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Some Notes of a Visit to the Works of the Grand Trunk Railway, west of Toronto, February, 1855.

By FRED. CUMBERLAND, *Esq., Chief Engineer of the Ontario, Simcoe, and Huron Railway.*

(Read before the Canadian Institute, March 31st.)

Having been favoured some short time since with an invitation to join a party of gentlemen on a private inspection of the works in course of execution on the Grand Trunk Railway of Canada, west of Toronto, I availed myself of an opportunity I had long desired, and having seen much that interested, and I confess, surprised me, I thought some descriptive notes of the more interesting points upon the line might be acceptable to the Institute; and accordingly I propose (without entering upon any close or technical criticism), to offer to your notice this evening the memoranda I have preserved in connection with the principal objects which attracted my attention. Works of this nature seem amongst us to be objects of general interest only at the time of their initiation, or when, being completed, we discover that they are of some importance to us; or, if it be otherwise, the interest which they attract is too frequently founded on a restless spirit of suspicion—a wilful faculty too prevalent amongst some of us for adopting a system of depreciation, instead of (what my experience teaches me would be the wiser one), of encouragement and support.

When I started on my visit, therefore, I had not been prepared by rumour to find very much to gratify or surprise me, and as I think it part of the business of this Institute to trace out and follow, as far as the opportunities of its members will admit, the progress and the manner of the public works constructing about us, it may not be altogether unprofitable perhaps if I acquaint you with what is doing on this line.

Most of us are acquainted with the system of construction adopted by the Province as the standard of the Grand Trunk Railway—that it is one of more substantial character than had previously obtained either in the United States or Canada, founded indeed on the British system, so far qualified and lowered, however, as was necessary to economy, yet consistent with stability and permanence. The first illustration of this standard of any moment is to be found in the Humber Viaduct, 8½ miles from Toronto, over the river and valley of that name. At the point of crossing, this valley (extremely picturesque in character), is 1500 feet wide between bold and precipitous banks, giving an elevation of 68′0 to grade line above the stream. The viaduct consists of 8 piers and 2 abutments, giving nine spans of 60 feet each, and a total length of structure of 560 feet, the remainder of the crossing being effected by embankments containing some 80,000 yards of material. The piers are of white brick on stone foundations, and will be spanned by wrought iron girders, the weight of metal in which will be somewhere about 150 tons. The construction of these girders being identical throughout the line (except for larger spans than those now mentioned) it may be well here to explain briefly that the guage being 5′ 6″ the girders are placed 7′ 6″ from centre to centre, the top and bottom flanges being 2′0″ wide and the main web 4′2″ in height, so that the clear width between the girders is identical with the guage of the road. Across, projecting over, and attached to these are heavy timber beams—upon which are laid the track strings—the whole width of the floor being 16.0 feet, the track occupying the centre and having a pathway on each side of it protected by handrails. It would be difficult to imagine a more simple or satisfactory system of construction than this, and on contemplating it one cannot help reverting with some regret to those not very distant times, (only immediately previous indeed to Stephenson and Fairbairn's enquiries in relation to the Menai Bridge), when the crossing of such a valley as the Humber would have been effected by a structure involving much more intricacy of design, vastly more material, and far heavier expense. There is one consideration, however, which may qualify our lamentations on past labours lost, and it is this, that although economically these structures are far more satisfactory than those in which engineers but recently indulged, they are undoubtedly less pleasing to the eye and altogether injurious as in connection with the picturesque, for their outline consists of two-hard horizontal lines, without relief, break or beauty of any description, a form indeed which how grand soever the structures in themselves, will, I suspect, mar every landscape and parallyze the hand of the most soulless artist.

We next came to the Mimico Valley Viaduct, 12 miles from Toronto, consisting of one centre span of 60 and two side of 30 feet each, giving a full length of structure of 162 feet, 28 feet high above water line, and together, with an embankment of some 30,000 yards, constituting a crossing of 600 feet in length.

The next work of importance is that in the valley of the Etobicoke at Brampton, 20 miles from Toronto, which is 1500 feet wide, having two girder bridges of 60 feet span each.

At 27 miles from Toronto we come to the most important structure of the line, forming the crossing of the valley of the River Credit, 2000 feet in width between banks. It consists of 8 spans of 96 feet each, giving a full length of structure of 931 feet, the remainder of the crossing being by embankment containing about 150,000 yards of material, about half of which is from a cut on the west side in indurated clay similar to the specimen which I present.

The piers and abutments of this structure are constructed entirely of a very beautiful quality of sandstone of fine close and hard grit, and of a very agreeable warm colour. This stone is brought by tramroad from the Georgetown quarries, 4 miles distant, and as it has attracted much attention recently as a material available for Toronto works I have secured a specimen for your inspection. Of this the piers and abutments are constructed in courses rising from 2′6″ to 18″ in height, with self face, ¼″ beds and joints and bold 3″ drove arrises at the external angles, with two bold plinth courses and tooled capping for girders.

These masses of masonry, of a description unsurpassed by anything I had previously seen in Canada, rise to a height of 115 feet above the water line, and this in connection with the great length (nearly 1000 feet) results in an effect which is grand in the extreme, although of course the appearance is marred as yet by the incompleteness of the structure, the presence of temporary trustle work and the want of unity which the absence of the girders begets. On enquiry I find that the masonry, when complete, will consist of 13,000 cubic yards, and the weight of the wrought iron girders 405 tons. Much as one is gratified on a first view of the Humber viaduct, on seeing that at the Credit one is tempted to regret the necessity existing there for the use of brick; for the Georgetown stone, built in the bold style adopted at the Credit, gives such complete assurance to the mind of permanent stability, and such satisfaction to the eye by the play of colour on its face that it tends to dissatisfy one with a material in itself unimpeachable but relatively inferior. The girders to be used at the viaduct being of 96 feet span are of different construction to those we have already described. Instead of the two single web girders as at the Humber, here we have single tubular girders, 7′0″ high and 7′0″ wide, with the track on the top of it and projecting sidepaths as before, giving a full width of floor of 16′0″, each girder weighing somewhere about 50 tons.

In the same style of masonry and of material from the same quarries we came, at about a mile further westward, to a 25 foot arched culvert, with a vertical height of 6′6″ to springing, and containing, I was told, about 3,000 cubic yards, with an embankment over of about 194,000 yards, crossing a valley 1,500 feet wide. I observed here an excellent expedient for securing a double use to these culverts, for after allowing sufficient height for the passage of the stream, by making a set off on the face of each side wall a bearing is obtained, joisting laid and planked, and a roadway thus provided above the waterway. We subsequently visited a 15 foot arched culvert of similar character 1½ miles further westward, coming, at about 31 miles from Toronto, to what is called "the Lindsey cut," a work which has given much trouble in consequence of the character of the material—hard cemented gravel—through which it is made. Of this I have secured a specimen, and although probably most of us have encountered material somewhat approaching it in difficulty of working, few of us have been tried by a cut in it such as this, 50 feet in depth and containing 173,000 yards.

In succession to this cut and immediately beyond it we entered another 60 feet in depth, containing, we were told, about 25,000 yards, in limestone rock of excellent hydraulic quality, the cement from which, setting somewhat slowly but with great tenacity and hardness, has been generally used throughout the works.

Immediately beyond this again, after passing over the embankment filled from these cuts, we came to another (called Scots) which, containing upwards of 192,000 yards, it was a relief to find, of pure sand, although as it approached to quick, it seemed to give some indication of trouble

Passing a 15 foot arched culvert similar to those already described, at 36½ miles. we reached the summit between Toronto and Guelph, which is 991 feet above the level of Lake Ontario. Here is a cut in indurated gravel from which some 36,000 yards have been taken.

Three miles further westward is another 25 feet arched culvert, built in limestone of highly fossillated character. The style of this masonry was even heavier than that of those previously visited, but like those, it was finished with bold self-faces and drave arrises, the arch stones being, if I remember rightly, tooled. I name this because I think this style of masonry highly applicable to works of this nature, and far superior (by reason of the play about the face, relieved as it is by the wide arrises which define the strict outline of all angles) far superior to any higher finish or tooled faces which in my judgment impart tameness when adopted in massive structures.

At 40 miles from Toronto we come to the Eramosa Valley Viaduct over the river of that name and near the Village of Rockwood. The full width of this structure is 570 feet, comprising 8 spans of 60 feet each, the full width of valley being 1200 feet, crossed at an elevation of 45 feet above water line. The stone used in this structure is obtained in the immediate vicinity; the whole district around it, on the east side of the river, presenting a bare broken face of highly fossillated limestone rock, abounding, we were told, in caverns of large capacity and interesting character, well worthy of the visit, which want of time obliged us to decline. At Eramosa the style of masonry consists with that of the other structures, but the colour of the stone, which varies from grey to purple, and passes in parts into a lighter ochreous tint gives it a distinctive and peculiar aspect as compared with the other viaducts, and one which, although preferred by some of my companions, I did not admire so much as the warm and even face of the Georgetown material.

The quantity of stone laid in the Eramosa structure, (the masonry of which is fully completed), was 5000 yards, the embankment connected with it containing 80,000, and the weight of metal in the girders being about 125 tons.

Passing on to Guelph, (where the road seems to me to have been located somewhat strangely, although doubtless with good reason, right through the heart of the town), we find the most peculiar structure on the whole line, and one indeed for which few, if any, precedents can be found. This peculiarity is due to the crossing of the Speed River at right angles on and over the line of a street which is approached at each end and on each side of the river by other streets, also at right angles. In crossing the river therefore at this point it was necessary to preserve the common road on the same site as that to be occupied by the railway and to connect that roadway at each end with the streets abutting upon it. This has been affected by the viaduct in question, which is 580 feet in length, comprising six spans of 60 and one centre span over the river of 80 feet. But instead of solid piers of the usual width, there are two rows of piers, leaving a transverse opening of 20 feet wide between them, spanned by short transverse wrought iron beams to receive the longitudinal girders or tubes in the direction of the rail and roadway, so that throughout the length of some 600 feet the railway will be above the road for which a headway of about 20 feet will be left clear of the transverse beams before mentioned; in fact, except that this work is on *terra firma* it illustrates the same conditions of use as the new Suspension Bridge at Niagara, with the carriage way immediately beneath the railroad. That any local necessity exists for retaining the road in its old position or for forcing the location of the railway to its site is not very apparent, but Municipalities are not always as considerate as they should be, and seem sometimes disposed to test their strength by the pressure of some unreasonable prejudice.

At 53½ miles from Toronto, and 6 miles beyond Guelph, we visited what is called the "Jack hill cut," in indurated clay and hard pan, of a depth of 40 feet and contents of 161,000 yards. So close and compact is this material that the sides of the gully stand for the full 40 feet at a perfectly fair and vertical face; and I traced on part of it which had been excavated from nearly 2 years since, the marks of the pick as sharp and clean as though they had been recently made rather than stood exposure through two winters.

In connection with these deep cuts, I availed myself of the opportunity for noticing the effects of the then recent heavy fall of snow in relation to the probable obstruction of traffic. The general depth of snow over the surface of the country was from two to three feet, and it drifted very considerably in places, sufficient to illustrate fully the circumstances of our average winters. I found almost universally that cuts from 5 to 15 feet were comparatively choked by drift, and that as the depth above 20 or 25 feet increased, the deposit was diminished. In the cut at Jack's hill, 40 feet in depth, although the snow was two feet deep at the summit of the sides, there was certainly not more than from 2 to 4 inches in the bottom. This result has been attributed to active passage of the wind through the cut, although of course much must depend upon its direction as in relation to the bearing of the cut.

At 57½ miles from Toronto we came to the Grand River Viaduct, consisting of three land spans of 60 feet each, and two over the river of 96 feet each. The full width of the valley is 2500 feet, of which the structure occupies 440 feet, the remainder consisting of an embankment containing 130,000 cubic yards, the grade line being at an elevation of 47 feet above the water. The piers and abutments are constructed of a grey limestone (from quarries in the township of Puslinch, 12 miles south-eastward from the works), and built of the same class as I have before described, the quantity of stone laid being 4000 cubic yards, and the weight of metal in girders some 200 tons.

This was the last structure of importance which we visited. Passing through Petersburgh, however, we gained a point about 86 miles from Toronto, which is the summit of the whole road, and 1003 feet above the level of Lake Ontario and 664 feet above Lake Huron. These levels give a difference in altitude above the sea of 339 feet between Lakes Ontario and Huron, and this difference consists, within one foot, of that ascertained by the surveys of the Northern Railroad Company extended from Toronto to the Georgian Bay.

It does not, however, agree with Bayfield's observations as published in Scobie's maps,—where the difference is shewn to be 361 feet. The railway profiles, checked as they have been by each other, will probably be accepted as the more reliable, especially when we remember that Bayfield traced his levels through the St. Clair River, where we may conclude he made his error in exaggerating the fall.

Immediately to the southward of the summit, in the Township of Wilmot, and two miles west of Petersburgh, is a mound known as Earl's Hill, said to be the highest point in Western Canada, and ascertained by the engineer of the Guelph Railway to be 1186 feet above Lake Ontario. I have not had any opportunity since my visit to that point of ascertaining the height of the Blue Mountains of Collingwood, but I am strongly disposed to believe that their altitude is considerably in excess of that of Earl's Hill as reported.

Such is a brief sketch, descriptive of the principal structures and works of the Toronto and St. Mary's Railway. I have not attempted to do more than give an idea of their character, which is so simple as almost to make their description monotonous.

One system and principle of construction being adopted throughout, the only special exception being the Speed Viaduct at Guelph, little remained to be told, after one had been described, beyond the extent, capacity and materials of each. Together they form as perfect a group of railway structures as I ever desire to see, for whilst their simplicity satisfies the feeling of the most prudent economy, their materials are so exceptionable, the character of the workmanship so excellent, and the taste of their finish so fitting, that one is satisfied with them as works of the most substantial permanence. For my part, I confess to having been most agreeably surprised when I found works of such a class constructed in connection with a Canadian enterprise; and whilst the immediate object of this paper will have been served by directing the attention of the Institute to them, I shall be better pleased if it induces my engineering brethren to journey over the ground which I have travelled with so much satisfaction and not a little profit.

Additional Note on the Object of the Salt Condition of the Sea.

By Prof. Chapman, University College, Toronto.

(Communicated to the Canadian Institute, April 14th, 1855.)

Subsequent to the publication in the March number of our *Journal*, of a brief memoir on the object involved in the salt condition of the sea, my attention has been called by the Director of the Observatory at Washington—the well known Lieutenant Maury, of the United States Navy—to a very elaborate paper on the same subject, embodied in the explanatory portion of his admirable Wind and Current Charts.* On opening Lieutenant Maury's volume, my first impression was, that I had been anticipated in my views. This, however, is not the case, as will be seen by the subjoined letter, in which I have attempted a critical review of the entire question. According to Lieutenant Maury's theory, the sea is salt in order to *produce circulation*; according to mine, in order to *regulate evaporation*. The two, nevertheless, may not be irreconcilable. To a phenomenon, indeed, of so complicated a character, more than one object is undoubtedly attached.

TO LIEUT. MAURY, LL.D.

Superintendent of the National Observatory, Washington, &c.

Dear Sir,—I beg to return you my best thanks for your kind present of a copy of the sixth edition of the "Wind and Current Charts."

When I sent to the Canadian Institute my Note "On the Object of the Salt Condition of the Sea," believe me, I was altogether unaware of your previous publications on that subject. My paper was read and discussed some weeks before it appeared in the *Journal* of the Institute; but no notice of your highly important work was elicited from any of our members. As it is, I shall remedy the omission, so far as it lies in my power to do so, by calling attention to your views in an additional Note on the subject, to appear, if possible, in the May number of the *Journal*.

Will you allow me, however, with all due deference to one so deservedly distinguished in this branch of enquiry as yourself, to call in question the justness of some of your inferences?

If I understand the matter rightly, your hypothesis is to the following effect, namely, that the salt condition of the sea has for its object the production of a system of circulation; this circulation being effected, first, by the surface water becoming salter (and hence heavier) by evaporation, and so, sinking downwards, and giving place to the lighter water from below; and, secondly, by the labours of coral animals, and by vital agencies generally, in removing the lime and other salts.

To the correctness of the latter view, I most willingly concede; although I can scarcely look upon the cause in question as sufficiently intense to produce the phenomena of oceanic currents, according, if I mistake not, to your suggestion at page 188 of the above-mentioned work. This, however, in the present state of our knowledge, is a mere matter of opinion. The merit of the enunciation belongs entirely to you; for, although writer after writer has instanced the compensa-

* Explanatory and Sailing Directions to accompany the Wind and Current Charts." By M. F. Maury, LL.D., Lieut. U.S.N. 6th Ed., 1854. The study of this interesting volume cannot be too strongly recommended to all engaged in physico-geographical inquiries. At page 177 there is a distinct chapter on the "Saltness of the Sea."—E. C.

ting power of the marine Mollusks and Radiata,* in withdrawing from the sea the various salts brought into it by rivers, no one appears to have hinted, even, at the further effects due to this action.

But these organic agencies are mainly referible to the abstraction of the lime salts from the sea water; the object of the chloride of sodium—the principal saline constituent of the pressure of the sea—being sought to be explained by the first hypothesis;† and it is here that I venture to differ from you, and to prefer my own explanation, as published in the March number of the *Canadian Journal*.

The surface water of the sea would necessarily be rendered salter, and consequently heavier, than the underlying strata, were no antagonistic influences at work; but I think we have sufficient experimental evidence to show that the effects of evaporation are counteracted by the constant additions of fresh water which the ocean receives at its surface, and by the comparatively high temperature of this latter (the surface) in those regions where evaporation is the most active. Comte d'Archiac, in his compendium of the Physics of the Globe (Vol. I of his Histoire des Progrès de la Géologie) has the following observations:—"Les recherches faites sur la composition des eaux recueillies en mer pendant le voyage de la corvette *La Bonite*, ont démontré que dans l'Océan Atlantique, le Golfe du Bengale, l'Océan Indien, et l'Océan Atlantique Méridonale, la densité generale de l'eau prise à la surface était moindre que celle de l'eau prise à une certaine profondeur. Une seule exception à cette règle a été reconnue. A une seule exception près aussi, le degré de salure est plus prononcé au fond [I suppose he means at considerable depths, not absolutely at the bottom] qu' à la surface."‡ This view is in accordance, I believe, with the usually received opinion.§ From all that I have read and thought upon the subject, it appears to me that in the phenomenon of the, so to say, reversed inequalities of temperature between the surface and deep water in the intertropical and polar regions, we have the main cause of oceanic movements. With all this, however, I do not mean to infer that the principle announced by you is to be wholly disregarded, in our attempts to frame a satisfactory hypothesis respecting the object of the saltness of the sea. In striving to uphold my own theory, I have done so, perhaps, in too exclusive a spirit.

With regard to the origin of the saline components of sea-water, you adopt, I perceive, the views of the elder Darwin and others, to the effect that these components have been entirely despoiled from the land, by springs and rivers, and so carried into the deep, the action continually going on. But here, again, you must allow me to differ from you. My reasons for this dissent are the following,—First, the striking preponderance of chloride of sodium over the other salts in sea-water; whereas, amongst the saline matters generally present in river-water, it by no means occupies a very conspicuous place. But even if the sea were fed by brine springs instead of rivers, my argument would still hold good; for in nine cases certainly out of every ten, these brine springs would be but returning to the ocean, what, in former geological epochs, the ocean had rendered to the land. Fownes's assertion, quoted in your note at page 179,* appears to me to be altogether untenable, or at least without true bearings on the point at issue. Lakes, so peculiarly conditioned as these of which he speaks, have evidently not been rendered salt (in the common acceptation of the term) by the rivers which flow into them, but have been salt from the beginning—as portions of ancient seas cut off from the main ocean by geological changes. Secondly, according to this view, the sea at one time must have been far less salt than at present, and have gradually become salter and salter—an inference, the assumption of which is scarcely warranted on palæontological data.†

This objection might be met, however, by assuming that marine life was created, as a compensating agent, so soon as the sea attained to its present saltness, and not before. I place, therefore, no great stress upon it.

Finally, may we not legitimately seek to ascertain why chloride

* And we may add that of marine vegetation also. Dr. Lyon Playfair was, I believe, the first to suggest the action of Algæ in abstracting carbonic acid from the water, and thus setting free the carbonate of lime.—E. C.

† "The vapor is taken from the surface water; the surface water thereby becomes more salt, and consequently heavier; it therefore sinks; and hence we have due to the salts of the sea, a vertical circulation, viz., a descent of heavier—because salter and cooler—water from the surface, and an ascent of water that is lighter—because it is not so salt—from the depths below."—Lieut. Maury; *Wind and Current Charts*, 6th ed. p. 182. This view has been entertained, however, by other observers. Thus, Sir Charles Lyell, in his "*Principles of Geology*," has the following remarks in reference to the Mediterranean —"After evaporation, the surface water becomes impregnated with a slight excess of salt, and, its specific gravity being thus increased, it instantly falls to the bottom, while lighter water rises to the top, &c." But here we have to consider, how far this surface water could sink without yielding a portion of its extra salt to the surrounding water, and so rendering the whole uniform. I question altogether the probability of a vertical descent of this kind taking place in ordinary seas, at least to any depth. Over broad areas, moreover, it would necessarily be subject to frequent and often long-continued interruptions.—E. C.

‡ "The results of the chemical examination of samples of sea-water collected during the voyage of the corvette *La Bonite*, have shown, that, in the Pacific Ocean, the Gulf of Bengal, the Indian Ocean, and the South Atlantic, the general density of water taken from the surface was *less* than that taken from a certain depth. Only a single exception to this law was noticed. With little more than a single exception, also, the degree of saltness was greater at great depths than at the surface." See also *comp. rend.*, vol. vi., p. 616, from which the above is quoted.—E. C.

§ Theoretically, the surface water, owing to evaporation, should be slightly cooler than the stratum of water immediately below it. I allude, of course, to warm and temperate seas.—E. C.

* "The case of the sea," says Fownes, "is what occurs in every lake into which rivers flow, but from which there is no outlet except *by evaporation*. Such a lake is invariably a salt lake. It is impossible that it can be otherwise; and it is curious to observe that this condition disappears when an artificial outlet is produced for the waters"—*Lieut. Maury*. To this I reply, that, owing to the comparatively small amount of chloride of sodium in ordinary river waters, a lake of this kind, if originally fresh, would become silted up by deposition of carbonate of lime, &c., long before it could possibly exhibit the composition of the ocean. An originally salt lake would necessarily become fresh in course of time, if river waters were constantly poured into it, and an outlet also provided by lower levels to the sea. If we place at three different levels, an empty vessel, a vessel containing a salt solution, and one filled with ordinary water, this latter occupying the highest level, and connect the three by strips of filtering paper, or a few cotton threads to act as syphons, the contents of the middle vessel (here representing the salt lake) will be gradually replaced by the water from above, and transferred to the under vessel. *Where no* outlet is provided, local conditions, on the other hand, as in the case of the Dead Sea, may modify to a marked extent the original composition of the water.—E. C.

† I am quite aware that the study of Fossil Ichthyology offers some slight support to the view mentioned in the text; but this, at the best of doubtful acceptation, is completely outbalanced, on the other hand, if we take into consideration the immense numbers of radiated animals, brachiopods, cephalopods, and other types which preceded fish-life, and which were undoubtedly marine.—E. C.

of sodium should have been chosen by Divine wisdom in preference to other salts, as the chief constituent of the solid matter of the sea. Apart from its manifold economic applications, I feel assured that some abstract principle is involved in its selection. I have been trying to devise some experiments to elucidate this, but hitherto without success. May not, however, the primary cause of its selection lie in the extremely slight variation which it exhibits in regard to its solubility in water of very different temperatures?

Trusting that you will look upon these observations, as they are meant, in the light of a friendly interchange of opinion,

I am, dear Sir, most truly yours,

EDWD. J. CHAPMAN.

University College, Toronto, Canada West,
April 3d, 1855.

The Unity of the Human Race.

The question of the unity and common origin of mankind, with the consequent opinions as to the human race consisting of only one, or of several species, promise, from various causes, to become one of the most prominent scientific problems of our day. The descent of all mankind from a single pair, has indeed until recently been considered, if not as an established point, as one scarcely open to dispute. The teachings of Scripture, and especially the Mosaic narrative of creation, were supposed to affirm this with an explicitness which scarcely admitted of discussion. The progress of inquiry, however, in various directions, leading to very remarkable and unforseen conclusions relative to the creation and extinction of species, and the geographical distribution of plants and animals, has revived inquiry in regard to the tenability of the opinion that mankind consists only of a single species, descended from one pair. The interest in the conclusions to which it may lead, has, moreover, been considerably extended throughout the American Continent by the peculiar circumstances under which different varieties of the human family are here associated together; though it may perhaps admit of question, how far the prejudices of cast, and the motives of self-interest, or political bias, leave the American of the United States open to the impartial investigation of this important inquiry.

The most recent work devoted to this subject, is the "Types of Mankind," issued only last year from the Philadelphia Press, by Dr. J. C. Nott, and Geo. R. Gliddon, Esq., but embracing contributions from various distinguished American savans, and one of special interest furnished by Professor Agassiz. The last of these contributions has excited renewed attention at the present moment, owing to peculiar circumstances. The vacancy of the Chair of Natural History in the University of Edinburgh, occasioned by the lamented death of Professor Edward Forbes,—noticed in a recent number of the *Canadian Journal*,—has induced some influential men in the Scottish capital to name Professor Agassiz as one peculiarly fitted in many ways to occupy the room of that distinguished naturalist and palæontologist. The consequence, however, of the first movements, made with a view to recommending this appointment to the officers of the Crown, who are the patrons of the Chair, has been to excite a keen controversy as to the compatibility of the views entertained and advocated by Professor Agassiz, with the responsible trust of an educational appointment in one of the national Universities. "We have no fear," says one writer, "that the Bible rightly interpreted, and the discoveries of Science rightly and thoroughly investigated and defined, will ever be found to clash; because we believe that they are equally, although through different channels, a revelation of the same Deity. But we do believe, and greatly fear, that crude and imperfect speculations, carried on by an ingenious and clever man, such as Agassiz is, in presence of ingenuous and ardent youths, may unsettle the faith of many, and effect a world of mischief."

We are rather inclined to believe that greater credit is attached to the influence of scientific teaching in producing the scepticism prevailing among some portion of the students of science, than a more rigid investigation of the premises would be found to justify. Sceptical men of science have indeed not unfrequently made use of their science to defend their scepticism, but we are not aware of even one solitary instance which can be produced in which science, even when misinterpreted, has made a sceptic of a believer. Truth need not fear inquiry; and in this question of the unity or plurality of the human species, as in all others, now that it has been broached, the greater latitude there is allowed to free inquiry and discussion, the sooner will its ultimate decision be recognised to be in harmony with Revelation, when rightly interpreted. It is a manifest injustice, however, to speak of the cautiously expressed views of Professor Agassiz as "crude and imperfect speculations;" or to represent him as a sceptic, because of his thus exercising the right of private judgment in relation to scientific research. On this subject Dr. Horatio R. Storer, of Boston, an American Physician temporarily resident in Edinburgh, supplies the following interesting information, in a letter addressed to one of the newspapers of that city, relative both to the opinions and domestic habits of the distinguished American Naturalist:—

"For several years a pupil of his, and for a longer time sharing largely the privilege of intimate acquaintance, I may be allowed to state, that, so far from being an irreligious man, or expressing opinions that, if properly investigated, would prove him an unbeliever, Professor Agassiz is at once an earnest and enthusiastic inquirer into the hidden mysteries of past and present life, and a very devout Christian—a believer in the revelation of God through His Word, as in those He has made through his works.

"Into the merits of the question of man's identity of origin, this is not the place to enter; to properly discuss the arguments that have been brought forward on either side would require many pages and hours. The advocates of several centres of birth and subsequent divergence thence, have only claimed that like those of geology as now by all received, yet so lately condemned as overturning Scripture, they but render certain evidence given by nature, and otherwise unintelligible, subservient to, and explanatory of, the teachings of the Mosaic record. And, besides, diversity of *origin* by no means implies diversity of *species*, nor is it so used.

"Never have I heard Agassiz say one word implying, nor do I believe he holds, that any tribe or variety of man, however degraded, whether black or not, has not a living soul, capable, under favourable circumstances, of indefinite development, and of becoming fitted for the Christian's heaven.

"Among other courses of popular lectures delivered by him, many of which have been repeated in various parts of America, and most fully attended, was one several years since upon "The Plan of the Creation." No one could have heard this course, either in whole or in part, without a quickened faith in the Almighty, All-wise, All-loving Creator.

"His religious views are very strong and decided. The circumstances of his early life in Switzerland could indeed but have rendered them so, his father having been a clergyman, and, I think, of Lutheran tenets. That father's old friend, now or lately pastor of a German Church in New Orleans, followed the son to America, devotedly attached to him, and for a long time was his domestic chaplain. Those quaint and fervent home religious services, at which I have been present, are still vividly before me."

But the interest attaching to this discussion involves much more than the character or religious belief of any single scientific enquirer, and it may not be uninteresting to the readers of the *Canadian Journal*, to peruse the following abstract of an article published recently in *The Scotsman* and which from the initials C. M. attached to it, is no doubt from the pen of Charles Maclaren, F.R S.E., long the talented editor of that journal, and now well known among the scientific geologists of the Scottish capital. The article is expressly written to refute the arguments advanced by a member of the Edinburgh corporation, in proof of the disqualification for a chair in a Scottish University of any one venturing to entertain a doubt as to the unity of the human race; and further to show that the doubt referred to is less novel or startling than unscientific readers may be aware of.

Referring to the arguments of this civic censor, the writer observes :—

"He seems to me to consider the question respecting the *unity* of the human race as one that had never been agitated till Agassiz published the memoir referred to. I thought it had been universally known that, from the days of Aristotle downward, opinions have been divided upon the subject; that, while some maintained that the white, black, yellow, and red men were distinct species, the progeny of distinct *primitive pairs*, others held that they were merely varieties of one species, and all sprung from a single pair. Buffon, the great authority of the last century, believed in the unity of the human race: but, in deference to those who embraced an opposite opinion, thought it necessary to argue the question, not on theological, but on physiological grounds. Cuvier, the founder of scientific zoology, came to the same conclusion, but apparently with hesitation, and on the narrow ground that mulattoes and other human hybrids have offspring like themselves, while among the lower animals mongrels were supposed to be universally barren. He does not say that the human species *is* single, but "*would appear to be* single, since the mingled progeny of all the individuals composing it is fecund."* And the learned translator, Dr. Carpenter, informs us, in a note, that Cuvier's argument rests on a sandy foundation, for that some hybrid animals are fruitful.

In 1825, Bory St. Vincent, a far-travelled naturalist, and editor of the "Dictionnaire Classique d'Histoire Naturelle," published *L'Homme, Essai Zoologique sur le genre Humain*, in which he maintained that the human race embraces fifteen different species, derived from as many primitive pairs. The book, in two volumes, has run through three editions at least. In the following year a work appeared on the same subject in one volume by M. Desmoulins, an anatomist (Histoire Naturelle des Races Humaines), who divides mankind into *sixteen* distinct species."

It is therefore apparent, that Agassiz is by no means the first who has broached the opinion that mankind does not consist of one, but of several species; nor did the doubt it implies, which, when first broached, presents so repulsive an aspect to many good men, deter the learned and pious Dr. John Pye Smith from giving the inquiry an impartial critical review in his work on "The relation between the Holy Scriptures and some parts of Geological Science." Note E of that work contains a "dissertation on the varieties of the Human Species," in which the learned divine remarks :

"'It would be wrong to conceal the difficulties with which the subject is surrounded, however satisfied we may be with the evidence in favour of the descent of all mankind from one original pair of ancestors.' To the unscientific reader these difficulties may appear to be far-fetched novelties of modern scepticism, but inquiry proves them to be as little novel as baseless. They were felt by writers in very ancient times; as appears from a targum, or old Jewish paraphrase, of Genesis ii. 7, quoted by Dr. Pye Smith, in which it is explained that God created man *red, black, and white*.

"Dr. Smith admits that the action of the solar light and heat in tropical climates only produces various shades of brown, but 'we have no instance of a white family or community acquiring the proper negro colour;' nor of a negro family becoming of a healthy European white, except by intermarriages. This permanence of the white and black complexions suggests another difficulty. 'The recent explorings of the Egyptian tombs and temples have brought to light pictures of native Egyptians, and of men and women of other nations, comprising *negroes*, who are distinguished by their characteristic form of face and their *completely black* colour. Some of these highly interesting representations are proved to be of the age of Joseph and earlier, and some in which the negro figures occur are of the eighth century after the flood. Assuming, then, that the complexion of Noah's family was what I have ventured to suppose as the normal brown, *there was not time for a negro race to be produced* by the operation of all the causes of change with which we are acquainted.' Who, indeed, will believe that a Spaniard transplanted to Guinea would become a negro in twenty-four generations? The force of the objection is vastly increased when we refer to the history of the Berbers, Tibboos, and Tuaricks, all speaking the same radical language, and spread over the oases of the Sahara, from Morocco to Egypt, who have lived under the same burning sun with the blacks since the time of Herodotus (2300 years), and are only *brown*—no more negroes than the Moors or Egyptians.

"Adam might be the first created man, the protoplast of the race, a fair representative of all its qualities, without being literally the father of all mankind. 'Mr. Edward King, a zealous Christian,' says Dr. Smith, 'strenuously maintained the opinion of the plurality of human ancestry.' The illustrious Dr. Arnold of Rugby also held that 'the physiological question was not settled.' 'Nor can we affirm it to be an impossibility that the Almighty Creator should have seen fit to bring originally into being duplicates, triplicates, or other multiples of pairs, formed so alike that there should be no specific difference between them.'

"With regard to Acts xvii. 26, it cannot be proved that 'one blood' necessarily signifies descent from a common ancestry; for, admitting a specific identity, though having proceeded from distinct foci of creation, both the physical and mental characteristics would be the same in all essential qualities.

"'But if we carry our concessions to the very last point—*if* the progress of investigation should indeed bring out such kinds and degrees of evidence as shall rightfully turn the scale in favour of the hypothesis that there are several races of mankind, each having originated in a different pair of ancestors—what would be the consequence to our highest interests, as rational, accountable, and immortal beings? Would our *faith*, the fountain of motives for love and obedience to God, virtuous self-government, and universal justice and kindness—would this faith, 'the substance of things hoped for, the evidence of things not seen,' sustain any detriment, after, by due meditation and prayer, we had surmounted the first shock? Let us survey those consequences.

"'If the two first inhabitants of Eden were the progenitors, not of all human beings, but only of the race whence sprung the Hebrew family, still it would remain the fact, that *all* were formed by the immediate power of God, and all their circumstances, stated or implied in the Scriptures, would remain the same as to moral and practical purposes.

"'Adam would be 'a figure of Him that was to come' the Saviour of mankind; just as Melchizedek, or Moses, or Aaron, or David. The spiritual lesson will be the same.

"'The sinful character of all the tribes of men, and the individuals composing them, would remain determined by the most abundant and and painfully demonstrated proofs, in the history of all times and nations. The way and manner in which moral corruption has thus infected all men, under their several heads of primeval ancestry, would be an inscrutable mystery (which *it is now*); but the need of divine mercy and the duty to seek it would be the same; the same necessity would exist of a Saviour, a redemption, and a renovation of the internal character by efficacious grace.

"'That the Saviour was, in his human nature, a descendant of Adam, would not militate against his being a proper Redeemer for all the races of mankind, any more than his being a descendant of Abraham, Judah, and David, at all diminishes his perfection to save us, 'sinners of the Gentiles.'

"'Some difficulties in the Scripture-history would be taken away; such as—the sons of Adam obtaining wives not their own sisters;—Cain's acquiring instruments of husbandry, which must have been furnished by miracle immediately from God upon the usual supposi-

* "Quoique l'espece humaine *paraisse* unique, puisque tous les individus peuvent se mêler indistinctment, et produire des individus feconds," &c.

tion:—his apprehensions of summary punishment: 'any man that findeth me will slay me';—his fleeing into another region, of which Josephus so understands the text as to affirm that Cain obtained confederates and became a plunderer and robber, implying the existence of a population beyond his own family:—and his building a 'city,' a considerable collection of habitations.

"'Thus, if contrarily to all reasonable probability, this great question should ever be determined in the way opposite to what we now think the verdict of truth, the highest interests of man will not be affected.'

"If then Agassiz adopts the idea that the human family has a plurality of ancestors, it is evident that he holds it in common with learned, pious, and good men, and it is plain that the doctrine would not have disqualified him in Dr. Pye Smith's estimation for any chair of Natural History."

These observations offer a fair summary of the arguments which present themselves to the mind of an earnest and thoughtful inquirer in reference to this extremely difficult question. The simple declaration addressed by St. Paul to the assembled Athenians, that God has "made of one blood all nations of men to dwell on the face of the earth," has been produced as conclusive; but a more rigorous criticism compels the Christian student of science to admit that the interpretation of it, as meaning strictly a universal descent of every human being from one common pair of ancestors, is not necessarily the logical deduction from that beautiful and significant passage. The writer on this vexed question, whose remarks we have specially referred to above, concludes by observing:

"One would think that the folly of attempting to settle physical questions in this way has been sufficiently exposed already. When Galileo affirmed that the earth turned on its axis, and revolved in an orbit round the sun, the Inquisition met him with texts of Scripture, denounced him as a heretic for his glorious discoveries, and put him in prison. What intelligent Catholic would not be delighted if these disgraceful proceedings could be blotted from the annals of his Church? How firmly was it believed, in very recent times, that all the existing species of land animals came out of Noah's ark; and how reluctant were many religious men, taking the words of Moses *au pied de la lettre*, to receive the new and sound doctrine that every great region of the world has animals peculiar to itself, and that there must have been many distinct centres of creation. When geologists first announced the vast age of the earth, and that its creation, instead of being completed in six days, extended over millions of years, texts of Scripture were again appealed to to put them down, and great was the outcry. The progress of science has been retarded, not arrested, by these proceedings, and have they not brought obloquy upon religion?"

The circumstances to which we have referred above, as calling special attention, at the present time, to this question of the Unity of the Human Race, cannot fail to give an additional interest to it in the minds of all who sympathise in the progress of science; and will abundantly justify us, we feel assured, in the estimation of our readers, for thus bringing it under their notice. At the same time, we are fully alive to the many difficulties with which the inquiry is beset, and to the deeply founded nature of all the preconceived ideas with which it seems to come into collision; and we might have hesitated to introduce the discussion in our pages, had it been characterised by a less reverential recognition of the sacred narrative, in all that relates to the origin and the destiny of man.

Report on the Results of the different Methods of Treatment pursued in Epidemic Cholera.*

This report is restricted to an analysis and statistical records placed in the possession of its authors, and supplied from the various metropolitan hospitals and medical practitioners, such deductions only being made from the results of their analysis as are plain and unequivocal.

2,749 cases of cholera are selected, of which 1,194 occurred in the metropolitan hospitals, 1,645 in the metropolitan districts (not in the hospitals), and the remainder in the provinces.

The treatment of the disease is divided into four heads:—1, the alterative mode of treatment; 2, the astringent; 3, the stimulant; and 4, the eliminant (or cathartic). The alterative and astringent modes are, according to medical writers, based on the theory that the specific poison of cholera attacks the mucous lining of the intestinal canal and sets up an action which provokes an exhausting effusion of the serum of the blood. The eliminative treatment obviously presupposes the necessity of assisting nature to get rid of the *virus*, her attempts to effect which object constitute, according to this theory, the leading symptoms of the disease. The alterative treatment includes the administration of calomel, in small doses at short intervals, and in larger doses at longer intervals, with or without emetics, salines, external stimulants, icewater, hot baths, injections into the veins, clysters, and sometimes opium (with calomel). The "astringents" consist of sulphuric acid (dilut.), chalk and opium, alum, salines, cinchona, gallic acid, quinine, and some of the remedies indicated under the "alterative" system. The "stimulants" administered under the third mode of treatment include ammonia, calomel, brandy, turpentine enemata, ether, opium, nitrous oxyde, camphor, and chloroform, with external stimulants, emetics, and hot baths, the "cordial tonic mixture," cajeput oil, icewater, salines, &c. The "eliminants," prescribed under the fourth head, were castor oil, with and without emetics, external stimulants and hot baths, calomel, capsicum, ginger, &c., emetics, ipecacuanha in small doses, olive oil, and the potass. tartr. of antimony. Many of these remedies are common to the various classes of treatment, such as the mineral acids, calomel, opium, and others. Out of the hospitals, chloric ether, soda, and mineral acids were prescribed under the first head (in addition to the other remedies); catechu, acetate of lead, tincture of the sesqui chloride of iron, logwood, and sugar, unde. the second, or astringent mode; chloroform, capsicum, creosote, &c.. under the stimulant course of treatment; and croton oil under the fourth or cathartic.

And now for the result of this great experiment The evidence of a carefully-prepared series of tables, set forth in the report, condemns altogether, as a principle of practice, the fourth, or eliminant, mode of treatment; it testifies against the stimulant principle, excepting as a resource in extreme cases; it displays a decided advantage in the alterative principle; especially as carried out by calomel and opium; and it shows a still superior advantage in the astringent principle, as applied through the medium of chalk and opium. The percentage of deaths was as follows:—viz., under the eliminant mode, 71.7; under the stimulant, 54; under the alternative (calomel and opium).36.2; and under the astringents (chalk and opium), only 20 3 per cent. These statistics are tested by the relative proportion which the cases of collapse bear to the number of deaths of their own classes respectively. Calomel and opium stand highest in the scale of success, if this criterion be adopted, the order of preference

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* Addressed to the President of the General Board of Health by the "Treatment Committee of the Medical Council." Presented to both Houses of Parliament by command of her Majesty.—*Even. Mail.*

being thus, viz. :—Calomel and opium, 59.2 per cent.; calomel (in large doses), 60.9; salines, 62.9; chalk and opium, 63.2; calomel (small doses), 73.9; castor oil, 77.6; and sulphuric acid, 78.9 per cent. The superior success of calomel and opium in severer cases thus appears a distinct fact elicited by the present inquiry. The relative advantages of the other modes of treatment mark calomel in small doses, castor oil, and sulphuric acid as actually to be deprecated in severer cases.

Chalk and opium stand at the head of the list in the general percentage, both in hospitals and private practice, but in the comparison of the collapse cases with the number of deaths the average declined to the fourth rank.

The success of various modes of treatment in the hospitals follows the same ratio as those in private practice. The greater mortality in hospitals is to be accounted for by the greater severity of the cases, and the poverty and previous exposure of the patients.

In the 1,100 cases in the hospitals 643 had emetics at the outset, of whom 410 had collapse, 140 consecutive fever, and 344 died; 457 cases were treated without emetics, of which 303 had collapse, 106 consecutive fever, and 226 died; out of 1,100 cases 102 had turpentine enemata administered. Of these 87 had collapse, and 59 died. Of 998 treated without turpentine 626 had collapse, and 511 died. Of 496 cases in which icewater was given 404 had collapse, and 248 died; and of 604 cases in which icewater was not given 309 had collapse and 322 died.

No definite information has been obtained on the subject of "consecutive fever," and of the statistics afforded no use can be made. This defect, however, need be the less deplored, since cholera, in the form of consecutive fever, becomes analogous to other fevers, the treatment of which is, or ought to be, generally understood.

It is to be regretted that the returns are almost silent on the very important topic of simple and choleraic diarrhœa passing into cholera. Some statistical tables are given, but the number of cases treated is so small, compared with the whole, that no fair inference can be drawn as to the comparative success of the various modes of treatment, nor do the reported facts warrant any specific induction. It is hoped that this most important branch of the statistics of cholera may receive the careful attention of the medical profession when they furnish future returns.

As regards the cases of simple and choleraic diarrhœa, which have not passed into cholera, it is shown, by a series of statements, that the astringent plan of treatment is decidedly to be preferred in the early stages of the disease, or in premonitory diarrhœa. The order of the percentage of failure to stay the disease in its earlier stages, or in that of premonitory diarrhœa, is as follows:—Salines, 13.6; chalk mixture, 8 9; calomel (with opium), 6,9; calomel, 2.4; chalk, with opium, calomel, and astringents, 1.5; sulphuric acid, with opium and calomel, 1.3; chalk, with opium, ammonia, and catechu, 0.2; sulphuric acid, with and without opium, and with calomel as an adjunctive remedy, 1.33; and chalk, with and without opium, together with aromatic confection and ammonia, with catechu, kino, logwood, and calomel as an adjunctive remedy, 1.31. Including the deaths from diarrhœa as failures, the percentage of failure is as follows, viz. :—Chalk mixture, 12 6; calomel and opium, 7.1; opium, 2.6; chalk, with opium, calomel, and astringents, 1.7; sulphuric acid, with opium and calomel, 1.5; and with opium alone, 0.3; sulphuric acid, with and without opium, and with calomel as an injunctive remedy, 1.54; and chalk, with or without opium, together with aromatic confection and ammonia, with catechu, kino, logwood, and calomel as adjunctive, 1.55.

The Committee of the Medical Council conclude their report by expressing an opinion that, although these and other facts throw a most useful light on the comparative value of different modes of treatment, still more decisive evidence might be obtained under more favourable circumstances. The inquiry was not undertaken till the epidemic had nearly reached its culminating point, and when leisure for pre-arrangement was wholly wanting. They entertain a conviction, which has grown with the progress of the work, that by insuring fuller and more numerous returns to a more complete and distinct form of inquiry, they would, on any future visitation of the disease, be enabled to collect ample store of available facts, and to deduce truths of the utmost importance both to guide medical practice and to enlighten science.

On the recent Cold Weather, and on the Crystals of Snow observed during its continuance.*

BY JAMES GLAISHER.

(Read before the Meteorological Society, London, March 27.)

The present year was ushered in with a high temperature, exceeding its average by quantities varying from 8° to 12° daily. On January 10th a cold period set in, together with a dense fog; and the temperature, which was as high as 49°·6 on the 9th, fell to 26° on the 10th. This diminution of temperature was accompanied by a change in the wind, which, from blowing a compound from the west, changed to a compound from the east; and, with few exceptions, has so continued up to the present time, as shewn by the returns published in the *Daily News*. On January 12th and 13th the temperature was about its average value; but after the 14th, when the cold set in, its departures were very considerable, particularly over the south-west and eastern parts of England. Scotland and the northern counties were frequently exempt from any share in the great severity of the period, which was also less severely felt at the sea-side than at inland places. The lowest temperature, viz., 0°·8, took place at Berkhampstead. At different places in England, on different days, it was as low as 3°, 5°, 7°, and 10°. For a similar period to the one which has just passed, it is necessary to go back to the year 1814. That year, however, commenced with a very low temperature—a frost having set in on December 26th, 1813. The intensity of the two periods was about the same. It ended, in 1814, on March 21st; whereas, with the exception of a short intermission about the first week in March, the temperature of the present period has descended lower and more frequently than it did in 1814, in which year the coldest day was on January 10th, when the reading was 19°·6. The lowest temperature of this year also occurred in January, and was 19°·2. In 1814 the lowest temperature in February was on the 4th, and was 22°. The lowest reading in this month of the present year was 20° 6, and took place on the 18th; and this February was a much more severe month than the February of 1814. The mean temperature of February, 1814, was 32°·4; and that of the present year was 29°·3. The remarkable feature of the late severe weather has been the peculiar character and continuous fall of snow; which first made its appearance on January 16th, and laid on the ground from that date till the end of February.

* Athenæum.

The average amount did not at any one time exceed a foot in depth; and its density has been of from 8 to 10 inches of fresh fallen to 1 inch of water, which its melting has produced. The drifts have varied from 5 feet to 10 feet. The snow this year has been of that kind which former writers have designated "Polar snow"—it having been chiefly composed of crystallized particles of compound figure, which they supposed to be confined, with rare exceptions, to the Arctic regions. This supposition, however, is not supported by the great prevalence this year of innumerable crystals, which have exhibited a degree of crystalline formation equal to any that have been recorded as seen in colder latitudes. They have been very generally distributed, and, whilst prevalent, attracted a considerable share of public attention. The primary figure or base of each crystal was either a star of six radii or a plane hexagon. The compound varieties included combinations of spiculæ, prisms, and laminæ, clustered upon and around the radii, and seem, in their various stages of formation, and almost endless variety, to defy any attempt to classify or arrange them into groups. At the commencement of the frost simple stellar forms were very prevalent, and fell in clusters of from 10 to 20 in a group, with a temperature at or about the freezing point. They were observed to fall both during a profound calm, with gusts and hard wind, and frequently unaccompanied with snow. On examination through a Coddington lens, they were found to be composed of transparent spiculæ, from which diverged other spiculæ set upon the main radii of the figure at an angle of 60°. A great number of plane hexagons fell on the morning of February the 8th. Some of these were of transparent laminæ, beautifully marked with successive and inner tracings. As the morning advanced, they became intermixed with others, set round with solid hexagons, which continued to fall until an hour before noon. For half an hour after several large crystals, of compound figure, fell with the snow. Their centre or nucleus was similar to the compound hexagons of the morning, from which diverged radii laden on either side with prisms, each set on at an angle of 60°. From this time till 4 o'clock few crystals were observed to fall; but after 4 o'clock, innumerable crystals, of arborescent form, were discernible. The nucleus of the greater number was a plane hexagon marked with inner parallel tracings, from which sprung radii, each of which intersected a crystalline formation very similar in appearance to the pinnæ of the Lady Fern. As the evening advanced, these became less prevalent, and were mingled with almost every variety which had previously fallen during the day. Snow continued to fall till late at night, when it lay upon the ground to the depth of 8 inches. The day will long be remembered as one of the most keen and inclement of the wintry period under discussion. The minimum of the preceding night had been 29°·8; and throughout the day, the temperature never rose higher than 32°. Snow fell, without intermission, from early morning till late at night. It was accompanied by a piercing wind; and in the afternoon, when the arborescent form again set in, it was blowing quite a storm. Traffic on the railways was for a time suspended, and the day was one of bitter and intense cold. When, says Mr. Glaisher, I went out, at long past midnight, the snow sparkled everywhere with crystals, as granite sparkles with the grains of mica; every leaf, cobweb, knotty projection and sheltered nook bore its burden of drifted snow and glistening crystals. It was a night to be remembered, for the extreme loneliness of Nature arrayed in her most wintry garb. A large number of crystals fell on the mornings of February 13th, 16th, and 17th. Some, and the great number of them, were aborescent, in different stages of formation, with three large alternating, with three small pinnæ, studded with prisms and spiculæ, extending on either side of the principal radii. Some exhibited an appearance, towards the end of each pinna, like a tuft of bended leaves, with serrated edges, beautifully white and seemingly opaque. Mr. Glaisher accounts for this appearance by the passage of the crystal in its descent through different regions of the atmosphere, in some one of which it has become partially thawed, and again frozen, in which condition it has been received on the surface of the earth. This conjecture is the more probable as the jagged and serrated appearance is often attendant upon the first thawing of these bodies on entering a temperature above the freezing point. The opaque and white appearance is communicated by a subsequent formation of granulated particles of snow, in all probability attaching to it, whilst in a transition state, in its descent to the earth. This is, however, only a surmise in the absence of any better solution of the fact. On February the 21st, with a temperature of 20°, there fell for an hour, unaccompanied by snow, a great variety of intensely beautiful and complicated figures. The radii were encrusted with solids, both of rhomboidal and irregular shape, cut into many facets, and heaped one upon the other. On this morning there were numerous double crystals, that is, two crystals united by an axis, at right angles to the plane of each. They generally fell with their radii intermediate, and the radii of the upper somewhat projected beyond the radii of the under crystal. Two days after, that is, on February 23rd, the frost gave way; but for some few hours in the morning Mr. Glaisher was able to continue his observations. The morning was overcast and calm, and snow fell in flakes, accompanied by minute spiculæ. Soon after 9 o'clock a change took place, and, mingled with the heavy flakes, there fell a large number of thick snowy crystals. On examining these with a Coddington lens, they were found to consist of an assemblage of prisms, grouped in thick arrangement, and bristling up (if the phrase may be allowed), at all angles, from some invisible nucleus. Some of the prisms were longer than others, but most of them were notched here and there, giving indications of the formation of other prisms or spiculæ. The longer prisms were midway in character between the prisms of high crystalline formation and the ordinary spiculæ. After the lapse of half-an-hour, the common flakes were fewer in number, and were accompanied with innumerable spiculæ. These did not fall separately, but in groups of several, clinging to each other at all angles. They had a fleecy appearance to the naked eye, but under the glass were long and rounded prisms, partaking much of the character of an icicle; but all notched and tapering to a point. At this time the air was soft and mild, and the snow was falling thickly. At 10*h*. 30*min*. the air was still calm, and the snow continued. At this time it was easy to detect here and there pinnules in an intermediate stage of formation. The spiculæ, which were still falling, were now of greater length, and their figure more perfectly developed. At 11*h*. crystals were falling, of great beauty and transparency, but of simple figure. They were thin and transparent in the highest degree, and bore a leafy appearance. Very many of them were double. Whilst observing them they changed their figure in the most curious and kaleidoscopic manner possible, the upper groups of prisms collapsing first, the next in order next, and so on,—the collapsing each time dissolving three or more prisms into one, a change effected with instantaneous rapidity. This was the first step preparatory to their dissolving; the next step was the rounding of every angle that remained; and the next step to that the extension and thickening of spiculæ, which had served as axes to prisms, and which now derived accession from their half-fluid and dissolving matter. In this manner they continued to exchange one simple form for another yet more simple, until the pristine drop of water occupied the site of the former crystal. At 11*h.* 15*min.* snow was falling quickly in minute crystals as described. The air was genial and mild, the clouds lightened as preparatory to sunshine, and the birds for awhile sang joyously. All nature seemed to rejoice in the mitigation of the weather. At 12*h.* the snow had all but ceased, and the temperature was 37°. The cocks crowed as anticipating a change; the birds answered each other from the trees; icicles, two feet in length, which had been noticed for sixteen days previously, began fast to melt away. All nature, but the birds, was still; and, what is rarely seen, the trees were dripping moisture while the snow lay like a rime upon their branches and bended stems. At 1*h.* 13*m.* the temperature was 35°.5, and small and fine snow was again falling; water was dripping everywhere, the birds were singing joyously, and the calm continued. After a short intermission, the cold set in again, but with much abated rigour; and on the mornings of March 8, 9, and 10, with a temperature a few degrees above the freezing-point, Mr. Glaisher observed a number of stellar crystals, made up almost entirely of spiculæ and half-dissolving prisms. They were between 0.3 in. and 0.4 in diameter; they fell sparingly, without snow, sometimes singly, but more often in groups of three or four together. The collapsing, which would seem to be a method of change peculiar to a temperature below freezing, was not witnessed on this day; but the process of dissolving at a temperature above 32° was seen to great perfection. The outer and boundary line of each figure, and its component parts, became exchanged for curved lines, bending inwards, whilst the crystalline matter, every instant becoming more watery, ran out at the angle of the prisms in the form of spiculæ. The prisms of the crystals, thus in a transition state to their original fluid medium, presented each an exact similitude to a holly leaf, and as being made up of curved lines a very anomalous appearance. This change was not always simultaneous, sometimes commencing at either or both ends of the radii. There is room for much examination and study respecting the manner of the dissolving of these bodies, which under some circumstances would doubtless show a reversal of the conditions under which they were originally formed and attained their compound figure.

The author next proceeded to give a brief summary of each day's observations. On Feb. 8, they commenced with a temperature of 29°, which subsequently increased to 32°, at which the temperature continued for many hours. During the whole of this time, conspicuous for its uniform temperature, the prevailing figure of the crystals continued to change, until towards the close of the day they fell mingled together in the greatest profusion. In the early part of the morning, it will be remembered that they were arborescent; that these forms suddenly ceased, and were exchanged for hexagons; that these again became the centre of a more complicated arrangement; that after a time these diminished in numbers, when the arborescent form again prevailed, and finally a mingling of nearly all that had previously fallen. On Feb. 16, with a temperature of 26°, there were two distinct orders of crystals, those which were arborescent and exhibited an intermediate formation, and those of cruciform character, of solid hexagons cut into numerous facets. Feb. 17, with a temperature of 32° throughout, exhibited figures, it will be remembered, composed of elongated prisms, ranged parallel to each other, and of very similar character. There were, however, exceptional instances of the prevailing character of Feb. 16. On Feb. 21, with the lowest temperature, viz. 20°, the figures were singularly compound, and departed more than on any previous day from the figure of the regular hexagon. On Feb. 23, the last day of the frost, there were a large number of aborescent crystals of one common character, and which never ceased collapsing into more and more simple figures. On March 8, after a week's respite, the cold set in again. The crystals on this and the next two consecutive days, were of a very distinctive class, of purely stellar figure, and composed chiefly of fine spiculæ. From these observations it would seem, that however temperature may affect these bodies, it is more than likely that other conditions of a different nature are involved in their first formation. This, apparently, was the view taken by a writer on the subject in the *Phil. Trans.* for 1672. Speaking of snow crystals (says the Rev. G. Langwith), "It is not easy to determine whether these figures may not be the result of the chemical components of the atmosphere, which as they preponderate may not under certain conditions of temperature give rise to these curiously simple and compounded bodies. Dr. Smallwood, of Isle Jesus, Canada East, imagines them to be intimately connected with the electrical states of the atmosphere, whether negative or positive. The foregoing observations show a wide difference between the various orders of crystalline formation, and it would seem from them that the greater the degree of cold the greater the departure from the simple star, with all its variously arranged spiculæ: also that shortly after the descent of a crystal, at any temperature below the freezing point, various processes of change take place, which are evidently an undoing, if not a reversal, of the operations which had assisted in their formation. These changes, through which every crystal never fails to pass, even at temperatures very many degrees below the freezing point, each more destructive than the last of its crystalline and compound figure, led the author to the same conclusions. The subject of snow crystals has engaged the attention of Aristotle, Descartes, Grew, Kepler, Dr. Nettes, Dr. Scoresby, and others, but like most subjects of meteorological inquiry, it has languished for want of extended and continuous observation. The published information concerning them is, however, likely soon to derive accession from Sir Edward Belcher's observations made in the Arctic Seas. Coming from this experienced and able officer, they will be of substantial benefit to the inquiry into the nature and circumstances of formation of these interesting bodies

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The Geological Survey of Canada.*

The Report of the Select Committee on the Geological Survey of Canada is a very important and valuable document, and we lose no time in presenting the main features of the Report before the readers of the *Canadian Journal*.

The minutes of evidence occupy above sixty pages of royal octavo, and contain much useful and curious information, mingled, of course, with matter irrelevant or detrimental to the purposes of the enquiry.

We confine ourselves, in the present instance, to the Report itself, proposing to advert to the evidence in the next number of the *Journal*.

* Report of Select Committee on the Geological Survey of Canada. Printed by order of the Legislative Assembly. 1855.

ABSTRACT OF THE REPORT.

Since the first commencement in 1843, Mr. Logan and his assistants have traversed and examined every part of Canada, from Gaspé to the head of Lake Superior, in the uninhabited portions, following, for the most part, the course of the Lakes, the St. Lawrence, and the Ottawa, and their principal affluents, and in the settled parts penetrating farther into the interior.

The minuteness with which the exploration of this immense tract of country has been conducted, has varied very much according to circumstances, as the means of access, the immediate requirements of the country, and the interest and importance of the formations under examination. In some cases, where the geological structure maintains an uniform character over large areas, as on the north side of Lake Ontario, little more has been done than to trace the boundary between the principal formations. In others, as on Lakes Superior and Huron, in the upper part of the Ottawa country, and in Gaspé, the nature of the country, and the entire absence of reliable topographical surveys, rendered any other examination impossible in a limited time, except to trace the course of the principal streams, with such occasional excursions into the interior, as the geological observations seemed to dictate; whilst in some, where the facilities were greater, and the field more inviting, considerable minuteness has been attained, as in the region between Lakes Huron, Erie, and Ontario, the country between the St. Lawrence and the Ottawa, and some parts of Lower Canada, south of the St. Lawrence. The result has been such, as to enable Mr. Logan to lay down with sufficient certainty the general geological features of the whole of Canada, and to fill up many of the more interesting parts in considerable detail.

From the absence of accurate maps, Mr. Logan and his assistants have, in almost all cases, been obliged to conduct a topographical survey, as well as an examination of the strata; a fact which should not be lost sight of, as having materially retarded the progress of the survey, but which, at the same time, has been of great use to the Province, in giving certain information as to rarely visited localities, and even in correcting erroneous surveys in settled parts of the country, as is acknowledged by Mr. Russell, of the Crown Lands department, in his evidence, who bears testimony to the great accuracy of some of Mr. Logan's surveys.

During these investigations many new fossils and mineral forms have been discovered, and new facts of great interest to geologists have been brought to light; amongst the latter may be mentioned the crustacean tracts discovered by Mr. Logan in the Potsdam Sandstone;* the chemical composition of certain fossil and recent shells, which had hitherto been thought exclusively to distinguish the skeletons of vertebrate animals; the parallelism of the disturbing forces throughout the Silurian, Devonian, and Carboniferous eras; and more particularly, the researches on the metamorphism of rocks, which seem to establish with certainty, that not only the crystalline formation of the great Apalachian chain, but also the still older rocks which separate the St. Lawrence from the Arctic Ocean, are merely stratified sedimentary deposits in an altered condition.

Of more immediate practical interest is the knowledge gained of the mineral wealth of our country. Besides building materials of all kinds, and limestone, the discovery of which in some parts is of as much practical value as that of gold itself, there is the copper of Lakes Huron and Superior, the slates, marbles, serpentines, soapstones, and iron and copper ores of the mineral region south of the St. Lawrence, and the magnetic iron ores of the Laurentine formation, of greater extent and value than exist probably in the rest of the known world.

Upon the whole, with the single exception of coal, the Canadas, on the testimony of Professor Hall, have been shown to stand higher in respect of their mineral products than any of the surrounding states. All these and numerous other economic materials, a list of which is given in the report of 1849, 1850, and the description of the London Exhibition of 1851, if not actually first discovered by the survey, have been made generally known, the formations which yield them pointed out, and in many instances the localities, where they can be profitably worked, indicated.

Whilst the survey was in progress, a very large collection of specimens has been brought together, with the intention of illustrating, not only the science of Canadian geology, but its practical application in the supply of useful materials, the whole of which are now deposited at the house of the survey at Montreal.

Such is the present result of the Canadian Geological Survey, and although much remains to be done, considering the vast extent of country under examination, the difficulties presented by the uninhabited state of much of it, the total absence of reliable topographical maps, and the short period of each year which our climate renders available for the field work, your Committee think they may pronounce with confidence, that in *no part of the world has there been a more valuable contribution* to geological science for such a small outlay (hardly more than £20,000 in all). In confirmation of this opinion your Committee would refer to the letter of Professor Agassiz, and the evidence of Professor Hall, and to the opinions of scientific men quoted by Mr. Logan and Mr. Hunt. They beg also to add two other quotations, as showing the estimation in which our survey is held by men of science in England and France. "In Canada especially, there has been proceeding for some years one of the most extensive and important Geological Surveys now going on in the world. The enthusiasm and disinterestedness of a thoroughly qualified and judicious observer, Mr. Logan, whose name will ever stand high in the roll of votaries of his favorite science, have conferred upon this great work a wide-spread fame."—*London Quarterly Review*, October, 1854.

"De toutes les colonies Anglaises, le Canada est celle dont l'exposition est la plus intéressante et la plus complète, on peut même dire qu'elle est supérieure à l'exposition minérale de toutes les contrées qui ont envoyé des produits à Londres; *cette supériorité vient de ce qu'elle a été faite d'une manière* systématique; il en résulte que son examen fournit des moyens d'apprécier à la fois la constitution géologique et les ressources minérales du Canada. Cette circonstance vient de ce que notre collègue, M. Logan, qui remplit dans le Canada, les fonctions de *Geological Surveyor*, a présidé sur les lieux aux choix de la plupart des échantillons qui ont été envoyés à l'exposition, et qu'il les a classés depuis leur arrivée à Londres."—*M. Dufrenoy, membre de l'institut*, in the Jury Reports of the London Exhibition.

It is mortifying to your Committee to have to report, that results of so much value are almost inaccessible to the public, and that a great proportion of the inhabitants of Canada, if not ignorant of the existence of the survey, are at least unacquainted with what it has achieved. The annual reports are presented to Parliament, and buried in the Journals of the House, except a few hundred copies, which are distributed by Members amongst

* This is a mistake which should not have occurred; the real discoverer being the late Mr. Abraham, of the *Montreal Gazette*. Mr. Logan mentions this fact in his Report for 1851-52, page 10.

their friends, so that the reports of two consecutive years rarely fall into the same hands. As a further proof of the ignorance which prevails as to what has already been done, your Committee may mention, that the existence of a combustible material, closely resembling coal, in the rock at Quebec, which has lately occupied so much attention, is fully described, and the reasons why there is *small probability of its being profitably* worked given at large in the report of 1844, pp. 19 and 20.—These facts speak for themselves as to the necessity of republishing the reports in some shape.

Another serious deficiency is the want of a map. Not only are the annual topographical measurements of the survey unknown, till the publisher of some new map obtains copies of them, but it is extremely difficult to follow a geological description without a map, and a student must colour one for himself from the reports, before he can get a clear knowledge of the geological features of the country.

Again, there are many things which even the reports do not contain, were they accessible, viz: plates and descriptions of new and characteristic fossils, sections and illustrations of the disturbances of the strata, &c., without which a complete understanding of the subject cannot be obtained. We may mention also generalizations, and theoretical conclusions, deduced, not from the report of one season's work, but from a comparison of the whole, such as the investigations upon the metamorphic rocks already mentioned, which must be sought for in a perfect form in the papers communicated by Messrs. Logan and Hunt to the scientific bodies of Europe and the United States.

Lastly, the vast collection of minerals accumulated at Montreal, from insufficiency of funds to provide for their proper arrangement, lie in a great measure buried in packing cases in the vaults and sheds of the Survey Office.

With a view to remedying these deficiencies, your Committee would recommend the immediate republication of the substance of all the former reports. The course which your Committee recommend, would be, to publish all that is necessary of the old reports, revising, re-arranging, and if necessary adding to them, so as to give a connected and systematic view of the geology of the Province, as far as it is at present known. This volume, which would not be a very large one, should be accompanied by a coloured geological map of the whole Province, upon a scale of from 20 to 25 miles to the inch, and should be illustrated with a few wood cuts of the most characteristic fossils, and, the most common crystalline forms of minerals, with plates of such geological sections as may be requisite to elucidate the subject, and, if necessary, with maps on a larger scale of particular localities, which may require more minuteness of detail to exhibit their structure, or the occurrence of mineral veins. There should also be a copious index of the localities reported upon, and another of economic materials, with a reference to the body of the work, where a fuller description of them and their geological relations, and geographical distribution, would be found.

The publication of the annual reports of future progress should continue as heretofore, with the addition of such wood cuts, sections, and detailed maps, as might be judged necessary to elucidate the report in an uniform shape with the volume above mentioned, to which they would, in fact, become an annual Appendix. In order to secure this uniformity, as the annual reports would be published by the House, and form part of the journals, the revised reports, though not on the journals, should be published in the same form.

Your Committee would also recommend the publication, in numbers, from time to time, as materials accumulate, of plates of new and characteristic fossils, with letter-press descriptions, together with such other illustrations, sections, &c., as may be thought of scientific value, but not of a nature to accompany the reports as above mentioned.

The importance of an accurate geological acquaintance with the country is so universally acknowledged, that it is unnecessary *to do more than point out some portions of the* evidence, which shew the immediate practical results; but as an apparent misapprehension exists in some quarters as to the objects of such a national undertaking, your Committee may be pardoned for making some additional observations. The discovery of valuable economic materials speaks for itself, although, even here it may be doubted, whether the relative importance of the minerals indicated is always justly appreciated, whether the crystalline limestones of the Laurentian series have not been of more real value, than some discoveries of a far more imposing character. But where the outline of some formation of no very obvious economic use is accurately traced for many miles, when minute and laborious investigations are carried on of the undulations, contortions and disturbances of other strata, with exact measures of their thickness and dip, and when the greatest attention is paid to the fossils they contain, some people are apt to think that the Geologist might be more usefully employed. They draw a distinction between practical utility and scientific interest. The ultimate object, however, of all science is practical utility; it is only a systematic, instead of a desultory search for valuable facts. The discovery of some useful material at a particular point would be an isolated fact though perhaps of great importance to that locality; but combined with a correct scientific knowledge of the geology of *the country, it would be not only available over an extensive* region, but would be the contribution of a valuable truth to the whole world. Instances of this intimate connection between science and economics will be found in the evidence.

Again different individuals, according to their several pursuits, expect information of a special nature from the Geological department. The agriculturist wishes to have every bed of marl pointed out, and an analysis of every soil; the architect or engineer calls for details of accessible building stone, brick-clay, and hydraulic lime; while the miner wants information of where mineral veins occur, the abundance of the ores, their chemical constituents, and the per centage of metal. Now, details of this description for the whole country cannot be expected, especially where it is to such an extent uncleared. The duties of persons engaged in a Provincial Survey is to ascertain and make known with such accuracy and detail as is practicable, the physical structure of the country; to record the localities where any valuable material has been observed, with its probable extent, and the direction in which its recurrence may be expected, and in the case of mineral veins, to describe their character as far as visible, the apparent richness and abundance of the ores, and the indications which the country exhibits of the frequent occurrence of the lodes. They cannot point out every bed of marl or brick-clay, or pause to search out every promise of a mine, or still more the probability of its being worked to commercial advantage. The practical details must, of necessity, be left to private enterprise to accomplish. No appropriation by Parliament, no staff of geologists, however extensive, would suffice for the whole Province, if more were expected. The public should provide general information for all; the individuals who are to turn it to their private profit, must supply the rest.

In conclusion, your committee beg leave to submit the following summary of their recommendations, with an estimate of the annual expenditure, which would be required to put them in practice.

1. The republication of not less than 20,000 copies of the revised reports, with a coloured map. The expense of this is already provided for by the additional appropriation of £2000 in the estimates of last year.

2. The publication of the same number of the annual reports of future years uniformly with the above.

3. The periodical publication of 3000 copies of plates and descriptions of fossils, &c.

4. The gratuitous distribution of the two former as follows: Four copies to each Member of the Legislature, copies to the Governments of all British Colonies, and the East India Company, for distribution by them to public libraries and Scientific institutions, and one copy to every University, College, Literary and Scientific Society, Mechanics' Institute, Library Association, Grammar, Normal and Model School, Municipal and Common School Library in this Province, applying for the same, and to the principal learned Societies in the United States and Europe. The gratuitous distribution of the latter to be confined to one copy to each member of the Legislature, the copies to Municipal and Common School Libraries to be omitted, and the number sent to British Colonies and foreign Societies proportionately restricted. The remainder, after keeping some on hand for parties subsequently added to the gratuitous list, to be for sale at cost price.

5. The establishment and maintenance of the Museum and Library upon an efficient footing.

6. To provide for the supply of Geological and Mineralogical specimens to other Museums.

7. The employment of topographical surveyors and their parties, to assist in the Geological Surveys, when judged necessary.

8. The employment of two or three additional explorers.

9. The employment of a Resident Assistant, as keeper of the Museum, and in the general business of the office.

10. The employment of a Second Assistant Geologist, charged more especially with the exploration of mineral localities. The Committee wish it to be understood that in the present state of the country they consider this the least essential addition to the establishment, and unless ample funds are provided, they would not advise it, to the prejudice of any other of their recommendations.

11. The encouragement of voluntary assistance by the publication of questions and short instructions how and what to observe and collect.

12. Securing the aid of Deputy Provincial Surveyors, and requiring all persons admitted as Surveyors for the future, to pass an examination in the rudiments of Geology.

13. The establishment of certain points in different parts of the country, as a basis from which local surveys may be reckoned.

14. Requiring all Railway Companies to furnish plans and sections of their surveys.

Estimated Annual Cost of the Department as Compared with the Present Expenditure.

	Present.	Future.
Salary of Director of Survey	£555	£555
" of Assistant Geologist	333	400
" of Chemist and Mineralogist	300	400
" of Resident Assistant		200
Explorers	120	450
Field expenses of two Surveys	600	600
Topographical Surveyors and their parties		750
Publications of fossils, sections, &c., including services of a Palæontologist		800
Laboratory	100	100
Museum		200
Books, Instruments, &c.		200
Fuel, Messenger, and incidental expenses	275	345
	£2,283	£5,000
Assistant more particularly charged with examination of mineral veins and his field expenses.		1,000
		£6,000

The whole nevertheless, respectfully submitted.

JOHN LANGTON, Chairman.

Committee Room, Legislative Assembly,
29th March, 1855.

On the Durability of Railroad Iron.

BY WILLIAM TRURAN, ESQ.

The duration of the iron rails of our great railroads is a subject of vast importance to all interested in the maintenance and extension of railway communication. In all estimates for new roads for thinly settled districts, the cost of the iron rails figures as the most prominent item; and even in the thinly settled States of Europe, where the metal is obtained at a comparatively cheap rate, the cost of the rails forms no inconsiderable portion of the whole expense of construction. On the first introduction of railroads, it was confidently asserted by their promoters, that the iron rails would last for an indefinite period. A few months working, however, demonstrated, that although manufactured from the best metal, iron railway bars were subject to lamination and disintegration from the repeated rolling of heavy loads. Their duration, in numerous cases, did not exceed two or three years, and in no instance of a raiload having a heavy traffic, have the rails remained sound and in working condition for more than 14 years. On some of the earliest constructed lines in England, the rails have been changed twice and even three times within twenty years. Opportunities have, therefore, presented themselves to the engineers of such lines, of ascertaining the actual traffic which iron rails are capable of withstanding under different circumstances.—But if note has been taken of the facts relating to rails, which have been taken up, it is to be sincerly regretted that they have not been recorded in one of the numerous scientific publications of Europe or this country. Their publication would be of the greatest benefit to railroad companies, and, eventually, would be of essential service to engineers and scientific men generally.

The traffic which rails of ordinary quality are capable of bearing, will depend on circumstances; but where the conditions are of a favorable nature, and the bars themselves perfectly sound, it will not fall far short of twenty millions of tons. But, although rails will stand the rolling of this traffic, those which are daily observed in a dilapidated state on numerous railways, have not, in the majority of cases, carried the one-fourth of this traffic; and immense quantities of rails have doubtlessly been renewed before they have borne the one-tenth of this weight. Well recorded observations are wanted on this head, and pending the publication of more extended observations, the writer would direct attention to the following observed cases of rails, which have stood the carriage of several millions of tons under very disadvantageous circumstances.

It may be necessary to state, that the rails used in every case, but the last, were of the usual quality, (those in case 2 are a portion of the bars manufactured for the Moscow and St. Petersburgh Railway.) They were manufactured in a manner commonly pursued at Welsh rolling mills, and were, in point of quality and appearance, equal to any manufactured or in use in Europe. The rails in the Hirwain road were rolled from inferior metal, and were not in other respects, well manufactured.

It may be necessary also, to mention in this place, that the gross weight of the trains is given in every instance.—This, it is believed, is perferable to giving the weight of the freight and omitting the weight of the engine and cars, which may be unnecessarily heavy or light for the loads which they convey.

CASE 1.—Railroad for the conveyance of minerals, near Merthyr Tydfil, Wales, length, 2 miles; gauge, 4 feet 8 5 inches. This line is a gradient of 2 inches rise in the chain through its whole length, and contains curves so low as 3 chains radius. The wagons employed weigh 3 tons 12 cwts when empty, and 7 tons 1 cwt. when loaded. They are mounted on 4 cast iron wheels, 30 inches in diameter, keyed fast on the axles, and have outside bearing brasses, but neither buffer, draw nor bearing springs The motive power consists of locomotive engines weighing from 14 to 16 tons each exclusive of tender. The rate of hauling ranges from 10 to 16 miles an hour.

This line was originally laid in a very temporary manner, with bridge rails 2·5 inches high, 2 inches wide at the top or bearing part, and 6 inches at the foot; and weighing 36 lbs per yard lineal. They were fastened by spikes through the flanches to cross sleepers, 6 inches by 4 inches, by 6 feet long, at intervals of 4 feet. The ballasting consisted of the clay and peaty soil excavated from the side drains, and distributed in a layer one foot thick under the sleepers.

After two years' wear, with the engines and wagons described above, the original rails were laminated to an extent that rendered their renewal a matter of necessity. The gross traffic that passed over them during that period, amounted to 1,822,800 tons. Had these rails been supported by larger sleepers at shorter intervals, and these sleepers packed up by proper ballasting, they would have stood the wear and tear of from twice or three times the above quantity of traffic.

CASE 2.—The railroad previously described, was relaid with T rails 3 75 inches high, 2·5 inches wide at the head, and 3 5 inches broad at the foot; and they weighed 63 pounds per lineal yard. The small sleepers were replaced by others, averaging 9 inches wide, by 9 feet long, at the reduced distance of 3 feet apart from centre to centre. The rails were also supported on shallow cast iron chairs, which were spiked to the sleepers, and the clay ballasting was strengthened by the addition of a thick layer of broken stones. The new rails with the altered mode of laying, have now been in use ten years, during which period the gross traffic over them has been 9,710,000 tons.

The height of these rails when new, was 3·75 inches, as previously stated, but by wear and abrasion from the rolling of the above weight, their height has been reduced to 3·63 inches. Taken collectively, these rails have endured very well, and with the exception of a very few crushed and bruised bars, which will require immediate renewal, they will, probably continue fit for the traffic for at least three years again. Hence their duration may be estimated as equal to the movement of 12,600,000 tons.

To show the ill effects which must result from inattention to the state of the sleepers, at different places on the line, a sleeper was permitted to remain without support. After a lapse of a few days, the rails immediately over the slackened sleepers, were found crushed and flattened for a length of 6 or 7 inches, so as to reduce the depth of the bar from 3·63 to 3·2 inches Similar results followed, when the distance between any two sleepers was increased to more than 4 5 feet; thus showing the necessity of having, under the rails, a firm and rigid support at very short intervals, to prevent as far as possible all injurious deflection.

In those rails which have broken down, either from lamination, or during the foregoing experiments, the impropriety of using any other than puddled iron in the top surface of the rail was fully displayed. These rail bars were manufactured from piles of the ordinary quality and description, with a top plate of the so-called "best iron," one inch in thickness This plate in the course of rolling was reduced in thickness to 16 of an inch in the finished bar Now, all the lamination which has yet been discovered, has occurred with this superfical coating of "best iron," which has often pealed off, in long narrow strips or splinters, of several feet in length.

CASE 3.—Mineral railroad, consisting of a steep incline plane of the 4 feet 8. 5 inches guage, with a double track of rails, each 480 yards long, and falling 6·7 feet per chain.—The direction of the traffic being downwards, this portion is worked by the gravity of the descending full wagons, which are made to draw up the empties, by means of ropes, working over rope rolls and friction drums, revolving on gudgeons at the incline top. The rails were of the bridge pattern, 2. 5 inches high, 2 inches wide at top, 6 inches broad at the foot and weighed 57 pounds per yard. They were supported on flat cast metal chairs, which were spiked to transverse sleepers of 8 inches wide, by 8 feet long, placed 3 feet apart.—Under the sleepers, there was a thin stratum of clayey soil as ballast.

The wagons described in case 1, roll over this section, also at velocities averaging 12 miles per hour The rails on this section were in use for eleven years, during which time the traffic over them amounted to 8 087,000 tons, equal to 4,043,500 tons over each track. The injury which results to the rails from the absence of adequate support under the sleepers was manifest in this case, and undoubtedly was the means of shortening their duration fully one-half.

While forming another mineral railroad, crossing under this section, it became necessary to evacuate an opening, 10 yards wide, over which the rails were carried by four pieces of pine timber; one being placed under the centre of each rail bar. The deflection of the beams by the passing of the loaded wagons, was from 2·5 to 3 inches, and from this cause alone, the whole of the rails on these pine stringers were battered and laminated so as to require renewal in the short space of two months, and after they had borne a traffic of no more than 61,300 tons.

CASE 4.—Mineral railroad, on a dead level throughout, consisting of a single track bridge rails, the same as those described in case 1, but spiked directly to sleepers, averaging 6 inches wide, by 6·5 feet long, placed 3 feet apart on broken limestone, as ballasting. The wagons previously described, work over this section also, but the motive power being horses, the rate of travelling rarely exceeds three miles an hour. The rails on this section have now been in use 11 years, have borne a traffic of nearly 4,900,000 tons, and with the renewal of the wood-work of the line, will probably last for a similar period, and for the passage of an equal quantity of traffic. Their duration may, therefore, be assumed to be equal to the transport of 9,800,000 tons.

From the foregoing examples it will be seen, that while bridge rails, weighing 56 pounds per yard, were destroyed with the passage of 1,822,800 tons, hauled at a velocity of 12 to 16 miles an hour, by locomotive engine, weighing from 14 to 16 tons each, with the same wagons, but at the reduced speed of 12 miles an hour, they have stood under the passage of 4,033,500 tons; and with the same wagons, but at the still further reduced speed of 3 miles an hour, they have stood the wear and tear from the passage of 4,900,000 tons, without material injury.

CASE 5.—Railroad for the conveyance of coal, consisting of an inclined plane, falling 7 inches per yard, forming a double track of rails of the 4 feet 8 5 inches guage, 400 yards long, and worked by stationary steam power at top, through the medium of ropes and drums. The rails are of the inverted U pattern or Evans' patent, weight 90 lbs. per yard, were 3·4 inches high, 2.74 inches wide at the head, 4 inches wide at the foot, rolled in lengths of 15 feet, and supported at intervals of 3·5 feet, by cast iron chairs resting on massive blocks of limestone.

Each track of rails is traversed by a single wagon, mounted on four cast iron wheels, 2 feet diameter, keyed on wrought iron axles, and revolving in brass fitted plummer blocks bolted to the frame work of the wagon. The weight of the wagon when empty is 7 tons 2 cwts., when full, 13 tons 16 cwts., and it is drawn at an average speed of 8 miles an hour.

These rails have now been in use seventeen years, and the gross traffic which has passed up and down the plane, amounts to 11,016,000 tons, or 5,508,000 tons over each track. The result of this traffic has been to reduce the height of the rails from wear and abrasion, from 3·4 to 3·26 inches.—In other respects they are in good condition, and will probably sustain a further traffic of 3,500,000 tons, making their duration equal to 8,000,000 tons.

CASE 6.—Railroad for the conveyance of limestone, a single track 2 1-2 miles long, worked by horse power. The rails were of the fish-bellied section, 5 inches high, 2 inches wide at the head, and .75 inches thickness of centre web, weighed 55 pounds per yard, and were laid in in cast iron chairs resting at intervals of 3.5 feet on limestone blocks of from 2 1-2 to 3 cwts. each.

The wagons, which were made wholly of wrought or cast iron, weighed, when light, 1 ton 19 cwts., and when loaded, 8 tons 10 cwts. each. The wheels were 2 feet 6 inches in diameter. and turned loosely on the axles, which were bolted to the under side of the carriage.

These rails stood for nine years with an average annual traffic of 180,960 tons, or a gross total of 1,628,640 tons, when they were replaced by stronger bars.

CASE 7.—Railroad consisting of an inclined plane, with a double track of rails raising 9 7 feet per chain forward. Rails of the bridge pattern, weighing 56 pounds per yard, 2.375 inches wide at head, and 5.625 inches at the foot, spiked directly to cross sleepers 9 inches wide, by 9 feet long, at distances of 3 feet 3 inches apart. The sleepers repose on a thick deposit of broken scoria, from the blast furnace in the neighborhood, which is found to be an excellent material for ballasting the permanent way of railroads.

The wagons running on this road are of wrought iron, mounted on 4 cast iron wheels, 30 inches in diameter, turning loosely on their axles, and are without springs of any kind. They weigh when light, 1 ton 8 cwts., and when loaded, 4 tons 16 cwts.; and are drawn by stationary steam power acting through drums and chains, at an average speed of 6 miles an hour.

These rails have been in use thirteen years, and appear but very little the worse for the traffic which has passed over them. This has amounted to a gross weight of 7,840,000 tons, or 3,920,000 tons over each track. Their duration may be fairly estimated at twice this weight, or 7,840,000 tons over each track of rails.

CASE 8.—Railroads for the conveyance of goods, metals, and minerals, consisting of a single track of rails of the bridge pattern, weighing 75 pounds per yard, 2.5 inches high, 2 inches wide at head, and 6 inches at base, laid in shallow cast iron chairs, which are spiked to sleepers 9 inches wide, by 7 feet long, placed at distances of 3.5 feet apart.

The wagons travelling over this road are of various patterns, and are, with a few exceptions, devoid of springs.—Their weight, when empty, varies from 26 to 63 cwts., and when loaded, from 6 to 11 tons. The speed at which they are drawn varies, also, from 3 miles an hour, the speed of those drawn by horses, to 12 miles an hour, for those drawn by steam locomotive engines.

These rails have had the wear and tear from the passage of 4,783,000 tons of miscellaneous traffic, but from their damaged condition, we cannot estimate their duration at more than 5,500,000 tons.

CASE 9.—Railroad for the conveyance of coal, consisting of a single track of parallel rails, weighing 40 pounds per yard, 3.87 inches high, 1.87 inches wide at the head, 1.2 inches wide at base, with centre web .56 inch thick, laid in cast iron chairs pegged to stone blocks, weighing from 4 to 6 cwts. each, and placed at an average distance of 3 feet apart from centre to centre.

The wagons running on this road are drawn by horses at an average speed of 4 miles per hour, and are mounted on four cast iron wheels, 28 inches in diameter, turning loosely on their axles, which are bolted to the wrought iron frame of the wagon. They weigh, when empty, 3 tons, and when loaded, 5 tons 17 cwts.

The gross traffic over this line has amounted, during the 13 years which it has been open, to 8,626,000 tons, and it now remains in a good working condition. The duration of these rails may, therefore, be estimated at about 15,000,000 tons.

CASE 10.—Taff Vale Railroad, for the conveyance of passengers, metals, minerals and general merchandize, between Cardiff and Merthyr Tydfil. Upper section consisting of a single track of parallel rails of a single head form, weighing 50 pounds per yard, 4.5 inches high, 2.2 inches wide at head, 2 inches width of lower web, and .66 inch thickness of centre rib or web, supported at intervals of 3 feet by chairs bolted to cross sleepers 10 inches wide by 9 feet long. The ballasting under the sleepers consists of a thick stratum of broken cinders.

The wagons and carriages running on this road, vary considerably in their weight—from 2 tons 10 cwts. to 4 tons 10 cwts, when light, and from 8 tons to 12 tons when loaded. They are furnished with wrought iron wheels and tyres, bearing springs and friction brakes, and the passenger carriages have buffer and draw springs. The locomotive engines employed, weigh about 20 tons, exclusive of tenders and work at speeds varying from 15 miles per hour, for slow mineral trains, to 30 miles an hour for passengers.

These rails have been in use nearly 13 years, and from the most careful computations, the traffic over them has been 5,400,000 tons. At the crossing and portions of the line where a considerable braking power is applied, their depth is reduced by abrasion, to 4.4 inches, but in all other respects these rails are generally sound. Their duration may be estimated as equal to the rolling of 10,000,000 tons.

CASE 11.—Taff Vale Railroad—the down-line from the Aberdare junction to Cardiff. Length of the line, 14 miles, and falls at the rate of 15 feet per mile. Rails of the parallel double headed section; depth, 5 inches; width of head and foot, 2.5 inches; centre web, .75 inch thick; weight, 72 lbs. per yard. They are supported at intervals of 2 feet 9 inches by cast iron chairs firmly bolted to cross sleepers, 10 inches wide by 9 feet long. In all other respects, the formation of this road is similar to that of the upper section near Merhyr Tydfil.

The carriages and engines last described, work on this section also, and at similar speeds. It is traversed daily by 3 passenger, 1 mail, and numerous luggage, metal, mineral and merchandize trains. The passenger trains average about 96 tons gross each, but the mineral and other trains sometimes exceed 1000 tons in weight.

From the annual traffic returns of this company, we find that in the eight years that these rails have been laid, the gross traffic which has rolled over them, amounts to 20,516,000 tons. Although this weight has caused considerable lamination and abrasion at the stations and on the sharpest curves, those rails are now in fair working order, and with attention to the sleepers and ballasting, they will last for the conveyance of as much more. Hence their duration may be estimated as equal to the rolling of 41,000,000 tons.

CASE 12.—Taff Vale Railroad—the up-line from the shipping port of Cardiff to the Aberdare junction. This line is of the same length, and is similar in its construction to the down line, with which it runs parallel throughout. It is traversed, also, by the same engines and and carriages, but the coal and coke wagons pass over this line empty.

The rails are of the same date as those of the down line, and the gross weight which has rolled over them, amounts to 11,200,000 tons. Their general condition is very similar to those in the down line; and their duration may be estimated as equal to the passage of an additional weight of 11,200,000 tons, or a gross total of 22,400,000 tons. The greater weight traversing the down line, is owing to the large quantities of coal sent down for shipment; the wagons used in the conveyance of of which return empty over the up line to the collieries.

The rails on both sections having suffered nearly alike in lamination and abrasion, although one has sustained little more than half the rolling of the other, is accounted for by the circumstance of the gradient being just sufficient to enable the engines and loaded wagons to roll down the one line, while on the other the ascent with 90 or 100 empty wagons is accomplished with difficulty by engines having 18 inch cylinders. The abrasion and injury to the rails by the slipping of the engine wheels in ascending gradients, is probably equal to, if it does not exceed, that from the rolling of the traffic.

CASE 13.—Railroad for the conveyance of minerals to the Hirwain Iron Works, consisting of a single track, 3 miles long, of the 4 feet 8.5 inch guage. Rails, of a parallel single head form, 4.25 inches deep, 2.5 inches wide at the head and .75 inch thickness of centre web. They weigh 46 lbs. per yard, and are screwed fast to single cheek chairs on massive stone blocks every 4 feet. The ballasting consists of blast furnace cinders, and dust from the coke yard.

The carriages are constructed of wrought and cast iron frames, and are mounted on 4 cast iron wheels 32 inches diameter, turning loosely on axles bolted firmly to the carriage frame. They weigh when light 2 tons 5 cwts., and when loaded, 5 tons, but are unprovided with any springs. The locomotive engines weigh 10 tons each when in running order and propel the loaded carriages at an average speed of 10 miles an hour.

This road has been laid with these rails about 4 years.—The gross weight which has passed over it in that time amounts to 1,055,000 tons. On carefully examining the state of the rails after this traffic, 25 per cent. were found laminated to an extent rendering their immediate replacement by sound rail indispensable; while the others cannot, under existing circumstances, last more than 2 years again. The duration, then, of the rails on this road may be estimated as equal to the passage of 1,318,000 tons, or considerably less than either of the previous examples.

In reference to the foregoing examples of the duration of railway bars under different conditions of laying and working, we may remark that in every instance where, in the construction of the permanent way, sufficient solidity has not been obtained by the employment of adequate sleepers, the destruction of the rails has been most rapid. This was the result with cases 1 and 6, and the effects are visible in 3, 4. 5, and 8. The greater duration of 11 and 12 over the others, must be ascribed to the use of heavy rails, wagons and carriages with bearing springs, and a well constructed and carefully maintained permanent way. No. 12 is a very favorable instance of durability—probably, equal to any ever laid, which has principally resulted from the very favorable grade of the line. No. 10, with heavier rails, would have equalled No. 11, as the conditions are otherwise similar.—The absence of bearing springs to all wagons, except those in cases 10, 11 and 12, must also have had a very prejudical effect on the rails and greatly lessened their duration.—In case 6 the rails were too weak, and the support unequal to the heavy wagons employed. Case 9, with heavier blocks and lighter wagons, is a very favorable specimen of a mineral railroad. Case 13 shows the most unfavorable results of the whole number detailed, but when the very inferior quality of the metal used and the defective nature of the fastening employed is fully considered, a different result could scarcely be expected.

In the tabular statement of the duration of the rails, it is supposed that the cost of labor and materials in replacing unsound bars and the ultimate expenses incidental to the entire renewal of the rails, when worn out, will be equivalent to the value of the old metal obtained. This is found to agree very nearly with the results obtained in practice.

We have in our possession, similar notes respecting the duration of cast iron rails, of which numerous examples may be seen at or in the neighborhood of Merthy Tydfil: but the general abandonment of this material for that of wrought iron, would cause such notes of little value, if published.

Tabular Statement of the Duration of Iron Railroad Bars.

Number of case or example	Weight of rail, in pounds per yard	Depth of rail in inches.	Bearing surface, presented by sleepers for each lineal foot of track, in superficial feet.	Greatest weight rolling on four wheels, in tons.	Greatest weight on a foot lineal of track, in tons.	Velocity of trains in mls per hour	Motive power employed.	Gross traffic over a single track of rails before renewal, in tons.	Weight of rails per mile for a single track, in tons.	Cost of rails per mile, estimated at 50 dollars per ton.	Number of tons carried over one mile of road for each dollar's worth of iron consumed.
1	56	2·5	·75	16	2·7	16	Locomotive	1,822,800	88	4400	414
2	63	3·75	2·25	16	2·7	16	Locomotive	12,000,000	99	4950	2421
3	56	2·5	1·75	7	1·2	12	Gravity	4,043,500	88	4400	919
4	56	2·5	1·1	7	1·2	3	Horses	9,800,000	88	4400	2227
5	90	2·4	1·7	14	2	8	Stationary	8,000,000	142	7100	1126
6	55	5·	1·1	8·5	2·2	3	Horses	1,628,640	86	4300	378
7	56	2·37	2·1	4·8	1·5	6	Stationary	7,840,000	88	4400	1781
8	75	2·5	1·5	11	2·4	12	Locomotive	5,500,000	117	5850	940
9	40	3·87	2·5	5·9	1·3	4	Horses	15,000,000	63	3150	4126
10	50	4·5	2·5	16	2·8	30	Locomotive	10,000,000	78	3900	2564
11	72	5·	2·7	16	2·8	30	Locomotive	41,000,000	113	5650	7256
12	72	5·	2·7	16	2·8	30	Locomotive	22,400,000	113	5650	3964
13	46	4·25	2·	10	2·1	10	Locomotive	1,318,000	72	3600	363

Discovery of Ancient Greek Sculpture.

Letters from Athens mention the discovery of 300 antique statues, or fragments of sculpture, recently brought to light by excavations at Argos, on the site of the Temple of Juno. These precious remains of ancient art have been recovered by the Greek Government; and, if it had any large spirit or interest in archæology, Argos possesses within its classic soil quarries of invaluable works of sculpture buried in the ruins of the ancient city, and which might be reclaimed at no great cost. Indeed, the sites of the old Greek temples in many districts, excavated by the Government or by the capital of associations, would probably, by sale of the works discovered, amply repay the outlay. We have evidence of value received in the voluntary and enterprising exertions of our own countrymen, Sir Charles Fellowes and Mr. Layard, and in the produce of the rival labours of M. Botta and M. de Sauley, under the auspices of the French Government. The small village of Argo stands on the ruins of the ancient Argos. The old town is described by Strabo as the principal city of Peloponnesus next to Sparta. In number and magnificence of temples and public edifices, in schools of art and great artists, it perhaps only yielded the palm to Athens. In sculpture the Sicyonico-Argive school, under Polycletus, rivaled the attic studios of Phidias and Praxiteles. Pausanias, in his description of the temples, statues, and paintings remaining in Greece, when about A. D. 177 he travelled throughout all its States, describes the classic relics with the detail and accuracy of a *Murray's Handbook*, and devotes several pages to the remains of Argos in his time. The temples and their inestimable works of art were then generally complete and perfect. Their marbles and casts of metal were of priceless value, comprising many statues in marble and brass by Lysippus and other eminent sculptors, besides the works of local artists. The Temple of Juno, in its architecture and riches of art, competed with the Parthenon. The Roman generals, the barbarians, and the pirates we know plundered the Greek cities, both before and after the visit of Pausanias. Nevertheless, the great bulk of treasures escaped, the majority of the "Temples of God" being preserved from sacrilege out of regard for the common sentiment of religion and the faith of the conquered races, Rome, Florence, and Naples, and private collections on the continent and in England doubtless contain many first-class works of Greek sculpture; but the mass, probably, remains, whole or fragmentary, beneath the ruins of their ancient resting places. Indeed, the Elgin Marbles have only within this century been rescued from ruin and destruction by their transference from the architraves of the Parthenon to the British Museum. The recent discoveries therefore at Argos have occasioned the deepest interest on the continent among artists and lovers of art. They may come to light unquestionable works of Polycletus. Although inferior to Phidias "in the fashioning of gods in general," he was the most celebrated of Greek sculptors in the perfection of his colossal statues and in the superior representation of beautiful gymnastic figures. One of his statues, the Doryphorus, became a canon of the proportions of the human frame. Pliny ascribes to him the establishment of the principle that the weight of the body should be laid chiefly on one foot, whence resulted the contrast, so significant and attractive, of the bearing and more compressed with the borne and more developed side of the human body. Polycletus is recorded to have conquered Phidias, Ctesilaus, Phradmon, and Cydon with his Amazon in a contest of artists at Ephesus. We are glad to learn that the Greek Government will permit casts to be taken of these newly-discovered sculptures, which we may therefore expect will soon become as general and as valuable models as the Niobe and the Elgin Marbles. The excavations also, we understand, are to be continued. We hope that this spirit of antiquarian research in Greece, thus rewarded and excited, will induce King Otho to direct similar explorations on the sites of the Argive Temples of the Lycian Apollo, Bacchus, Minerva, and of other monuments of Argos. Their localities are minutely described by ancient and modern travellers. The majority of our readers, may not know that Pausanias commonly gives the distances and measurements of the Greek temples with minute accuracy, as tested by travellers of our own times. He moreover, records particularly all the chief works of sculpture in every building. His account, also, of pictures is equally singular and full. The description of one great work of Polygnotus—the subject of which was the taking of Troy and the embarcation of the Greeks—occupies several pages. The new Ministry at Athens will find a useful guidebook if they only first exhaust Pausanias. If Greece will not progress, His Majesty may as well increase the stores of Dresden and Munich.—*Evening Mail.*

Inaugeration of the Calcutta Railway.

This great event took place on the 3rd February 1855. The line is now completed for 122 miles to the collieries at Ranee-gunge, but Burdwan, a town of importance, about 68 miles from Calcutta, was selected for the ceremonies of the day, in order to suit the convenience of all parties. Two trains were appointed to convey 600 passengers from Calcutta to that station. The terminus at Howrah opposite Calcutta was decorated for the occasion with great taste.

"The train reached Burdwan in about three hours. The whole Government (the Governor-General excepted) was on board, and a bishop and a bishop elect. It was important, therefore, that the utmost care should be exerted to prevent accidents. At Burdwan the station was decorated in the most tasteful style, and a sumptuous entertainment was spread in a noble pavilion for 700 guests.

The enthusiasm of the natives along the line was boundless. The towns and villages poured forth their inhabitants by hundreds and thousands to witness the grand spectacle, and in many places, more especially where education had made progress, gave us the most hearty cheers.

Contracts have been made for the completion of more than 600 miles from Burdwan to Cawnpore, and Mr. Stephenson is pushing forward the operations with all his characteristic energy, and is so sanguine as to expect that the works will be accomplished in three years. There can be no doubt that all the earth-work and masonry may be completed within that period; but four bridges have to be constructed as large as London-bridge, and one of them at a depth of 70 feet, and, as it appears to the engineers desirable to avoid the construction of temporary bridges, and to make those which are built permanent, there may be more delay than is at present anticipated."

Three thousand miles of Telegraph have been completed during one year in this Presidency, and it is hoped to furnish one thousand miles of Railway in three years. The value of the electric telegraph is likely to be fully shown during the approaching summer. The Governor-General Lord Dalhousie, whose health is in a declining state, will pass the hot weather and the rains at Ootacamund. The Foreign and Military Secretary will accompany him, and, thanks to Dr. O'Shaughnessy, he will be able to direct the affairs of India from his mountain eyrie with such facilities as no previous Governor-General has ever enjoyed. The electric telegraph has now been completed to the capital of each presidency, and it passes through the Ootacamund. By this matchless instrument he will be in daily and hourly communication with all the subordinate Governments, and will be able to issue his instructions to every part of the country, and before sunset to receive information of their having reached the most distant extremities of the empire. By the time he arrives at Ootacamund the telegraph will have been completed to Peshawur, and he will be enabled, though 2,000 miles distant, to regulate the negotiations with Dost Mahomed day by day.—(*Correspondent of the Times.*)

Novel Galvanic and Electrotype Apparatus.

An important invention has recently been specified by Mr. Charles Weightman Harrison, of Richmond, Surrey, for "Improvements in obtaining and applying electric currents, and in the treatment of certain products derived in obtaining the same," parts of such improvements being applicable to the production of motive power. The inventor employs cast amalgam plates, produced by melting zinc in a crucible, and carefully adding mercury thereto in small proportions at a time, through a small earthenware funnel, with the end of the tube inserted in the molten metal. This amalgam is, for a short time, exposed to a slow heat, and then cast into the form and size required. Plates formed of 1 part mercury and 100 parts zinc, are said, when galvanically arranged, to give a current of higher power than common amalgamated zinc plates, and to retain a protective character throughout. As negative electrodes, an alloy of iron and platinum, formed by strongly heating the metals together in a covered crucible, is used; 1 part of platinum and 100 parts of iron, give a product which is unaffected by nitric or sulphuric acids of the ordinary commercial strengths, and which may, when cast, be hammered or rolled into thin sheets, and cut into convenient sizes. There is a peculiarity in the form of the negative electrodes which gives them a large increase of effective surface over the positive electrodes, and consists of bending the plates in a zigzag manner over their whole surface, and then dividing the bends to within a short distance of one or both ends, so as to afford openings whereby the lines of electric induction may pass direct to the back of the plates, or by partly dividing plates of metal into numerous bars, or segments, by which the same increase of surface and results are obtained. A powerful galvanic current is produced by bending a negative electrode, formed as above, across the middle, so as to oppose it to both surfaces of the positive electrode, and then immersing them in a vessel containing, in addition to the usual electrolytes, an oxide of chlorine, the protoxide, or euchlorine, being preferred; such galvanic combination, from the characteristic properties afforded by the compound of oxygen and chlorine, is called by the inventor "the euchlorine battery." The presence of an euchlorine compound of oxygen in the exciting fluid, gives rise to the ready production of secondary results, and thereby affords a powerful development of electricity, equal to that of the nitric acid double fluid batteries; while it is free from the inconvenience attendant on their use, and, by proper adaptations, its operations may be maintained for a lengthened period. The peculiarities of the inventor's concentric battery are, that each of the positive plates is formed of a like quantity of metal, consequently they are progressively thicker as their size diminishes; two negative plates intervene between the positive plates, and these are separated from each other by a non-conducting material, each pair of negative plates, however, being united so as to operate as one plate. The whole of the plates are contained in a square case, and the exciting solution employed, where long-continued action and moderate power is required, is a saturated solution of muriate of ammonia, a supply of the solid salt being placed in the vacant spaces at the corners, behind perforated screens. To avoid the inconvenience which is often experienced by the use of porous earthenware cells, from their being rarely alike permeable, asbestos, or other incombustible amphibolite mineral is employed, by reducing it to a pulpy mass, and manufacturing it into sheets by the usual process of paper-making, these sheets being cut into the required sizes for diaphragms, and the edges united with gutta percha, or other material.

The second branch of the invention consists of the application of electric currents around electro-magnets through square or rectangular-formed wires or ribbons, that conductor being found to possess great superiority over common round wire. In the application of electric currents as a motive power, what is termed a "plate horse-shoe electro magnet" is used. It is manufactured of drawn plates of fibrous decarbonized soft iron, about a quarter of an inch in thickness, which are bent along the middle in the direction they have been drawn to the shape of an ordinary horse-shoe magnet, and until the arms are about a third of an inch distant from each other; the great length of poles, and the large, thin rectangular arms being the main peculiarity of the magnets. They can be applied in various ways for the production of motive power. The inventor gives descriptions of several methods of producing motion; it is not necessary here to enter into detail.

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The third and last branch of the invention consists of improvements in the manufacture of colouring matter from the metallic salts derived in obtaining galvanic electricity, the improvement being that, instead of producing colouring materials from galvanic solutions, by the addition thereto of the alkaline salts of chromium and ferrocyanogen, the acid solutions of these colouring bases are employed, and the chromic and ferrocyanic acids are caused to combine with, and be taken up by, the metallic salts or oxides. The colours thus produced are adapted for use in the manner of ordinary colours, and from the fact of their being principally composed of oxide of zinc, they possess a more permanent character than common colours or paints.—*Mining Journal.*

Canadian Minerals at the Paris Exhibition.

Specimens of the following Minerals and products of Mineral origin have been sent to the Great Exhibition at Paris, as representatives of the Mineral wealth of Canada:

Iron Oxydes, from Marmora, Madoc, Sherbrooke, Crosby, Hull, Leeds, and Portage du Fort.
Bog Iron, from McNab, Wallace, Lake Nipissing, Houghton, Vaudreuil, Nicolas, Machiche, Pont de Lac, St. Pierre, Cap de la Madeleine and St. Valier.
Titanic Iron, from Sutton and Brome.
Ilmenite, from Bay St. Paul and St. Urbain.
Blende, from Lake Superior.
Galena, from Lake Superior, Gaspe, Ramsay and Lansdowne.
Copper Ore, from Lake Superior, Lake Huron and Inverness.
Native Copper, from Lake Superior.
Gold and Silver Pyrites, from the Eastern Townships.
Nickel, from Lakes Huron and Superior and d'Aillebout.
Native Silver, from Lake Superior.
Native Gold, from Rivière-du-Loup, Fief Saint Charles, Aubert de l'Isle, Etchemin, Chaudière and Famine Rivers and from the neighbourhood.
Platinum, from the Fief St. Charles.
Iridium, from do.
Gold Pyrites, from Beauce.
Silver Pyrites, from do.
Arsenical Pyrites, from do.
Ochre of Uranium, from Madoc.
Chromiferous Iron, from Bolton and Ham.
Cobalt, from Lake Superior.
Manganese, from Quebec.
Iron Pyrites, from Lanoraye and the Eastern Townships.
Molybdenite, from Lake Superior and Sommerville.
Dolomite, from Dalhousie, Blythefield, Sutton, Brome, Shipton, St. Sylvestre and Pointe Levi.
Magnesia, from Sutton and Bolton.
Iron Ochre, from St. Anne, near Quebec, Cap de la Madeleine, Shipton, Pointe de Lac and Rimouski.
Barytes, from Burgess and Lansdowne.
Phosphate of Iron, from Vaudreuil.
Lithographic Stone, from Marmora.
Agates, from the North Shores of Lake Superior.
Labradorites, from Grenville.
Jasper, from Lake Huron.
Red Quartz Agate, from Lake Superior.
Perthites, from Bathurst.
Rubies, from Burgess.
Talc, from Bolton and Potton.
Mica, from Grenville.
Plumbago, from Grenville and Burgess.
White Freestone, from St. Maurice.
Amianthinite, from Dalhousie and Kamouraska.
Phosphate of Lime, from Perth.
Gypsum, from Brantford and Oneida.
Shell-Marl, from Ottawa, Sheffield, Montreal and Stanstead.
Whet-Stones, from Madoc and the Eastern Townships.
Canadian Tripolite, from Laval.
Slate, from the Eastern Townships.
White Granite, from Hereford, Barnston, St. Joseph and Nicolet.
Pseudo-Granite, from Nicolet and Lorette.
Freestone, from Ramsay, Pembroke and St. Maurice.
Calcareous Freestone, from Lauzon and Chaudiere.

Lime, from Marmora, McNab, Les Chats, Gloucester, Montreal, Packenham and Caughnawaga.
Trap, from St. Roch.
Marble, from Oxford, Brompton Lake, Dudswell, St. Armand, St. Lin, McNab and Pakenham.
Hydraulic Lime, from Thorold, Quebec, Oneida, Nepean and Brantford.
Bricks for Building, from various places.
Peat, from Longueuil and Sheffield.
Asphaltum, from Enniskillen.
Aerolite, found in Madoc, forming a mass of Iron with 6.35 per cent. of Nickel, weighing 370 lbs.

The Refuse of the Smelting Furnaces.*

The production of iron by the smelting-furnaces of Great Britain has reached 3,000,000 tons annually; and by a moderate calculation, it may be assumed that for every ton of iron two tons of slag are formed, making an aggregate of at least 6,000,000 tons of this hitherto refuse material. Not only has this vast accumulation of slag been to the present time comparatively useless, but it has proved an incumbrance and source of heavy expense to the ironmasters; for it is calculated that a sum of not less than £150,000 sterling is annually expended by and lost to them in removing the unsightly heaps from their premises, to be used as the most worthless of materials in mending old roads, and in filling gullies and other vacant spaces. We are, however, destined, before long, to witness this singular substance applied to economic purposes of the highest utility; and we venture to predict that it will be hereafter seen superseding the labours of the quarry, rivalling the most valuable marble, and even in beauty and brilliancy many of the precious stones, such as the agate, the jasper, the different classes of variegated marbles, and even the very attractive malachite.

We now proceed to notice a highly interesting paper, read at the Society of Arts, by Dr. William H. Smith, of Philadelphia, U.S., "On the Utilisation of the Slags, or Molten Mineral Products of Smelting Furnaces." The term "slag" has been defined by most standard authorities as the "refuse vitreous products of smelting furnaces," a definition which, being only applicable to slag in its altered conditions, after having been rendered brittle and worthless by improper treatment succeeding its withdrawal from the smelting furnace, he rejects as erroneous. In order to be fairly viewed and justly appreciated, slag must be considered both in its molten state, as a fused mineral product, and in the variety of combinations, forms, and general properties it may be made to assume, under scientific treatment, subsequent to its removal from the smelting furnace. The first general view which slags thus considered naturally present, is that which relates to their philosophic character, which we briefly notice before passing to consider a more important aspect—viz., their commercial value.

In the wide range of geological science we find but few general phenomena which cannot be elucidated by the chemico-mineralogical transformations of the smelting furnace. In that vast apparatus, by the study of existing operations, agencies, and laws, the geologist finds a clue to the formation of the earth, an exponent of those laws and phenomena which have modified and determined the condition of the rocky crust of the globe. When his cupola is built, and his blast started, the metallurgist is at once ready to daguerreotype, or rather reproduce, although in minature, the mountainous deposits and diversified formation of the igneous rocks; and if his researches verge upon chemical science, in studying the agency of heat on the form colour, and other properties of matter, he can observe the influences which determine the crystaline or amorphous structure of slag, and those wonderful chemical affinities which bind together in definite atomic proportions the elementary molecules of slag, however complex the combinations it may assume under the smelting operation.

The rocks of igneous origin are well known to the scientific world, and highly appreciated by the practical architect; they are the rocks of which Nature builds her loftiest mountains, and man constructs his most enduring monuments. Many of the mountain ranges even of this island are composed of those strata which have been thrown up and altered in mineral aspect by molten masses and veins, presenting no traces of decomposition, and which, like slag, are of igneous origin. Granite, syenite, protogine, serpentine, porphyry, basalt, felspar, greenstone, lava, &c., are amongst the varieties of the igneous rocks, and the industrial purposes to which they are applied are numerous, and of primary importance. If we admit the existence of some deep-seated source of heat to which these rocks owe their origin, the anagoly between them and the products of smelting furnaces, which are composed of the same elements, fused by the same igneous agency, and modified in form, colour, and character, by the same fixed chemical laws, a doubt cannot be entertained of the value of this artificial mineral product, as combining in itself qualities possessed and divided amongst many natural varieties. Selecting the slags of iron furnaces, they will be found composed of silica, lime, and alumina, as their chief ingredients, in combination with traces of magnesia, protoxide of iron, sodium, potassium, carbon, manganese, carbon, sulphur, titanium, and phosphorus. According to the analysis of M. Berthier, the slag of the Dowlais furnaces, from which some of the manufactured samples exhibited were made, consists of silica, 40·4; lime, 38·4; alumina, 11·2; magnesia, 5·2; protoxide of iron, 3·8; and a trace of sulphur. Slags from other iron furnaces in France and England presented similar analytical results, varying slightly as to the relative quantities of manganese and sulphur, while a mean average of the anthracite furnaces of America shows their slag to consist of silex 51, lime 21, and alumina 15. Prof. Philips, in his mineralogical work, observes:—"If we look more narrowly into the composition of the crust of the globe, as consisting chiefly of the earths and earthy materials, we find that only three of the earths which have been discovered—viz., silica, alumina, and lime, are found to constitute its great bulk." Regarding, therefore, silica, lime, and alumina, as the chief constituents of slag, we are furnished with the very ingredients out of which Nature has fashioned and annealed nearly all the valuable building materials of the mineral kingdom.

In the utilisation of slag for commercial purposes, by the processes of casting, pressing, rolling, moulding, and annealing, the facilities afforded by the extremely liquid molten state to which the slag is reduced in the smelting furnace are availed of, so that by suitable appliances any desired form, colour, or texture, can be imparted. We here adopt the descriptive language of Dr. Smith:—"According to the treatment it receives, slag can be rendered brittle or tough, hard or soft, compact or porous, rough or smooth. It can be cast into as great a variety of forms, solid and hollow, as iron itself, with the superior advantage of being susceptible of the admixture and blending of colours, so as to render it equal in brilliancy to agate, jasper, malachite, the variegated marbles, and other more valuable varieties of the mineral kingdom. When properly annealed, it can be made to acquire a surface, or texture, at least 10 times as durable as that of marble, and is susceptible of a polish equal to agate or cornelian. As a building material slag can be readily adapted to any variety of architectural design, from the simple slab to the most ornate and complex decoration; whilst its beauty and durability chiefly recommend it as an article of luxury."

Dr. Smith entered into a comparison of the relative expense of the manufacture of clay bricks as compared with that of bricks or blocks of slag; and he reminded us, that in making bricks of the latter, the raw material cost less than nothing, inasmuch as the ironmaster saves by its utilisation the heavy expenditure now attendant upon its removal from the furnace premises. In fusing slag for the operation of casting no expense is incurred, inasmuch as this item of expenditure is charged by the metallurgist to the metallic and *not* to the earthy products of the smelting operation; whereas, in making bricks of clay, the raw material has an intrinsic value, while the consecutive operations of digging the clay, preparing it for use, and transporting it, added to the process of pressing and annealing, consume at least twice as much time and labour as are employed in working slag. "From these simple, yet clear data," observed Dr. Smith, "we can fairly infer that the cost of making clay brick will be double that of making blocks, tiles, or more decorative and valuable articles from slag. By extending this calculation to other products, such as marble slabs, columns, carved architectural ornaments of stone, &c., and in our estimate contrasting the plastic power of fusion available in slag with the laborious hewing and fashioning by mechanical means required for blocks of marble and other stones, we may arrive at still more satisfactory results in proving the commercial value of slag."

The samples which were exhibited and examined by the auditory excited general admiration, from the closeness of the texture, the height of the polish and the beauty and apparent durability of the articles. Some of them had been made from the slags of American furnaces, others from those of the furnaces of France and England; and it was evident, from their inspection, that the commercial value expressed in the above calculation was by no means extravagant. To

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* *The Mining Journal.*

the vast quantity of iron slag produced in England may be added the amount also yielded in the reduction of ores of copper and lead, without considering zinc and other metalliferous sources; the supply will, accordingly, be found sufficient to create a new channel of productive industry, which may possibly equal in extent, interest, and importance, any single one that now affords employment to the capital and industry of civilized nations.

CANADIAN INSTITUTE ESTABLISHED 1849

CANADIAN INSTITUTE—SESSION 1854-55.

Fifteenth Ordinary Meeting—March 31st, 1855.

The name of the following candidate for membership was read:—

Mr. Sheriff Jarvis........................ Toronto.

The following gentlemen were elected members:—

John Macpherson Hamilton.................. Toronto.
William Dickson............................ "
H. T. Bown................................ Hamilton.
Robt. J. Johnston......................... Thorold.
W. H. Lambe............................... Montreal.
Frederick W. Torrance..................... "
Hon. John Young........................... "

Mr. Cumberland read a paper, entitled "Some Notes of a Visit to the Works of the Grand Trunk Railway of Canada, West of Toronto."

A Paper, communicated by Mr. Paul Kane, was read by Mr. G. W. Allan, "On the Habits and Customs of the Chinook Indians."

Various articles of dress worn by the Chinook Indians, specimens of their bows and arrows, spears, cooking utensils, and a skull taken from one of their graves, were exhibited. Several admirable oil paintings, executed by Mr. Kane, illustrated many important features of the lives and characters of the Chinook Indians.

Sixteenth Ordinary Meeting.—April 14th. 1855.

The names of the following candidates for membership were read:

Rev. W. Ritchie........................... Georgina.
George Perkins............................ Toronto.
Stephen Heward............................ "

The following gentleman was elected member:—

W. B. Jarvis.............................. Toronto.

In pursuance of an order from the Council, the First Vice-President brought under the consideration of the meeting the subject of a new building for the purposes of the Institute, invited discussion thereon, and announced that a special general meeting would be called for Saturday, the 21st instant, for the purpose of considering the propriety of issuing authority to the Council to act in the matter.

The First Vice-President nominated Mr. Dalrymple Crawford, Auditor of Accounts for 1855, in conformity with the regulations of the Institute. Mr. Samuel Spreull was nominated on the part of the meeting.

Professor Chapman communicated an "Additional Note on the Object of the Salt Condition of the Sea," and submitted further views and authorities in support of his observations on an example of the igneous origin of Carbonate of Lime.

Professor Cherriman read a communication from Mr. A. Hood, of Dunnville, being "A Description of a new Astronomical and Surveying Instrument."

Special General Meeting.

April 21st, 1855.

The name of the following candidate for membership was read:—

George Morphy.............................. Toronto.

The following gentlemen were elected members:—

Stephen Heward............................. Toronto.
Rev. W. Ritchie............................ Georgina.
George Perkins............................. Toronto.

The following donations from the Hon. J. M. Brodhead, of Washington, through Mr. A. H. Armour, were announced:—

Espy's Report on Meteorology.
United States' Coast Survey, with Maps, 1853.
Stanbury's Expedition to the Great Salt Lake, with Maps.
Patent Office Report, Part 2, 1853.
Official Army Register, United States, for 1855.
Navy Register of the United States, 1855.
From Mr. A. H. Armour, Toronto:—
Census of Canada, 1851-52, in two volumes.

The thanks of the Institute were ordered to be given to the Hon. J. M. Brodhead and Mr. Armour for their valuable donations.

Mr. Sandford Fleming, C.E., read a paper by Mr. T. C. Clarke, C.E., "On the Action of the Ice upon the Bridge at Rice Lake."

Professor Hind made some observations "On the occurrence of Crystallized Carbonate of Lime in the Native Copper of Lake Superior."

The meeting then entered upon the subject of the new building, and after a prolonged discussion, the following resolutions were adopted:

Moved by Mr. Ure, seconded by Mr. Recorder Duggan:—

1. "That it is the opinion of this meeting that the ground which has been so handsomely offered by Mr. Allan, for a permanent building for the Canadian Institute should be at once accepted, and that the cordial acknowledgments of the Institute be tendered to the generous donor for his munificent gift"

Carried, *nem con.*

Moved by Mr. Recorder Duggan, seconded by Mr. W. G. Storm,

2. "That in the event of its being found possible to erect a building for the purposes of the Institute, the Council be authorized to take such steps as shall seem most advisable both for that purpose, and also for securing such temporary accommodation as will be required."

Moved by Mr. Walter Mackenzie, seconded by Mr. Secker Brough,

3. "That the thanks of the Institute be tendered to Mr. Cumberland for his generous offer to give his services as Architect of the building proposed to be erected."

LITERARY AND HISTORICAL SOCIETY OF QUEBEC.

LITERARY OR STATED MEETING.

Wednesday, 7th March, 1855.

The following gentlemen were proposed as Associate and Corresponding members, viz.:—

As Associate Member..................Geo. Desbarats.
As Corresponding Member..........T. E. Campbell, C.B., late Major 7th Hussars.

A paper "On Russian America" was read by Mr. A. R. Roche.

STATED MEETING.

21st March, 1855.

The following donations were announced from T. D. Harington:—

Guizot's Life of Cromwell.

Mackintosh's Military Tour through the Seat of War, Crimea, &c.

Slavery on African Coast.

Huc's Travels in Tartary, Thibet, &c.

Scientific Annual, 1852 and 1853 (United States).

Year Book of Facts, 1852 and 1853.

From G. B. Faribault:

Public Accounts of the Province of Canada for 1853.

Annual Report of the Postmaster General, for the year ended 31st March, 1854.

Return from the Clerk of the Crown in Chancery, showing the number of Votes polled in each County.

Documents submitted by the Bureau of Agriculture to the Legislature.

Report of the Superintendent of Education, Lower Canada, for 1853.

The Seigniorial Tenure of Canada, and Plan of Commutation, by J. C. Taché.

Tables of the Trade and Navigation of the Province of Canada, for 1853.

Census of Canada for 1851 and 1852, vol. 2.

The thanks of the Society were ordered to be given to T. D. Harington and G. B. Faribault.

The following gentlemen were proposed as Associate Members.

Walter Serocold, late Captain, 66th Regiment.

William Chessell.

A Paper was read by F. N. Boxer, submitting certain suggestions for the better conducting the affairs of the Society.

Resolved that F. N. Boxer's paper be referred for the consideration of the Council of the Society.

A Paper was read by A. R. Roche, entitled, "A Proposal for extending the Trade of the Province."

HENRY E. STEELE,
Recording Secretary.

Chair of Natural History, Edinburgh University.

Some difficulty appears to be found in selecting a fitting successor to Professor Edward Forbes; and we have referred, on another page, to a discussion this has given rise to. According to the latest accounts, we learn that the idea is gaining ground of subdividing the Chair into two Professorships. One of Geology, for which it is understood the Duke of Argyle—who takes a lively interest in the question—destines Hugh Miller; the other of Natural History, in its several distinct branches, exclusive of Botany, which already constitutes a separate Chair. For this Mr. Allman, of Trinity College, Dublin, is favourably spoken. Though there are various other candidates—Mr. Huxley, of the London Museum of Practical Sciences, and recently one of the candidates for the new Chair in University College, Toronto; Professor Nichol, formerly of Cork, and now of Aberdeen; and Dr. Fleming, of New College, Edinburgh. The revenues of the Chair are estimated at upwards of £1000 stg.; so that it is a rare prize in the scientific lottery, and may be expected to excite abundant emulation. The great difficulty in finding a fit successor to Edward Forbes is no slight testimony to the profound and singularly varied range of acquirements of the late Professor of Natural History at Edinburgh.

The Hurricane of the 18th April, 1855.

The progress of the remarkable storm which swept over a large portion of Western Canada during the 18th of last month, has been recorded by the local Press of many localities where its destructive effects were visible, or the various phenomena which accompanied it particularly manifest. We propose to condense the various accounts which have reached us, and present them in a connected form in the June number of this *Journal.* We shall feel indebted to our readers and correspondents for any exact information or description they may have it in their power to communicate.

Miscellaneous Intelligence.

Elevation of the Land in Human Period.—General De la Marmora, who has been employed twenty-four years on a geographical and geological survey of Sardinia, presented an outline of his researches in the latter department to the Geological Society of France on 6th November last. In this paper he states that near Cagliari he found a raised beach containing shells mixed with works of human art (pottery), at an elevation of 197 feet (60 metres) above the sea. It seems to be slightly *inclined;* and he speaks of another deposit, probably a newer one, a little farther on, which is horizontal and almost at the level of the sea. He estimates that at Alghero, 100 miles NNW., the rise produced by the same upheaval has been 328 feet, not attested, however, by human remains, but by the position of a "quaternary sandstone." The extreme rarity of raised beaches containing such remains renders these facts interesting. Mr. Lyell refers only to three—one which I have seen, at Putzuoli, 20 feet above the present sea level; another near Stockholm, 60 feet above it, and a third in Peru, seen by Mr. Darwin, 85 feet. It now appears that some parts of Sardinia have been upheaved 197 feet since the island was occupied by man.

Velocity of the Electric Current.—At the meeting of the Belgian Royal Academy on 2nd December, M. Quetelet described Mr. Airey's experiments with the electric telegraph to determine the difference of longitude between Greenwich and Brussels. The time spent by the electric current in passing from the one observatory to the other was found to be 0s.109, or rather less than the *ninth part of a second* and this determination rests on 2,616 observations. The distance between the towns being 270 miles, the velocity of the current, supposing it to be uniform, must rather exceed 2,500 miles per second, or about one-seventh greater than that obtained by the American observers, a speed which would "girdle the globe" in ten seconds. The difference of longitude from two series of observations, and by two methods, was found to be 17m. 28s.9. Observations made by an eclipse of the sun in May 1836, gave precisely the same results which may be considered the most correct; an eclipse of the sun in 1842, gave four-tenths of a second less; lunar occultations gave nine-tenths of a second less; and observations by chronometers gave 1 second and three-tenths less. A second in this case represents a distance of 455 yards, and a tenth of a second 45½ yards. Assuming the first-mentioned time to be correct, the error in the chronometrical determination is equivalent to 591 yards, or the ninth part of a mile, which, after all, is only the 2430th part of the whole distance.

Egg of the Epyornis.—At the meeting of the Academy of Sciences on 5th March, M. I. G. Saint Hilaire presented two eggs of this gigantic bird. The volume of one of them exceeded nine cubic decimetres, and must therefore have been equal to a sphere 10.4 inches in diameter, or to an egg-shaped body (an oblong spheroid) measuring 9 inches by 12. In a later number of the journal from which this notice is taken, we find the dimensions of three eggs of the Epyornis, of which the largest is as follows:—Longest axis 12.15 inches, shortest axis 9.37 inches; elliptical circumference 36.4 inches. The Epyornis is an extinct Madagascar bird, supposed to have been nearly *fourteen feet* in height.

New Gigantic Fossil Bird.—Professor Constant Prevost submitted to the Academy of Sciences on 12th March, the fossil bone of a bird found in the Paris basin, near Meudon. It was a *tibia* or leg bone; its length 17¾ inches its breadth at the lower end fully 3 inches; at the upper 3¾; at the middle 1¾. A difference of opinion existed among the naturalists as to whether it belonged to an Echassier (a long-legged bird) or a Palmipede. If the former, M. Prevost thought that it must have had twenty times the bulk of the swan. M. Valenciennes regarded it as more allied in form to the albatross, and in this case its dimensions will not be so great as M. Prevost conjectured. It has been named Palæornis Parisiensis, and was found at the bottom of the tertiary beds, resting on the chalk. It was therefore much older than the huge birds of New Zealand and Madagascar, which are found in alluvial deposits.—C. M., *Scotsman.*

Meteorological Observations, Fort Brady, Michigan. February, 1855.

Latitude, 46°·39 North; Longitude, 84°·43 West. *Altitude of Barometer above the Ste. Marie River 22 feet.*

Compiled for the Canadian Journal, by John T. Newton, *Acting Assistant Surgeon, U.S.A.*

Feb.	Barometer.				Therm'ter Attached.				Thermometer Detached.					Clearness of Sky.				Wind.				Rain.			
1855	S'nrise	9 A.M.	3 P.M.	9 P.M.	Sun-rise.	9 A.M.	3 P.M.	9 P.M.	Sun-rise.	9 A.M.	3 P.M.	9 P.M.	D'ly M'n.	Sun-rise.	9 A.M.	3 P.M.	9 P.M.	S'nrise	9 A.M.	3 P.M.	9 P.M.				
1	29·252	29·268	29·122	28·910	16	18	21	15	4	7	11	8	7·5	0	0	5	5	N E 3	N 3	S 5	S 3				
2	28·862	28·858	28·588	28·862	3	18	14	11	— 9	19	25	1	8·	7	9	7	5	N E 0	E 0	W 2	S W 5				
3	28·847	28·906	28·957	28·963	3	— 1	10	— 5	—13	3	2	—14	- 5·5	7	5	4	2	S W 0	N E 3	N E 3	N E 2				
4	29·063	29·055	29·004	29·012	—11	—10	— 2	— 7	—20	—12	5	—26	- 7·5	2	2	6	10	N E 0	N E 0	N E 2	N 0				There is no weather so cold as this on the records retained in the Hospital.
5	28·969	28·969	29·079	29·236	—15	—13	— 5	—12	—31	— 7	—11	—28	-21·	0	9	5	10	E 0	E 3	S E 3	N 2				
6	29·260	29·217	29·236	29·323	—19	—15	— 1	— 6	—32	—19	— 5	—19	-18·5	8	7	4	8	E 2	E 0	E 2	E 2				
7	29·292	29·134	29·138	29·138	— 6	0	10	— 3	—12	3	7	—16	- 2·5	6	3	6	10	E 0	E 0	E 2	E 0				
8	29·150	29·130	29·172	29·172	— 5	0	15	14	—17	— 2	7	7	- 5·	3	5	2	3	E 1	E 2	E 2	E 2				
9	29·236	29·244	29·260	29·291	3	13	17	22	— 8	15	17	16	4·5	8	1	0	0	S 0	S 2	S 2	S 3				
10	29·252	29·252	29·244	29·165	28	30	31	21	14	22	20	10	17·	0	0	5	8	S 2	S 2	S 2	W 5				
11	29.181	29·276	29·276	29·292	6	22	28	9	— 1	23	25	— 6	12·	10	10	10	10	N 2	N 2	N2	N 2				
12	29·292	29·292	29·295	29·189	12	20	20	24	5	8	20	20	12·5	0	0	0	0	S 2	S 4	S5	W 5	10 A.	M.		
13	29·088	29·091	29·055	29·004	27	29	35	30	26	27	23	27	29·5	0	0	0	0	E 2	S E 2	S E2	S E 2				
14	29·134	29·138	29·138	29·256	29	30	37	24	25	23	25	11	25·	0	0	1	1	S 2	N E 2	N E2	N 4				The Thermometer detached shows a mean of -3°·3 below zero. The register of no other winter comes near equalling it in continued severity. While our Thermometer stood at -32° the Thermometers in the village stood at -36° and at the head of the 'Portage, half a mile distant, -39° below zero. The wind, though marked strong the latter part of the month, falls far short of giving the real strength of the gale when outside of the pickets.
15	29·272	29·328	29·347	29·295	20	24	33	22	13	19	31	15	22·	0	0	0	2	N 2	N 3	N 3	N 2	In the night			
16	29·228	29·229	29·213	29·217	24	23	28	24	16	18	23	16	19·5	2	2	0	0	N 2	W 2	N W 3	N 3				
17	29·240	29·284	29·366	29·366	19	22	28	27	11	21	21	20	16·	7	7	4	0	N W 2	W 0	W 2	W 0			0·65	
18	29·483	29·441	29·429	29·449	21	23	26	22	13	21	25	12	19·	1	6	6	10	W 0	N 1	N 3	N 0				
19	29·433	29·465	29·449	29·465	10	14	35	30	— 3	34	53	15	25·	10	10	10	10	W 0	W 2	N W 2	N W 2				
20	29·583	29·587	29·587	29·581	16	16	25	17	4	13	39	4	21·5	5	2	5	10	N 0	N 0	N 2	N 0				
21	29·575	29·575	29·579	29·402	15	29	33	27	5	39	41	12	28·	2	3	5	0	S 0	S 0	S 3	W 7				
22	29·391	29·449	29·449	29·551	12	16	15	10	— 5	16	5	— 5	0·	7	6	4	7	N W 2	N W 5	N W 6	N W 5				
23	29·469	29·461	29·551	29·500	— 4	— 2	— 2	— 1	—15	1	— 2	— 5	- 8·5	8	5	6	7	N 0	N 1	N 3	W 5				
24	29·425	29·449	29·449	29·449	— 0	2	2	2	—21	8	1	— 6	10·	10	7	7	7	S E 0	W 6	W 7	W 5				
25	29 276	29·256	29·205	29·189	— 2	2	5	6	—10	2	3	— 1	- 3·5	7	6	5	6	W 6	W 7	W 7	W 6				
26	29·193	29·205	29·114	29·193	5	10	17	14	3	10	23	— 1	12·5	0	5	7	9	W 6	W 5	W 4	W 0				
27	29·284	29·315	29·445	29·457	6	15	18	15	— 7	19	5	— 3	- 2·5	6	6	7	10	S 0	S 1	S W 4	S W 5				
28	29·575	29·638	29·630	29·634	2	5	22	19	—12	16	35	0	11·5	10	10	10	10	S 0	S 0	S 1	S 1				
	29·272	29·268	29·287	29·237	8.15	14·10	18·25	13·9	-3·3	16·2	17·8	2·8	3.21	4·9	5·7	4.23	5·8							0·65	

The above will show February to be an extremely cold month, far exceeding any month since 1844, (the period which our Registers date back to), in continued severity, as the following synoptic analysis will show :—

The grand mean temperature of the month of February, 1844, was 21°·?0 above zero. The *minimum* mean was 14°·65, and the *maximum* mean was 27°·62 above. The lowest observation registered was -20°· (below zero). The month was comparatively calm. No Auroras or Halos. The amount of snow in a fluid state was 0·43 hundredths of an inch. Navigation opened this year on the 22nd of April.

The grand mean of February, 1845, was 20°.3 above zero. The *minimum* mean was 14°·7, and the *maximum* mean was 23°·9 above. The lowest observation registered was -16°· below zero. The wind moderately strong. Two Auroras were observed. The quantity of snow 1·88. Navigation opened this year on the 25th of April.

The grand mean temperature of February, 1846, was 17°·8 above zero. The *minimum* mean was 11°·2, and the *maximum* mean 24°·5. The lowest observation registered was -22°· (below zero.) This month was extremely calm. Two dim Auroras were observed. The quantity of snow 9·35. The nine thirty-five is evidently an error in the Register. Navigation opened on the 23rd of April.

The grand mean temperature of February, 1847, was 15°· above zero. The *minimum* mean was 6°·5, and the *maximum* mean 24°· above zero. The lowest observation was -16°· (below zero). One bright Aurora. The quantity of snow was 0°·80. Navigation opened on the 9th of May.

The grand mean temperature of 1848 was 21°·20. The *minimum* mean was 15°·4, and the *maximum* mean 29°·5. The lowest observation registered was -5°· (below zero.) The month was extremely calm. One beautiful Aurora. The quantity of snow 1·83. Navigation opened on the 26th of April.

There was no Register kept during the winter of 1849. The grand mean temperature of the month of February, 1850, was 22°·27. The *minimum* mean was 13°·26. and the *maximum* mean was 31°·26 above zero. The lowest observation was -11°· (below zero). Wind at times very strong. The quantity of snow 1·83. Navigation opened on the 3rd of May.

The grand mean temperature of February, 1851, was 21°·19. The *minimum* mean was 14°·26, and the *maximum* mean 31°·13 above zero. The lowest observation -10°· (below zero). Navigation opened on the 2nd of May.

The grand mean temperature of February, 1852, was 16°·17 above zero. The *minimum* mean was 12°·23, and the *maximum* 22°·22 above zero. The lowest observation -26°· (below zero). The quantity of snow was 2·00 (two inches). Navigation opened on the 7th of May.

The grand mean temperature of February, 1853, was -28°·12 above zero. The *minimum* mean was 8°·27, and the *maximum* mean 24°·4. One Lunar Halo observed. The quantity of snow was 1·19. Navigation opened on the 28th of April.

The grand mean temperature of February, 1854, was 11°·3 above zero. The *minimum* mean was 4°·23, and the *maximum* mean 17°·14 above zero. Two Auroras were observed, and a luminous meteor on the night of the 28th was observed to pass from the zenith to the Northern Horizon. Navigation opened on the 7th of May.

Monthly Meteorological Register, at the Provincial Magnetical Observatory, Toronto, Canada West.—March, 1855.

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

Day.	Barom. at temp. of 32 deg. 6 A.M.	2 P.M.	10 P.M.	Mean.	Temp. of the Air. 6 A.M.	2 P.M.	10 P.M.	M'N.	Mean Temp. + or − of the Average	Tension of Vapour. 6 A.M.	2 P.M.	10 P.M.	M'N	Humid'y of Air. 6 A.M.	2 P.M.	10 P.M.	M'N	Wind. 6 A.M.	2 P.M.	10 P.M.	Mean Vel'y	Rain in Inch.	Snow in Inch.
1	30·060	29·966	29·952	30·001	−2°·9	31°·5	21°·1	19°·2	− 6°·0	0·039	0·120	0·116	0·097	·93	·68	·86	·82	N W b W	S W	W S W	7·74	...	...
2	29.900	·788	·733	29·798	23·7	35·2	30·2	29·6	+ 4·2	·119	·184	·150	·151	92	90	89	90	S W b W	S W b S	Calm	6·46	...	1·0
3	·653	·564	·659	·625	29·4	34·7	34·8	33·3	+ 7·6	·148	·165	·183	·170	91	86	92	90	S W b W	S W b W	W b S	4·98	...	...
4	·740	·706	—	—	26·6	39·5	—	—	—	·127	·176	—	—	87	73	—	—	N W b W	S	S W	7·00	0·170	...
5	·335	·187	·031	·182	36·5	39·7	39·5	37·7	+11·4	·205	·214	·184	·192	95	88	76	85	S W b W	S W b S	W b S	15·41	0·005	...
6	·391	·161	·564	·482	26·6	33·9	20·6	26·5	0·0	·126	·160	·102	·126	·86	81	90	85	W N W	W N W	N	8·97	...	...
7	·524	·481	·717	·584	17·6	27·3	23·7	23·3	− 3·5	·076	·128	·119	·111	75	85	92	85	N	E b N	N N E	2·10	...	2·0
8	·790	·720	·309	·591	9·0	31·9	29·1	24·4	− 2·8	·058	·133	·148	·117	83	74	92	86	N	S b E	S S E	2·42	...	1·2
9	·238	·438	·771	·501	26·6	29·0	17·2	24·4	− 3·1	·136	·111	·085	·116	92	68	85	84	W b S	N W b W	N N W	20·72	...	0·1
10	·994	·903	·776	·880	7·9	25·5	24·8	19·4	− 8·4	·054	·102	·119	·092	81	73	87	80	N N W	S W b S	S S E	3·75	...	...
11	·586	·490	—	—	28·4	29·8	—	—	—	·146	·134	—	—	94	81	—	—	E	E N E	N E b N	7·27	...	...
12	·658	·712	·766	·726	24·8	35·1	25·5	27·9	− 0·6	·119	·128	·126	·120	87	63	89	79	N	E b S	E N E	7·58	...	...
13	·602	·304	·174	·352	25·1	27·8	30·2	28·2	− 0·8	·100	·141	·163	·139	72	91	97	88	E N E	E	E b S	20·74	...	6·0
14	·260	·369	·395	·344	33·0	38·8	36·3	36·6	+ 7·3	·169	162	·183	·179	90	69	86	83	Calm	S S E	Calm	3·47	0·680	...
15	·137	·153	·578	·310	36·3	41·4	32·4	36·1	+ 6·4	·213	·179	·167	·181	100	69	92	86	E	W b N	W	10·92	0·415	...
16	·716	·741	·736	·730	22·7	37·8	30·5	31·1	+ 1·1	·106	·142	·148	·135	84	63	88	78	Calm	S b W	Calm	2·18	...	0·1
17	·473	·126	·403	·323	32·7	38·4	34·8	35·4	+ 4·9	·139	·167	·151	·159	86	72	74	79	E	S b W	S W b W	17·70	0·215	...
18	·625	·644	—	—	31·7	39·9	—	—	—	·149	·160	—	—	83	66	—	—	W b S	W b S	Calm	6·83	...	...
19	·653	·507	·408	·506	21·9	40·2	24·9	28·8	− 2·5	·102	·159	·113	·129	84	64	82	77	Calm	S E b S	W S W	9·72	...	0·5
20	·453	·553	·788	·613	21·0	28·0	21·9	23·7	− 7·9	·101	·095	·097	·098	89	62	80	76	W S W	W b S	W	18·35	...	Inap.
21	·933	·940	·916	·934	21·2	28·2	26·9	24·0	− 8·0	·100	·131	·131	·114	85	84	88	86	N W	W	W N W	5·25	...	...
22	·846	·679	·508	·652	17·4	32·7	23·7	25·4	− 7·1	·079	·094	·099	·097	79	51	75	69	W N W	W S W	S W b W	10·99	...	0·1
23	·143	28·858	28·960	28 981	26·9	34·0	29·8	29 6	− 3·2	·131	·161	·102	·133	88	81	61	79	S W b W	S W	W N W	16·31	...	0·3
24	·1[illegible]8	29·248	29·351	29·266	7·9	23·8	21·5	17·1	−16·0	·051	·078	·10[illegible]	·076	76	61	84	74	N N W	N W b W	W	18·46	...	...
25	·367	·313	—	—	23·3	33·2	—	—	—	·111	·165	—	—	86	87	—	—	W b S	W b S	W	12·72	...	0·3
26	·202	·014	·082	·113	27·3	30·0	26·2	27·8	− 6·2	·133	·140	·131	·134	88	83	91	87	Calm	E b S	W b S	10·88	...	6·5
27	·260	·426	·554	·429	22·6	28·2	20·2	23·1	−11·3	·114	·124	·096	·109	91	79	86	85	N b W	N W b N	N W b W	12·52	...	...
28	·575	·515	·546	·559	20·0	29·5	23·3	24·8	− 9·9	·092	·106	·112	·102	82	64	86	75	N W b W	W b N	W b S	14·82	...	...
29	·519	·492	·537	·521	22·3	43·2	33·0	33·5	− 1·6	·100	·130	·148	·131	80	47	78	69	W b S	W S W	S W	10·55	...	...
30	·560	·546	·521	·540	29·8	46·5	34·8	37·6	+ 2·1	·136	·168	·153	·160	82	54	74	72	W S W	S W b S	Calm	5·90	...	...
31	·511	·345	·118	·308	35·0	48·6	36·6	39·8	+ 3·9	·188	·229	·184	·194	93	68	85	81	Calm	S b W	Calm	6·74	...	...
M	29·540	29·485	29·513	29·513	23·1	34·1	28·0	28·5	− 1·9	0·116	0·143	0·134	0·132	·86	·72	·85	·81	8·71	11·25	9·49	9·95	1·485	18·1

Highest Barometer...... 30·079, at 11 a.m. on 21st } Monthly range:
Lowest Barometer....... 28·792, at 8 p.m. on 23rd } 1·287 inches.
Highest registered temperature +49°·4, at p.m., 31st } Monthly range:
Lowest registered temperature −2°·9, at a.m. on 1st } 52°·3.
Mean Maximum Thermometer............. 36°·52 } Mean daily range:
Mean Minimum Thermometer............. 19°·63 } 16°·89.
Greatest daily range.........37°·3, from a.m. to p.m. of 1st.
Least daily range .... 7°·8, from p.m. of 14th, to a.m. of 15th.
Warmest day....... 31st. Mean temperature......39°·82 } Difference,
Coldest day......... 24th. Mean temperature......17°·15 } 22°·67.
Greatest intensity of Solar Radiation, 58°·2 on p.m. of 30th } Range,
Lowest point of Terrestrial Radiation, 2°·8 on a.m. of 10th } 55°·4.
Aurora observed on 5 nights: viz. 6th, 9th, 12th, 15th and 18th.
Possible to see Aurora on 16 nights. Impossible on 15 nights.
Raining on 5 days. Raining 20·0 hours; depth, 1·485 inches.
Snowing on 11 days. Snowing 44·2 hours; depth 18·1 inches.
Mean of Cloudiness, 0·67. No thunder or lightning observed during the month.
Halos were observed on the 1st, 2nd, 10th, 16th, 22nd, 26th, 28th and 30th.
Parhelia were noted on the 16th at 7 a.m., and on the 30th at 6 p.m.

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

North—1641·90 West—4790·04 South.—509·00 East—1255·00.
Mean direction of the Wind, W 16° N.
Mean velocity of the Wind, 9·95 miles per hour.
Maximum velocity, 36·0 miles per hour, from 10 to 11 a.m. on 20th.
Most windy day, the 13th; mean velocity, 20·74 miles per hour.
Least windy day, the 7th; mean velocity, 2·10 " "
Most windy hour, 5 p.m.; Mean velocity, 12·48 miles per hour.
Least windy hour, 2 a.m.; Mean velocity, 8·08 miles per hour.
Mean diurnal variation, 4·40 miles.

March, 1855, was remarkable as the most windy month recorded during the last eight years, the mean hourly velocity exceeding the average by 2·94 miles, and surpassing the next most windy month, (Dec., 1854), by 1·31 miles per hour.

The quantity of snow which fell was considerable, exceeding the average of the last thirteen years by 8·2 inches, being only surpassed on two occasions—in March 1843 and 1852.

It was also a cold month, the mean temperature falling 1°9. below the average of the last sixteen years.

The Barometric pressure (29·5129) is the lowest monthly mean for any March during the whole series.

Comparative Table for March.

Year.	Temperature. Mean.	Dif. from Av'ge	Max. obs'vd	Min. obs'vd	Range	Rain. D's.	Inch.	Snow. D's.	Inch.	Wind Mean Velocity.	
1840	33·1	+2·9	56·9	8·7	48·2	8	1·640	8	...	...	
1841	27·7	−2·7	53·5	−6·9	60·4	5	1·170	7	...	0·51	lb.
1842	35·8	+5·4	68·7	14·9	53·8	4	3·150	8	...	0·70	lb.
1843	21·3	−9·1	38·6	−2·8	41·4	2	0·625	18	25·7	1·18	lb.
1844	31·3	+0·9	50·3	9·6	40·7	8	2·470	8	14·0	0·57	lb.
1845	35·4	+5·0	61·7	9·9	51·8	5	Impf.	8	2·8	0·66	lb.
1846	33·1	+2·7	49·3	7·6	41·7	9	1·965	5	2·3	0·30	lb.
1847	26·2	−4·2	44·3	4·8	39·5	5	0·850	6	4·2	0·71	lb.
1848	28·6	−1·8	58·9	0·9	58·0	5	1·220	6	9·7	5·80	Miles.
1849	33·5	+3·1	53·4	15·4	38·0	7	1·525	2	2·3	5·37	Miles.
1850	29·8	−0·6	46·0	6·0	40·0	2	0·745	7	11·2	7·62	Miles.
1851	32·4	+2·0	58·7	13·1	45 6	3	0·770	9	8·8	7·65	Miles.
1852	27·7	−2·7	44·8	−3·2	48·0	8	3·080	12	19·5	5·81	Miles.
1853	30·6	+0·2	56·3	−0·1	56·4	6	1·080	8	7·1	5·87	Miles.
1854	30·7	+0·3	52·8	10·4	42·4	9	2·425	3	2·8	8·02	Miles.
1855	28·5	−1·9	48·6	−2·9	51·5	5	1·485	11	18·1	9·95	Miles.
										0·66	lbs.
M'n.	30.37		52·67	5·34	47·34	5·7	1·613	7·9	9·9	7·01	Miles.

Monthly Meteorological Register, St. Martin, Isle Jesus, Canada East.—March, 1855.

NINE MILES WEST OF MONTREAL.

BY CHARLES SMALLWOOD, M.D.

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

Day.	Barom. corrected and reduced to 32° Fahr.			Temp. of the Air.			Tension of Vapor.			Humidity of Air.			Direction of Wind.			Velocity in Miles per Hour.			Rain in Inch.	Snow in Inch.	Weather, &c. A cloudy sky is represented by 10; A cloudless sky by 0.		
	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.			6 A.M.	10 P.M.	2 P.M.
1	30·187	30·100	30·102	0·0	[illegible]	18·3	·040	·163	·106	·88	·94	·87	S W b W	S W b W	S W	0·55	5·55	7·56	...	...	Clear.	Cir. Cum. Str. 8	Cir. Cum. 4.
2	·060	29·999	29·900	9·6	37·0	29·8	079	221	168	88	92	90	S W	W S W	W b S	0·47	5·73	5·25	...	...	Do.	Clear.	Str. 10.
3	29·890	·714	·700	27·5	33·1	31·0	146	199	178	88	96	92	S W b S	S W b S	W b S	3·27	2·00	3·75	...	Inap.	Cum. Str. 10.	Slight snow.	Cir. Str. 10.
4	·935	30·004	·890	20·1	28·3	17·9	107	153	106	82	88	87	N W	W b N	S S E	11·14	4·33	0·76	...	...	Do. 4.	Cum. Str. 4.	Cir. 2.
5	·540	29·440	·269	37·0	48·7	39·0	167	312	214	70	86	84	S W	W b S	S S W	3·37	11·25	5·66	...	...	Do. 9.	Do. 2.	Rain at 9 p.m.
6	·210	·514	·719	34·5	38·0	14·4	191	226	095	84	91	87	W	W	W N W	12·81	8·38	2·56	0·531	Inap.	Str. 10.	Snow at 9 a.m.	Clear.
7	·771	·814	·845	3·2	31·4	15·7	053	191	091	94	94	87	N N W	N E	N E	0·15	Calm	Calm	...	...	Clear.	Clear.	Do.
8	·999	·990	·790	5·0	37·1	16·0	053	191	076	85	80	68	N E	E b S	S b W	0·26	1·45	Calm	...	...	Do.	Do.	Cl'r Auro. Bor.
9	·500	·490	·652	12·0	28·8	22·2	085	161	123	89	88	88	N E b E	E b N	W N W	1·75	3·62	1·75	...	...	Str. 10.	Str. 10.	Do. do. do.
10	30·020	·980	·880	0·5	20·9	10·9	047	111	077	95	83	84	W N W	W b S	W b S	13·75	1·82	1·06	...	...	Clear.	Clear.	Clear
11	29·984	·829	·830	8·7	23·0	19·8	066	082	083	90	57	63	N N W	N E b E	N E b N	Calm	2·50	0·51	...	...	Cum. Str. 8.	Cum. Str. 8.	Str. 10.
12	·750	·985	30·080	21·1	39·9	21·5	111	198	123	83	75	88	N E	S W	N W	0·09	1·42	2·25	...	...	Str. 8.	Clear.	Cl'r Auro. Bor.
13	30·150	·920	29·850	11·1	21·0	19·6	082	092	097	87	68	77	N b E	N E b E	N E b E	5·50	0·75	16·25	...	...	Clear.	Cum. Str. 4.	Snow.
14	29·741	·700	·871	12·6	19·9	17·0	080	094	096	83	72	83	N E b E	N E b E	N E b E	5·40	29·93	14·33	...	5·80	Snow.	Snow.	Do.
15	·751	·541	·482	22·2	31·6	35·5	102	160	192	72	80	83	N E b E	S E b E	W b S	11·61	8·22	15·41	...	3·70	Str. 10.	Do.	Rain at 10 p.m.
16	·821	·898	·989	30·1	37·4	30·6	171	218	158	91	92	81	W b S	W b S	N W b W	34·00	11·25	7·90	Inap.	...	Cum. Str. 5.	Cum. Str. 4.	Str. 10.
17	·976	·789	·545	15·7	26·9	32·0	087	119	190	78	71	96	N N W	N E b E	S	1·14	0·27	6·56	...	1·30	Clear.	Cir. Str. 10.	Cum. 10.
18	·680	·501	·890	30·6	35·0	26·6	178	203	146	92	91	88	W b S	W b S	W b S	18·30	11·81	9·12	...	...	Cir. Cum. 4.	Cir. Cum. Str. 10.	Cl'r Auro. Bor.
19	·894	·876	·869	14·0	41·2	21·1	089	233	098	84	83	73	S W b W	S W b W	E b S	1·37	Calm.	1·65	...	...	Clear.	Clear.	Do. Do. do.
20	·700	·742	·769	22·0	33·6	16·7	115	186	102	82	86	88	W. S. W.	W S W	W S W	4·98	8·90	6·29	...	2·10	Do.	Snow.	Clear.
21	·930	30·049	·971	11·0	28·1	10·8	077	126	067	83	73	75	W	W S W	N W b W	13·87	13·01	6·22	...	...	Do.	Clear.	Str. 8.
22	30·090	29·879	·740	14·2	32·6	18·8	084	161	080	83	78	70	W b S	S W b W	S W b W	2·92	2·52	7·12	...	...	Str. 4.	Cir. Cum. 4.	Clear.
23	29·451	·214	·045	16·3	29·0	27·9	098	150	144	88	84	86	S S W	S S W	S	1·54	4·27	8·75	...	2·70	Do. 10.	Snow.	Snow.
24	·100	·246	·340	9·4	16·1	15·9	074	081	072	82	70	73	W	W	W	14·00	16·35	12·25	...	...	Clear.	Clear	Cum. Str. 5.
25	·401	·381	·382	8·9	29·0	22·4	079	116	115	88	64	82	W	S W b W	S W	18·74	11·21	7·03	...	...	Str. 2.	Cum. Str. 9.	Cum. 2.
26	·437	·543	·436	17·1	36·7	18·6	102	161	088	88	69	72	W	S W	E b N	9·62	6·87	0·40	...	...	Light Cir.	Clear.	Str. 10.
27	·399	·481	·549	19·0	30·0	15·8	096	168	081	78	70	73	N N W	W b N	W b N	11·24	8·02	14·80	...	...	Clear.	Do.	Cir. Cum. 8.
28	·590	·560	·489	16·1	23·9	20·6	080	124	086	73	70	66	W b N	W b N	W b N	15·94	12·55	10·64	...	...	Cir. Str. 10.	Cum. Str. 10.	Cir. 8.
29	·497	·546	·599	20·5	39·0	31·9	107	164	182	82	64	90	W b N	N W b W	W	6·12	14·35	11·00	...	...	Str. 10.	Cir. 4.	Cum. 4.
30	·649	·749	·742	29·0	47·6	34·2	161	196	178	89	56	83	W b N	W b S	W N W	12·40	6·29	10·28	...	...	Clear.	Clear.	Clear.
31	·741	·610	·591	31·5	52·1	36·7	167	304	201	83	76	89	W b S	S W b S	S W b S	3·05	1·32	2.05	...	...	Do.	Do.	Do.

Barometer .... { Highest, the 1st day .... 30·187
Lowest, the 23rd day .... 29·045
Monthly Mean .... 29·716
" Range .... 1·142

Thermometer { Highest, the 31st day .... 56°·6
Lowest, the 1st day. .... — 0°·0
Monthly Mean .... 24°·08
" Range .... 56°·6
Mean Humidity .... ·815

Greatest Intensity of the Sun's Rays .... 98°·1

Rain fell on 2 days, amounting to 0,531 inches, raining 7 hours 40 minutes.

Snow fell on 7 days, amounting to 15·60 inches. Snowing 58 hours 10 minutes.
Most prevalent Wind, W b S. Least prevalent Wind, E b N.
Most Windy Day, the 16th day; mean miles per hour, 17·71.
Least Windy Day, the 7th day; mean miles per hour, 0.05.
Aurora Borealis visible on 5 nights. Might have been seen on 8 nights.
Zodiacal Light frequently seen, and was well defined.
The Electrical state of the atmosphere has been marked by very high tension during the month, more especially at the time of the Vernal Equinox.
Ozone was in very small quantities during the month.
First Snipe shot on the 30th April.

Monthly Meteorological Register, Quebec, Canada East, March, 1855.

BY LIEUT. A. NOBLE, R.A., F.R.A.S., AND MR WM. D. C. CAMPBELL.

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

Date.	Barometer corrected and reduced to 32 degrees, Fahr.				Temperature of Air.				Elasticity of Air.				Humid'y of Air.				Direction of Wind.			Velocity of Wind.			Rain in Inch.	Snow in Inch.	REMARKS.
	6 A.M.	2 P.M.	10 P.M.	MEAN.	6 A.M.	2 P.M.	10 P.M.	MEAN.	6 A.M.	2 P.M.	10 P.M.	MEAN.	6 A.M.	2 P.M.	10 P.M.	M'N.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.			
					°	°	°	°																	
1	30·029	29·925	29·915	29·956	14·7	23·8	21·0	19·8	0·077	0·092	0·090	0·086	86	70	78	78	W N W	W S W	W S W	3·8	6·2	3·8	...	...	
2	29·941	·801	·776	·840	18·6	31·5	27·9	26·0	·095	·137	·140	·124	91	78	90	86	W S W	W S W	W S W	5·2	6·2	5·2	...	...	
3	·730	·563	·434	·576	17·7	31·0	29·5	26·1	·092	·151	·157	·134	91	89	96	92	W S W	Calm.	N W	3·8	0·0	5·2	...	0·6	
4	·619	·791	·785	·733	16·0	18·9	11·6	15·2	·070	·088	·062	·073	77	82	78	79	N N W	W N W	Calm.	14·3	7·2	0·0	...	0·8	
5	·453	·214	·080	·249	14·4	34·0	37·2	28·5	·083	·141	·188	·137	93	72	85	83	Calm.	Calm.	Calm.	0·0	0·0	0·0	...	1·0	
6	28·939	·247	·541	·242	23·0	25·3	17·3	21·9	·126	·122	·081	·110	100	87	81	89	N E	N W	Calm.	16·0	11·5	0·0	...	Inap	
7	29·602	·681	·784	·690	5·4	16·8	11·4	11·2	·052	·072	·192	·105	85	73	87	81	W	E S E	Calm.	3·8	2·0	0·0	...	...	
8	·881	·821	·645	·784	9·1	22·3	12·6	14·7	·062	·090	·073	·075	87	74	88	93	N W	Calm.	Calm.	5·2	0·0	0·0	...	...	
9	·409	·338	·461	.403	16·2	21·6	21·5	20·8	·092	·111	·104	·102	95	82	87	88	E N E	Calm.	Calm.	8·8	0·0	0·0	...	Inap	
10	·757	·819	·871	·826	10·2	18·1	11·3	13·2	·060	·078	·074	·071	82	75	96	84	W N W	Calm.	N	8·8	0·0	3·8	...	...	
11	·862	·707	·656	·742	4·6	19·6	17·5	13·9	·053	·096	·083	·077	90	91	81	87	N	E N E	E N E	2·0	13·9	7·2	...	0·1	
12	·626	·677	·877	·727	16·8	29·3	20·7	22·3	·088	·132	·070	·097	91	95	60	82	S E	N W	N N W	3·8	14·7	8·0	...	...	12th. A very fine Aurora visible at 7 p. m.
13	·967	·947	·887	·934	8·6	18·8	17·3	14·9	·050	·063	·059	·057	73	73	58	68	Calm.	E N E	E N E	0·0	16·0	25·4	...	0·1	
14	·858	·884	·910	·884	9·3	13·4	16·1	12·9	·068	·074	·080	·074	96	85	84	88	E N E	E N E	E N E	32·2	34·1	16·0	...	0·8	
15	·828	·574	·335	·579	17·2	22·2	23·5	21·0	·089	·116	·126	·110	89	94	97	93	E N E	E N E	E N E	10·0	30·1	13·9	...	...	
16	·490	·553	·769	·604	30·9	34·2	25·4	30·2	·154	·124	·100	·126	89	63	72	75	N N W	W N W	Calm.	8·8	13·4	0·0	...	...	
17	·873	·735	·529	·712	15·4	24·0	25·5	21·6	·080	·103	·138	·107	87	77	99	88	S W	E S E	E S E	3·8	17·2	21·3	...	4·4	
18	·426	·521	·651	·533	28·1	31·0	28·1	29·1	·155	·139	·125	·140	100	80	80	87	Calm.	W S W	W	0·0	22·7	7·2	...	0·3	
19	·768	·652	·722	·714	19·3	33·0	22·7	25·0	·099	·105	·105	·103	91	56	84	77	W	Calm.	Calm.	6·2	0·0	0·0	...	...	
20	·571	·530	·538	·546	19·7	27·8	20·6	22·7	·100	·112	·106	·106	91	72	91	85	E N E	S W b W	Calm.	10·0	7·2	0·0	...	...	
21	·574	·761	·895	·743	16·7	23·5	13·4	17·9	·085	·077	·055	·072	87	60	66	71	W	N W	N N W	6·2	12·9	10·0	...	...	
22	·904	·683	·515	·712	2·6	24·4	15·7	14·2	·044	·071	·070	·062	84	53	75	71	W	S W	Calm.	8·8	6·2	0·0	...	...	
23	·359	·090	28·953	·134	9·7	26·9	23·9	20·2	·063	·128	·117	·103	88	86	88	87	Calm.	Calm.	Calm.	0·0	0·0	0·0	....	11·0	
24	28·779	28·977	29·058	28·938	24·7	14·7	12·2	17·2	·128	·067	·068	·081	91	75	82	84	N E	W b N	W b N	8·8	17·2	39·4	...	2·5	
25	29·134	29·110	·151	29·133	8·0	18·5	19·2	15·2	·057	·071	·074	·067	83	67	68	73	W b N	N W	N W	10·0	17·9	10·0	...	...	
26	·172	·313	·293	·259	16·8	22·0	16·9	18·6	·079	·068	·073	·073	81	57	74	71	N W	W b S	W S W	7·2	7·2	2·0	...	...	26. Lunar halo at 10 p.m.
27	·168	·143	·266	·192	10·9	28·3	17·1	18·8	·063	·096	·066	·075	82	62	66	70	Calm.	W	W N W	0·0	14·7	16·0	...	...	
28	·351	·256	·182	·263	9·9	22·0	21·0	17·6	·059	·080	·112	·084	80	66	90	81	W N W	W b W	W S W	8·0	13·9	10·9	...	...	
29	·126	·165	·321	·204	23·2	36·6	31·0	30·3	·105	·120	·091	·102	81	56	52	66	W	W N W	W N W	15·2	14·3	10·0	...	...	
30	·395	·493	·642	·510	31·2	42·2	30·8	34·7	·119	·142	·156	·139	68	54	91	71	N W	W N W	Calm.	10·0	6·2	0·0	...	...	
31	·602	·478	·409	·496	27·7	44·4	40·1	37·4	·145	·140	·160	·148	75	48	65	63	Calm.	E	W N W	0·0	3·8	3·8	...	...	
	29·555	29·532	29,516	29·5440	15·98	25·91	21·29	21·06	0.087	0·104	0·103	0·098	87	73	80	80				6·97	10·21	7·00	...	21 6	

Maximum Barometer, 6 a.m. on the 1st	30·029
Minimum Barometer, 6 a.m. on the 24th	28·779
Monthly Range	1·250
Monthly Mean	29·5440
Maximum Thermometer on the 31st	47°·3
Minimum Thermometer on the 22nd	2·4
Monthly Range	44·9
Mean Maximum Thermometer	28·29
Mean Minimum Thermometer	11·87
Mean Daily Range	16 41
Mean Monthly Temperature	21·06

Greatest Daily Range of Thermometer on 24th	24°·6
Least Daily Range of Thermomter on 14th	8°·8
Warmest Day, 31st. Mean Temperature	37·4
Coldest Day, 7th. Mean Temperature	11·2
Climatic Difference	26·2

Possible to see Aurora on 12 Nights.
Aurora visible on 11 Nights.
Total quantity of Rain, ·000 inches.
Total quantity of Snow, 21·6 inches.
No Rain fell.
Snow fell on 12 days.