the inscription, but the letters C·L· present no ordinary difficulty. In Camden's Britannia, ed. Gough, III, p. 457, we find reference to a discussion by Professor Ward of the meaning of these letters, as they were applied to the same cohort on another altar found at Castlesteeds. Prof. Ward was of opinion that they were numerals, standing for 150, and supports this opinion by arguments, from which it is plain that he was not aware of the difference between auxiliary and legionary cohorts. Mr. Hodgson, (vide Bruce's Roman Wall, p. 264,) "after a careful and learned examination of [the inscription already cited] and kindred inscriptions" regards the letters C·L· as used for *Civium Latinorum.* Henzen (Orell. Inscrip.nn.6780 and 6781) boldly removes the difficulty by substituting R as a correction for L—*i.e.* he reads, C·R· the well-known representatives of *Civium Romanorum.* This might be admitted as a satisfactory solution, if the letters C. L. had been found on but one stone, but as there are at least four altars on which these letters appear in the same connexion, Henzen's assumption of a mistake is highly improbable. Mr. Hodgson's interpretation is certainly preferable to either of the others. It is liable, however, to the objection that, so far as I am aware, there is no certain example of this use of the letters C. L. in any other inscription.

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* This represents the ordinary symbol for 1000.

The only other point which deserves attention, is the name of the Præfect, CS L AVSPEX. Instead of the reading which has been proposed, *Caius Lucius Auspex*, I should suggest that I between S and L has been overlooked, that SIL is an abreviation of SILVIVS, and that the full names of the officer mentioned in this and the other inscriptions, were *Caius Silvius Auspex*.

According to my views, the inscription may be translated thus:

"To the goddess Minerva, the second cohort of the Tungrians, a thousand strong, furnished with cavalry, consisting of Latin citizens, under the command of Caius Silvius Auspex, Præfect,"—have erected this altar.

6. In December, 1854, two coffins, evidently of the Roman period, were found at Combe Down, near Bath. One of these was partly covered by a stone bearing the following inscriptions:

PRO SALVTE IMP· CES· M· AVR
ANTONINI PII FELICIS INVIC
TI AVG . . NAEVIVS AVG
LIB ADIVT PROCC PR. . I
PIA RVINA OPRESS·A SOLO RES
TITVIT.

Mr. Hunter (Archæological Journal, March, 1855,) supplies M after I in the 4th line and gives the following explanation:

"For the safety,—or whatever *salus* in this connection, where we forever find it, may mean,—of the Emperor Cæsar Marcus Aurelius Antoninus Pius, happy, invincible (or unconquered) Augustus, (supply a prenomen where the stone is damaged, probably one represented by two letters, as CN.) Nævius, a freed man of Augustus, the adjutor of the procurators, (then comes the doubtful word, which perhaps may be PROVINCIE,) restored from its foundations, (this building, temple, or whatever it was, for the edifice was there to speak for itself,) when it had been thrown down by an impious act of ruination.

"Another reading of the doubtful word may be PRIMARIVS, and I think some one suggested PRETORIVM. I fear the word is too far gone for any one to venture to pronounce conclusively what the reading of it is.

"A question arising upon this inscription is, which of the emperors calling themselves Antoninus, it commemorates. It is a question of about fifty years, A. C. 180–230. On a first view one would refer it to Marcus Aurelius, the immediate successor of Antoninus Pius, the first of the Antonines, and I see not why it should not belong to his reign, unless it can be shown (a point I have not examined) that his name is never found in inscriptions with the additions Felix and Invictus. If it shall appear that his name does not occur with these additions, then undoubtedly it may be assigned to the three years' reign of Heliogabalus, or to any intermediate emperor who called himself Antoninus, and who is known to have used those additions. But at present I see no improbability in assignin it to the emperor so well known by his name of Marcus Aurelius."

Mr. Hunter here offers a conjecture that *impia* may refer to 'some religious or political ferment,' and cites in illustration the words *locum religiosum per insolentiam erutum,* found in another of the Bath inscriptions.

"Nævius the Adjutor, a Roman officer, to whose duties sufficient attention seems hardly to have been paid by the writers on Roman antiquities, may seem to have been the proper officer to superintend this re-edification.

"His name, I believe, is not found in any other inscription discovered in England. But in Gruter, civ., No. 9, we have—P. Nævius, Adjutor, in an inscription found at Tarracona. We find also, in Gruter ccclxxi., No. 8, Adjutore Procc. Civitatis Senonum Tricassinorum Meldorum &c., which shows that the Adjutor to the Procurators is not an officer unknown to inscriptions."

In the same number of the Journal, we have also Dr. Bruce's observations:

As far as my present knowledge goes, I am disposed to expand the inscription thus:—

Pro salute Imperatoris Cæsaris Marci Aureii Antonini Pii Felicis Invicti Augusti ....Nævius Augusti libertus adjutor Procuratorum principia ruina oppressa a solo restituit.

"It may be translated in something like this form:—For the safety of the Emperor Cæsar Marcus Aurelius Antoninus, the pious, fortunate and invincible Augustus....Nævius, the freedman of Augustus and the assistant of the Procurators restored these chief military quarters, which had fallen to ruin.

"The first question that arises here is respecting the emperor, specially addressed. I find that the names and epithets used in this inscription are in others applied both to Caracalla and Heliogabalus, with the exception of the word *invictus;* and in no other instance that I can find is this applied to either of these emperors. I incline to Mr. Franks' opinion, that Heliogabalus is the person here intended, for the following reasons:—1. On the murder of Heliogabalus his name seems to have been erased from inscriptions, or the slabs themselves thrown down. This stone having been used to cover a tomb must have previously been removed from its original position. 2. From the indistinctness of some of the letters, I take it for granted that the inscription is not deeply carved; this, together with the omission of the A in Cesaris, and the occurrence of tied letters, seems to indicate the later rather than the earlier period. 3. Had Caracalla been the person intended, one of his well known epithets, such as *Parthicus, Britannicus* or *Germanicus,* would probably have occupied the place of *invictus;* so far as I have noticed. Heliogabalus had earned no such distinctions; his flatterers, therefore, on his assuming the purple, would have no resource but to bestow upon him the indefinite title of *invictus.*

"The next thing which occurs in it is the name of the dedicator. Mr. Hunter remarked that the name NAEVIVS occurred in Gruter. It is not without interest to observe, that one of the examples furnished by that author (P. civ., No. 9,) contains that name with the epithet *adjutor* appended.

TVTELÆ
V. S.
P. NAEVIVS
ADIVTOR.

"The Nævius of the slab found at Bath was a freedman of Augustus, and an assistant or secretary of the procurators of the province. We are not without an authority for the reading *Adjutor Procuratorum.* In Gruter (P. ccclxxi, No. 8) the following occurs:

....MEMORIÆ AVRELI
DEMETRI ADIVTORI
PROCC.................

"The word which I conceive to be *principia* presents the greatest difficulty. It appears that the stone is damaged in this part. We are necessarily driven to conjecture in order to supply the vacuity between the N and the I at the end of the fourth line. The inscription speaks of the restoration of something which had become ruinous. If I correctly read the other parts of the inscription which seem to be quite plain, this is the only word left to reveal to us the precise object of the dedicator's exertions. In the station at Lanchester, a slab has been found (Horsley, Durham, No. xii.), containing on its third and fourth lines the following words:

PRINCIPIA ET ARMAMEN
TARIA CONLAPSA RESTITVIT.

Here we have evidence that there was a class of buildings called *principia,* which, like other buildings, would fall into ruin and require restoration. This word seems best to suit the damaged part of the inscription before us. The only letters that we require to draw upon the imagination for are the first I in the word, which has probably been attached to the top of the left limb of the N, and the C, for which there is sufficient room on that injured part of the stone between the N. and the I. Perhaps the word *principia* might be translated officers' barracks. The remainder of the inscription requires no remarks."

In the number for June, 1855, Mr. Franks states the grounds of his conviction that the tablet should be assigned to the reign of Elagabalus:

"The inscription can only apply to Caracalla or Elagabalus, but it does not appear that the epithet *Invictus* was given to the former. There are, however, coins of Elagabalus on which he is thus styled. The inscription may have suffered mutilation in a slight degree, and the popular indignation, which defaced or destroyed the memorials of the Emperor, may possibly account for the occurrence of this tablet used as a part of the cover of a sepulchral cist."

The Rev. H. M. Scarth, by whom the stone was purchased and presented to the Bath Institution, communicated a very interesting paper on the subject to the Somersetshire Archæological and Natural History Society, in which he gives full particulars of the discovery of the coffins and expresses his assent to Dr. Bruce's interpretation of the inscription.

The only difficulties in the text of the inscription relate to the prænomen of *Nævius*, and the word or words between PROCC and

RVINA. As to the first it is of but little moment and can never be determined with certainty or probability. It may have been *Publius,* as in Gruter, civ. 9, but it must be borne in mind that in that inscription ADIVTOR is more probably a cognomen and not the designation of an Office.

With reference to the word or words between PROCC and RVINA, Dr. Bruce's citation of the inscription given by Horsley, (Durham, n. xii.) seems to remove all doubts on the point. I do not, however, feel quite satisfied with the interpretation of the word *principia,* as "chief military quarters" or "officers' barracks;" or of *ruina oppressa,* as "which had fallen into ruin."

The latter expression, (which is so rare that I have been unable to find any other example in inscriptions,) seems to me to indicate that the *principia,* whatever they were, were destroyed by the falling of something else,—either the building of which they formed a part, or some adjacent edifice. It is certainly in this sense that the words are used by Cicero, *de Oratore,* ii, 86. "*ea* ruina *ipsum* oppressum *cum suis periise.*

The ordinary form of expression, which is found in inscriptions, relating to the falling of buildings, is *vetustate collapsum.* In Steiner, Cod. Inscrip. Rom. Rhen. n. 852, we find the following variety, approaching that in the text:—

DIS. CONSER
VATORIBVS. Q· TAR
QVITIVS. CATVL
VS· LEG· AVG·
CVIVS· CVRA· PRAETOR
IVM· IN· RVINAM
CONLAPSVM· AD· NO
VAM· FACIEM·
RESTITVTVM.

But the principal and most interesting question relates to the emperor, whose names and titles are given.

As there were three emperors, each of whom was commonly known as *Marcus Aurelius Antoninus Pius,* our only hope of determining to which of them we should refer the inscription, is in the other epithets *Felix* and *Invictus.* Now there is satisfactory evidence that Commodus was the first Roman emperor to whom the epithet *felix* was given, and consequently the question is limited to Caracalla and Elagabalus.*

* There are one or two inscriptions, in which Commodus is styled *M. Aurelius Antoninus Pius Aug. Felix,* and *Invictus,* but, however, the question in the present case seems to be properly limited to Caracalla and Elagabalus.

That the epithet *invictus* was applied to the first of these cannot be questioned, as the following examples leave no doubt on the subject.

IIII.

IMP· CAESAR
M· AVRELIVS ANTONINVS
INVICTVS· PIVS· FELIX· AVG.
PART· MAX· BRIT· MAX· GERM
MAX· PONT. MAX· TRIB· POTES[T]
XVIIII· IMP· III· COS· IIII· PROCOS
VIAM· ANTE· HAC· LAPIDE[I]AM
INVTILITER· STRATAM· ET
CORRVPTAM· SILICE· NOVO
QVO· FIRMIOR· COMMEANTIBVS
ESSET· PER· MILIA· [PAS]
SVM· XXI· SVA· PECVNIA FECIT
LXXI.

(Mommsen, Inscrip. Regni. Neapol. Lat. p. 354.)

IMP· CAES· M· AVRELIO
ANTONINO· PIO· FELICI
INVICTO· AVG· PARTH
MAX· BRITANN· MAX
PONT· MAX· TRIB· POT· XVI
IMP· II· COS· IV· P. P· PROCOS
DOMINO
INDVLGENTISSIMO
NEGOTIANTES
VASCVLARI
CONSERVATORI· SVO
NVMINI· EIVS
DEVOTI.

(Henzen, Orell. Inscrip. Lat. n. 7262.)

[From Eckhel, VII, 179, we learn that the epithet was also given to him on coins.]

The use of this term in the case of Elagabalus, although probable in consequence of his assumption of other titles of Caracalla,* cannot, so far as I am aware, be established by any inscription clearly belonging to him. But Mr. Franks (Archæological Journal, June, 1855)

* From Dio Cassius, lxxix, 2, we learn that he assumed the titles *Cæsar*, *Augustus*, *Imperator*, *Proconsul*, *Trib. Pot.*, *Ant. Fil.* and *Severi Nep.* From coins, however, we learn that this is not a complete enumeration, he is styled on some of these *Pater Patriæ*.

states, that "there are coins of Elagabalus in which he is thus styled." I am not aware of any such, excepting those noticed by Eckhel, VII, p. 249, and Rasche II, ii, p. 792, as bearing the legend INVICTVS SACERDOS AVG, where *invictus* seems to be applied to him as priest of Sol, of whom that term is a *perpetuum epitheton.*

If we assign the inscription to Caracalla, a question still remains as to the date of it. As there is no mention of either Severus or Geta, it is most probable that it was after the death of both. Now Severus died at York in February, A. D. 211; and Caracalla and Geta left England in the same year, for Rome, where Geta was murdered in February A. D. 212. The limits then are February, 212, and April, 217, when Caracalla himself was murdered. The statement by Eckhel, that *Felix* did not appear on the coins of Caracalla until A. D. 213 suggested to me that year as one of the *cancelli*, but there is unquestionable evidence that *Felix* was amongst his epithets on stones before that date, not only in conjunction with his father, (of which there are well known examples,) but also separately after his accession.

7. In the year 1754 an altar was found in Upper Stall Street, Bath, bearing the following inscription:

PEREGRINVS
SECVNDI FIL
CIVIS·TREVER
IOVCETIO
MARTI ET
NEMETONA
V·S·L·M.

Mr. Gough (Camden's Britannia, i. p. 118) observes, that the altar "was erected by Peregrinus to two new local deities. Jupiter *Cetius* may be the *Ceaicus* or *Ceatius* on an inscription given by Mr. Horsley, 278, in Cumberland, and takes his name from Mount *Cetius* in Noricum, under which was the town of *Cetium*, and Nemetona, one of the many local deities mentioned only in these inscriptions."

Mr. Warner (Hist. of Bath, p. 120, Append.) remarks, that "It is dedicated to three deities, the Cetian Jupiter, Mars, and Nemetona, a local deity. The name of the person who erected it does not appear; for the word *Peregrinus* is merely an appellative, implying that he was a stranger or traveller. We find, however, by the second and third lines, the name of his father *Secundus:* and the city of his residence, Treves in Germany. The last of the deities mentioned in the inscription seems to have been a British one, and known only in the south-western parts of England. The name Nememotacio (which

Baxter considers as synonymous with Nemetomagus) seems in the chorography of Anonymus Ravennas, and is conjectured by Baxter, to be the present Launceston. If this be allowed, the near approach of Nemetona to the town Nemetomagus, will justify the opinion of the former being the local divinity of the latter."

Mr. Scarth (Somersetshire Archæolog. & Nat. His. Soc's Proceedings, 1852, p. 99) mentions the opinions (which have been above stated) relative to Jupiter Cetius and Nemetona, without, however, expressing approval of them, or offering any other explanation.

There can, I think, be but little doubt in the mind of those who have noticed *Marti Leucetio* in Gruter, lviii. 3, that I, the initial letter of the 4th line of the inscription, is a mistake for L, and that we should read the names of the deities

LOVCETIO
MARTI ET
NEMETONA[E]

In Steiner, 1 Dan. et Rh. 1, n. 472 (cited by Henzen, n. 5899, who also proposes this emendation) we have

CVRTELIA·PREPVSA
MARTI·LOVCETIO
V·S·L·L·M

and

MARTI·LEVCETIO
T. TACITVS CENSORINVS
V·S·L·L·M

The deities are joined in the following inscription, found at Altripp, *prope Nemetas*, and given by Henzen, n. 5904:

MARTI·ET·NEMETO
NAE
SILVIN IVSTVS
ET·DVBITATVS
V·S·L·L·P

Leucetius seems to be derived from *Leuci*, and *Nemetona* from *Nemetes*, both being names of peoples in the neighbourhood of the Treviri.* It is scarcely necessary to add, that there is no foundation for Mr. Warner's assertion, that "*Peregrinus* is merely an appellative." The name often occurs in inscriptions; and it must be borne in mind

* Of these derivations, the latter appears to be certain, but the former doubtful, as we have evidence that Jupiter was called *Leucetius*, as the giver of light. *Vide* A. Gell. Noct. Att. v. 12; Festus x, i, and Serv. on Virgil, Æn. ix. 570. Another derivation, which has been proposed, from *Leuce*, an island in the Euxine, is very improbable.

that the use of but one name was not uncommon among the Gauls. The meaning of CIVIS TREVER, also, is not "a citizen of Treves," but a Trever citizen, *i. e.* a citizen of the people called Treveri, or Treviri.

ON SOME NEW TRILOBITES FROM CANADIAN ROCKS.

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Read before the Canadian Institute, March 20th, 1858.

I. ON A NEW SPECIES OF ASAPHUS FROM THE LOWER SILURIAN ROCKS OF UPPER CANADA.

§1. *Introductory Notice*:—In the autumn of 1856, I communicated to the "Canadian Journal," under the title of *Asaphus Canadensis*, a brief notice of a supposed new trilobite from the Utica Schist (Lower Silurian) of Whitby in Canada West; and in a subsequent number of our Journal, I gave a more detailed description of the form. At the same time, I pointed out that Professor Hall of Albany believed it to be identical with a species founded by him (under the name of *Asaphus*(?) *latimarginatus*) on two imperfect caudal shields, figured in the first volume of his "Palæontology of New York." At the period in question, I was not in a position, from the want of works of reference and other sources of information, to claim this trilobite as actually new; but an extended investigation having shewn it to be really a distinct form—a view adopted also by others—I now publish a complete description of the species, together with as accurate a figure as I am able to get executed in Canada. In this communication, also, I have attempted to shew, by a brief analysis of all the fairly-established species of the genus ASAPHUS, that our Canadian species is undoubtedly distinct. I should state, with regard to the figures of Professor Hall, alluded to above, that it is impossible to determine whether our species be identical or not with these. In the words of Barrande, in his great work on the Silurian Basin of Bohemia, they are too incomplete to be determined with any certainty.* For this reason, in the Museum of

* Divers fragments d'Amerique nommés *Asaphus* par J. Hall, et figurés dans la Paléontologie de New York, sont trop incomplets pour être surement déterminés. Barrande, Système Silurien du Centre de la Bohême. vol 1, p. 657.

the Geological Survey of Canada, the specific name of *Canadensis*, as originally bestowed on this trilobite by the author, has been retained. Barrande, in the work just cited, allu les to another American trilobite in the possession of M. de Verneuil, but unnamed and unfigured, with which our species may very possibly agree: only, the caudal shield of this specimen would appear to possess no lateral segmentation, and to have a scarcely defined axis, as M. Barrande refers it to the *platycephalus* or *gigas* type.* His statement respecting it is as follows:—" Nous avons vu récemment, dans la belle collection de notre ami M. de Verneuil un *Asaphus* des Etats-Unis, qui, portant à l'angle génal une pointe longue et grêle, constitue une espèce très distincte d'*As.* (*Is.*) *gigas*. Malheureusement, nous ne savons quel est le nom spécifique qui lui a été donné par les savans Americains. Ce trilobite se rangerait dans le group de *A. gigas*, d'après les souvenirs qui nous restent de sa conformation."

§ 2. *Description of Asaphus Canadensis.* This description is based on what is probably the long or male form.

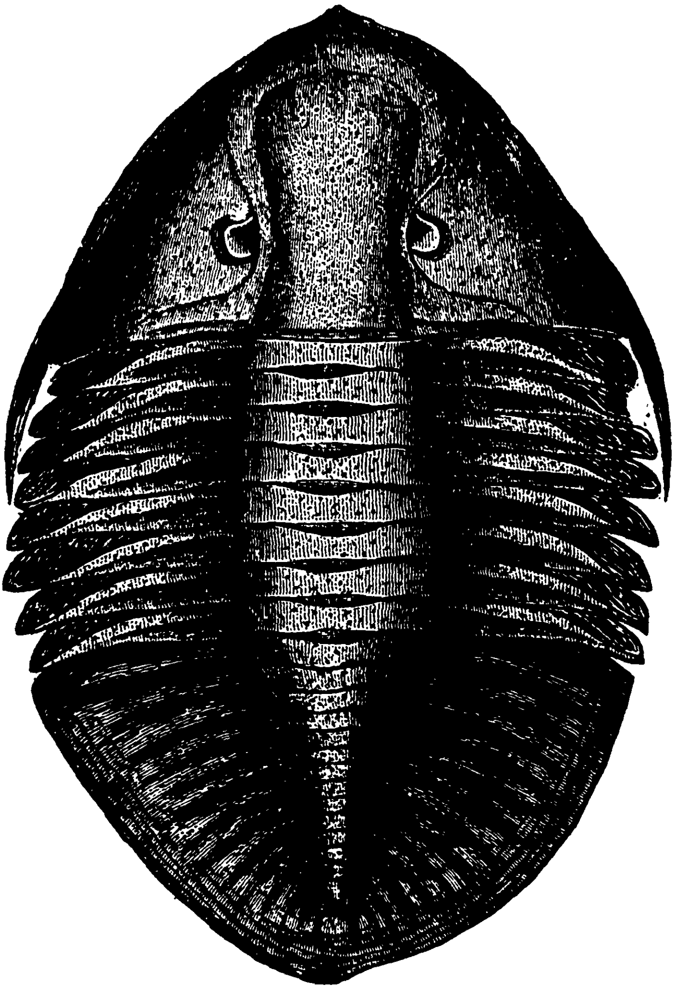
General outline, a broad oval. Vertical to transverse diameter, nearly as 3 : 2. Relative lengths of head-shield, thorax and pygidium, as 1 : 0.88 : 1.1.

Head-shield obtusely pointed anteriorly, much as in *Asaphus platycephalus*. Genal angles terminating in sharply-pointed horns of the Paradoxides type, extending downwards to about the middle of the body.† Facial suture, as shewn in the figure; the branches uniting in an obtuse but clearly defined angle above the glabella, nearly at the extreme anterior margin of the head-shield, and terminating at the lower margin, about midway between the glabella and the genal angles. Glabella, feebly raised, broad, and generally conformable at its upper part to the outline of the facial suture. At its base, there occurs a slight but evident neck-furrow. There are no furrows on the glabella itself. Length of glabella to length of head-shield, as 0.8 : 1.0. Eyes, moderately raised, and delicately reticulated; although, in most specimens they are more or less destroyed. Breadth between the eyes, to extreme breadth of head-shield across them, as 5 : 11. Whole surface of the head-shield covered with fine punctures, except at the striated limb.

Thorax, with eight segments. Axis well defined; narrow, somewhat broader in the middle than at the ends. Mean breadth of axis, to

* It is perhaps the *Asaphus Iowensis* of Dale Owen.

† In most specimens, as in the figure, the horns extend to the bottom of the fourth thoracic segment; but in a small specimen obtained quite recently from Whitby, and kindly submitted to us by Mr. J. F. Smith of Toronto, they reach to about the middle of the sixth pleura. In our figure they do not make a sufficiently sharp angle with the lower border of the head-shield.



ASAPHUS CANADENSIS.

(E. J. Chapman, sp. 1856.)

breadth of each side-lobe, as 5 to 6. Pleuræ, terminating in slight points, and curving slightly downwards*; furrowed to about half their length from the axis, and then crossed obliquely by a curvilinear ridge. A second, but slighter, furrow runs along the lower edge, and two short deep furrows shaped together like the letter V placed upon its side with the point inwards, separate each pleura from its axis-segment. Beyond the ridge the points are delicately striated. Fine punctures occur upon the axis and also on the pleuræ. On the latter the punctures are larger and farther apart; and when examined through a magnifying glass, they appear to be of a semi-lunar form with the convex side turned inwards. They are likewise more deeply indented at the convex side.

Pygidium, oval, with striated limb and well developed, tapering axis. This terminates somewhat abruptly before reaching the end of the pygidium. It contains from 12 to 14 segment-markings, and a similar number are present on the side-lobes. All are destitute of secondary furrows. Those on the side-lobes bend downwards near their extremities, and merge into the striated limb. The lower ones are nearly vertical. The whole surface of the pygidium is covered with fine punctures shaped and arranged exactly like the punctures on the surface of the thorax. *Asaphus platycephalus*, as mentioned by Professor Hall, exhibits in some specimens a delicately punctured surface; but in the present species the punctures appear to be much more striking. Our other new species, *A. Halli*, is also very visibly punctured; although the punctures, as shown in our figures, are too coarse and too far apart.

The only specimens of *Asaphus Canadensis* hitherto obtained, have been procured from the Utica Schist (Lower Silurian) of the Townships of Whitby and Nottawasaga, (localities about eighty miles apart), in Canada West. They occur in association with *Triarthrus Beckii*. In length they appear to vary from about an inch and a half (=38.1 millimetres), to about five inches (=127 millimetres). I have not yet been able to observe the under side, so as to make out the direction of the under sutures, and the form of the hypostoma. An isolated hypostoma, however, found near Whitby, probably belongs to this species. It is badly preserved, but it appears to resemble very closely the hypostoma of *A. platycephalus*.

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* In the horned Asaphidæ, and in nearly all the horned trilobites, the pleuræ point downwards, whilst in the forms with rounded genal angles, the pleuræ have almost invariably an upward curve, as in the figure of *A. Halli*, on page 236. When the side-pieces or cheeks of the head-shield are broken off, we may generally determine the nature of the genal angles by this character.

§ 3. *Specific Differences*:—(1.) *Asaphus Canadensis* differs from *A. platycephalus*, Stokes (*Isotelus gigas*, Dekay); *A. expansus*, Linn; *A. Barrandei*, de Verneuil; *A. læviceps*, Dalman; *A.* (*Is.*) *affinis*, McCoy, (including *Is. gigas*, *Is. planus* and *Is. Powisii* of Portlock)—in having, with other opposing characters, the genal angles of the head-shield extended into horns.

(2.) It differs from *A. tyrannus*, Murchison; *A. Powisii*, Murchison; and *A. ingens*, Barrande—in having, with other opposing characters, the branches of the facial suture united above the glabella on the upper surface of the head-shield.

(3.) It differs from *A. nobilis*, Barrande—in wanting the curved furrows on the axis of the pygidium, as exhibited by that species; and also by the greater number of the segment-markings on the side-lobes of its pygidium, as well as by the general outline of the facial suture, and other characters.

(4.) It differs from *A. extenuatus*, Waldheim—by the obtuse outline of its cephalic shield, and by other marked characters.

(5.) It differs from *A.* (*Is*) *laticostatus*, Green—the genal angles of which are unknown—by its thorax being nearly of the same length as its head-shield, and by the greater number of segment markings on the side lobes of its pygidium, as well as by other characters.

(6.) It differs from *A. ovatus*, Portlock, by the presence of segment markings on the side lobes of its pygidium. I am not acquainted with the head-shield of *A. ovatus*, and I cannot obtain here a copy of Colonel Portlock's Report in which the species is figured.

(7.) It differs from *A. angustifrons*, Dalman; and *A. frontalis*, Dalm.; by the greater development of its genal points, Dalman's species being placed by him under his subdivision of "Mutici," comprising the forms with rounded or but slightly pointed genal angles. I am not sufficiently acquainted, however, with these Swedish species to name any other distinguishing characters, and I have no means of procuring here a copy of Dalman's "Palaeden," in which the species are described.

(8.) It differs from *A. Iowensis*, Dale Owen, by its genal points reaching only to the middle instead of to the end of the thorax; by its facial suture being pointed, instead of curved, above the glabella; and by the presence of segment-markings on its pygidium.

The head-shields of *A. grandis*, Sars; *A. Fournetti*, de Verneuil; and *A. latimarginatus*, Hall—are yet unknown.

Finally, apart from the absence of secondary furrows on the pygidium segments, *Asaphus Canadensis* differs from the generally admitted species of Ogygia, by the following characters:

(1.) From *O. Buchii*, Brongniart; and *O.* (?) *Portlockii*, Salter—by the branches of the facial suture being united on the upper part of the head-shield.

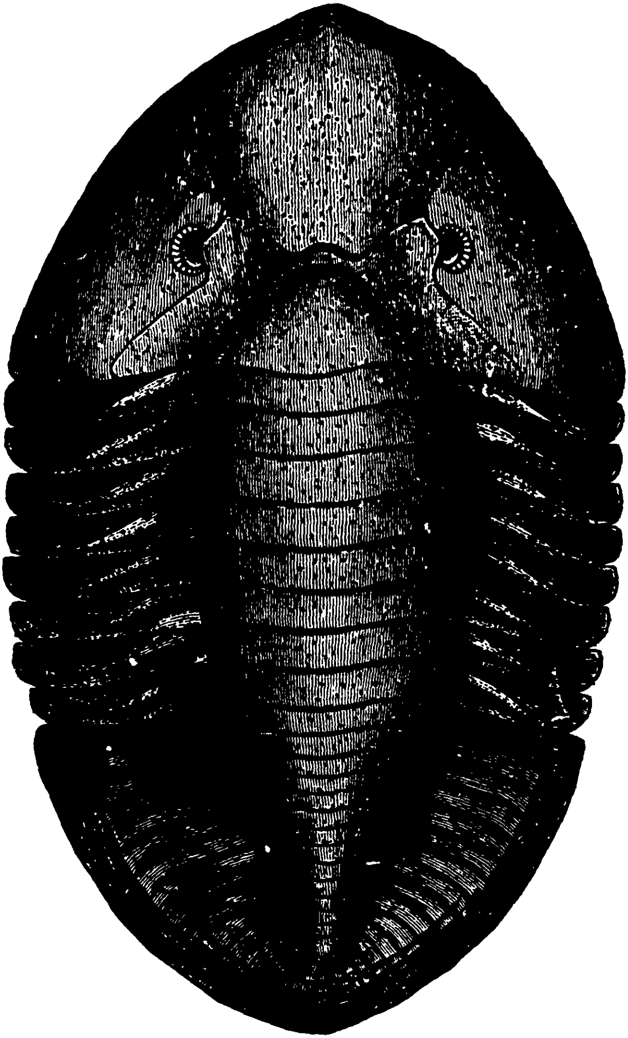
(2.) From *O.* (?) *Guettardi*, Brongniart; *O.* (?) *Desmaresti*, Brong.; *O.* (?) *Brongniarti*, Roualt; and *O.* (?) *Edwardsi*, Roualt—by the angular junction of the branches of its facial suture above the glabella.

(3.) From *O. radians*, McCoy—by the large number of the segment-markings on the axis of its pygidium, *O. radians* exhibiting only three. The head-shield of *O. radians* is unknown, but McCoy refers the species to Ogygia, on account of the short segmental furrows between the larger markings on the side lobes of the pygidium.

II. ON A SECOND NEW SPECIES OF ASAPHUS FROM CANADIAN ROCKS.

The accompanying figure represents a new species of Asaphus, from the Trenton limestone (Lower Silurian), of Peterborough, and other localities in Upper Canada. The same form is believed to occur also in the Utica Schist. General outline, a broad oval; length to breadth, as 3 to 2, or thereabouts; relative lengths of head-shield, thorax, and pygidium, as 1 : 0.87 : 0.87.

Head-shield obtusely pointed anteriorly, and much resembling that of *A. platycephalus* in its general outline. Limb striated with concentric lines; genal angles rounded; facial suture as shewn in the figure. The branches unite above the glabella in a well-defined angle, almost touching the extreme anterior margin of the head-shield, and they terminate at the lower margin, about midway between the glabella and the genal angles. Where they join this lower margin they make a short curve inwards (see the figure), somewhat as in *A. expansus*, a peculiarity not exhibited bv the facial sutures of *A. platycephalus* (?) or *A. Canadensis*. Glabella, feebly raised, and divided into two disinct portions; the lower portion of a semi-oval shape, is defined, as it were, by a prolongation of the body axis. Directly above this, an undulating furrow occurs (as shewn in the figure), strongly marked in



ASAPHUS HALLI.

(E. J. Chapman, sp. 1858)

the centre, but becoming fainter where it joins the facial suture, a little above the eyes. The anterior portion of the glabella is altogether undefined. The eyes appear to be of the usual Asaphus type; they are somewhat widely apart; the breadth between their central points, to the entire breadth of the head-shield across them, is as 5 to 9. Except at the striated limb, the whole surface of the head-shield is finely punctured.

Thorax with eight segments; division line between the axis of each segment and its pleuræ not very sharply defined. There are no intermediate V-shaped furrows, as in *A. Canadensis*. The pleuræ curve upwards at their slightly rounded extremities; they are furrowed to about half their length from the axis, and then crossed by a curvilinear ridge, beyond which the upper portions are delicately striated. The axis and the side lobes (in the transverse measurement of the trilobite) are of equal breadth. The middle segments of the axis are slightly broader than the upper and lower segments. The surface is very delicately punctured. The pygidium closely resembles that of *A. Canadensis*. In the axis there are from twelve to fourteen segment markings, with a similar number on each side lobe. There are no secondary furrows. The striæ on the limb are largely developed. *Hypostoma, &c.*, unknown. The two nearly perfect specimens and the various fragments of this species that I have examined, belong to individuals of comparatively large size. Of the perfect specimens, one is nearly five inches in length (= 127 millimetres), and the other exactly six inches (= 152.4 mill.)

Specific Differences. *Asaphus Halli*, on account of its rounded genal angles, need only be compared with the following species: *A. platycephalus*, Stokes (*Is. gigas*, Dekay, &c.); *A. expansus*, Linn.; *A. læviceps*, Dalman; *A. Barrandei*, de Verneuil; and *A.* (*Is.*) *affinis*, McCoy, the latter species being made to include Portlock's *Is. gigas*, *Is. planus*, and *Is. Powisii*. All the other well recognised species of Asaphus are horned forms.

The new species differs from *A. platycephalus*, more especially by its divided glabella, and by the presence of furrows on its pygidium.

It differs from *A. expansus* and *A. læviceps*, by the form of the glabella, the angular junction of the branches of the facial suture, and the segment-markings on the side lobes of the pygidium. The latter character distinguishes it also from *A. affinis*.

It differs from *A. laticostatus*, Green— of which species the genal angles are unknown—by its thorax and pygidium being of equal or nearly equal length, and by its divided glabella.

M. de Verneuil's species, *A. Barrandei*, from the south of France, is only known to me by name. Reasoning from analogy, however, it may be fairly admitted that the two species are distinct.

Our new Canadian species somewhat approaches Barrande's *Asaphus nobilis*, by the curious transverse furrow on its glabella. In *A. nobilis*, however, the genal points of the head-shield terminate in horns, and the segments of the thoracic and caudal axis are marked by peculiar furrows, characters not exhibited by the present species. The transverse furrow on the head-shield probably corresponds more or less in outline with the underlying hypostoma, but no traces of the latter organ, as already remarked, have yet been found.

In the preceding article on *Asaphus Canadensis*, it was stated that Professor Hall had published, in the first volume of the "Palæontology of New York, two imperfect caudal shields, under the name of *Asaphus* (?) *Latimarginatus*. I would willingly adopt this specific name for our second Canadian form, because, so far as it is possible to determine, the two may prove eventuallv to be alike; but, on due consideration, I have thought it advisable bestow upon the form in question a name altogether distinct. My object in this, is solely to avoid the chance of confusion, in case the thorax and head-shield of Professor Hall's form should hereafter be discovered, and be found on examination—as would very likely happen—to constitute a different species. I therefore claim the privilege of naming the trilobite described in this article, a privilege to which I am justly entitled by the really indefinite character of the figures referred to above. The name I adopt as the most appropriate, under the circumstances of the case, is that of *Asaphus Halli*. Palæontologists, I am sure, will receive it willingly.*

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* The author's best thanks are due to his colleague the Rev. Professor Hincks, as well as to John Head, Esq., and J. F. Smith, Esq. of Toronto, for the loan of specimens of *Asaphus Canadensis*. He has also to express his obligations to the Rev. Vincent Clementi of Peterborough, Canada West, for a specimen of *Asaphus Halli*.

REVIEWS.

Report of the Commissioner of Patents for the year 1856.—*Agriculture.* Washington: 1857.

We have here a volume consisting of upwards of five hundred pages, well printed and profusely illustrated. It furnishes another of the many examples constantly presented to us, of the public-spirited liberality with which the funds of the United States are expended on objects of general interest and value, lying altogether beyond the range of political influence. Such reports frequently embody matter of great importance. We shall endeavor to indicate the nature of this very miscellaneous but highly useful volume. The subjects treated of are various, including several of general interest and of national importance; such as the origin, history and habits of the domesticated animals; birds injurious to agriculture; improvement of land; drainage, &c.; fertilisers; the culture of wheat, potatoes, Chinese yam, sugar, &c.; Textile and forage crops; hemp, cotton, &c.; grafting and budding; reports on fruit culture; wine making; meteorology, &c.

It appears that the Government of the United States appropriated in 1856 the munificent sum of seventy-five thousand dollars for agricultural purposes; upwards of twenty thousand of which were expended in the purchase and freight of foreign seeds for experimental purposes in various sections of the Union. Nearly eighteen thousand dollars were absorbed by salaries and expenses incurred in the preparation of the Report; two hundred and ten thousand copies of which were ordered to be printed at the expense of Congress. It was deemed expedient to afford to the planters of Louisiana and adjoining States, the means of replenishing the stock of cane from which sugar has been heretofore solely obtained. The sugar crop has for years been gradually diminishing in the southern States, in consequence, it is thought, of the cane being carried further north than its native and congenial climate. To remedy this evil ten thousand dollars were expended in procuring fresh plants from South America, in numbers sufficient to enable every sugar planter within a few years to introduce the new and vigorous plants, and so to displace entirely such as are old and deteriorated. Changes of this nature in the several departments of cultivation, when made with judgment, are usually attended with the happiest results.

The Report contains a long and very able article (one of a series) on Meteorology in its connection with Agriculture, by Professor *Henry*, Secretary of the Smithsonian Institution, illustrated by a chart of Isothermal lines in North America, as determined by the joint labors of many observers throughout the continent. The mode hitherto adopted of collecting Meteorological facts by a staff of experienced observers scattered through the country, and of making such deductions therefrom as pertain to agriculture, has been attended with increasing confidence in its eventual utility. Already these exertions have thrown much interesting light on the climatology of this continent, and enabled us to comprehend, in some degree, phenomena that were previously regarded as anomalous. By presenting some of the physical laws on which meteorology depends, the general principles at which it has arrived, and their application to the peculiarities of the climate of the United States, it is hoped to awaken a more lively and general interest in the subject. The system about being introduced in Upper Canada, of furnishing the principal grammar schools with correct instruments for ascertaining the more interesting and important meteorological phenomena, and carefully registering the same, will, no doubt, constitute a useful auxiliary to similar agencies in the neighbouring republic, and be productive of valuable results.

It appears that the chemical analysis of soils, products, manures, &c.; with entomological researches, and botanical investigations, recommended in the previous report of 1855, have not been carried into effect. These investigations, however, have not been wholly lost sight of. Individuals and scientific societies have to some extent commenced them, and in a few instances carried them to a successful issue. That chemistry is destined to achieve similar triumphs in the wide and interesting field of agricultural research, to those it has already won in physiology and the arts, few can reasonably doubt; and the future progress of this all important pursuit will in no small degree depend upon chemical discovery, with its varied applications. Hitherto there has been much both of dogged scepticism and unreasonable expectation in relation to these matters; some obstinately affirming that science is incapable of affording any aid to the practical farmer, while others as vehemently maintain that chemistry alone is already capable of pouring a flood of light on the most hidden processes of his art. Chemical analysis, as commonly conducted, has certainly not realised the sanguine expectations expressed not many years since, when Baron Liebig presented his celebrated report to the British Association for the Advancement of Science. It should be borne in mind, however, that all healthy progress, whether social or scientific, is usually of slow growth. Let the agriculturist and chemist earnestly and repeatedly interrogate nature, and await her reply in the true spirit of faith and patience, and the way of progress will appear clear and certain.

The services of a botanist engaged by the State, as proposed in a former Patent Offic Report, might no doubt be made of great economic value, as for instance in the department of agricultural grasses. Still when the British Islands are regarded as a sort of standard in reference to pasturage and grazing, we on this continent must make the necessary allowance in our estimates, arising from diversities of climate, or we shall certainly be deceived when we come to practical results. The extremes of heat and cold, with the frequent sudden changes of temperature, so generally characteristic of the climate of this continent, will not allow either of the number or kinds of grasses that are indigenous to the soil, and constitute the permanent pastures of the old country. That the pastures of North America are susceptible of immense improvement no one can doubt; and in the following observations of the report we entirely concur:—

"There is no subject of more importance to the American farmer than the knowledge of the means which shall best enable him to increase the number and value of his live stock, of which grass furnishes the principal sustenance. It may safely be said that the great defect in our agriculture is the failure to rear the proper number and quality of animals. The experience of England and France sufficiently demonstrates the important truth, that on the same number of acres which are now cultivated in the United States, if the quantity of live stock were doubled, the aggregate quantity of grain produced might also be greatly increased, and without any corresponding increase of expense. The explanation of what seems at first so paradoxical is found in the fact that, in this manner, the land would be kept constantly in better heart. Instead of deteriorating from year to year, as is the case when grain alone is the principal product, if a proper proportion of live stock were reared, the land would retain its fertility for centuries, and might, perhaps, be constantly improving. The effort to keep up the productiveness of land, which is solely used for the cultivation of grain, by means of guano or artificial manures, is believed to be a vicious system of husbandry. That such manures are highly valuable in their way, and, in the hands of the judicious cultivator, will produce advantages which can hardly be over-estimated, is undoubtedly true; but, after all, with the exception of the alkalies and phosphates they contain, they do not possess the elements of permanent benefit. They should be regarded as in the nature of medicines, or like artificial stimulants on the human system. The true pabulum of the soil, provided and arranged by nature for this very purpose, is obtained by the rearing of live stock, and in no other manner. Indeed, it is probably true that the use of other manures, followed by the continual cropping of the grain for market, will be found in the end only to render the soil more hopelessly bankrupt. It will galvanize it into spasmodic action for the occasion, but leave it afterwards more prostrate than before. . . . . . The skilful and wise cultivator so graduates the growth and disposition of his products as not to draw from the soil what is not in some manner fully restored to it. No system of agriculture has been discovered for accomplishing this purpose effectually, but the simple and natural one of rearing a large proportion of domestic animals, sufficient to consume most of the products of the farm upon its surface."

The principle above enunciated, viz., the making farms self-sustaining as regards manures, is doubtless a sound one, but it should admit of modifications to meet the wants of varying conditions and circumstances. In the neighborhood of large populations, the farmer often finds it to his advantage to dispose of his hay, straw, &c., and purchase manure in their stead. Barnyard manure containing all the ingredients necessary to the growth and maturity of plants is always more or less certain in its action; the only objection of a practical nature is that it is too bulky to transport to long distances, whereas artificial manures are more concentrated, and can be widely and cheaply applied, so far as the expense of transport is concerned, to the more remote parts of the country. As a general rule, in a country like this, those manures, which usually contain only a portion of the constituents of plants, should be principally employed on defective or worn-out soils, with a view not only to the increase of grain, but more especially to that of the grasses, the chief source from which domestic animals derive their sustenance, and the sure way of promoting permanent fertility.

It would appear from a number of facts embodied in the Report, that the recent introduction of the Chinese yam into the United States has not been attended by any very encouraging degree of success, and that its economic value is still debateable. And with regard to the Chinese sugar-cane, although the results of experimentalists are by no means uniform, varying of course according to differences of soil, climate, culture, &c., yet upon the whole there is sufficient evidence to conclude that its utility is hardly doubtful. If in the northern portion of the States it should ultimately be found not adapted to the production of sugar, as would seem to be the case from the little experience we have of it in Canada, there appears no reason to doubt but that it will, at least, prove a valuable forage crop. We find from experiment that it can be cut for such purpose twice during the season, and that it is relished by horses, cattle, and pigs. We are also inclined to think that it may prove an accession to our cultivated crops, from the amount of syrup which it yields, and the Report contains several facts in confirmation of this view.

The articles on the domesticated animals, drainage of land, and Fertilizers, will all repay a careful perusal, although they contain little or nothing of novelty, either as to facts or illustrations: most of the matter may be found in the usual standard publications that treat of such subjects. "The English and Scotch systems of dairy management" is a carefully compiled paper from authentic sources, and cannot fail to improve that important department of American husbandry.

The birds injurious to agriculture, and the quadrupeds of Illinois injurious and beneficial to the farmer, are the only papers that can claim much originality, either in execution or mode of application. The accompanying illustrative engravings are numerous, and, for such a work, pretty well executed. The cuts will throw much interesting light on the text; and we have no doubt but these articles will be perused with interest and profit, not only by farmers, but by a large circle of general readers.

Upon the whole, the annual volumes issued by the Patent Office, strongly indicate a progressive improvement, and the zeal and activity of the Department. And when it is considered that the mechanical and manufacturing arts receive at its hands at least an equal share of attention and patronage with agriculture, there is sufficient ground for concluding, that such an organization so liberally sustained by the State, must be productive of the most valuable and wide-spread benefits to the country at large.

Contributions to the Natural History of the United States of America. By Louis Agassiz. First Monograph. Vols. I. and II. Boston: Little, Brown & Co. London: Trübner & Co., 1857.

At length we have received two volumes of this fine work. Of delay previous to publication we make no complaint, as it was obviously occasioned by a desire to improve the valuable materials collected; but we confess we felt some dissatisfaction, when week after week passed away, after we knew the volumes to be in the hands of others, without a copy reaching Canadian subscribers. The publishers, we trust, will see the propriety of treating all subscribers alike in this respect, and we venture at the same time to observe that, if there is sufficient reason for publishing two volumes together now, it is a departure from the proposed plan, likely to be inconvenient to many subscribers, and therefore to be avoided in future. The book is got up in a very handsome style. The accompanying plates are beautifully executed and very valuable, doing the highest credit to all engaged upon them, and the contents of the volumes, consisting of a general introduction and exposition of the author's views on classification, with an admirable monograph on the North American Testudinata, cannot fail to be accounted an important contribution to science. There are occasionally points on which we cannot agree with the learned professor, but we fully feel the importance of his labours, and cordially thank him for the additions he has made to our knowledge in a highly interesting department, as well as for a clear and elegant exposition of his views respecting the principles of classification, and their practical application. We quote the following passage from Section VII. of the Essay on Classification, as a concise statement of the principles maintained:

"Thus far I have considered only those kinds of divisions which are introduced in almost all our modern classifications, and attempted to show that these groups are founded in nature, and ought not to be considered as artificial devices invented by man to facilitate his studies. Upon the closest scrutiny of the subject, I find that these divisions cover all the categories of relationship which exist among animals, as far as their structure is concerned.

"*Branches* or *types* are characterised by the plan of their structure:

"*Classes*, by the manner in which that plan is executed, as far as ways and means are concerned:

"*Orders*, by the degrees of complication of that structure:

"*Families*, by their form, as far as determined by structure:

"*Genera*, by the details of the execution in special parts, and

"*Species*, by the relations of individuals to one another, and to the world in which they live, as well as by the proportions of their parts, their ornamentation, &c."

The author goes on to speak of such divisions as *sub-classes, sub-orders, sub-families, sub-genera, varieties,* respecting which he thus expresses himself:

"These distinctions have long ago been introduced into our systems, and every practical naturalist who has made a special study of any class of the animal kingdom must have been impressed with the propriety of acknowledging a large number of sub-divisions, to express all the various degrees of affinity of the different members of any higher natural group. Now, while I maintain that the branches, the classes, the orders, the families, the genera, and the species are groups, established in nature respectively upon different categories, and while I feel prepared to trace the natural limits of these groups, by the characteristic features upon which they are founded, I must confess at the same time that I have not yet been able to discover the principle which obtains in the limitation of their respective subdivisions. All I can say is, that all the different categories considered above, upon which branches, classes, orders, families, genera and species are founded, have their degrees, and upon these degrees, sub-classes, sub-orders, sub-families, and sub-genera have been established. For the present their sub-division must be left to arbitrary estimations, and we shall have to deal with them as well as we can, as long as the principles which regulate these degrees in the different kinds of groups are not ascertained. I hope, nevertheless, that such arbitrary estimations are for ever removed from our science, as far as the categories themselves are concerned."

We are quite prepared to go with our author to the extent that, in every really good classification, man is only the interpreter of nature, and that every division rests upon really natural characters; but we must confess to some doubt as to the possibility of laying down precise laws as to the kind of characters upon which each degree in classification must be founded, and we must add that when we test the accuracy of the learned author's views, by the consideration of his own system, we cannot resist the conclusion that there is still something wrong, either in his principles or in their application. We are not easily convinced, for example, that fishes demand four *classes* in order properly to express their relations. Embryology is destined to afford the most important assistance to the naturalist, but the real value of its revelations must be judged of by comparison with other well established principles, and we must not be hastily led by it to multiply leading divisions. We are bound to acknowledge that our author proposes these classes with great modesty, and with some hesitation; and whilst expressing a present strong feeling against them, we would be prepared candidly to consider any evidence that may be produced.

The account given of various systems of classification is very valuable, and shows the author's power of doing justice to those whose views differ widely from his own, and appreciating what is good whilst offering candid criticism. Possibly Macleay and his followers have found in him the least appreciation of the kind of merit they possess, and may justly seem to be undervalued; but this part of the work will be found useful by many, and its execution cannot but be admired for extent of information, clearness and conciseness of statement, and liberal though profound criticism.

It is time now that we invite the reader's attention to the first monograph, a treatise on North American Testudinata. Any attempt, within the space we can command, to give an abstract of the contents would be useless, and still less can we give expression to the doubts or difficulties which occur to us. The author makes Testudinata (a name which has precedence of Chelonians) the highest order of the class Reptilia, and considers it as containing the two sub-orders CHELONII and AMYDAE, the former of which he makes to consist of two families, Chelonioidæ and Sphargididæ, whilst the latter is regarded by him as including seven families. We have then an examination of all the particulars in the organization of the family. Sections follow on their growth, Psychological developement, geographical distribution, and fossil history. The characters of the sub-orders are then more particularly considered, which leads us to the conclusion of the first chapter. Desiring to bring under the notice of our readers any peculiar and striking opinions of our author, whether or not we are able at once to receive them in their whole extent, we quote the following passage from the concluding section:

"Such a method" [full anatomical illustrations of structure in Zoological works] "will, in due time, relieve our science of all the exaggerations respecting homologies, with which it has of late been incumbered. As soon as it is understood that the great branches of the animal kingdom are characterised by different plans of structure, and not by peculiar structures, we shall have fewer of those unsuccessful attempts to force every peculiarity of every type into a diagram, by which, renouncing almost entirely the study of the wonderful combinations of thought, which are manifested in the endless diversity of living beings, authors substitute for them a dead formula of their own making. Having once understood, for instance, what constitutes the plan of Vertebrates, we shall be prepared to find it executed in a variety of ways, and with innumerable complications; and we shall no longer try to force the framework of a fish into a Procrustean bed, to which we may reduce at the same time all other Vertebrates, with man. When the axis of the body consists of a simple dorsal cord, we shall be willing to acknowledge that it is not to be considered as an articulated back-bone; when the skull-box consists of a continuous cartilage, that it is not to be artificially divided into isolated parts; and, where there are no limbs at all, we shall not assume that they exist potentially in the same degree of complication as in animals more favourably endowed. And let it not be supposed that such sobriety of views excludes general comparisons; it only withdraws them from the field of fancy to the rich field of life."

We must not stop now to suggest the explanation and defence with which a disciple of RICHARD OWEN might reply to this passage, but the subject is certainly open to further discussion. The second chapter is devoted to the families of Testudinata; the third to the genera and species, concluding with a view of the Chelonian faunæ of North America. The second volume is entirely devoted to the Embryology of the order. We can hardly express too highly our estimate of the value of this portion, which deserves the careful study of those who desire really to understand this division of the animal kingdom, and which displays an amount of exact knowledge, patient industry, and minute research worthy of all praise. If these volumes, by the extraordinary success of the subscription list, commemorate the great popularity of their author, and his pre-eminent power of awakening interest in the subjects to which he is devoted; they also form a noble and durable monument of his genius and learning, which his friends and his adopted country will contemplate with proud gratification.

W. H.

Human Physiology, Statical and Dynamical: or, the conditions and course of the life of man. By John William Draper, M. D., LL.D., Professor of Chemistry and Physiology in the University of New York. Harper & Brothers, New York. 1856.

Well may a retrospect of the last thirty years bring to the chemist cause for congratulation and quiet triumph; for during that period the march of chemistry has been an ever-accelerating, almost culminating power, and ever more comprehensive in its application to the laws of physiology: indeed far beyond that period its influence and history may be traced even to the Iatro-chemical schools of the middle of the 17th century. But we have no wish to recall that time, not from shame, however; and we prefer leaving the statement as it is, inasmuch as exact chemistry may justly be said to date from the discovery of oxygen in 1772, and its association with the phenomena of life in rational connection cannot strictly be placed at a period earlier than that given, viz., at thirty or forty years past.

At this day more than at any other, without figure, the chemist perceives that the cosmos—universal nature—is an illimitable laboratory:—that in the abyss where sparkle distant worlds, and in the microscopic cell, its laws are unremittingly at work producing those cosmic mutations and transformations by which planets are built up, and, as in ours, are probably stratified and geologically arranged; and that in cell evolution its affinities are unweariedly developing those complex relations which end in the expanded membrane—the deployed tissue—the rolled canal—the elongated fibre—the rigid bone—the perfected animal:—whole—complete—self-contained—independent.

If we trace the influence of chemistry in explaining the functions of organisms—which is nothing other than an assemblage or system of organs—beyond the last forty years, we shall find that from the time of Scheele, Priestley, and Lavoisier, almost up to that of Liebig, little disposition was shown to give it the prominence which in later years, at first sparingly and with reluctance, and more recently without stint, has been, conceded. Look at the history of oxygen which recognized as vital, and even styled empyreal air, was of course known to be necessary to breathing animals, but whose action within and without the system was not admitted to be the same in kind and degree; it is true that tardily and almost by compulsion the true relation of this gas to respiration in its full meaning was perceived, but whether its effects were confined to the lungs or extended to the system at large, remained for at least forty years a mooted question even up to the time of Edwards: to what was colorification attributed? certainly to the action of oxygen, but not directly; for, while arterialization was the result of its absorption into the blood, and carbonic acid was exhaled from the lungs, being formed therein, animal heat was caused by the difference of capacity for caloric of arterial and venous blood—an application of Black's theory of latent heat. Lavoisier had clear conceptions on the matter, which there is reason to believe would, had he been permitted to give them, have anticipated the exact views of the moderns; yet with this exception and meagre, timid and hesitating admissions of the possibility of such an action, oxygen was held to oxygenate the blood and nothing more. Chemistry was deemed too common and consequently too mean a science to hold intercourse with life. For thus overlooking and depreciating the agency of chemistry there is excuse; it had hitherto done little for physiology, and the latter rested but little and depended less on the laws of the former for the elucidation of any of its functions: accurate anatomists—pure solidists—the physiologists of that day, accounted for the vital functions on mechanical principles. When, however, the relation was perceived, it rapidly increased to closer connections and inseparable alliance, so that in the cycle of the actual state of chemistry we may limit our research to the air—to the soil—to the food derived from both, and to the animal the aggregate microcosm of the three: so may we trace down our biography and measure its intrinsic value.

The work which heads this article is written by a professor of chemistry, and is another proof of the advance in the manner already pointed out. For several years we find that physiologists have more and more trusted to chemistry for the explanation of many of the obscure portions of their subject, and more and more have been multiplied works of physiological chemistry. Simon, and Lehmann, and Robim and Verdeil, all attest this—and now reciprocally we see a chemist become physiologist, which in truth every chemist virtually must be. If man ever can attain to an absolute knowledge of his functions, chemistry must undoubtedly be the light to guide him in his path; nor is this an unwarrantable assertion: at the enthusiasm of the chemists a smile may be excited—some fears may be entertained that they shall be carried clear off their feet in their rapid progress—but we care little for the first and have no apprehension of the last gentle suggestion. They are not yet beyond their depth, and the rather that they are borne on the full stream—they have no idea of possessing, as their progenitors the alchemists had, "the art of perfection;" alas, they know too well in this meaning, and pathologically, that theirs is but the art of imperfection; for, knowing the normal and abnormal states, they may explain but not imitate the former, nor always cure the latter;—to what branch or department of the whole circle of the sciences can we turn to obtain even an insight into the mechanisms of organization—what positive science can avail us in our search? None—not one—other than this which lays bare the pregnant and instinct affinities of its forces in the simplest products of its action from the formation of water and carbonic acid gas to the elaboration of tissue—of secretion and excretion.

At the present day these subjects (chemistry and physiology) are not only closely allied, but almost identified, and the publication by Professor Draper is but evidence of the fact now pointed out; a publication opportune, graceful, and, as far as the work goes, meriting commendation. In a spirit then not only of social consideration, but of professional respect, we have perused this book, and select such portions as our time and the interest of the subjects permit and urge us to do—premising that as an original work it cannot, of course, be considered—being nothing more in reality than a compilation, and that a rather curt one, of what is known on the subject of which it treats.

His arrangement is peculiar, and, unlike recent writers either on physiology or physiological chemistry, he does not open the subject by a history and description of the elements which enter into the composition of the organism—he scarcely indeed alludes to what Robin we believe calls stoichiology—himself a chemist and familiar with that which he daily teaches, he seems to forget that others may not be in the same happy state, and, curiously enough, does not dwell on its influence so prominently as the pure physiologists constantly do. While then these last introduce many pages of the chemistry of the stoicheia—for so the elements or principles were called by the Greeks—originally meaning a letter, by easy transition, from being an element in the name, it became an element in the thing named. Dr. Draper at once, *per saltum*, begins with nutrition. So, too, his division into statical and dynamic is singular—perhaps original—very mathematical, but certainly not biological; where all are dynamic, the result at least of some principle or agency (the vital principle he almost condemns, and yet offers no other "final cause" in its stead) —no function, *per se*, can be regarded as statical when every thing is marked by perpetual change, where in nutrition we have the task of the Danaides in evidence—a perpetual filling and a perpetual emptying —where the parts come and go—are elaborated and destroyed, there cannot be said to exist the state of equilibrium. Taken as a whole, doubtless, the sum of the functions leads to what is justly considered static or normal condition, but individually not so: the whole is made up of its parts, but here the parts (organs) maintain the whole. The division, were the desire of peculiarity the object, might have been into hematogenic or histogenic, within which category all could justly be classed, and neurasthetics, into the functions of nutrition and those of the nerves cranial, spinal, and sympathetic; but the division of Bichat is really in our idea the least objectionable. The book will answer well for the educated man or the practitioner, for whom this survey, at once condensed, accurate and excellent, will be an epitome of biology; but to the student of medicine, we much fear that it can scarcely, to the exclusion of others more elementary though more diffuse, be recommended as a text-book, so that a large portion of its popularity may thus not be attained. Of the wood-cuts we can speak in unqualified terms—many of them are from other authors—some of them original and obtained by the aid of the microscope applied to photography, "the process having been so far improved by the author as to be rendered very available for these uses."

Selecting one of the many chapters which merit notice, that on respiration, and that portion of it especially which describes the entrance of the air into the lungs, three stages are given: 1st, the filling of the trachea and larger ramifications of the bronchial tubes; 2nd. The translation of the fresh air from the bronchial tubes to the ultimate air cells (vesicles), accomplished by gaseous diffusion; the 3rd stage is the passage from the vesicles to the blood, through the wall of the air cell (epithelium and mucous membrane)—the wall of the blood vessel and the sac of the blood disc; this involves movement through membranes and implies condensing action. The first of these is well understood, was surmised even by Empedocles, and has never been misinterpreted; the second is not so simple, is consecutive and gradual, and, in his own words, is thus performed: "The carbonic acid, vapor of water and excess of nitrogen, if any, that have accumulated in the cells belonging to any given bronchial tree, are expelled therefrom by the muscular contraction of the circular organic fibres, and are delivered into the larger bronchial tubes, in which diffusion at once takes place with the air just introduced; as soon as the expiration is completed, relaxation of the muscular fibres occurs, and the passages and air cells dilating both through their own elasticity and the exhaustive effect arising from the simultaneous contraction of other bronchial trees, fresh air is drawn into them: the alternate expulsion and introduction being accomplished by muscular contraction and elasticity; *the different bronchial trees coming into action at different periods of time, some being contracting while others are dilating.*" With the first portions of this extract we have no fault to find; besides the information given, the impression is that the vesicles contain a larger percentage of carbonic acid than the tubes, and these than the trachea—just as the trachea has more than the atmosphere without; it gives the distinct information that the act of inspiration is not instant but consecutive—that the pure air does not at once reach the periphery of the air cells, but is diffused into, intermingled with that left after the preceding expiration; but that with each flow and ebb of this tidal current, less charged air penetrates to the utmost bounds of its excursion, while a relatively noxious mixture is in turn expelled into the ethereal reservoir without, in each act of inspiration and expiration, the whole volume of the air in the lungs is in movement, and hence the vesicular murmur heard by the ear. But the whole of the deteriorated air is not expelled, nor is the whole of the oxygen of the inspired air absorbed; portions of each are being commingled, the one losing carbonic and acquiring oxygen, while the reverse occurs with the other; and hence the comprehension of the value of a sigh-deep inspiration, in languid or depressed condition, and so, too, the positive luxury of a sneeze, in which a larger volume than ordinary of vitiated air is expelled and a proportionately large inspiration follows. So, too, we think may be explained the effect of blowing steadily for a short time—a fire, for instance—by which act many persons are made to feel giddy—a cerebral effect, doubtless; during the act of blowing in this manner, it is not air from the lungs that is expelled, but air drawn in through the nostrils; thus then expiration, properly speaking, is not efficiently carried on, accumulation of carbonic acid *pro tanto* occurs, begins to influence the system, the first manifestation of which is that of giddiness. A part of this effect may be and is, we believe, usually wholly attributed to the pressure on the jugular veins, retarding during the act the return of the blood from the brain; but that this cannot be the sole cause is shown by the fact that exertion, as in lifting for instance, does not produce the same effect even though the vessels swell and be visibly prominent.

To the portion of the extract which we have sketched and amplified we said that we offered no objection, but to that portion which we have italicised we do make exception. We cannot perceive why and how different bronchial trees (an expression equivalent to ramification we suppose) come into action at different periods of time, some contracting (we omit the word being as redundant and in reality ungrammatical), while others are dilating. Most assuredly nothing proves this; in the normal state the air penetrates to the utmost bounds of the ramifications, but with unequal velocity, yet, in equivalent regional zones, if we may so geographically designate them, in equal quantity, in a proportion best perhaps expressed by the inverse ratio of the distance from the glottis, every vesicle dilating and contracting synchronously, all receive the purified air simultaneously, all partially expelling the vitiated air coincidently; the first portions of this air, when tested, giving a notably smaller percentage of carbonic acid than the last portions. We cannot conceive that some air cells are patent to receive, while others in their vicinity are contracted to expel air; were this so, what oscillation, so to speak, would ensue? Just such as we have revealed in some forms of asthma and emphysema, and even occasionally in bronchitis, and the first period of tuberculosis: certainly not the soft, breezily audible whisper or murmur which the ear detects and experience regards as the manifestation of the normal of healthy breathing; and so too is audible the same sound, but shorter in duration, during expiration, and this, without disease, as Cammann's stethoscope proves. The third stage or the passage of the oxygen from the air cells to the blood is carefully explained, and the volume of the oxygen absorbed being greater than that of the carbonic acid evolved is shown not to depend on the diffusion law of volumes of these gases as originally given by Professor Graham, and adopted by Valentin and Brunner, but on the conjoint condensing action of moist membranes, as of the cell wall, of the pulmonary capillary vessel and of the blood disc, which action disturbs the condition of ordinary diffusion. For these views, partly the result of his own experiments and of those of Professor Mitchell of Philadelphia, we refer the reader to the work itself.

This, by the way, would seem to indicate that the author regards the blood disc as an oxygen carrier, so indeed he says, p. 128: "They (the discs or cells) receive that vivifying principle as they move over the respiratory cells, and freighted with it, pass to all parts of the body, not united with it, nor disorganized, nor burnt up by it, but holding it loosely and ready to give it up, and go back again for a fresh supply." Now, herein lies a grave question; is the oxygen merely mechanically absorbed by the blood, for it is admitted that other constituents than the corpuscles absorb oxygen, or does it enter into combination, unstable, yet chemical? Many lean to the former view, we to the latter, and we confess that with the apodictic reasons of Liebig we very nearly coincide. But we cannot give to these their proper consideration; in truth much beyond our wish have these remarks been carried in extent, and hence anxious, not to weary the reader, we hurry to a conclusion.

To an amusing paragraph on saliva we would in sad earnest draw the attention of those who are given to the solace of tobacco, that best and worst of sedatives: "Though so large a quantity of saliva as twenty ounces may be secreted in a day, this being about one half of the urinary discharge, it is to be remembered that the water is not lost to the system, as in the latter case. If here the impure habit of profuse spitting is indulged in, it is interesting to remark (*more physiologico*), the reflected effect which takes place in the reduced quantity of urine and an instinctive desire for water, a kind of perpetual thirst. It is probable that under these disgusting circumstances, the percentage amount of saline substances in the saliva is increased, and that, so far as that class of bodies is concerned, the salivary glands act vicariously for the kidneys, and the mouth is thus converted into a urinary aqueduct."

Of the brevity of some of the descriptions we have already spoken, this is a fault almost everywhere to be perceived, thus in that most obscure portion of the economy, the region and functions of the liver, the author dismisses the composition of the bile in this summary way: "Bile, from whatever animal it may have been derived, contains a resinous soda salt, a coloring material, cholesterin and mucus, the acid of the soda salt is the taurocholic or glycocholic." Taurine is a few lines below mentioned; this verges on the incomplete, almost on the inaccurate; if there be hope of finally comprehending the functions of this or any other organ, a knowledge of the composition of its peculiar secretion ought surely to be an element in the sequence of reasoning thereon. To speak of the glycocholate or taurocholate of soda, as if one or the other of these solely, and not both, existed in bile is to give a wrong impression to those who have not the means of ascertaining the facts. It seems as if the fullness of his vision had condensed, but yet contracted his intellect as light contracts the pupil, so that he compels his readers to see through the same medium.

Hence on the "book and volume of the brain" there are produced sparse and detached bright spots instead of a broad sheet of diffused light illustrating in clear display the wide expanse, teeming with richness, gravid with genetic force. W. S.

History of Ancient Pottery. By Samuel Birch, F. S. A. 2 vols. 8vo. London: John Murray. 1858.

The value of fictile remains of ancient art, as instructive memorials of the past, grows more and more in general appreciation; and now, through the labors of Mr. Samuel Birch, of the British Museum, we are in possession of a highly condensed and portable book of reference on nearly all that relates to the history and classification of ancient pottery. The subject is no insignificant one in the hands of an archæologist so accomplished and laborious. The potter's art has, in all lands, long preceded the labors of the chronicler of history, and has thereby preserved to us many a lively record of ages whose heroes are all unsung. The primeval civilization of Egypt and Assyria is thus exhibited, and the oldest definite chronicles of the East come down to us in like manner,—not on papyrus or parchment, but on the potter's clay. From the bricks of Egypt have been recovered names of her ancient dynasties, and the cartouches of Pharaohs, whose architectural memorials Time slowly erases from the half-deciphered history of the Nile-valley. The Assyrian and Babylonian bricks have become inseparably associated, in the popular mind, with the mysteries of Cuneatic inscriptions; while in later and more familiar eras of ancient history, the impressed brick gives us the names of Roman Consuls, and appropriates the works of Roman cohorts. Thus we find the tiles of Chester, the Roman *Deva*, bearing the name and title of the Twentieth Legion, LEG. XX. V.V. Again, at York, we learn from like fictile chronicles, that the military architecture of the Roman *Eburacum*, was executed by the Second, and by the Ninth Spanish Legion, LEG. VI. VICT. and LEG. IX. HISP.; while of greater interest is the accepted interpretation of the CL. BR. generally found on the Roman bricks and tiles discovered along the Kentish coast, the *classiarii Britannici*—the marines of the British fleet; or the more conjectural rendering of the P. P. BR. LON. of the London tiles—*proprætor Britanniæ Londinii*, which, if accepted, establishes the metropolitan character of Roman London as the seat of government of the propraetor of Britain. We presume it is due to a typographical slip that we receive from Mr. Birch a novel reading whereby the Roman propraetor becomes the *proprietor* of London, in the following paragraph:

"Some fragments of tiles or bricks, evidently the *semilateres*, or half-bricks of Vitruvius, dug up on the site of the Post Office in London, were impressed with the letters P. P. BR. LON., denoting the residence of the Roman proprietor in Britain. (!) Still more interesting are the inscriptions stamped on the tiles relating to the legions and othor military divisions stationed throughout the provinces of the vast empire. They contain the number and titles of the legions, and mark the limits of the Roman conquests. The route of the XXII. Legion has been traced through Germany; and in our own country, an examination and comparison of these tiles, shows the distribution of the military force, and the change of the quarters of the different legions which held Britain in subjection."

From the simple brick we pass, by natural gradation, to the more elaborate clay cylinders of Mesopotamia and Assyria,—not stamped like the tile, with mere epithets or titles, but executed on purpose to preserve the national chronicles entrusted to their durable custody; and thus we find ourselves transferred at once from the mere consideration of the potter's ingenious and tasteful art, to the investigation of some of the most ancient of human records, coeval with portions of the Old Testament scriptures, and furnishing the materials wherewith a Rawlinson and a Wilkinson now seek to illustrate and supplement the narrative of "the Father of History."

It might scarcely be anticipated that volumes devoted exclusively to the elucidation of the *History of Pottery*, would be found to bear any relation to the *History of Herodotus*—yet so it is; nor is it by any far-fetched process that the connexion is established.

"The materials used for writing on," says Mr. Birch, "have varied in different ages and nations. Among the Egyptians, slices of limestone, leather, linen, and papyrus, especially the last, were universally employed. The Greeks used bronze and stone for public monuments, wax for memorandums, and papyrus for the ordinary transactions of life. The kings of Pergamus adopted parchment; and the other nations of the ancient world chiefly depended on a supply of the paper of Egypt. But the Assyrians and Babylonians employed for their public archives, their astronomical computations, their religious dedications, their historical annals, and even for title-deeds and bills of exchange, tablets, cylinders, and hexagonal prisms of terra-cotta. Two of these cylinders, still extant, contain the history of the campaign of Sennacherib against the kingdom of Judah; and two others, exhumed from the Birs Nimrud, give a detailed account of the dedication of the great temple by Nebuchadnezzar to the seven planets. To this indestructible material, and to the happy idea of employing it in this manner, the present age is indebted for a detailed history of the Assyrian monarchy; whilst the decades of Livy, the plays of Menander, and the lays of Anacreon, confided to a more perishable material, have either wholly or partly disappeared amidst the wreck of empires."

The certainty which attaches to every recorded name or word, apart from all reasoning or induction, gives a peculiar importance to such records; and hence even the potters' stamps on the fine red Samian ware, or the ruder initials on the handle of the old Roman amphora, have a significance and a value; while the stamp of the broken tile or brick supplies a fragment of history, more unquestionable than Herodotus, and far more trust-worthy than Livy. And yet these are, for the most part, the rudest and least studied works of the old fictile artificer.

It thus becomes a subject of unwonted interest to follow down—not in mere imagination, but by investigation and inductive reasoning,—the successive stages of the first workers in clay; the making of the rude sun-dried bricks by the presumptuous builders on the plain of Shinar, or by the oppressed Israelites in their Egyptian Goshen; the invention of the brick-kiln, and the grand conversion of the destructive element of fire into the most conservative of powers. Next comes the construction of the rude domestic, or sepulchral urn; the introduction of decorative arts in varying form; the application of indented patterns on the plastic clay; or, finally, the discovery of pigments, from the fictile employment of which grew at length the art of an Apelles, as in the higher skill of the plastic modeller we may trace the germ of Phidian art, and all the beauty which genius has perpetuated in marble and enduring brass.

The use of clay as the first plastic vehicle of the modeller's thoughts, from which, by means of moulds, his art could be multiplied and modified by numerous combinations of parts; and, again, the invention of the potter's wheel: each mark progressive stages in the development of human intellect; though doubtless such inventions were independently made in many separate centres of isolated and immature civilization.

A well-known Egyptian sculpture, on the walls of the Temple of Philæ, represents the ram-headed Phtah holding a rounded object on a potter's wheel, which he turns with his foot, and, as the inscription implies, as "the Father of Creation, sets in motion the egg of the sun and moon." The same inscription is differently rendered by Gliddon, in his "Ancient Egypt;" but there is little room for questioning the interpretation of the sculpture, in so far as it illustrates the ancient Egyptian mode of using the potter's wheel. It may also not unfitly serve to illustrate the beautiful metaphor of Isaiah: "But now, O Lord, thou art our Father; we are the clay, and thou our Potter; and we are all the work of thy hand." On the subject of the potter's wheel, so important in relation to the development of fictile art, Mr. Birch remarks:

"The application of clay to the making of vases, probably soon caused the invention of the potter's wheel, before which period only vessels fashioned by the hand, and of rude unsymmetrical shape, could have been made. But the application of a circular lathe, laid horizontally, and revolving on a certain pivot, on which the clay was placed, and to which it adhered, was in its day a truly wonderful advance in the art. As the wheel spun round, all combinations of oval, spherical, and cylindrical forms could be produced, and the vases became not only symmetrical in their proportions, but true in their capacity. The invention of the wheel has been ascribed to all the great nations of antiquity. It is represented in full activity in the Egyptian sculptures. It is mentioned in the Scriptures; and was certainly in use at an early period in Assyria. The Greeks and Romans have attributed it to a Scythian philosopher, and to the States of Athens, Corinth, and Sicyon, the three great rivals in the ceramic art. The very oldest vases of Greece, some of which are supposed to have been made in the heroic ages, bear marks of having been turned upon the wheel. Indeed, it is not possible to find any Greek vases except those made by the wheel or by moulds; which latter process was applied only at a late period to their production."

On the subject of the Greek vases here referred to, Mr. Birch enlarges in terms that would seem extravagant to any one unfamiliar with the grace and beauty of Hellenic fictile art, of which so many exquisite specimens are accumulated in the Museum of which he is so distinguished an officer. In form, they are worthy to stand alongside of the works of the Parthenon; while in their decorations we have preserved to us the sole evidence of what Greek pictorial art actually was in the age of Pericles. The marbles of that grand era of art survive, mutilated, yet wonderful in the genius which their fragments reveal; but the painters of the same era are to us but names, and the very stories preserved in evidence of their perfection,—as the competitive pictures of the curtain and the grapes,—suggest to the modern critic a mere mimetic art, like that of our Van Huysums of the modern Dutch School, rather than of the Da Vinci and Raphael, who maintained the rank of their pictorial creations alongside of that which the chisel of Michael Angelo restored to the work of the sculptor. On these grounds, the painted vases of ancient Greek, Etruscan, and Italian art have a peculiar importauce, which attaches in an especial manner to those of Hellenic origin, alike from their intrinsic value and from the fact that they are actual pictorial works contemporaneous with the rise and full development of the Attic Drama, or produced under the later fostering largess of the Macedonian Conqueror. They occasionally depict scenes from Æschylus or Euripides, drawn by contemporary pencils; or exhibit the actual products of art of those who have listened to the Philippics of Demosthenes, or wrought for the gold of Alexander. Mr. Birch accordingly remarks:

"By the application of painting to vases, the Greeks made them something more than mere articles of commercial value or daily use. They have become a reflection of the paintings of the Greek schools, and an inexhaustible source for illustrating the mythology, manners, customs, and literature of Greece. Unfortunately, very few are ornamented with historical subjects; yet history receives occasional illustration from them; and the representations of the burning of Crœsus, the orgies of Anacreon, the wealth of Arcesilaus, and the meeting of Alcæus and Sappho, lead us to hope that future discoveries may offer additional examples. The Rhapsodists, the Cyclic poets, the great Tragedians, and the writers of Comedy, can be amply illustrated from these remains, which represent many scenes derived from their immortal productions; and the obscurer traditions, preserved by the scholiasts and other compilers, receive unexpected elucidations from them. Even the Roman lamps and red ware, stamped with subjects in relief, present many remarkable representations of works of art, and many illustrations of customs and manners, and historical events; such as the golden candlestick of the Jews borne in the triumph of Titus, the celebration of the secular games, and the amusements of the circus and amphitheatre."

Such then is the dignity and value which justly attaches to the potter's art, as a means of elucidating and illustrating ancient history; nor is the fictile ware of our Western Continent without its value in a like direction. The singular, though doubtless accidental, correspondence between the rude pottery of the most northern regions of America, and that of the ancient British Barrows, alike in material, form, and decoration, has already been noticed in this journal. De Soto and other early European travellers, note the great mastery acquired by the Natchez and other tribes in the manufacture of fine earthenware. The examples of the fictile art of the Mound Builders, in like manner disclose interesting evidence of ingenuity and artistic skill; while among the great variety of Peruvian antiquities, none are more curious than those which illustrate the inventive ingenuity of their ancient potters.

"All the moulded works of the ancient Peruvians," says Von Tschudi, "have a peculiar character which distinguishes them from those of the other American nations; a character which, by those versed in antiquities, will be recognized at first sight. Some of them bear a certain resemblance to the forms presented by the old continent; especially the most simple: such is a seated figure which has an Egyptian type; a vase which may pass for Etruscan, and a blackish vessel that has been found, seems to be identical with those of the Celtic-Germans; so perfect, indeed, is the resemblance, that if mixed with the known remains of those countries, the archæologist would find no difference between them: but these works, so simple, and so easy to manufacture, cannot serve as a criterion to denote the special character of the works of art of any nation.

"All the skill of the Peruvian potters was laid out upon the manufacture of the Huacas, Conopas and sacred vessels which they placed with the corpses in the sepulchres. The kitchen furniture and other vessels for domestic use are very simple, and without art. The material which they made use of was colored clay and blackish earth, which they prepared so well, that it completely resisted fire, and did not absorb liquids. It seems that they did not burn the vessels, since the substance of these differed very materially from burnt clay, and judging from appearances, they dried it in the sun, after having prepared and mixed it in a manner of which we are ignorant. At this day there exist in many houses, pitchers, large jars and earthen pots of this material, and they are generally preferred for their solidity to those which are manufactured by our own potters, a proof of their superiority. The greater part of the sacred vessels, buried with the mallquis and destined to receive the chicha of sacrifice on feast days, have an enlarged neck, placed ordinarily near the handle, with a hole to pour out the liquid, and an opposite opening, for the air to escape when the vessel is filled. Many are double, and it seems that they made them thus from preference; others are quadruple, or sextuple, or even octuple, that is, the principal vessel is surrounded with regular appendages, which communicate among themselves, and with the principal vessel. The double ones were made in such perfection, that when they were filled with a liquid, the air escaping throgh the opening left for that purpose, produced sounds at times very musical: these sounds sometimes imitated the voice of the animal which was represented by the principal part of the vessel, as in a beautiful specimen we have seen, which represents a cat, and which, upon receiving water through the upper opening, produces a sound similar to the mewing of that animal. We have in our possession a vessel of black clay, which perfectly imitates the whistle of the thrush, the form of which is seen on the handle. We also preserve two circular vases, which, being filled with water, through a hole in the bottom, on being turned over, lose not a single drop, the water coming out when it is wished, by simply inclining the upper part of the vase: which proves that the Peruvian artisans had perhaps some knowledge of atmospheric pressure.

"On many of the sacred vessels there are designs and paintings, which, however, give an idea of the progress of the art of designing among the Peruvians. The architectural designs with straight lines are the only parts correct and even beautiful in appearance; but all the designs with curved lines, such as the representation of men and animals, are of little value. There is one worthy of notice which is seen very often, either painted on vessels of clay, or engraved on the arms, or worked in raised work in gold or silver, and represents a man with the arms open holding in his hands staves similar to lances (Chuqui), and the head covered with a broad cap. There is no doubt that these figures represent Deities (Huacas); others have long garments, and on the head a species of mitre, showing themselves also to be Huacas, as may be inferred from what Garcilasso relates

(Hist. Chap. 121), saying 'that the Indians, when they saw the bishop, Don F Geronimo Loayza, asked if he were the Huaca of the Christians.'"

We have spoken of Mr. Birch's work as a book of reference, and such is its real character. In it we have a somewhat unornate, (excepting in pictorial illustration,) and unseductive pair of volumes; but substantial, thorough, and nearly exhaustive, in their brief condensation of an amount of learning and research, enough to expand into whole libraries of modern popular literature. A thousand suggestive hints supply material which might have been expanded into singularily attractive pages. The colloquies, exclamatory phrases, addresses to purchaser or spectator, and frolicsome or sarcastic Iambi of the potter's inscriptions, abound with interesting illustrations to the classical scholar. Again the modern fabrications are scarcely less curious, such as that engraved by Brondsted and Stackelberg, in a fit of archæological irony; and gravely reproduced by the credulous Inghirami as a genuine antique. A modern antiquary appears running after a draped female figure called ΦΗΜΗ, or "Fame," who flies from him, exclaiming: ΕΚΑΣ ΠΑΙ ΚΑΛΕ: "Be off my fine fellow!" But the author's purpose was to produce a substantially useful, not a popular book, and in this he has fully succeeded. The references, moreover, are equally various and minute; and will doubtless guide many a laborer on the same prolific theme, to authorities, of which, but for the accuracy and the honesty of the author of this "History of Ancient Pottery," they would never have known the existence. But such writers, though they may supplement, illustrate, and paraphrase our author,—beating out his sterling ingots into acres of leaf for purposes of showy and superficial gilding,—cannot supersede Mr. Birch's "History" as an authoritative book of reference for all who appreciate the historical value of the art of the potter.

D. W.

SCIENTIFIC AND LITERARY NOTES.

GEOLOGY AND MINERALOGY.

GEOLOGICAL SURVEY OF CANADA.

The Report of Progress for the years 1853–54–55–56, of Sir W. Logan and his able colleagues, has at length been issued. The publication of the separate Reports for each of these years was unavoidably postponed until the present time, in consequence of Sir William Logan's manifold engagements in connexion with the Paris Exposition during 1854 and 1855. The Reports thus brought out together, constitute a volume of five hundred pages, containing several outline maps, and accompanied by a quarto atlas of eleven lithographed plates, shewing the results of a series of explorations in various districts between Lake Huron and the Ottawa. In a scientific as in a practical point of view, these united Reports may be looked upon as the most valuable publication yet issued by the Survey. Not only will they sustain most fully the reputation of Canadian science beyond our borders, but they cannot fail also to awaken renewed attention to the undeveloped resources of the Province. A detailed notice of the volume, with copious extracts, will appear in the next number of the Journal.*

PERMIAN ROCKS IN THE UNITED STATES.

Some years ago, Professor Dawson—now Principal of McGill College, Montreal—announced his conviction that a large portion of the red sandstone strata of Prince Edward's Island and Nova Scotia, belonged to the Permian Epoch.† This view, although sustained by good evidence, was seemingly opposed by the assumed absence of Permian strata in the United States; the so-called New Red Sandstone of the Connecticut valley, and other districts, being then looked upon as belonging to the higher part of the Triassic or even to the Jurassic series. Some recently published fossil evidence, however, seems likely to modify this opinion (Silliman's Journal, No. 72;) and still more recently, proofs have been brought forward simultaneously by several observers—more especially by Professor Swallow of Columbia, Missouri, and by Mr. Meek and Dr. Haydon of Albany—of the actual occurrence of Permian strata in Kansas Territory. In a letter addressed by Professor Swallow to Professor Dana (Silliman's Journal, March, 1850, p. 305) several genera and species, obtained by Major Hawn, are enumerated in support of this opinion. These species are closely analogous to, if not identical with, certain well-known types from the Permian beds of Russia.

FOSSIL BATRACHIANS FROM THE COAL STRATA OF OHIO.

Professor Wyman in the last number of Silliman's Journal, has given a brief but very interesting description of three fossil batrachians discovered some time ago in the coal beds of Jefferson County, Ohio, by Dr. Newbury and Mr. Wheatly. These examples present many remarkable features. In two of the forms, however, the characters are not sufficiently complete to throw much light upon their real nature; and hence, Dr. Wyman, with a forbearance that cannot be too highly appreciated, has abstained from naming them. The third form, *Raniceps Lyellii*, is tolerably perfect. It appears to occupy an intermediate position between the tailed and the tail-less batrachians, presenting a combination of characters belonging separately to each division. Thus it shows the convex external outline of

* Since the above was in type, we have received a letter from Sir William Logan, pointing out an error of the lithographer, in the lettering of the map of Anticosti, p. 234. Sir William writes:—"*A*, *B*, *C*, and *D*, indicating the divisions of Mr. Richardson's map, are each one place out of position. The narrow division, along the north coast, should be marked *A*. The division *A*, as shown in the map, should be *B*; B should be *C*; *C* should be *D*; *D* should be *E* 1; and *E* should be *E* 2. *F* is placed correctly. Of course the base of the middle Silurian must be removed one place to the north, with the division to which it belongs."

† See Canadian Journal, New Series, Vol. I., page 43.

jaw, the lengthened vertebral column, and the two-boned fore-arm, of the Urodela; together with the non-existence of ribs, a condition characteristic of the Anoura generally, and the presence of backward-projecting jaws as in the typical family, the Ranidæ. It is to be hoped that further explorations in the Ohio coal strata, may be rewarded by additional examples of these ancient and most interesting types of batrachian life.*

CHALCODITE.

Professor J. G. Brush (Sill. Journal, March, 1858) has published some new analyses of Shephard's Chalcodite from Sterling, N. Y. These analyses go far to sustain the opinion of Professor Brush, that Chalcodite and Stilpnomelane are identical. The new analyses lead apparently to the formula $2\ (RO,SiO^3)+R^2O^3, SiO^3+3HO$; in which $RO=FeO, CaO, MgO$, with traces of MnO, NaO and KO; and $R^2O^3=Al^2O^3$ and Fe^2O^3. The bases RO however, are somewhat deficientin quantity for this formula, whilst the water is in excess; but in minerals of this kind we may naturally look for a certain amount of admixture or alteration; and examples of the partial replacement of the monatomic bases (more especially) by water, are not uncommon.

SAUSSURITE, ETC.

We quote the following remarks from a letter recently addressed to us by Professor T. Sterry Hunt, of the Geological Survey:—"I have been examining lately the Euphotides of the Alps, such as Saussure and Haüy studied: not the diabase or feldspathic rocks, mistaken for saussurite, and more recently examined by Delesse and others. True saussurite, as de Saussure long since showed, has the hardness of quartz, and density of 3·3—3·4. It is nothing more than a *zoizite*, or lime-alumina epidote, with a little soda. My analyses of the saussurite of Monte Rosa agree closely with those of Boulanger, which lead equally to the formula of zoizite. The grass-green smaragdite, from the same rock, is simply a vanadiferous bronzite, like that from near Genoa, analysed by Schafhäutl. I suspect that much of what we have taken for chrome in similar minerals, is vanadium. I have found it in one serpentine from Gaspé, and I am now searching for it in others. You are, of course, aware that it was found by Ficinus in the serpentine of Zöblitz."

ALLEGED DISCOVERY OF GOLD IN WESTERN CANADA.

No little interest has been occasioned within the last few months by the alleged discovery of gold in the ferruginous sands of the north-east shore of Nottawasaga Bay. Samples of these sands, said to have been obtained from a locality about twenty miles to the north-east of Collingwood, were submitted to us in the early part of last January. In these samples, which consisted essentially of a fine granular mixture of magnetic iron-ore, red garnet, quartz, dark green and black tourmaline, zircon (?), and black spinel, we detected unmistakeable evidence of the presence of gold. Samples of the same sand, containing minute specks of gold, were also sent to our colleague, Professor Croft. The gold, although in very fine

* We may perhaps be allowed to refer to a somewhat obscure passage in this instructive paper, which, if left unexplained, might lead to misapprehension on the part of the more general reader. In alluding to the fossil impressions with five finger-marks, referred to batrachians, Professor Wyman states that no existing batrachians have more than four fingers. The author, however, alludes here, of course, to the *fore-arm* only, as the hind limbs of most species exhibit five fingers.

particles, was readily separated by washing in an agate mortar; or by simply shaking small portions of the sand in a piece of writing paper bent into a trough, and held in a somewhat inclined position. Mr. Dewe, of Toronto, the proprietor of the land on which the auriferous sand was alleged chiefly to occur, not feeling exactly satisfied with the statements made to him from Collingwood, paid a visit to the spot, and collected personally many samples of sand from various points upon and adjacent to the district in question. In these he failed to detect gold. We have also, by the kindness of Mr. Dewe, examined the same samples. They certainly do not contain the slightest trace of that metal. We have likewise examined many other samples (in part collected by ourselves) of sand of an exactly similar character, from the islands on Lake Couchiching, the shores of the River Severn, Matchadash Bay, the north shore of Lake Huron, and the Manitoulin Islands—all of which are entirely free from any trace of gold. It is difficult, therefore, to avoid the conclusion, that the gold in these so-called "Collingwood Sands" has been placed there for the purpose of deception. Some of the minute particles, when examined under a powerful microscope, had the appearance of having been subjected to the action of a file.* If gold really occurred in the sands of this western region, the occurrence would be of great geological interest, as the iron-sands are here evidently derived from Laurentian rocks; whereas the auriferous deposits of the Eastern Townships are the detritus of metamorphosed Lower Silurian strata, belonging to the general age of the Hudson River group.

Note:—Under the head of "Circular Polarization in Cinnabar." in the last number of the Journal, the term "hemihedral" should be properly "plagihedral." In order, also, to avoid misconception, the reader is requested to add to the characters of the *Orthisidæ*, pages 159 and 160,—" No internal shelly process, properly so called: *id est*, neither loop nor spiral process." The genus *Productus*, p. 160, is stated by d'Orbigny to range from the Silurian to the Permian strata, but in all probability it does not descend below the Devonian. It is most abundant as a Carboniferous form.

THE WOLLASTON MEDALS—1858.

At the moment of going to press, Professor Wilson has placed in our hands a copy of the London Literary Gazette, announcing the awards of the Wollaston medals for the present year, by the Geological Society of London. One of these most honorable recognitions has been conferred on the distinguished palæontologist Hermann von Meyer, of Frankfort on the Maine; and the other on our no less distinguished palæontologist of the Western World, Professor James Hall, of Albany. The justice of these awards will be universally acknowledged.

E. J. C.

PHYSIOLOGY AND NATURAL HISTORY.

MAZATLAN SHELLS: MUSEUM OF THE UNIVERSITY OF TORONTO.

The Museum of the University of Toronto has recently received an accession in the department of Conchology, so interesting and important, that a short account of it may not be unacceptable to the members of the Canadian Institute.

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* Since writing the above, we have found that the gold contains *copper*. Of its origin consequently, there can be no doubt.—E. C. J.

In addition to the valuable Canadian collections made by Dr. Boys, with contributions from Dr. Bird, of Oshawa, and the land and fresh-water shells of Germany and of Southern Europe, presented by Dr. Croft: Professor Hincks brought over with him a set of illustrations of genera obtained from the late Mr. Sowerby; and many valuable tropical shells were presented by Mrs. Dall, a lady then resident in Toronto. To these have been added an extensive series, including some fine specimens purchased from an eminent dealer in Boston, U.S.; and one or two friends, particularly Professors Wilson and Chapman, have contributed useful additions. Mr. Bland, of New York, has also kindly furnished a series of North American species, with some land shells from other localities.

It will thus appear that the Conchological department was by no means in a low condition, when the attention of the Professor of Natural History was called to the fact that a valued friend, the Rev. P. P. Carpenter, of Warrington, England, had purchased the principal part of a fine collection, the result of several years' labour made at Mazatlan, in Mexico, opposite the southern point of California, by M. Frederic Reigen, a Belgian gentleman, who died just as he had completed them, and by whose executors they were sold in Liverpool—first to a wholesale dealer, and by him to Mr. Carpenter. The latter gentleman generously resolved to present to the British Museum a full series, including many specimens of each of all the species obtained, and proposed then to issue, by subscription, sets of the remainder to those who might desire to obtain them. The matter coming to the knowledge of Professor Hincks, he was of opinion that shells illustrating the western coast of this continent, would have a special interest for us in Canada, and the subscription appearing moderate in comparison to the usual charges, he recommended them for purchase. Mr. Carpenter was good enough—besides expending for the University collection a small additional sum in selected specimens of known locality—to present to the Museum above four hundred specimens from his own collection, all with their localities carefully marked; so that the whole addition made to the University cabinet is very extensive.

The circumstances which may be regarded as giving special interest to the Mazatlan shells are:

1. That they furnish trustworthy data for inquiries respecting the geographical distribution of mollusca. All who have studied the subject know the difficulty of obtaining authentic information on this subject. Even scientific collectors are often very careless in separating the productions of different localities; and when it is considered how numerous are the places at which ships may touch in long voyages, at all of which something may be obtained, and the practice of purchasing collections often brought together from remote points, we cannot wonder that specimens, introduced in the way of trade, are difficult to trace to the place in which the animals lived. Nor is this all. When shells fall into the hands of dealers they are are strangely mixed, and the accounts given of them are not always strictly truthful. A person seeking shells from a particular region may frequently obtain more than ever really belonged to it. M. Reigen appears to have laboured diligently in collecting the shells of the interesting spot which he visited, but not to have at all sought to extend his collection by miscellaneous purchases; and the history of what he had brought together, subsequent to his death, is well known, so that there is little room for error.

2. The specimens of each species are in most instances numerous, showing the

amount and limits of the variations to which species are subject: a point of some importance, upon which the one or two examples, possibly from various places, found in most collections, throw no light. M. Reigen seems never to have been satisfied that he had got sufficient of one kind; and the gentleman into whose hands his stores have fortunately fallen, fully estimating the value of researches respecting the true limits of species, and the difficulties under which ordinary naturalists labour, has, not only in his noble present to the British Museum, but as far as was possible in all the collections sent out, been careful to supply good series of specimens.

3. The condition of the specimens in this collection is very remarkable. They are as they were taken from the water, without having undergone any process of cleansing or polishing. Many of the gasteropods have their opercula. The lamellibranchiata appear with their hinges undetached, and the surfaces in their original state. Even a few such objects in a large collection are invaluable, as a source of instruction, and contribute to render the ordinary specimens far more useful.

4. This collection contains a considerable number of new species. The locality was an unexamined and remarkably favourable one—in a tropical climate, and at the junction of a great gulf with the ocean. The collector devoted adequate time and great diligence to his work, and his success was fully equal to what we might expect in such circumstances.

We must regret that M. Reigen did not live to make use of his own accumulated stores, and to communicate the peculiar information which he must have gained in the course of their acquisition: but they have fallen into excellent hands. Mr. Carpenter's donation to the National Museum—considering its intrinsic value pecuniarily as well as scientifically, and the labour involved in its preparation, and coming too from a hard-working professional man, with very limited means—must be accounted a commendable example of public-spirited generosity; and his dealings with the Toronto University, even putting out of the question the very handsome present which he took the opportunity of contributing to our rising Museum, are marked by a liberality which deserves to be felt and acknowledged.

At a meeting of the Canadian Institute, in the month of December last, Prof. Hincks exhibited to the members present a series of specimens illustrating his remarks in the previous paragraphs on the collections of Mazatlan shells. It may be stated here, that the collection acquired for the University Museum, contains about two hundred and thirty distinct species, many of them new, and a large proportion illustrated by good series of specimens. The whole number of species described as occurring at Mazatlan, approaches seven hundred; but of these a great many were unique,—not a few described from fragments—a good many others so very rare as to allow no specimens for distribution—and some were not contained in the Liverpool collection. Many, too, are microscopic, which makes the supply more uncertain. On the whole, the collection is rich as a local group, and adds greatly to the value of the conchological cabinet of the University Museum.

W. H.

CANADIAN FLORA; NEIGHBOURHOOD OF TORONTO.

Having noticed several European plants naturalized in this country (introduced no doubt with grass seed), which are not recorded by Dr. Gray in his valuable manual, I am desirous of placing them on record, and I avail myself of the opportunity to offer a few general remarks on the Canadian Flora, and the state of our knowledge respecting it. I shall confine myself at present to Phænogamous plants and ferns, with their allies. Mosses, Liverworts, Lichens, Algae, and Fuci, are studied by a much more limited class, and our knowledge of the limits of species is in a much less advanced state; we will not, therefore, at present, venture any opinion respecting them.

Dr. Gray enumerates 2426 species of Phænogamous plants and ferns, as constituting the Flora of the Northern United States, rejecting from this number the Southern forms and the maritime plants, with all those which, from any cause appear to be unknown in Canada about 1000 remain as constituting the Flora of Canada, such as we may expect to find it. Some peculiar forms may be expected northward and eastward, but they can be supposed to make but a very small numerical addition.

I have kept a list of the plants found by me near Toronto, and in a few occasional country excursions, and find the number recorded to be just under 600. Here it is to be considered that, besides the comparatively small space examined, there are several numerous families which have not yet been made a subject of particular examination, and which could hardly fail to add another hundred species. In the number of the *Canadian Journal* for April, 1854, is inserted a list of indigenous plants found in the neighborhood of Hamilton, by Dr. Craigie and Mr. W. Craigie, which appears to be carefully drawn up, though as it seems to note the results of one season's botanizing, there are of course many omissions. This list contains 362 species, of which 15 are not found in my list. The great difference is due partly to oversight, as the list is apparently only the result of one year's botanizing, and partly to the circumstance that most trees and all Cyperaceous and Graminaceous plants have been entirely omitted.

A complete Flora of Canada cannot be expected for many years; but it appears to me that a tolerably correct and sufficiently useful list of the plants of Western Canada might now be formed, and would include a little above 1000 species of Phænogamous plants and ferns. Even conjecturally the limits may be marked out with sufficient accuracy for practical use, and a few journeys at a favorable season, or the opportunity of examining a few carefully formed local lists, would now settle everything excepting a small number of doubtful species.

Comparing our Flora with that of Great Britain we find we have both less variety upon the whole, fewer successive changes with the progress of the season and less difference of districts. We have a few plants that are only to be found in rocky districts, which are, of course, more limited in their range; but excepting these there is a remarkable conformity in the productions of the different parts of our country. This, with the allowances required for mountain ranges and the sea-coast, as well as for the gradual introduction, as we proceed southward, of new forms, is found also in the Flora of the United States, and is characteristic of the vast continent we inhabit. Our vernal Flora is one of great variety as well as beauty and interest. We have only to regret that it is so transient. At other seasons we make a less favorable appearance, and it seems easy for the botanist to acquaint himself with all the species within his reach; excepting that as autumn advances the numerous and difficult species of the great genera Aster and Solidago, of which this continent is the special home, may exercise his patience and discriminating skill. Among the plants of peculiar interest from the nature of their distribution in this country, which I have had the good fortune to meet with, I would mention two rare ferns, *Aspidium Lonchitis*, a scarce British fern, which has a narrow range over this continent, and *Scolopendrium Officinale*, a common British plant, but here very rare, both of which I found on the limestone rocks at Owen's Sound. The following are the plants not found in Gray's list which I have noticed as naturalized in this neighborhood, and which as familiar objects in that country which we always speak of as *Home*, it is pleasant to add to our list:

Papaver Rhœas, Common Poppy.

Lychnis flos cuculi, Ragged Robbin.

Lychnis vespertina, Evening scented white campion.

Hieracium pilosella, Mouse ear hawkweed, at Altamore, near Woodstock, North Oxford, C. W., the residence of Thos. J. Cottle, Esq.

Rumex acetosa. Sorrel.

Veronica Buxbaumii. I have not withdrawn this pretty speedwell from the list, although since I made my note it has been introduced by Dr. Gray into his new edition. It is found near Toronto.

Cynosurus cristatus, Dog's-tail grass.

I withhold my list only because I have reasonable expectations of greatly increasing it during the coming season.

NOTE.—Since the above was in type, I have seen in the Canadian Naturalist and Geologist for February, a list of indigenous plants found growing in the neighborhood of Prescott, C. W., by B. Billings, Junr. Setting aside a few mosses and Hepaticæ, the number contained in this list is 407, all of which, excepting two or three, are also found in my list. The supplement which the author promises. will probably render the difference in extent much less considerable.

W. H.

ENGINEERING AND ARCHITECTURE.

AN IMPROVED FLOOR TO SECURE GROUND FLOORS AGAINST WET, HEAT, ETC.

At a meeting of the Canadian Institute on the 10th of April, M. Alphonze Coulon, C. E., read a description of an improved mode of flooring, originally introduced by him in Paris, of which the following is an abstract:

It consists of a level stratum of asphalte cement covering the area of the rooms, laid about ½ inch in thickness, and before its laying the joists for the support of the boarding have been fitted in a hollow full of asphalte. Such is the improved floor introduced at Paris, in 1852, for the entrepot of Cereales, which M. Coulon superintended, and after several experiments of the same kind he was led to the following conclusions:

1. The wet is entirely excluded.

2. The peculiar advantages of this floor compared with the kind, the battens of which rest directly over the asphalte, cannot be over estimated.

In fact, the last one being composed of battens fitted only in the asphalte, its surface is very rough for walking, and presents many inequalities to retain the wet, especially when any weight is placed in circulation upon it, as the battens are often driven out. But with the improvement now described all these objections are removed, and as the battens are ploughed, tongued and nailed on the joists, they cannot fail to produce a compact and solid floor. Also, the distance between the asphalte and the floor being less than half an inch, there is a certain degree of elasticity, and this is sufficient for the ventilation of the floor, but too narrow for the passage of mice or rats.

By putting sand in this empty space, the passage of the sound (in the case of an upper floor) will be effectually arrested.

This improvement offers, also, the advantage of avoiding the use of masonry work for fitting the joists, which, in that case increases considerably the height of the floor; and thus the cost is considerably diminished. For the joists being all along well fitted in an asphaltic bath, it is then advisable to diminish their thickness and that of the floor.

Further, if we desire to secure complete dryness for the first story or the cellar, we have only to re-cover all over the inner walls with a combination of wood and asphalte, similar to the improved floor already described, which forms a waterproof stratum.

CANADIAN INSTITUTE.

SESSION—1857-58.

SIXTH ORDINARY MEETING—*30th January*, 1858.

The Hon. Chief Justice DRAPER, C.B., President, in the Chair.

I. *The following Gentlemen were elected Members:*

ARTHUR HARVEY, Esq., Hamilton.
ARTHUR R. SOWDON, Esq., Toronto.
WILLIAM HAY, ESQ., Architect, Toronto.
A. C. MESSER, Esq., Civil Engineer, Toronto.
CHILION JONES, Esq., Civil Engineer, Toronto.
CHARLES J. CARROLL, Esq., Toronto.
WILLIAM DAVIDSON, Esq., Berlin.
JOSEPH BOUCHETTE, Esq., Dep'y Surv. Gen., Toronto.

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

From Messrs. Crosby, Nichols & Co., Publishers, Boston.
Mabel Vaughen.
American Almanac, 1858.

III. *The following Papers were read:*

1. By Thomas Hector, C. E.:
"Scale for computing areas of irregular figures."

2. By Col. Baron de Rottenburg, C. B.:
"Observations made at Toronto on Solar Spots in the month of January, 1858."
3. By Prof. Croft, D.C.L.:
"On the purification of Sulphuric Acid for toxicological investigations."
4. By S. Fleming, Esq., C.E.:
"On a method of launching large vessels."

SEVENTH ORDINARY MEETING—*6th February*, 1858.

The Hon. Chief Justice DRAPER, C.B., President, in the Chair.

I. *The following Gentlemen were elected Members:*

JOHN FLEMING, Esq., Toronto.
WILLIAM HUTTON, Esq., Toronto.

Corresponding Members.

Capt. A. NOBLE, Royal Artillery.
Rev. G. C. IRVING, M. A.

II. The President announced that a Special Meeting would be held on the second Saturday from this date, to take into consideration, on the recommendation of the Council, the addition of the following clause to Rule 4 of Sec. IV. of the Regulations:

"And it shall be the duty of the Secretary to furnish a printed list of persons nominated to office (with the proposer and seconder of each) to every country member who shall apply to him in writing, signed by himself, for the same; and the Secretary shall produce the said application at the time of election, otherwise the vote shall not be valid."

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

1. From Thomas Henry, Esq.
Logan's Geological Report, 1853–1856, together with Maps.
2. From Major Lachlan.
A preserved specimen of the *Agama Cornuta*, popularly styled the Horned Frog, of Mexico.

IV. *The following Papers were read:*

1. By Major Lachlan:
"A communication accompanying a specimen of the *Agama Cornuta*, with remarks on the Natural History of the animal."
2. By Rev. J. McCaul, LL. D.:
"On Latin inscriptions found in Great Britain." Part II.

EIGHTH ORDINARY MEETING—*13th February*, 1858.

Col. BARON DE ROTTENBURG, C. B., Vice-President, in the Chair.

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

ROBERT CLELAND, Esq., Toronto.

II. *The following Papers were read.*

1. By S. Fleming, Esq., C.E.:
"Note on an improved kind of Rail.

2. By Prof. J. B. Cherriman, M.A.:

"On the application of Acoustics to Public Buildings, as illustrated in the Lecture Room of the Smithsonian Institution at Washington.

NINTH ORDINARY MEETING—*20th February*, 1858.

Hon. Chief Justice DRAPER, C.B., President, in the Chair.

I. *The following Gentlemen were elected Members:*

S. DERBISHIRE, Esq., Toronto.
THEODORE CLEMENTI, Esq., Peterboro.
Capt. RETALLACK, Assist. Military Sec'y, Toronto.

II. The Secretary having read the notice of the proposed addition to Rule 4 Sec. IV. of the Laws, as recommended by the Council, on a remit to them from a former meeting,—It was moved by Dr. Wilson, seconded by Mr. Langton, and carried, that such addition be now made.

III. *The following Donation to the Museum was announced, and the thanks of the Institute voted to the donor:*

From C. Unwin, Esq., D.P.L.S.

Two specimens of the Eggs of the great Northern Diver, from Gull Lake.

IV. *The following Papers were read:*

1. By Prof. Cherriman, M.A.:

"Description of the Observatory at St. Martin's, C.E. From notes furnished by Prof. Smallwood."

2. By Col. Baron de Rottenburg, C.B.:

"Some Astronomical Notes."

3. By Rev. Prof. Kendall, M.A.:

"Geometrical Notes."

TENTH ORDINARY MEETING—*27th February*, 1858.

JOHN LANGTON, M. A., Vice-President, in the Chair.

I. *The following Gentlemen were elected Members:*

CHARLES SPROUTT, Esq., Toronto.
DOUGLAS S. SUTHERLAND, Esq., Guelph.

II. Dr. Wilson laid on the table the Canadian Journal for March, now ready for distribution, and drew the attention of Members to the Catalogue of the Institute Library, which accompanied it. For this carefully prepared catalogue the members are indebted to the zeal of the Librarian, Prof. Croft.

A vote of thanks was unanimously passed to Professor Croft, for the diligence and care bestowed in the rearrangement of the books, and the compilation of the Library Catalogue.

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

From J. F. Smith, Esq., Junior.

LIBRARY.—Descriptive Guide to the Museum of Practical Geology, London.
" Hindostanee Interpreter, &c., &c.
MUSEUM.—Specimen of Fossil Bone from the late Dr. Buckland's collection.

IV. *The following Papers were read:*

1. By M. A. Coulon, C.E.:
"On the calculation of Road and Railway Excavations and embankments."
2. By Prof. Henry, LL.D., Smithsonian Institution, Washington:
"On Climatology." Read by Prof. Cherriman, M.A.
3. By Prof. Wilson, LL.D.:
"On the true value of the Colon as a mark of Punctuation.."

ELEVENTH ORDINARY MEETING—*6th March*, 1858.

The Hon. Chief Justice DRAPER, C.B., President, in the Chair.

I. *The following Gentlemen were elected Members:*

W. ELLIS, Esq., Civil Engineer, Prescott.
JESSE THOMPSON, Esq., Toronto.

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

From the Regents of the University of the State of New York.
Census of the State of New York. 1 Vol.
Historical documents relating to the State of New York. Vol. X.

III. *The following Papers were read:*

1. By the Rev. D. Inglis, Hamilton:
"On the relation of Quantity to the Æsthetic sentiment."
2. By the Rev. Prof. Hincks, F.L.S.:
"Considerations respecting anomalies of Vegetable Strucutre, their causes, scientific importance, proper arrangement, and some of the conclusions derived from them or supported by them.

TWELFTH ORDINARY MEETING—*13th March*, 1858.

Col. BARON DE ROTTENBURG, C.B , Vice-President, in the Chair.

I. *The following Gentlemen were elected Members:*

FRANCIS C. DRAPER, Esq., Toronto.
REV. W. CHECKLY, B.A., Barrie.
ALEX. KELLOR ROY, Esq., Toronto, (Junior Member.)

II. *The following Donation to the Library was announced and the thanks of the Institute voted to the donor:*

From the Hon. Chief Justice Sir John B. Robinson, Bart.
"Contributions to the Natural History of the United States of America," by L. Agassiz. Vols. I. and II.

III. *The following Papers were read:*

1. By Prof. Hind, M.A.:
"On ancient Lake Ridges and Beaches in the Valley of the Red River."
2. By T. Sterry Hunt, Esq., Montreal:
"Considerations on the Theory of Igneous Rocks."
3. By Col. Baron de Rottenburg, C.B.:
"Remarks on the spots now visible on the Sun's disc."

THIRTEENTH ORDINARY MEETING—20*th March*, 1858.

Col. BARON DE ROTTENBURG, C.B., Vice-President, in the Chair.

I. *The following Gentlemen were elected Members:*

JAMES McCUTCHEON, Esq., Toronto.
Rev. VINCENT CLEMENTI, B.A., Peterboro, C.W.
W. S. MACDONALD, Esq., Gananoque, C.W.
J. S. Playfair, Esq., Toronto.

II. *The following Papers were read:*

1. By Rev. Prof. Hincks, F.L.S:
"On the Classification of Mammalia."
2. By Prof. E. J. Chapman:
"On a New Trilobite from Canadian Rocks, with some additional remarks on the *Asaphus Canadensis.*"
3. By Prof. Croft, D.C.L.:
"On some compounds of Palladium."

FOURTEENTH ORDINARY MEETING—27*th March*, 1858.

Col. BARON DE ROTTENBURG, C.B., Vice-President, in the Chair.

The following Papers were read:

1. By the Rev. J. McCaul, LL.D.:
"On Roman Military and Naval Epitaphs."
2. By T. Henning, Esq.:
"Inquiry into the means of rendering our Educational System applicable to the social condition of large cities."

FIFTEENTH ORDINARY MEETING—10*th April*, 1858.

JOHN LANGTON, M. A., Vice-President, in the Chair.

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

1. From George Brown, Esq., M.P.P.
LIBRARY.—Logan's Geological Survey, 1853-1856, with Maps. Two Vols.
2. From And. Russell, Esq., Assistant Commissioner Crown Lands Department.
LIBRARY.—Logan's Geological Survey, 1853-1856, with Maps. Two Vols.
3. From Major Lachlan, Cincinnati, Ohio.
MUSEUM.—Miscellaneous specimens of Minerals, and other objects. Sixty parcels, numbered, with descriptive catalogue.
4. From A. Macdonald, Esq., Alexandria, Lochiel, Glengary.
Curious Copper Medal.

II. Professor Chapman deposited with the Institute, on the part of T. Sterry Hunt, Esq., of Montreal, a sealed packet, containing a notice of some researches to be communicated to the Institute, hereafter, in a more complete form.

III. *The following Papers were read:*

1. By Rev. Prof. Young, M.A.:

"On the impossibility of representing by Algebraical functions the roots of Equations of a higher order than the fourth."

2. By F. W. Cumberland, Esq., C. E.:

"Notes on the paper read by Mr. Henning at the last meeting, on our Educational System."

3. By M. A. Coulon, C.E.:

"On an improved floor, specially applicable for ground floors."

SIXTEENTH ORDINARY MEETING—17*th April*, 1858.

Col. BARON DE ROTTENBURG, C.B., Vice-President, in the Chair.

I. *The following Gentlemen were nominated for election as Members:*

THOMAS REYNOLDS, Esq., M.D., Brockville, C.E.

J. J. BURROWS, Esq., Kingston.

The following Gentlemen were nominated for election as Junior Members:

G. T. CARRUTHERS, Esq., Trinity College, Toronto.

C. J. BETHUNE, Esq., " " "

II. *The following Paper was read:*

By F. W. Cumberland, Esq., C.E.:

"Notes on the course of the Western Trade, Eastward to the Atlantic."

III. Messrs. SPREULL, and SPRATT were nominated Auditors for the present year.

IV. The Chairman announced this meeting as the closing one, and took occasion to congratulate the Institute on having thus brought another session to a successful termination. The communications read before the meetings had been of a highly varied character, and while he believed that they had in some respects been less attractive to many than those of some previous seasons, he was inclined, from his own observation, to look upon this as no unfavorable aspect. The communications of this year would, he believed, be found to have included more of a strictly scientific character than in any previous session; and if some of them were on that account less calculated to interest a popular audience, they would be found to maintain and extend that scientific character which it was most desired that the Journal of the Canadian Institute should assume. The prospects of the Society were now, in all respects, most encouraging. Their library had been greatly extended, by valuable additions of a strictly scientific character, both by purchase and gift: and its utility had been largely increased through the exertions of their efficient Librarian, Prof. Croft, by whom it had been systematically classified, arranged and catalogued, during the session now brought to close.

In concluding, the Vice-President invited the attention of the members during the approaching summer to such subjects of interest in science, literature, and the mechanical and industrial arts, as may furnish materials for valuable communications to future meetings, and contributions to the Journal of the Institute. He then declared the adjournment to the 1st Saturday in December.

MONTHLY METEOROLOGICAL REGISTER AT THE PROVINCIAL MAGNETICAL OBSERVATORY, TORONTO, CANADA WEST,—FEBRUARY, 1858.

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

Day.	Barom. at temp. of 32°.				Temp. of the Air.				Mean Temp. + or — of the Average	Tens. of Vapour.				Humidity of Air.				Direction of Wind.			Resul't. Direction.	Velocity of Wind.					Rain in inches.	Snow in inches.
	6 A.M.	2 P.M.	10 P.M.	Mean.	6 A.M	2 P.M	10 P.M	ME'N		6 A.M	2 P.M	10 P.M.	M'N	6 A.M	2 P.M.	10 P.M.	M'N	6 A. M.	2 P. M.	10 P. M.		6 A.M.	2 P.M.	10 P.M.	Result'.	ME'N		
1	29.787	29.628	24.402	29.5768	23.9	29.0	29.7	27.63	+ 3.75	.096	.118	.152	.120	.74	.74	.92	.78	S S E	E N E	E b N	N 80 E	5.0	19.0	22.2	15.63	16.08	...	6.0
2	.071	.024	.271	.1370	31.0	33.9	30.3	31.97	+ 8.12	155	180	127	156	89	92	75	86	E b S	S W	W b S	S 70 W	9.2	6.0	14.0	7.49	9.35	inap.	0.5
3	.508	.558	.715	.0122	30.3	32.8	21.6	27.52	+ 3.75	150	164	081	129	89	87	70	82	W S W	S W b W	W	S 69 W	13.5	14.0	18.0	11.67	12.00	...	0.5
4	.757	.731	.743	.7430	10.0	24.5	13.7	15.40	— 8.28	054	078	054	063	78	59	67	71	Calm.	W b S	W b S	S 70 W	0.0	9.3	3.0	4.21	4.20	...	...
5	.693	.644	.718	.6962	1.4	23.9	15.1	13.65	— 9.93	020	067	074	058	43	52	86	64	Calm.	W S W	W b S	S 75 W	0.0	8.0	11.0	8.19	8.30	...	...
6	.812	.755	.565	.6970	19.1	25.2	28.3	24.57	+ 1.05	090	098	137	109	87	72	88	81	W b S	S W b S	S	S 30 W	12.2	7.5	8.2	8.46	9.75	...	0.4
7	.517	.583	—	—	31.3	30.6	—	—	—	166	152	—	—	95	89	—	—	W S W	W S W	W b S	S 82 W	13.3	11.5	9.0	11.91	12.83	...	0.2
8	.828	.824	.774	.8082	19.8	23.0	18.7	20.10	— 3.27	095	092	075	083	90	73	75	77	N W b W	Calm.	N N W	N 16 W	6.0	0.0	1.5	1.88	2.03	...	0.4
9	.555	.115	28.991	.1972	20.9	30.1	22.0	24.37	+ 1.10	005	144	110	118	85	86	93	89	N N E	E S E	W b N	S 72 E	6.0	8.5	7.2	0.67	8.40	...	5.0
10	.083	.325	29.540	.3103	23.0	10.4	5.0	11.58	—11.68	106	055	049	062	86	78	90	82	S W b W	W b N	W	S 86 W	18.6	26.6	18.2	21.21	21.80	...	0.5
11	.657	.765	.816	.7530	3.2	4.3	2.8	2.77	—20.50	047	046	042	043	95	86	83	86	S W b W	N W b W	W b N	S 76 W	15.0	2.2	0.5	4.35	4.63	...	...
12	.806	.848	.924	.8667	6.1	19.8	11.3	11.80	—11.45	048	070	061	057	83	65	83	77	W b S	Calm.	W b N	N 12 W	4.0	0.0	6.5	2.87	5.57	...	...
13	.944	.788	.692	.8035	4.3	10.4	14.4	9.67	—13.58	030	045	070	052	55	63	83	72	N E b N	N E b E	E b N	N 58 E	15.5	14.5	24.2	16.68	17.29	...	6.0
14	.487	.604	—	—	9.0	12.6	—	—	—	054	066	—	—	82	86	—	—	N E b N	N b W	N N W	N 8 E	13.5	5.5	0.5	6.00	6.96	...	2.5
15	.818	.908	.887	.8695	9.3	17.8	19.1	15.67	— 7.58	062	082	071	067	93	83	69	76	N N W	Calm.	W b N	N 66 W	15.0	0.0	2.0	4.48	5.16	...	...
16	.794	.802	.915	.8427	14.0	11.3	-0.1	7.52	—15.85	062	045	037	047	76	61	85	75	N W b N	N N W	N W	N 39 W	10.0	14.0	12.0	12.10	12.26	...	...
17	30.028	.982	.929	.9815	-6.6	9.0	2.4	1.60	—21.75	022	048	043	037	66	73	90	73	N W	W b N	N W	N 50 W	7.5	4.0	6.2	3.97	4.38	...	...
18	29.885	.858	.894	.8862	6.1	10.0	3.2	6.15	—17.28	037	039	043	039	62	57	83	67	W N W	N N W	N	N 3 E	1.8	6.6	8.2	6.93	7.37	...	...
19	.863	.760	.641	.7447	1.4	9.7	9.3	6.75	—16.78	041	046	062	050	88	67	94	84	N E b N	E N E	N E	N 44 E	17.0	16.2	17.8	16.06	16.30	...	3.0
20	.537	.524	.491	.5120	11.1	15.5	10.4	13.33	—10.28	061	076	057	068	85	86	80	84	N N E	Calm.	W S W	N 84 W	13.8	0.0	2.5	2.79	6.70	...	0.5
21	.391	.366	—	—	20.9	24.1	—	—	—	095	097	—	—	85	74	—	—	S W b W	N W b N	W	N 80 W	13.0	13.5	5.5	9.79	11.97	...	0.2
22	.799	.802	.842	.8222	11.8	16.2	11.8	12.43	—11.38	063	061	061	059	86	67	81	77	N W b W	W N W	N	N 51 W	4.4	6.0	2.0	8.10	3.64	...	...
23	.961	30.057	.941	.9913	1.0	17.6	12.9	11.50	—12.43	036	076	057	060	76	79	73	77	N	S b E	W S W	S 60 W	1.0	1.5	5.5	2.34	3.52	...	...
24	.755	29.554	.519	.5980	6.8	25.7	24.5	20.55	— 3.58	049	095	088	084	81	68	67	74	W b S	S W b S	W	S 45 W	3.9	19.3	5.0	9.04	9.61	...	...
25	.458	.485	.602	.5205	25.6	31.0	22.0	26.48	+ 2.15	110	091	110	103	80	52	93	73	W b S	W N W	N W b W	N 60 W	7.0	15.5	6.8	6.44	7.18	...	0.1
26	.632	.586	.446	.5448	15.5	30.3	30.3	26.53	+ 2.00	069	108	135	109	79	64	79	73	Calm.	S b W	S S W	S 26 W	0.0	11.2	11.8	11.19	11.28	...	...
27	.283	.274	.353	.3018	33.2	40.7	38.2	38.07	+13.35	166	146	161	152	87	57	69	66	S S W	S W b S	W b S	S 70 W	12.2	8.6	5.5	4.54	9.18	...	0.1
28	.329	.290	—	—	32.2	34.2	—	—	—	171	172	—	—	93	87	—	—	N b W	N	N W b N	N 25 W	10.0	6.2	1.0	7.14	7.55	...	0.8
M	29.6797	29.6499	29.6506	29.6603	13.42	20.92	16.54	16.98	—6. 69	.074	.086	.081	.080	.80	.71	.81	.77	....	....	....	....	8.87	9.11	8.42	......	9.12	inap.	26.7

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR FEBRUARY.

Highest Barometer........................ 30.060 at 4 p. m., on 23rd } Monthly range=
Lowest Barometer ... . 28.940 at 8 p. m.. on 9th } 1.120

Self-regist'ing Thermom.
- Maximum Temperature........... 42°.4 on p. m. of 27th } Monthly range=
- Minimum Temperature........... —7°.3 on a. m. of 17th } 49°.7
- Mean maximum Temperature .... 24°11 } Mean daily range=
- Mean minimum Temperature .... 10°85 } 13.26
- Greatest daily range .... 25°6 from a. m. to p. m. of 12th.
- Least daily range................. 3°2 from p. m. of 15th to a. m. of 16th.

Warmest day......... 27th ... Mean temperature......... 38.07 } Difference = 36°47.
Coldest day........... 17th ... Mean temperature........ 1°60 }

Maximum Radiation. { Solar.................................. 61° 0 on p. m. of 27th, } Monthly range=
{ Terrestrial.........................—15°.0 on a. m. of 17th. } 76°0

Aurora observed on 6 nights, viz.. on 12th, 14th, 15th, 16th, 17th and 18th.
Possible to see Aurora on 11 nights; impossible on 17 nights.

Snowing on 16 days,—depth 26.7 inches; duration of fall 96.0 hours.
Raining on 1 day,—depth inapp. inches; duration of fall 0.5 hours.

Mean of cloudiness = 0.69.
Most cloudy hour observed, 2 p. m., mean = 0.75; least cloudy hour observed, midnight, mean, =0.62.

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

North.	South.	East.	West.
1986.62	1324.35	1244.28	3302.41

Resultant direction N. 72° W.; Resultant Velocity 3.22 miles per hour.
Mean velocity.......... .... 9.12 miles per hour.
Maximum velocity ... . 31.2 miles from noon to 1 p. m., on 10th.
Most windy day........................ 10th...Mean velocity 21.80 miles per hour.
Least windy day .... 8th...Mean velocity 2.03 ditto.
Most windy hour .. 11 a.m. to noon.........Mean velocity 10.69 ditto. } Difference
Least windy hour. 9 to 10 p. m............Mean velocity 8.07 ditto. } 2.62 miles.

1st. Clouds of dust flying in Toronto during the afternoon. Perfect Solar Halo at 2 p.m.
3rd. Zodiacal Light very bright at 7 p. m.
10th. Very Stormy, cold day.
11th. Zodiacal Light bright and well defined during the evening.
13th. Stormy day. Snowing and drifting heavily.
18th. Perfect Lunar Halo from 7 p m.
20th. Corona round the Moon at 9 p. m.
22nd. Corona round the Moon at midnight.
23rd. Lunar Halo, 6 to 8 p. m. Corona at 10 p. m.
26th. Lunar Halo at 9 p. m.

The mean Temperature of February 1858 was 5°68 below the average of 19 years; and although the quantity of Rain was inappreciable, the amount of the Moisture almost reached the average, as the fall of Snow was 8.84 inches in excess of the usual depth.

The mean velocity of the Wind was 1.37 miles per hour above the average of 11 years, and the Resultant direction and velocity from 1848 to 1858 inclusive were respectively N 71° W. and 2.96 miles.

COMPARATIVE TABLE FOR FEBRUARY.

Year.	Temperature.					Rain.		Snow.		Wind.		
	M'n.	Diff. from Aver.	Max. ob'd.	Min. ob'd.	Range.	No. of days.	Inch's.	No. of days.	Inch's.	Resultant. Direction.	Resultant. V'y.	Mean Force or Velocity.
	°	°	°	°	°							
1840	28.0	+5.2	49.1	+ 8.3	40.8	8	1 475	6	...	...	...	....
1841	22.4	—0.3	43.4	— 0.3	43.7	1	0.000	9	...	...	...	0.61 lbs.
1842	26.9	+4.2	48.7	+ 2.5	46.2	8	3.625	9	...	...	...	1.03
1843	14.5	—8.2	37.5	—10.2	47.7	1	0.475	21	14.4	...	...	1.05
1844	26.0	+3.3	47.1	— 0.4	47.5	4	0.430	7	10.0	...	...	0.43
1845	26.0	+3.3	46.6	— 3.9	50.5	5	...	9	19.0	...	...	0.99
1846	20.4	—2.3	41.4	—16.2	57.6	0	0.000	13	46.1	...	...	0.65
1847	21.5	—1.2	42.2	— 1.0	43.2	2	0.550	13	27.3	...	...	0.69
1848	26.6	+3.9	46.9	— 0.6	47.5	4	0.775	8	10.8	N 65° W	2.53	5.69 mls.
1849	19.5	—3.2	41.1	— 9.2	50.3	2	0.240	13	19.2	N 41° W	1.48	6.58
1850	26.0	+3.2	49.2	+ 1.3	47.9	7	1.235	9	23.1	N 80° W	3.43	7.61
1851	27.6	+4.9	50.2	+ 1.3	48.9	7	2.600	4	2.4	N 64° W	1.99	6.94
1852	23.4	+0.7	41.2	— 3.2	44.4	3	0.650	11	13.0	S 75° W	3.34	6.42
1853	24.1	+1.4	43.4	— 0.6	44.0	4	1.030	15	12.6	N 49° W	2.51	7.29
1854	21.1	—1.6	42.7	— 5.7	48.4	5	1.460	15	18.0	N 7° E	1.68	6.91
1855	15.4	—7.3	37.3	—25.0	62.3	2	1.770	14	21.8	N 40° W	4.34	8.17
1856	15.7	—7.0	35.3	—18.7	54.0	0	0.000	8	9.7	N 81° W	7.70	10.71
1857	28.5	+5.8	51.2	— 5 9	57.1	11	3.050	11	11.7	S 78° W	3.68	9.82
1858	17.0	—5.7	40.9	— 6.6	47.5	1	inap.	16	26.7	N 72° W	3.22	9.12
M	22.66	...	43.97	—4.95	48.92	3.9	1.076	11.1	17.86	...	...	7.75 mls.

MONTHLY METEOROLOGICAL REGISTER, AT THE PROVINCIAL MAGNETICAL OBSERVATORY, TORONTO, CANADA WEST—MARCH, 1858.

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

Day	Barom. at temp. of 32°.				Temp. of the Air.				Mean Temp. +or— of the Average	Tens. of Vapour.				Humidity of Air.				Direction of Wind.			Resultant Direction.	Velocity of Wind.					Rain in Inches.	Snow in Inches.
	6 A.M.	2 P.M.	10 P.M.	MEAN	6 A.M	2 P.M	10PM	ME'N		6 A.M	2 P.M	10 P.M	M'N	6 A.M	2 P.M	10 P.M	M'N	6 A.M.	2 P.M.	10 P.M.		6 A.M	2 P.M	10PM	Re-sul't.	ME'N		
1	29.424	29.485	29.560	29.4897	23.8	21.2	10.8	18.28	− 6.93	.103	.066	.060	.074	.81	.57	.90	.74	W N W	N W b N	N W b W	N 44 W	14.5	11.0	11.5	12.93	13.25	......	...
2	.504	.453	.581	.5180	8.6	13.1	3.7	7.92	−17.50	.053	.037	.042	.043	.82	.46	.81	.70	N W	N W b N	W N W	N 60 W	12.0	9 5	3.0	8.34	8.50	......	...
3	.598	.592	.792	.6687	2.1	15.5	6.4	7.07	−18.65	.039	.072	.044	.050	.80	.82	.75	.79	W N W	W S W	N W	N 69 W	0.2	8.9	9.0	6.76	7.22	......	0.2
4	.868	.890	.936	.9153	−1.5	12.3	3.9	4.98	−21.02	.038	.040	.037	.038	.91	.52	.70	.69	N W	N W b N	N W b N	N 25 W	4.7	7.0	9.0	5.55	5.69	......	...
5	30.056	.931	.777	.9182	−5.5	6.8	4.8	2.12	−24.08	.024	.029	.052	.037	.70	.47	.95	.75	N N W	N W	N W	N 41 W	5.0	23.2	27.5	20.69	20.88	......	...
6	29.720	.608	.599	.6310	3.9	18.0	7.1	9.73	−16.77	.035	.050	.048	.043	.65	.49	.78	.62	N W	W	Calm.	N 56 W	19.5	2.4	0.0	5.85	6.11	......	...
7	.563	.473	—	—	4.3	24.4	—	—	—	.049	.110	—	—	.96	.84	—	—	W b N	W N W	W N W	N 71 W	7.2	9 4	3.0	4.21	4.41	......	...
8	.349	.260	.216	.2643	5.7	22.1	16.5	14.95	−12.28	.047	.075	.069	.062	.83	.83	.78	.73	Calm.	S S W	N W b W	N 53 W	0.0	3.0	11.2	4.28	5.04	......	Inap
9	.147	.123	.237	1733	12.6	20.1	18.0	17.32	−10.20	.061	.063	.078	.067	.78	.58	79	.71	N W b W	N W b W	Calm.	N 61 W	11.0	14.0	0.0	7.09	7.69	......	Inap
10	.321	.355	.167	.2712	22.0	31.2	33.9	29.83	+ 2.02	.099	.105	.156	119	.84	.59	.80	.72	W S W	S W b S	S b E	S 22 W	4.4	14.5	7.8	5.65	6.83	0.015	...
11	.002	.336	.710	[illegible]	39.3	35.9	27.0	33.60	+ 5.37	.214	.105	.086	.137	.89	.49	.58	.68	S W b W	W b N	W N W	N 77 W	11.0	32.0	11.0	16.92	17.12	......	...
12	.807	.670	986	[illegible]	18.0	40.9	28.8	29.47	+ 0.92	.071	.078	.111	.090	.72	.29	.70	.57	Calm.	W S W	W b N	S 88 W	0.0	18.0	1.5	8.58	10.09	......	...
13	30.148	30.066	.888	30.0105	22.0	31.7	31.3	28.58	− 0.38	.089	.103	.152	.115	.75	.56	.86	.72	W N W	S E b S	E	S 72 E	1.2	6.0	3.5	3.34	3.96	0.012	...
14	29.640	29.643	—	—	32.8	45.8	—	—	—	.171	.239	—	—	.91	.77	—	—	Calm.	W S W	Calm.	S 66 W	0.0	6.0	0.0	0.58	1.25	0.305	...
15	.788	.736	.740	29.7502	37.5	37.5	36.4	37.00	+ 7.28	.221	.212	.209	.213	.98	.94	.97	.96	E N E	E b N	Calm.	N 80 E	5.6	1.0	0.0	1.72	1.72	0.120	...
16	.706	.544	.434	.5375	36.8	48.0	42.2	41.77	+11.73	.212	.310	.255	.253	.97	.92	.95	.93	Calm.	Calm.	Calm.	N 81 E	0.0	0.0	0.0	0.01	0.01	0.230	...
17	.348	.157	.061	.1820	40.0	54.1	46.5	46.70	+16.25	.241	.302	.279	.275	.97	.71	.88	.86	Calm	S S W	S S W	S 45 W	0.0	2.0	19.2	8.23	9.47	0.078	...
18	.200	.577	.762	.5490	45.4	47.6	38.6	43.12	+12.27	.221	.201	.151	.188	.72	.60	.64	.66	W b S	W	W b N	N 86 W	31.5	23.5	7.3	14.35	14.60	......	...
19	.929	.981	.984	.9700	33.5	39.4	32.1	34.88	+ 3.62	.172	.161	.150	.161	.89	.66	.82	.79	N W b W	S E b S	S E b S	S 35 E	4.5	7.0	3.8	2.84	5.33	......	...
20	909	.642	.243	.5532	31.0	36.8	—	36.42	+ 4.75	.147	.130	.217	.164	.85	.59	.92	.76	S E	E b N	E b N	N 84 E	6 0	14.1	1.8	6.62	7.55	0.125	...
21	28.921	28.998	—	—	45.8	37.8	38.8	—	—	.287	.190	—	—	.93	.84	—	—	W b N	W	W N W	N 87 W	3.5	34.0	23.5	22.69	23.62	0.010	Inap
22	29.538	29.638	.721	.6365	32.8	36.1	28.1	32.07	− 0.42	.130	.125	.098	.104	.70	.58	.63	.57	W b N	N W b W	N b W	N 43 W	14.5	19.6	6.5	10.77	12.14	......	Inap
23	.734	.725	.748	.7357	24.5	33.2	27.0	29.07	− 3.72	.102	.092	.115	.112	.77	.48	.77	.70	N b W	E	Calm.	S 74 E	4.0	6.9	0.0	3.06	3 67	......	...
24	.782	.738	.655	.7200	25.9	38.4	33.7	33.78	+ 0.62	.093	.106	.126	.113	.66	.45	.65	.59	Calm.	Calm.	Calm.	S 8 W	0.0	0.0	0.0	1.14	1.37	0.020	...
25	.470	.364	.514	.4582	34.2	48.3	36.9	39.22	+ 5.65	.168	.099	.150	.142	.85	.28	.67	.62	N N E	W	N W	N 62 W	0.5	24.0	18.0	12.91	13.88	0.002	...
26	.674	.672	702	.6858	27.6	39.7	29.5	32.37	− 1.62	.122	.074	.092	.086	.81	.30	.55	.49	N W	N W	N W b N	N 35 W	7.5	16.0	11.7	10.84	10.97	......	...
27	.670	.535	.371	.5170	25.6	30.6	31.7	30.17	− 4.25	.103	.123	.125	.117	.74	.72	.69	.69	N W b N	E N E	N	N 33 E	2.2	6.4	8.5	3.78	4.61	......	Inap
28	.418	.484	—	—	33.2	45.1	—	—	—	.151	.119	—	—	.80	.39	—	—	N	N W b W	N W b W	N 49 W	4.8	7.2	7.4	8.47	8.91	......	...
29	.687	.701	.830	.7353	33.7	49.6	39.4	41.52	+ 6.42	.134	.115	.204	.162	.69	.32	.85	.63	N W b N	N W b N	N W b N	N 31 W	9.0	14.6	12.0	12.22	12.35	......	...
30	.855	.790	.812	.8150	36.8	48.7	38.9	42.60	+ 7.10	.113	.178	.092	.115	.51	.50	.38	.41	N b W	S b W	N b W	N 23 W	15.2	7.8	12.4	8.57	9.65	......	...
31	.826	.816	.762	.7975	34.2	48.7	42.2	43.27	+ 7.35	.118	.119	.125	.130	.59	.34	.46	.46	N b E	E b S	N E	N 77 E	5.6	9.8	6.0	6.90	7.36	......	...
M	29.6315	29.6069	29.6218	29.6107	24.09	33.54	27.19	28.44	− 1.94	.117	.117	.123	.119	.79	.55	.75	.69	....	....	....	....	6.62	11.57	7.62	......	8.56	0.97	0.2

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR MARCH, 1858.

Highest Barometer . . . . 30.159 at 8 a.m. on 13th } Monthly range=
Lowest Barometer. . . . . 28.849 at 10 a.m. on 21st } 1.310 inches.

Self-register-ing Ther.
- Maximum temperature . . . . 55°4 on p. m. of 17th } Monthly range=
- Minimum temperature . . . . —5°5 on a. m. of 5th } 60°9
- Mean maximum temperature . . 37°01 } Mean daily range = 15°08
- Mean minimum temperature . . 21°93 }
- Greatest daily range . . . . 25°4 from a. m. to p. m. of 12th.
- Least daily range . . . . 2.2 from a. m. to p. m. of 15th.

Warmest day . . 17th ... Mean Temperature . . . 46°70 } Difference=44°58.
Coldest day. . . . 5th ... Mean Temperature . . . 2°12 }

Maximum { Solar . . . . 70°2 on p. m. of 17th } Monthly range=
Radiation { Terrestrial . . . . —16.5 on a. m. of 5th } 86°7

Aurora observed on 4 nights, viz.: 2nd, 12th, 17th and 18th; possible to see Aurora on 19 nights; impossible on 12 nights.

Snowing on 6 days; depth, 0.2 inches; duration of fall 11.0 hours.
Raining on 10 days; depth, 0.917 inches; duration of fall, 31.5 hours.

Mean of cloudiness=0.50; most cloudy hour observed, 2 p. m., mean=0.59: least cloudy hour observed, midnight; mean=0.46.

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

North.	South.	East.	West.
2779.23	650.28	664.17	4115.70

Resultant direction of the wind, N 58° W; Resultant Velocity, 5.45 miles per hour.

Mean velocity of the wind 8.56 miles per hour.
Maximum velocity . . . 35.4 miles per hour, from 3 to 4 p. m. on 21st.

Most windy day . . . . 21st—Mean velocity, 23.62 miles per hour.
Least windy day . . . . 16th—Mean velocity, 0.01 do

Most windy hour, 2 to 3 p.m.—Mean velocity, 11.78 do } Difference
Least windy hour, 3 to 4 a.m.—Mean velocity, 5.33 do } 6.45 miles.

5th—Very cold stormy day.
11th—Zodiacal Light very bright at 7 p. m.
12th—Beautiful display of Aurora; arches, patches, streamers and pulsations from 9 p. m. of 12th to 3 a. m. of 13th.
15th, 16th and 17th—Dense Fog.
20th—Solar Halo during the forenoon.
21st—Very Stormy day; severe squall of Rain, Sleet and Snow, 1 to 2, p. m.
22nd—Solar Parhelia and Halo at 4 p. m.; Lunar Halo from 7.30 p. m.
26th—Lunar Halo at 10 p. m. and midnight.
31st—Large and perfect Lunar Halo at midnight.

Temperature—The mean temperature of March was 1°31 below the average of 19 years.

Rain—The depth of rain was 1.497 inches less than the mean of 18 years.

Snow—The quantity of snow was 9.56 inches below the average of 16 years, and absolutely the least of the series.

Wind—The mean velocity of the wind was 0.66 miles per hour above the average of 11 years.

The Resultant Direction and Velocity of the Wind, from 1848 to 1858 inclusive, were respectively N 60° W, and 3.34 miles per hour.

COMPARATIVE TABLE FOR MARCH.

YEAR.	TEMPERATURE.					RAIN.		SNOW.		WIND.		
	Mean.	Difference from Average.	Maximum observed.	Minimum observed.	Range.	No. of days.	Inches.	No. of days.	Inches.	Resultant Direction.	Resultant Velocity.	Mean Velocity
1840	33.3°	+ 3.8°	56.9°	+ 8.7°	48.2°	8	1.640	8	...	...	...	...
1841	27.7	— 1 8	53.5	— 6.9	60.4	5	1.170	7	...	...	...	0.51lbs
1842	35.8	+ 6.3	68.7	+14.9	53.8	4	3.150	8	...	...	...	0.70 "
1843	21.3	— 8.2	38.6	— 2.8	41.4	2	0.625	18	25.7	...	...	1 18 "
1844	31.3	+ 1.8	50.3	+ 9.6	40.7	8	2.470	8	14.0	...	...	0.57 "
1845	35.4	+ 5.9	61.7	+ 9.9	51 8	5	...	8	2.8	...	...	0.66 "
1846	33.1	+ 3.6	49.3	+ 7.6	41.7	9	1.965	5	2.3	...	...	0.30 "
1847	26.2	— 3.3	44.3	+ 4.8	39.5	5	0.850	6	4.2	...	...	0.71 "
1848	28.6	— 0.9	58.9	+ 0.9	58.0	5	1.220	6	9.7	N 66 W	2.03	5.80ms.
1849	33.5	+ 4.0	53.4	+15.4	38.0	7	1.525	2	2.3	N 3 W	1.48	5.37 "
1850	29.8	+ 0.3	46.0	+ 6.0	40.0	2	0.745	7	11.2	N 52 W	2.62	7.62 "
1851	32.4	+ 2.9	58.7	+13.1	45.6	3	0.770	9	8.8	N 21 W	1.93	7.65 "
1852	27.7	— 1.8	44.8	— 3.2	48.0	8	3.080	12	19.5	N 8 W	0.71	5.81 "
1853	30.6	+ 1.1	56.3	— 0.1	56.4	6	1.080	8	7.1	N 62 W	2.56	5.87 "
1854	30.7	+ 1.2	52.8	+10.4	42.4	9	2.425	3	2.8	N 50 W	3.25	8.02 "
1855	28.5	— 1.0	48.6	— 2.9	51.5	5	1.485	11	18.1	N 88 W	4.76	9.95 "
1856	23.1	— 6.4	39.3	—13.6	52.9	0	0.0	12	16.2	N 71 W	7.68	11.39 "
1857	27.8	— 1.7	56.5	— 3.9	60.4	4	0.335	15	11.3	N 63 W	6.63	10.84 "
1858	28.4	— 1.1	54.1	— 5.5	59.6	10	0.917	6	0.2	N 58 W	5.45	8.56 "
Mean	29.75	...	52.25	+3.28	48.96	5.5	1.414	8.4	9.76	...	...	7.90

MONTHLY METEOROLOGICAL REGISTER, ST. MARTIN, ISLE JESUS, CANADA EAST—FEBRUARY, 1858.

(NINE MILES WEST OF MONTREAL.)

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

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

Day.	Barom. corrected and reduced to 32°			Temp. of the Air.			Tension of Vapor.			Humidity of Air.			Direction of Wind.			Velocity in miles per hour.			Mean direction of Wind.	Rain in Inches.	Snow in Inches.	WEATHER, &c. A cloudy sky is represented by 10; A cloudless sky by 0.		
	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.				6 A.M.	2 P.M.	10 P.M.
1	30.185	29.972	30.005	—9.2	10.1	3.0	.017	.045	.044	.57	.60	.85	N E b E	N E b E	N E b E	0.71	1.78	9.96	...	...	...	Clear.	Clear.	Cirr. Str. 10.
2	29.504	.315	29.363	2.7	20.5	17.7	.038	.096	.086	.73	85	.84	N E b E	N E b E	N b E	27.09	20.07	2.63	...	...	9.80	Snow.	Snow.	Do. 10.
3	.547	.538	.709	20.9	28.0	23.2	.075	.099	.100	.72	.64	.74	W S W	W S W	N W	13.08	19.60	12.61	...	...	...	C. Str. 4.	C. Str. 4.	Do. 10.
4	.863	.800	.898	6.4	23.0	15.0	.043	.088	.061	.75	.62	.73	W b S	W b S	N E b E	7.95	6.15	5.77	...	...	...	Clear.	Clear.	Do. 10.
5	.894	.835	.875	1.0	12.4	7.0	.030	.051	.048	.69	.69	.77	W b N	W b N	S S W	1.30	4.81	8.57	...	...	...	Do.	C. Str. 4.	Do. 10.
6	.996	.956	.969	—1.8	18.2	7.2	.034	.075	.040	.84	.71	.79	W S W	W S W	S S E	0.20	7 46	1.40	...	...	...	Do.	Do. 4.	Clear.
7	.765	.627	.698	8.6	21.0	22.0	.042	.070	.101	.68	.80	.86	N E b E	N E b E	S W	5.43	4.37	1.81	...	...	0.75	C. Str. 10.	C. Str. 10.	Cirr. Str. 6.
8	.944	.971	30.050	9.0	15.0	—0.3	.051	055	034	.77	.68	.81	N W	S b W	S b W	19.71	10.50	1.31	...	...	...	C. Str. 6.	Clear.	Clear.
9	30.031	.674	29.377	—14.1	4.2	9.1	.012	.038	.051	.50	.73	.77	N E b E	N E b E	N E b E	1.47	8.58	15.30	...	...	3.10	C. C. Str. 6.	Nimb. 10.	Nimb. 10.
10	29.201	29.344	.526	10.3	16.4	—2.0	.054	.074	.030	.78	.83	.80	W b S	W b S	W	14.85	14.05	23.05	...	...	0.97	Cirr. Str. 4.	C. Str. 10.	C. Str. 4.
11	.787	.910	30.044	—15.7	1.0	—13.4	.010	.032	.012	.45	.70	.54	W	W	W	23.35	1.22	18.30	...	...	...	Clear.	C. C. Str. 4.	Clear.
12	30.120	30.124	.183	—26.3	9.8	—11.9	.002	.054	.063	.18	.78	.81	W	W	W S W	4.21	11.14	0.18	...	...	...	Cir. Str. 2.	Clear.	Do.
13	.330	.310	.236	—30.2	—3.0	—15.5	.002	.025	.010	.2	.66	.46	W S W	W	W	0.08	0.11	0.33	...	...	...	Clear.	Do.	Do.
14	.010	29.952	29.876	—14.7	0.0	—0.3	.011	.034	.034	.48	.70	.80	N E b E	N E b E	W b S	3.12	4.60	3.50	...	...	Inp.	C. C. Str. 8.	C. Str. 10.	Do.
15	29.973	.920	30.032	—9.8	14.0	2.8	.019	.067	.036	.60	.81	.72	W S W	W S W	W S W	0.32	3.15	12.47	...	...	...	Cirr. 2.	Do. 4.	Do.
16	.886	.724	29.855	—9.3	11.9	2.2	.018	.051	.028	.58	.70	.67	W S W	W b S	W b N	7.27	2.22	25.40	...	...	...	Clear.	Clear.	C. Str. 10.
17	.933	.976	.990	—5.0	8.8	0.1	.022	.054	.036	.63	.78	.80	W b N	W b N	W b S	23.83	5.71	1.91	...	...	...	Cir. Str. 4.	Do.	Cl. Au. Bor.
18	.983	.948	30.079	—5.4	5.0	—4.0	.022	.057	.024	.63	.62	.65	W	W	W	20.03	11.47	10.87	...	...	Inp.	Do. 10.	Do.	Do.
19	30.227	30.137	.182	—20.2	10.6	—9.4	.006	.054	.022	.33	.78	.78	W S W	S E	E N E	1.13	0.11	0.13	...	...	...	Clear.	Do.	Cirr. Str. 4.
20	29.958	29.748	29.701	—10.9	12.0	10.6	.021	.063	.050	.77	.81	.70	N E b E	E N E	W	4.90	7.97	1.10	...	...	...	C. C. Str. 8.	C. C. Str. 10.	Cirr. Str. 10.
21	.606	.596	.565	9.5	24.5	20.5	.051	.111	.085	.77	.81	.78	S b W	S W	W b N	8.08	7.22	3.56	...	...	0.06	C. Str. 10.	C. Str. 10.	Do. 8.
22	.910	.920	30.001	—3.6	18.3	—3.7	.025	.080	.125	.66	.79	.66	W b N	W S W	W b N	9.46	1.64	4.72	...	...	...	Clear.	Clear.	Clear.
23	30.114	30.179	.275	—16.9	16.4	3.5	.009	.065	.032	.43	.74	.60	S W b W	S S W	S W b S	0.02	0.40	8.17	...	...	...	Do.	Do.	Do.
24	.156	29.928	29.728	—5.3	25.5	14.5	.022	111	.061	.63	.81	.73	S S E	N E b E	N N E	1.63	2.25	1.22	...	...	...	C. C. Str. 8.	C. Str. 10.	C. Str. 10.
25	29.683	.540	.720	13.1	30.0	21.0	.063	.130	.091	.80	.78	.78	E b S	S	W b N	0.01	3.35	10.06	...	...	...	C. Str. 10.	C. C. Str. 8.	Do. 4.
26	.796	.781	.763	7.0	34.9	13.2	.045	.155	.051	.76	.79	.72	W b S	S S W	S	2.06	1.07	2.96	...	...	...	Clear.	Clear.	Clear.
27	.604	.470	.550	13.6	39.4	32.0	.063	.192	.169	.81	.82	.89	S b E	S b E	S b E	9.72	7.00	0.93	...	Inp.	...	C. Str. 8.	C. Str. 8.	C. Str. 4.
28	.600	.460	.410	32.0	34.0	32.5	.162	.155	.156	.89	.79	.85	S S E	E N E	W b N	0.73	3.57	5.90	...	Inp.	290	Do. 10.	Sleet.	Snow.

MONTHLY METEOROLOGICAL REGISTER, ST. MARTIN, ISLE JESUS, CANADA EAST—MARCH, 1858.

(NINE MILES WEST OF MONTREAL.)

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

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

Day.	Barom. corrected and reduced to 32° Fahr.			Temp. of the Air.			Tension of Vapor.			Humidity of Air.			Direction of Wind.			Velocity in miles per hour.			Mean direction of Wind.	Rain in Inches.	Snow in Inches.	WEATHER, &c. A cloudy sky is represented by 10; A cloudless sky by 0.		
	6 A.M.	2 P.M.	10 P.M.	6 A. M.	2 P. M.	10 P. M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.				6 A.M.	2 P.M.	10 P.M.
1	29.562	29.642	29.780	22.0	36.3	21.0	.112	.171	.101	.93	.82	.86	W N W	E S E	E	0.00	0.31	0.01	...	...	0.30	C. C. Str 4.	C. Str. 10.	Nimb 10.
2	.514	.425	.571	14.6	18.0	9.4	.054	.087	.057	.78	.84	.88	N N E	W	W S W	18.11	7.50	12.40	...	...	1.00	C. Str. 10.	Nimb. 10.	C. St. 10.
3	.816	.879	30.016	—9.0	15.4	—15.5	.019	.065	.016	.60	.74	.72	W S W	S W	E S E	7.17	3.31	1.48	...	...	...	Clear.	Clear.	Clear. Aur. Bor.
4	30.112	30.052	.125	—21.9	18.0	—3.2	.011	067	.025	.63	.68	.66	S S E	S	N N E	0.01	0.30	0.48	...	...	...	Do.	Do.	Do.
5	.110	29.797	29.714	—15.8	11.8	8.1	.016	.051	.048	.70	.69	.71	W	W	W S W	2.30	10.53	15.55	...	...	Inp.	C. C. Str. 4.	Do.	C. St. 4.
6	29.762	.743	.700	3.0	9.0	0.2	.040	.051	.036	.74	.77	.84	W	W b N	W N W	14.03	4.10	9.43	...	...	1.00	Snow.	C. Str. 10.	Clear.
7	.626	.500	.371	—5.0	11.1	10.1	.022	.057	.054	.62	.76	.78	W N W	W N W	W N W	14.30	1.55	6.07	...	...	...	Clear.	Do. 10.	C. C. Str. 8.
8	.565	.464	.464	—1.1	26.9	2.9	.023	.117	.036	.61	.82	.72	N W	S W	E by S	7.10	0.70	0.06	...	...	...	Do.	Clear.	Do. 10.
9	.211	.134	.238	2.5	16.0	12.0	.034	.065	.060	.71	.74	.80	N N E	N N W	N N W	0.87	5.77	11.63	...	...	Inp.	C. Str. 10.	C. St. 8.	C. Str. 4.
10	.353	.424	.517	14.0	36.7	20.2	.051	.154	.076	.63	.88	.71	W b N	W	W	5.17	6.22	28.16	...	...	Inp.	Do. 8.	Do. 4.	Clear.
11	.257	.226	.539	15.7	31.0	20.6	.065	.155	.075	.74	.89	.70	S W	W	W b N	1.31	8.57	14.48	...	...	2.00	Do. 10.	Snow.	Snow.
12	.899	.850	.937	3.0	32.0	13.1	.036	.149	.048	.72	.84	.62	W S W	W S W	E	17.71	10.47	5.80	...	...	...	Clear.	C. St. 4.	St. 2. Aur. Bor.
13	30.361	30.270	30.223	2.0	19.0	14.1	.034	.071	.051	.71	.69	.63	E by N	S W	S W	6.01	1.51	3.92	...	...	...	Do.	Clear.	Clear. Do.
14	29.958	29.850	29.999	7.1	24.1	17.5	.045	.094	.072	.75	75	.75	S E	N	W N W	1.60	5.41	0.02	...	...	0.90	Snow.	C. Str. 4.	St. 2 Do.
15	30.050	30.060	30.050	28.0	52.3	34.0	.135	.334	.175	.88	.86	.89	S W	S W	W	1.06	0.01	0.21	...	...	...	C. Str. 10.	Do. 10.	C. St. 10.
16	29.941	29.842	29.741	32.1	35.2	34.6	.162	.183	.175	.89	.90	.89	N E	S E	W b S	1.96	0.63	0.02	...	...	...	Do. 10.	Rain.	Rain.
17	.547	.471	.344	38.0	52.4	40.3	.208	.334	.212	.91	.86	.82	S W b W	W b S	S W	0.24	0.48	2.47	...	0.199	...	Do. 1.	C. Str. 4.	C. St. 8.
18	.246	.382	.682	38.0	43.0	36.7	.216	.254	.193	.91	.84	.82	S W	W S W	W b N	10.97	10.60	15.47	...	0.041	...	Do. 10.	Do. 10.	Rain.
19	30.001	30.150	30.199	26.0	44.4	26.1	.117	.186	.105	.76	.67	75	N b W	S W	S S W	12.63	1.71	0.26	...	...	...	Clear.	Clear.	Clear.
20	.170	29.971	29.793	18.4	49.8	34.0	.075	.170	.153	.70	.71	.79	S S W	S W b W	W b S	0.01	0.01	0.28	...	...	...	Do.	Do.	Do.
21	.180	.021	.110	32.1	44.2	34.1	.143	.241	.175	.79	.84	.89	S b E	W S W	W S W	8.20	13.85	9.41	...	0.045	...	Rain.	Rain.	C. St. 8.
22	.489	.682	.782	25.5	24.4	20.4	.111	.083	.085	.81	.74	.78	W b N	W b N	N W	34.61	23.83	27.52	...	...	...	C. St. 4.	Clear.	Clear.
23	.882	.882	.918	11.1	34.8	25.0	.048	.149	.105	.69	.74	.80	N W	S S W	N b W	4.80	2.26	1.00	...	...	...	Clear.	Do.	C. C 4. Lun. Halo.
24	.963	.863	.984	11.4	40.6	24.6	.057	.188	.094	.79	.77	.73	S E	S S W	W b N	12.72	0.72	8.57	...	...	...	Do.	Do.	Clear.
25	.759	.584	.626	15.1	36.2	35.0	.065	.156	.162	.74	.75	.80	W b N	S S W	N W b W	1.46	1.70	7.11	...	...	...	C. C. St. 6.	C. C. St. 2.	Do.
26	.675	.584	.770	32.1	36.2	26.1	.162	.156	.105	.89	.75	.75	N W b W	S S W	W N W	11.97	13.77	1.20	...	...	...	C. Str. 10.	Clear.	C. St. 6.
27	.763	.661	.678	19.9	42.6	30.6	.075	.199	.148	.71	.74	.89	N b W	W b N	S S W	16.55	9.00	2.73	...	...	...	Do. 8.	C. C. St. 4.	Clear.
28	.632	.595	.694	18.9	48.9	36.2	.071	.245	.170	.70	.80	.80	W by S	S W b S	S W b W	0.50	0.17	0.11	...	...	...	Clear.	Clear.	Do.
29	.754	.737	.830	31.0	55.0	40.0	.130	.349	.203	.74	.81	.82	W S W	S W b W	N b W	0.56	0.22	7.30	...	...	...	Do.	Do.	Cir. Cum. 4.
30	.950	.937	.995	32.4	53.2	38.7	.137	.269	.201	.74	.67	.86	E N E	W S W	S S W	2.55	0.95	0.01	...	...	...	Do.	Do.	C. St. 8.
31	30.002	.964	.959	30.0	61.6	40.6	.136	.383	197	.83	.71	.78	E N E	S b W	S b W	1.96	0.01	0.00	...	...	...	Do.	Do.	Clear. Aur. Bore

REMARKS ON THE ST. MARTIN, ISLE JESUS, METEOROLOGICAL REGISTER FOR FEBRUARY.

Barometer	Highest the 13th day	30.330
	Lowest the 10th day	29.201
	Monthly Mean	29.809
	Monthly Range	1.129
Thermometer	Highest the 27th day	39°.4
	Lowest the 13th day	—30°.2
	Monthly Mean	7°56
	Monthly Range	69°6

Greatest Intensity of the Sun's Rays .... 62°1

Lowest Point of Terrestrial Radiation .... —31°2

Mean of Humidity .... .703

Rain fell on 1 day, Inp.; it was raining 15 minutes.

Snow fell on 8 days, amounting to 17.58 inches. *It was snowing 53 hours and 45 min.*

Most prevalent wind, W. by S. Least prevalent wind, E.

Most windy day, the 10th day; mean miles per hour, 17.31.

Least windy day, the 13th; mean miles per hour, 0.14.

Aurora Borealis visible on 1 night.

Moon eclipsed—visible.

Zodiacal Light very bright and well defined.

The Electrical state of the atmosphere has indicated high tension.

Ozone was in moderate quantity.

REMARKS ON THE ST. MARTIN, ISLE JESUS, METEOROLOGICAL REGISTER FOR MARCH.

Barometer	Highest, the 13th day	30.361
	Lowest, the 21st	29.021
	Monthly Mean	29.804
	Monthly Range	1.340
Thermometer	Highest, the 31st day	61°.6
	Lowest, the 4th day	—21°.9
	Monthly Mean	23°52
	Monthly Range	83°5

Greatest intensity of the Sun's Rays .... 89°.0

Lowest point of Terrestrial Radiation .... —22.1

Mean of Humidity .... .789

Rain fell on 3 days amounting to 0.285 inches; it was raining 19 hours 0 minutes.

Snow fell on 8 days, amounting to 4.20 inches; it was snowing 20 hours 45 minutes.

The most prevalent wind was W. by N.

The least prevalent wind N.

The most windy day the 22nd; mean miles per hour 28.65.

Least windy day the 28th; mean miles per hour 0.26.

The most windy hour was from 8 to 9 on the 22nd; 37.70 miles.

Aurora Borealis visible on 4 nights.

Lunar Halo on 1 night.

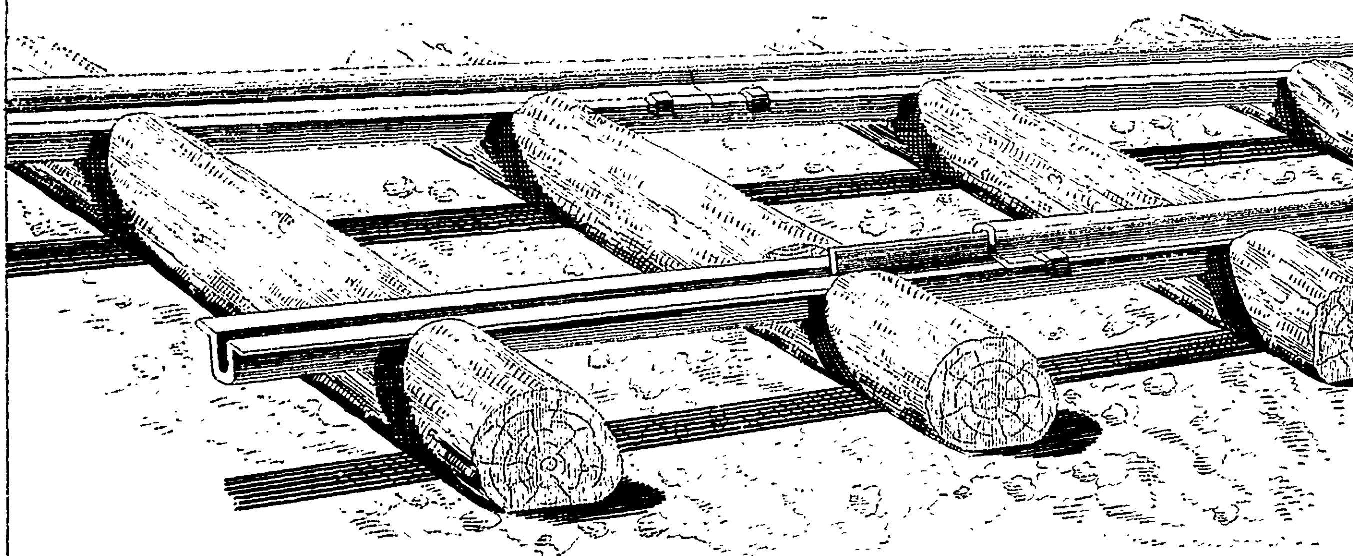
The electrical state of the Atmosphere has indicated feeble intensity.

Ozone was in moderate quantity.

The Song Sparrow (*Fringilla Melodia*) first heard on the 20th.

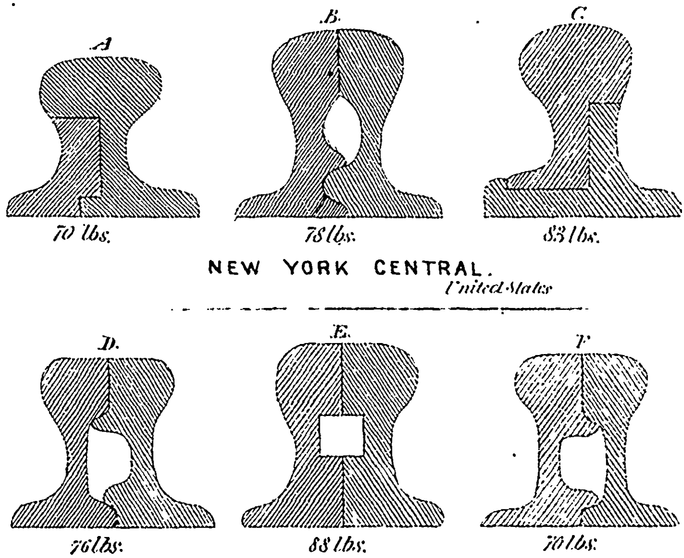
The Snow Bird (*Plectrophanes Nivalis*) was very seldom seen during the winter.

Sketch showing an Improved COMPOUND RAIL designed by Sandford Fleming C.E.



Fuller & Bencke Lith Victoria Hall Toronto

Sections of COMPOUND RAILS tried on Various Railways.



ALBANY NORTHERN. U. States. TROY UNION. U. States GREAT WESTERN. Canada.

Drawings of New COMPOUND RAIL see Art. page 273.

by Sandford Fleming, C.E.