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The Canadian Journal.

TORONTO, MARCH, 1854.

### Norris's Railway Joint Chair.*

The following paper on Mr. Norris's new joint chair was read at the last meeting of the Institution of Mechanical Engineers at Birmingham:—

In bringing before the Institution a plan for a new kind of joint chair for railways, it will be unnecessary to expatiate on the advantages of a *firm joint*, as regards economy of maintenance of the road and rolling stock, and safety.

The object of this paper is to describe a method which has been in use on a crowded part of the London and North Western Railway for above eighteen months, during which time it has stood well, and is now being extensively used on the same line.

The plan is to cast a chair or coupling on the rails at the joints as they lie in the line, by means of chills and a portable cupola. The hot metal flowing freely into the chill is allowed to come in close contact with the rails, and in cooling contracts so as to grip the ends of the rails firmly together. The great object to be attained is the converting of the rail into a continuous girder, which shall not deflect at the joint more than at any other part; every successive year's experience having forced the attention of engineers and others to this point, to attain which many plans have been tried with more or less success.

Whatever mode of joint is adopted, or whatever method of jointing the ends of rails, it is necessary that a certain allowance should be made for the longitudinal motion caused by the expansion and contraction of the rail. This object is attained, wherever necessary, by putting the chills, previously heated, on the ends of the rails for a short time, until they become hot, when they are taken off, and a thin wash of loam and blacking is laid upon the rail end, which instantly dries on, and when the melted iron is poured against it, absolute contact with the rail is prevented. Although provision is thus made for the expansive and contractile force of the rail, the cavity in the chair being parallel to the rail, clips it sufficiently tight to prevent any vertical or lateral motion of the rails; the amount of surface of contact between the rail and chair is about 100 square inches, being 50 square inches to each rail end.

This great surface prevents any perceptible wear taking place on rail-ends from the longitudinal motion of expansion; and as no motion can take place vertically or laterally, no shock can take place by the action of the wheels, so that the joint will remain good for years, which has been confirmed by practice, so far as it has gone.

The operation of casting is very simple, and is performed without hindering the pacing of trains during the execution of the work.

The apparatus consists of chills and a portable cupola, and the process is as follows, when operating on a line already laid:—Each joint-sleeper or block is first lowered by the plate-layers about three inches, so as to give room for the application of the chills, or is removed altogether for the time, and the old chair being taking off the joint, the chills are applied, consisting of a bed plate with two lips, one on each side, holding down the side-chills, which slide in the grooves; these are put to the rail and held together by screw-clips, forming a mould for casting the chair. This operation is quickly performed, and the chill is then packed under temporarily with loose metal plates: the moment this is done a train may pass over it without hindrance.

Two steel pins are then put in their places in the chills, so as to form the cores for the holes of the holding-down spikes. The chill mould being thus fastened in its place is ready for the melted metal, which is run into it at the lip, until it is level with the top of the sides, where a large open space is left for the escape of air, which prevents all possibility of blowing.

The chills are made to fit the rails by projections at each end, which grip the rail firmly, and a little loam is applied on the outside, to prevent the hot metal making its way out of the chill-mould.

After a lapse of about five minutes the mould is taken off, which is done in an instant, leaving the chair perfect, and closely embracing the contiguous ends of the rail. The form of this chair is such as to make it a strong and rigid clip, closely fitting the two ends of the rail along its whole length. Chairs may by this method be cast of any form. When the chair is cold enough, the sleeper or block is replaced, and the chair spiked to it.

The operation is the same in relaying new roads, only that the expense of lowering or removing the block or sleeper is saved.

The metal used up to the present time has consisted of old chairs, mixed with a little new iron. This is melted in a portable cupola, formed of a cylinder of sheet-iron 1-16th of an inch thick, 2 feet 3 inches in diameter, and 4 feet 6 inches high, lined with fire bricks and clay in the usual manner, 4 inches thick.

The cupola weighs about 6 cwt., and is easily lifted by the workmen on to a plate-layer's lorry, and taken to the place required, when it is lifted off, and placed on a few sleepers laid on the slope of a cutting or embankment. When once so placed it will serve for a half a mile of road without moving again, as the metal is so hot as to enable its being taken, in a moulder's ladle, on a lorry, to the chills at a quarter of a mile on each side the cupola.

The cupola has a belt or air chamber, into which passes the air from the fan, and it has four tuyeres of two inches orifice to admit the air to the fire. The fan consists of a chamber 1 foot 10 inches inside in diameter and 9 inches wide, and weighs about 3 cwt.; it is detached from the cupola by drawing out the nozzle from the entrance to the air belt, and can then be lifted separately into its place. The fan is either turned by hand-winches, or, when the operations are extensive, by a small steam-engine, weighing about 10 cwt., and can be lifted by eight men, and placed on and off a lorry, and on the slope, in the same manner as the cupola.

The yield of metal from so small a cupola is very great: as much as 3½ tons has been run down in seven hours, by two men turning the handles of the fan, and nearly 4½ tons by the use of the engine in the same time. A smaller cupola, weighing about 2 cwt., is used for repairs of the line.

A good fastening is made for middle chairs by taking out the wooden key from the common middle chair, and casting an iron

* From the London Mechanics' Magazine, October, 1853.

one in its place. This is done by heaping dry sand around the chair, as it stands in its place, and then running metal into the cavity so formed, leaving a lip projecting over the chair. Only a few of these have yet been put down; but they have stood the test of two years' working over without failure, and are still tight. In casting, the hot metal running into the chair expands it, and its contracting upon the cast key in cooling makes it tight.

It may be remarked, that the new chair occupies exactly the same position on the sleepers, and has the same fixing, as the common joint-chair; so that in case of damage to the line from accident or slips, it can be repaired quickly in the ordinary manner, by using the old chairs and wood keys until the same cupola can be brought to bear.

Mr. Norris exhibited specimens of the chairs and the cast iron mould, complete; also a specimen of one of the new joint-chairs from the North Union Railway, which had been laid down for eighteen months in a line of great traffic, where 500,000 wheels had passed over it during the time; the two rail ends were cut off, and remained fixed fast in the chair, and the surface of the joint was level and smooth, although the rail ends had been much indented at the time the chair was cast on, from the rails having been recently turned.

The Chairman inquired what length of line had been tried with the new chairs and how long they had been at work?

Mr. Norris replied, that five miles had been recently laid with these chairs near Rugby, and about a mile was previously laid near Crewe, and elsewhere, which had mostly been at work one and a half years.

Mr. Woodhouse said, the recent trial of the chairs near Rugby had been made under his superintendence, and he had found the result highly satisfactory. It had been intended to relay that portion of the line during the present summer; but the new joint-chairs had proved of such benefit, that they would probably give several years additional life to that road. He consequently recommended the adoption of the plan on a considerable length at other parts of the line, which was now in progress.

The Chairman asked what difference was felt in the train running over the joints on the portion that had been altered at Rugby?

Mr. Woodhouse said, the joints could not be felt at all with the new chairs; there was no comparison of the ease in traveling over the old plan of joints.

The Chairman asked what was the usual time required for the process of casting the chairs?

Mr. Woodhouse replied, that the average of the work done at Rugby was about one chair cast every four minutes, including the whole process of preparation.

Mr. Slate remarked, it was certainly a very ingenious process of casting the chairs, and must make a thoroughly firm joint; he inquired what was the expense of casting?

Mr. Norris said that the labor of casting cost about 6d. per chair, and the cost was about 1s. per chair, including all expenses except the metal, which weighed about 50 lbs. The expense of casting was much diminished as the men got more experienced in managing it. At first they could only cast 40 chairs per day, but the rapidity of casting increased with practice to 80 per day; and now 120 per day were cast by common plate-layers, who had never before had anything to do with melted iron.

Mr. Slate said he had seen the first of these chairs one and a half years since, and had then an unfavorable opinion of their standing in work from the great contraction of the melted metal in cooling on the rigid rail: but it appeared that the wrought iron rail was expanded by the heat of the melted metal sufficiently to make the chair safe by its contraction again in cooling. He thought the new chair made a very perfect coupling of the rail ends, and was a great improvement on fishings and other plans, which he could only regard as makeshifts; and though they had a very good effect compared with the previous plan of having nothing to couple the rails together at the joints, they were still far removed from perfection. The new chair might be said to be quite perfect, if it could be made quite fast on the rail without allowing it to slide.

Mr. Norris observed, that only every third or fourth joint was made a slip joint for expansion; he was aware what a great advantage it would be to have no slip-joints, and by no means maintained that to be impracticable; the expansion of the rails successively by the heat of casting the chairs on, would perhaps elongate them sufficiently to make provision for the expansion from the highest temperature they would be afterwards exposed to, and the tension would then resist the contraction from cold.

Mr. May remarked, that Mr. Brunel had now many miles' length of Barlow's rail on the South Wales Railway, all rivetted fast together, without any provision for expansion and no difficulty was experienced in consequence. There was some misconception on this point, respecting the action of expansion; it was limited in amount of force, and if opposed by a greater force, no amount of expansion or contraction could take place. Wrought iron raised in temperature 15° was expanded 1-10,000th of its length, and exerted a force of 1 ton per square inch of section by the expansion; consequently, no expansion of the rails would take place if a resistance were opposed of 1 ton per square inch for each 15° rise of temperature. He thought it probable that Mr. Norris's plan ultimately would require to have no expansion joints to perfect it, and in many cases he did not doubt the plan being an excellent one.

Mr. James Nasmyth said he had witnessed the whole process of casting the chairs, and fitting on the iron moulds, and considered it a very successful plan, and of the utmost value and importance to the durability of the line as well as to the safety of the public. The trains ran full speed over the red hot chairs directly after they were cast. He thought the slight tortuosities of all roads, even in the straight parts, would be probably found sufficient to allow for the effect of expansion, without making any provision of slip joints.

Mr. May suggested, that an experiment could readily be tried to ascertain the actual amount of expansion of the rails, by having a number of thin graduated wedges, to be dropped into the joints at the hottest part of the day and at night, to measure the amount of expansion over a considerable length of rail. It would probably be found to be very insignificant, as the ordinary chairs offer a considerable resistance to a longitudinal motion of the rail, by the hold of the keys on the rail, the chairs on the keys, and the ground on the sleepers; though of course the resistance in Barlow's rail was a different case, where the rail, chair, and sleeper were all one.

Mr. Woodhouse remarked, that in laying the rails the men place small wooden or iron packing pieces, 1-16th of an inch thick, between the rail ends at the joints, to make the ordinary allowance for expansion; and they always find that if these pieces are put in early in the day, they become so tight in the middle of the day that they cannot be got out, but are quite loose in the cool of the evening.

The Chairman observed, there was no doubt the expansive action of the heat would always produce its full effect, either by compressing the iron of the rails, or producing some motion or distortion in their position.

Mr. Norris said, that cases had occurred of the road becoming hog-backed, rising with the sleepers out of the ballast, from the want of sufficient allowance for expansion; also in curves, the rails and sleepers had been pushed bodily outwards in the ballast by the effect of expansion. The extreme change of length in this country, from 80° or 90° variations of temperature, amounted to a yard per mile, and this yard length must be disposed of somewhere in each mile, either by sliding or tension, or else by bending upwards or laterally, if there was not less resistance to compression of the iron.

Mr. C. Cowper remarked, that the extreme change of temperature of 90° would cause a total strain on the iron of 6 tons per square inch, at 1 ton for 15°, which amounted to the very severe total force of 40 or 50 tons on the whole sectional area of the rail of 7 or 8 square inches, to overcome any supposed resistance.

Mr. May thought the change of temperature in the rails would be considerably less than that of the air, because they were partly buried in the ground, and must therefore follow the temperature of the surface of the earth, which fluctuated much less than that of the air.

Mr. Duclos remarked, that the expansion or contraction of the rails would only take place from the mean temperature to the maximum or minimum: and as the mean temperature of the air in this country was about 50°, and the maximum 90°, making a change in the air of 40°, the actual change in the rails from the mean temperature was probably less than 30°, causing a strain of not more than 2 tons per inch expansion or contraction.

The Chairman observed, it was an important subject for consideration, whether the allowance for expansion could be entirely dispensed with; and the new chair appeared an important step in that direction, and might lead to doing away with longitudinal bearings.

Mr. Norris said that his attention had been first directed to the subject of this chair about two years since, by the circumstance of a very extensive alteration having been in contemplation from the ordinary rail and cross sleepers to a bridge rail on longitudinal timbers, the alteration being proposed entirely on the ground of obtaining a superior coupling of the joints with the longitudinal bearing than the ordinary rail and chair. But he objected to the bridge rail and longitudinal timbers as more expensive; and the idea then occurred to him of running the melted metal into the chairs to fill them up solid, and make a rigid coupling of the joint; and this led him to casting the joint-chairs solid upon the rails in their places, as the complete way of carrying out the object.

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**Preliminary Account and Results of the Expedition of Dr. Richard Lepsius to Egypt, Ethiopia, and the Peninsula of Sinai.***

The fertile and extensive province of Dongola, on the northern frontier, which we traversed on the 4th of June, after our departure from Barkal, afforded us but few remarkable ancient remains; we may, however, mention among these the Island of Argo, with its monuments, from the 13th Manethonic Dynasty. They became still more numerous in the northern borders of Dongola, from which a nearly continuous cataract country extends as far as Wadi Halfa. Near Tombos we found traces of the Egyptian dominion under the Pharaohs of the 17th and 18th Dynasties, rock-tablets with the shields of the two first Thuthmosis and of the third Amenophis. Farther on, at Seebi, there were the remains of temples of the first Sethos of the 19th Dynasty. The great Temple of Soleb, built by Amenophis 3rd and 4th, detained us five days. The ruins of the Temple of Sedeinga, and those upon the island of Sai, belonged to the 18th and 19th Dynasties. Opposite this island stood the remarkable Temple of Amara, which was built by the Kings of Meroe and Naga, and is still an important proof of the extent of their dominion.

Semneh was the next point, we reached. The Nile is here compressed within a breadth of only about 1150 feet, between high rocky shores. On both sides there are ruins of old Temples of the 18th Dynasty. But these were not the earliest buildings which were erected here. We found a considerable number of inscriptions from the 12th and 13th Manethonic Dynasties, especially on the large foundations of the Temple of Kummeh, situated lower down, opposite Semneh on the eastern bank, as well as on the scattered rocks on both banks in the neighbourhood of that Temple. Many of them were intended to indicate the highest risings of the Nile during a series of years, especially in the reigns of the Kings Amenemhe 3rd and Sebekhotep 1st, and by comparing them, we obtained the remarkable result, that about 4000 years ago the Nile used to rise at that point on an average twenty-two feet higher than it does at present. This, therefore, which we saw before us was the most ancient Nilometer, and the earliest statements of the heights, and their greatest number, were recorded during the reign of the same King, the Moeris of the Greeks, with whom we had already become acquainted in the Faium, as the great hydraulic architect. The strong fortifications on both banks of that narrow part of the river convinced us at once that, during the early times of the 12th Dynasty, this remarkable point served as the boundary of the Egyptian dominion, against the Ethiopian nations who dwelt more to the south.

At Wadi Halfa, on the 30th of July, we again left the cataract country, remained from the 2nd to the 11th Aug. in Abu Simbel, examined until the end of the month the ruins of Ibrim, Anibe, Derr, Amada, Sebua, Dakkeh, Kuban, Gerf-Hussen, Sabagura, Dendur, Kalabscheh, Debot, and spent the whole of the following month in examining the monuments of the island of Philæ, and the islands of Bigeh, Konosso, Sehel, and Elephantine, surrounding it, and of the stone quarries between Philæ and Assuan. October was spent visiting Ombos, the two Silsilis, Edfu, the desert Temple of Redesieh, El-Kab, Esneh, Tod, and Erment.

On the 2nd of November we again arrived on Theban ground, and first visited the rock-tombs of Qurnah, on the west side, where we remained nearly four months, till the 20th of February, 1845, when we encamped for three more months at Karnak. The number of monuments of all kinds both above and below ground at Thebes, is so great that they may be truly called inexhaustible even for a combined power like ours, and for the limited portion of time which we were able to devote to their investigation. But the age of the monuments at Thebes, is almost exclusively limited to the New Monarchy; and the most ancient we discovered, such as one might generally expect to find, are not earlier than the 11th Manethonic Dynasty, the last but one of the old Monarchy; for this simple reason, because it was in this Dynasty that Thebes

* Extracted from "Letters from Egypt, Ethiopia, and the Peninsula of Sinai," by Dr. Richard Lepsius.—*Continued from page 152*

became a royal residence, and hence the focus of Egyptian splendour. The great break in the succession at the end of the 12th Dynasty, caused by the invasion of the Hyksos, and their dominion, which lasted many centuries, first drove the Egyptian power back into Ethiopia, and at length entirely destroyed it, till the powerful Pharaohs of the 17th, 18th, and 19th Dynasties again advanced from the south, drove back the Semitic intruders, and raised the power of the Egyptian empire to its summit. The greater proportion of Theban monuments date also from this period. As we may suppose they have been the principal object of investigation to all travellers, therefore our work here had been for the most part anticipated.

Nevertheless it was necessary to re-examine the whole ground most carefully, partly to complete the deficiences left by our predecessors, partly to make a proper selection of those monuments which were of most importance for our particular purpose, and which we were anxious to insert among our collections, either in the shape of a drawing or an impression upon paper, or even in the original itself. We directed our principal attention during the whole journey, and especially here, to taking the most exact architectonic plans of all the buildings and other localities which appeared to us to be of any consequence; and for this purpose we did not hesitate to make extensive excavations. By this means we succeeded, amongst other things, in discovering and recording for the first time, a perfect plan of the most beautiful of all the Temple buildings, namely, the Ammon Temple, built by Ramses 2nd, which is described by Diodorus under the name of the sepulchre of Osymandyas. We made several excavations also in the valleys of the royal tombs, and opened, for instance, the rock-tomb of the same Ramses 2nd, one of the largest of those which have hitherto been accessible. Unfortunately, the interior chambers were so much destroyed by the dirt and rubbish that had fallen in, that we could make out little more from the representation upon the walls than the proprietor of the tomb.

Accompanied by the artist Max Weidenbach, I made an intermediate journey from Karnak to the Peninsula of Sinai. We went thither by the old road from Koptos to Aenum (Philotera), now leading from Qeneh to Koser, which conducted us first to the remarkable stone quarries of Hammamat, already worked out during the old Monarchy. The numerous rock-inscriptions, which date as far back as the 6th Dynasty, occupied us here for five whole days. From this place we passed through the Arabian chain of mountains to the north, as far as Gebel Zeit, where we embarked for Tor, situated opposite. We ascended through Wadi Hebran to the convent, and from thence through Wadi e Schech, Wadi Firan, W. Mokatteb, W. Maghara, by Sarbut el Chadem, down again to Abu Zelimeh, where we got into our vessel, to return to Koser and Thebes.

As early as the 4th Manethonic Dynasty, between three and four thousand years before Christ, this Desert Peninsula was subject to Egypt, and was principally colonised by the Egyptians on account of the copper mines, which are there met with on the limits of the primitive mountain range, and the surrounding sandstone mountains. Upon several rock-tablets of Wadi Maghara, the kings of those oldest Dynasties were represented fighting with the Semitic aboriginies, and the inscriptions of Sarbut el Chadem, were at least as early as the 12th Dynasty. We did not, also, lose sight of the great interest which is attached to these localities of the Peninsula in connection with the Old Testament. More especially, I believe, that I have succeeded for the first time (not accepting Burckhardt) in determining the correct position of Sinai, since contrary to the tradition of the convent, hitherto accepted, I did not recognise in it one of the southern mountains, but in Serbal, which is situated several days' journey more to the north, at whose base lies the only fertile oasis of the whole Peninsula. This opinion which has been already published in a preliminary account of the journey, addressed to the King of Prussia, has met with frequent oppositions, but has also latterly received much approbation, I believe, in a special treatise upon the question, by W. Hogg, printed in the last half of the "Transactions for the Royal Society of Literature." (1848) I have not hitherto been able to discover any material counter-arguments in the discussions which have been held upon the subject, but, on the other hand, much stronger evidence that, contrary to the later Byzantine tradition, the more ancient Christian, and probably the Egyptian tradition itself, considered Serbal, at whose foot the oldest convent was situated, to be the true Sinai.

On the 14th of April we returned to Thebes, and finally left it on the 16th of May. On our way back to Lower Egypt, we re-examined more minutely the monuments of Schenhur, Dendera, Hou, Abydos, Echmim, El Bosra, Tel el Amarna, and El Hibe, and on the 27th of June, our party, which had been increased at the last stage by the addition of Dr. Bethmann, again entered Cairo.

I was detained there myself some months longer than the other members of the expedition, in order to direct the transportation of several sepulchral chambers in the neighbourhood of the great Pyramids, and to superintend the embarkation of the valuable blocks of stone, together with the other monuments, which we brought with us from Upper Egypt and Ethiopia, and which the Viceroy Mohammed Ali sent as a present to his Majesty the King of Prussia. In this troublesome as well as important affair, for the practical performance of which four experienced workmen had been expressly sent from Berlin to Egypt, I had only the kind assistance of Dr. Bethmann, who accompanied me on an independent footing during the remainder of the journey back.

After a final visit to Alexandria, we embarked on the 25th of September at Cairo for Damietta, but on the way visited the ruins of Samanud, Behbet, and the Ramses Temple of San, (Tanis) and left Egypt on the 1st of October, in a vessel which took us to Jaffa. After we had traversed the whole length of Palestine, and from Jerusalem had visited the Dead Sea, and from Beyrout, Damascus, and Baalbec, at the mouth of the Nahr el Kelb, the ancient Lykos, we came upon the last Egyptian monuments in the north, namely, those celebrated memorial-tablets, which the great Ramses 2nd engraved beside the old Military road, as a recollection of his warlike and victorious Asiatic compaigns in the fourteenth century before Christ. After a period of more than 3000 years, neither the form, nor even the Name-Shield of the powerful Pharaoh, at whose court Moses was educated, had been destroyed by the destructive sea-air. On one tablet, indeed, I was able to distinguish the date of the fourth, on another that of the second year of his reign.

According to the testimony of Herodotus, similar monuments of Sesostris are also found in Ionia, and some time ago, one which he describes as being there, was re-discovered. But an excursion from Smyrna to that spot soon convinced us that the rock-picture of Karabel was produced by an Asiatic and not by an Egyptian chisel.

Lastly, we saw in the Hippodrome, at Constantinople, the obelisk of the third Tuthmosis, but, like others, sought in vain for the second, which earlier travellers would have us believe that they had seen. On the 24th December, I left Constantinople, and landed on the 5th January, 1846, in Trieste.

The whole journey, of which this is a very hasty sketch, was one of the most fortunate expeditions which has ever been under-taken for a similar purpose. None who participated in it suffered from the climate or the accidental casualties of a journey. We travelled under the powerful and in every way efficient protection of the Viceroy. We had an explicit and written permission to make excavations, wherever we should consider it desirable, and we employed it, to acquire a number of interesting monuments for the Royal Museum at Berlin, which would either have remained in Egypt as rubbish under the sand hills, or exposed, like so many others, to be destroyed for all kinds of material purposes.

(*To be continued.*)

**The Austrian Imperial Printing Office.***

The Imperial Printing Office of Austria has exhibited the whole collection of the new applications of the typographical art, such as the galvanoplastic process, galvanography, galvanoglyphy, and chemitypy, which, bringing their co-operation to the aid of typography, enable it to reproduce, in some degree, nature itself. It may, therefore, be said that these new branches are to typography what photography is to the art of drawing.

The Galvanoplastic Process.—We have, for instance, seen antediluvian fishes reproduced upon paper, at this exhibition, with the exactness of nature itself. By means of successive layers of gutta percha applied to the stone inclosing the petrified fish, a mould is obtained, which, being afterwards submitted to the action of a galvanic battery, is quickly covered with coatings of copper, forming a plate upon which all the marks of the fish are reproduced in relief, and which, when printed at the typographic press, gives a result upon the paper identical with the object itself. M. Hulot, a mechanist and chemist attached to the mint of Paris, has exhibited some sheets, each of them containing three hundred heads intended for postage stamps, which are impressed at one stroke from a plate of brass of a single piece, containing these three hundred figures in relief. By a peculiar process, M. Hulot succeeds in identically reproducing, without the least contraction, the original engraving, which is on steel, but which might be engraved on any other metal, or even on wood. It is by this same process that M. Hulot has reproduced, for the Bank of France, the notes engraved in relief in such perfection by French artists.

Galvanography.—The Austrian Printing Office has shown us some remarkable results of this process. An artist covers a plate of silvered copper with different coats of a paint composed of any oxide, such as that of iron, burnt terra sienna, or black lead, ground with linseed oil. The substance of these coats is of necessity thick or thin, according to the intensity given to the lights and shades. The plate is then submitted to the action of the galvanic battery, from which another plate is obtained, reproducing an intaglio copy, with all the uneveness of the original painting. This is an actual copper-plate, resembling an aquatint, and obtained without the assistance of the engraver.

Galvanoglyphy.—The experiments in galvanoglyphy are no less interesting. Upon a plate of zinc, coated with varnish, a drawing is etched; then, with a small composition roller, a coat of ink is spread upon this varnish, and left to dry. The ink is deposited only on those parts where the varnish has not been broken through by the graver, and leaves the sunken portion of the engraving free. When the first layer is dry, a second is applied, then a third, and so on, until it is considered that the original hollows are deep enough. The plate thus prepared is placed in the galvanic battery, and another plate is the result, on which all the hollows of the engraving are reproduced in relief. This relief is more or less raised, according to the number and thickness of the coats of ink successively applied. The process was invented in England and patented by Mr. Palmer, of Newgate Street.

Chemitypy.—For the purpose of obtaining casts in relief from an engraving, the process of chemitypy is equally ingenious. A polished zinc plate is covered with an etching ground; the design is etched with a point, and bitten in with diluted aquafortis; the etching ground is then removed, and every particle of the acid well cleaned off. For this purpose, the hollows of the engraving are first washed with olive oil, then with water, and afterwards wiped, so that there may not remain the least trace of the acid. The plate, on which must be placed filings of fusible metal, is then heated by means of a spirit-lamp, or any convenient means, until the fusible metal has filled up all the engraving; and when cold, it is scraped down to the level of the zinc plate, in such a manner that none of it remains except that which has entered into the hollow parts of the engraving. The plate of zinc, to which the fusible metal has become united, is then submitted to the action of a weak solution of muriatic acid, and as of these two metals the one is negative and the other positive, the zinc alone is eaten away by the acid, and the fusible metal which had entered into the hollows of the engraving is left in relief, and may then be printed from by means of the typographic press.

Paneiconography.—This is a new process, invented by M. Gillot, of Paris, and consists of a method of reproducing, by means of the typographic press, any lithographic, autographic, or typographic proof, any drawing with crayon or stump, or any engraving upon wood or copper. Upon a plate of zinc, polished by means of pummice-stone, the artist executes the required design with lithographic crayon or ink, or transfers impressions from lithography, wood engraving, or copper plates. The surface is then inked over with a roller, so as to increase the thickness of the ink, which is afterwards consolidated by dusting finely-powdered rosin over the plate by means of a pad of wadding; the rosin adheres only to the ink, and is readily removed from the other parts of the plate. Afterwards, for the purpose of obtaining a relief block, the plate is placed on the bottom of a shallow trough, containing very dilute sulphuric or hydrochloric acid. By means of a rocking motion given to the box, which, for that purpose, is fastened to an axis, the acid is caused to pass slowly and continuously to and fro over the surface of the plate. After the lapse of half an hour, if it be a crayon drawing, the etching is completed, and a relief block is obtained, in which it is only necessary to remove the large whites by saw-piercing. In case, however, of the plate containing written matter, or many very fine lines, it is necessary to withdraw it from time to time, and again ink the surface with lithographic ink, and dust the powdered rosin, so that the edges may be protected as much as possible from the undermining action of the acid. These operations must be repeated until the necessary depth is obtained. Transfers may be made from very old impressions of wood engravings, by sponging them several times at the back with acidulated water, and then operating as is usual with lithographic transfers.

**Atmospherical Electricity.**

BY PROFESSOR JOSEPH LOVERING, OF HARVARD UNIVERSITY.

*Continued from page 159.*

The third general division of this article proposes to inquire how it is that the earth becomes charged with electricity. I begin this inquiry by observing that there are three dynamical processes, very general and very efficacious, which are going on at all times

* Reports of the Juries of the Great Exhibition.

with greater or less violence in the air, all which probably are concerned in the production of the electricity we observe in it; namely, 1. Evaporation; 2. The friction of the wind; and 3. Combustion. As early as 1749, Franklin had a theory that electricity was produced by evaporation, and in a way which had some resemblance to Black's theory of specific heat. When water evaporates, it requires a greater capacity for electricity as well as for heat. The electricity and heat, essential to the physical change of state involved in the transition of matter from a liquid to a gaseous state, must be abstracted from surrounding bodies which are thus cooled and left, electrically speaking, negative. As the vapor rises with its latent charge of heat and positive electricity, it finally reaches a region of cold where it is again condensed, and the electricity and heat become free again, and make some demonstration. Thus, if Franklin had reasoned by strict analogy, he would have made the charge of the clouds positive, whereas at this time he was under the impression that they were negatively electrified. In 1767, he had come to the opinion that the vapor is often positive. In the mean while, that is, in 1752, Nollet had made experiments upon evaporation. In 1782, Volta published his experiments upon electricity as a product of evaporation; especially that which he made by a mixture of water, sulphuric acid, and iron filings, in the presence of Laplace and Lavoisier. Saussure and Bennet also experimented on the evaporation of various liquids and from various vessels they remark that the *kind* of electricity developed in the vapor was often anomalous. Saussure suggested, that in some cases a chemical decomposition of the liquids might take place, or perhaps even of the vessel, which disguised the genuine result of evaporation. Pouillet, who has gone largely into the subject of the origin of atmospherical electricity, has come to the conclusion, that the material of the vessel which holds the evaporating water has much influence, and that pure distilled water develops no electricity by evaporation; and that the saline or other impurities which water generally contains are in some way essential for the production of electricity by evaporation. If, says Bird, common salt be put into the water which is passing into vapor, the vapor acquires positive electricity at the cost of the vessel, which is negative. If, on the other hand, acid is mixed with the water, the vessel takes the positive charge and the vapor goes up with a deficiency of electricity. Peltier has made many experiments upon the subject, and finds, as he thinks, something besides evaporation to be necessary to the production of electricity, and something the conditions of which can hardly be found in ordinary evaporation. It is proper, also, to add this fact given by Pouillet, that Lemonnier discovered electricity in the air every day for six weeks between the middle of September and the end of October, 1753, although the season was very dry and no clouds were seen. On the other hand to prove that evaporation developed electricity, Rowell and Spencer made an experiment which showed that, where electricity was cut off by insulation, the evaporation was retarded. For this purpose, they put the same weight of water into two vessels, one of which was insulated, and the other connected with the ground by conductors of electricity, and they always found that the latter lost the most by evaporation. I will give the following method of Howard for showing the electricity of evaporation: "To the cap of a gold-leaf electroscope I affixed a horizontal support for a candle, which projected two feet from the cap of the instrument placed near the edge of a table; on the floor, immediately beneath, was an earthen vessel containing hot water an inch in depth. The candle being lighted, two or three hot coals were dropped into the water, so that there rose a sudden cloud of vapor. The electricity of this being collected by the candle, the leaves of the electroscope opened and struck against the sides."

Another cause of atmospherical electricity, and the one upon which Reiss particularly insists, is friction. Faraday shows by experiment that dry air, rubbing against dry air or against some other substance, would be inactive in respect to electricity. But moist air grinding against the hills, the trees, the rocks, would acquire a positive charge of electricity. The friction of two masses of moist air driven by opposite currents against one another might charge each, though with different kinds of electricity, and to a less degree than where the two rubbing bodies are more heterogeneous. Kæmtz, the distinguished meteorologist, relies on the efficacy of friction,—of friction between strata of air differing in temperature as well as moisture, of which the coldest, and therefore generally the highest, takes the positive charge. In elucidation of this point, I may refer to the discovery by Armstrong, in 1840, of hydro-electricity, as it is called. When high pressure steam issues from a boiler through a stopcock, lined, for example, with partridge-wood, electricity is abundantly produced; the steam and water being charged positively and the boiler negatively. The elaborate experiments of Faraday have clearly shown that the cause of the electricity in this case is friction; not the friction of the steam, but of the liquid particles mixed with the steam, against the inside of the pipe. Dry steam will not answer. Hence the apparatus makes provision for cooling and condensing, by a circuitous channel artificially chilled, a part of the steam before it escapes, so that it may contain the particles of water which do the rubbing. The steam itself is the mechanical power which works the electrical engine. The hydro-electric machine accordingly differs from the ordinary friction machine for producing electricity, incidentally in employing steam power instead of manual labor to work it, but essentially in selecting drops of water and wood for rubbing in place of glass and the usual amalgamated rubber. Leave now the workshop and the laboratory and go out into the broad atmosphere, substitute for the working power of steam that of the wind, and you have a hydro-electric machine of Nature's own handiwork, and upon a magnificent scale. I will offer only two further remarks concerning friction, as one of the contracting parties for forging the glittering artillery of the clouds. 1. As friction of the air is inoperative without moisture, evaporation in the last analysis is to be thanked for the electricity which friction produces. 2. As the friction of moist air, as it is driven before the wind, must be one cause, if not the only or principal cause, of atmospherical electricity, have we not some elucidation of the thunder and lightning which accompanies many moist storms, and makes so dazzling a part of the retinue which marches in the track of the tropical hurricane and the tornado everywhere!

Vegetation and combustion must not be omitted in making a catalogue of the sources of atmospherical electricity. Pouillet inferred from experiments, that the oxygen which plants give out by day is charged with negative electricity; and that a surface of one hundred square metres in full vegetation produces as much electricity in one day as the largest Leyden battery can contain. Kæmtz lays some stress on combustion as a generator of atmospherical electricity. The carbonic acid gas carries off with it positive electricity.

This experiment of Matteucci may have some applicability to the subject. He insulated a metallic plate of three square feet, covered with earth and salt; as soon as the sun acted upon it, the gold leaves of an electroscope connected with it diverged.

After it has been proved that an assigned cause is of the right kind in quality, the demands of a rigid science are not satisfied unless it is also shown that it is of sufficient force in quantity. In the case under consideration, it may be difficult to do all this, it may be difficult to calculate from such data as exist how much electricity is concentrated on the average in the atmosphere at any one time for which an account is to be rendered; and it may be no more easy to estimate correctly the producing power of evaporation, friction, and their co-operatives. There are few of the mechanical operations of nature which can be brought within the limits of strict mathematical investigation. The precision of delicacy of finish, united with great boldness of conception, which are claimed for astronomy, belong only to the mechanics of the solar system, and this which is called the higher mechanics is considered piecemeal. It hath not yet entered into the mind of man to conceive of that highest and truly celestial mechanics which metes out the forces ordained to balance and move not merely planets and comets, but stars, clusters, and nebulæ. Here it is the multiplicity of the stars which swarm in space, and the unnatural and parallactic crowding in certain districts, which make the confusion of thought. In meteorology, and indeed on many an arena of nature infinitely smaller than the earth's atmosphere, there is the same multitude of objects, and the same ambiguity of their position; and besides all this, there is a variety of forces which cut in at various points besides the force of gravitation, and there also exist an irregularity of figure and a crowding of parts in the matter concerned, which contrast widely with the almost spherical units and the ample spaces of astronomy. To walk even in one of the narrowest paths of meteorology, who can compare numerically the quantity of electricity which diverges the tell-tale leaves of the gold-leaf electroscope and that which fills the Leyden jar, and then who can compare the quantity in the jar with that in the thunderbolt, and afterwards say how many such thunderbolts strike upon a certain assignable area of the earth's surface, and how much electricity besides this discharges silently and steadily upon the mountain-peaks, the million tree-tops, and the innumerable natural lightning-rods which point ever to heaven, and preserve the earth from frequent and violent electrical excitement, by bringing the electricity back harmlessly to the earth? And to account for the existence of so much electricity, after its value has been accurately ascertained, who can calculate, from the electricity which the evaporation of a drop of water contributes to the sky, how much ascends from the earth's waters? And who will undertake to calculate the friction of the winds and the electricity which they grind out?

Beccaria, who was one of the first to follow the lead of Franklin in pursuing the study of atmospherical electricity, estimated that, as much electricity passed through the rods on the palace of Valentino every hour as was sufficient to kill three thousand men. Arago estimated that, when a cloud was present, a hundred sparks would pass a break in a lightning-rod in ten seconds, and this would be enough to kill a man; enough, therefore, to kill three hundred and sixty men an hour. In respect to evaporation, Leslie computes, that 52,120 million cubic feet of water, each weighing about sixty-two pounds, are lifted 18,000 feet into the air by evaporation each minute. Now if the evaporation of a drop of water develops electricity sufficient to throw apart the gold leaves of the electroscope, who can say that the whole fund of evaporation, which is mechanically equivalent to 200,000 times the labor of the working population of the globe, may not be competent for all the requirements of electrical meteorology.

The last general division of this article has to do with the effects of atmospherical electricity. There are meteorologists who, in their discussions and theories have entirely overlooked the agency of electricity. There are other meteorologists, who have exalted the electrical forces into the first rank, and placed them in the van of the great movements in the atmosphere. Both of these views, in my opinion, are at variance with the truth. The electrical forces are not to be despised on the one hand, nor, on the other, to be enthroned above every other influence. The statistics of meteorology are various, and are collected for various purposes. But the most important questions of meteorology, considered as a science, relate to motion. The statical aspect of this science is valuable as showing when equilibrium cannot exist, and where there must be motion, and how much motion, there must be. The phenomena of meteorology are emphatically those of change and transition. The dynamical side of the problem contemplates the laws of these changes and the origin and character of the forces which produce them. The degree of change and its direction are conveniently gauged and registered by the difference in the barometric height at the same moment for two places, or for the same place at two successive periods. But the cause of the oscillation in the barometer and of the motions which are measured by them is to be found in a disturbance of the mean temperature or humidity, or both, of the air; a disturbance originating, in each case, directly or remotely, in the action of the solar rays. While evaporation is going on under the provocation of the sun, and while the winds are blowing in virtue of moisture and of heat, both the winds and the evaporation produce electricity. This electricity, acts by its own laws of attraction and repulsion, and produces motions which combine, according to the established principles of mechanics, with the other motions which heat immediately causes; or one of the effects of heat, that is, gravitation disturbed by vapor. If we take a glass-plate electrical machine, and suppose it to be turned by a wind-mill instead of by manual strength, and if we apply the electricity which it generates to almost any mechanical purpose, we shall see that it would do much less execution than the wind itself which was spent in producing the electricity. Or if we examine the hydro-electric machine, the boiler of a locomotive, for example, we discover that it can generate large sums of electricity, surpassing, perhaps, all that we have ever seen produced artificially. Collect now the electricity which this maximum of art produces, husband it carefully, dispose it so as to exert to the best advantage its mechanical power, and how much work can it do compared with the locomotive which generated it? If it were harnessed by any artifice, however skilful to the heavy train of freight which the locomotive hardly feels to press upon its Herculean shoulders, would it not be utterly crushed by it? Hence we infer that in meteorology the work which is done by electricity is small in comparison with that which is done by the heat, acting through the wind and moisture, which sets free this electricity. And if it were otherwise, if heat could act with more economy through the medium of electricity than through that of elasticity or gravity, or through any other medium, would a thorough analysis of the phenomena of meteorology be satisfied with stoping at the electrical forces? Would it not finally come to the sun's heat as the prime mover and disturber? So it would appear that, although the phenomena of meteorology are limited to this planet, the cause is cosmical and not metoric.

Without regarding electricity as the exclusive or even the principal force which manifests itself in meteorology, we may refer certain classes of phenomena to its more particular agency. Of this description is the aurora. The great elevation of the aurora, in many cases, might require us to consider it as without the pale of meteorology, did we not expand the limits of the earth's atmosphere, and therefore the limits of the science which treats of it, beyond the region of twilight to a spot as distant as any of which gives indications of the existence in it of any substance affiliated with the grosser matter of the earth. Now the relation which has been observed to hold between the direction of the dipping needle at any place and the vanishing point of the auroral beams, indicates a dependence of the aurora on terrestrial magnetism, that is, upon an inseparable property of the earth. Again, it is supposed the clouds do not shine entirely by the light of the sun, but that they are themselves to a small degree self-luminous. In proof of this, Mr. Spencer alleges the case of an astronomer who could not see to read his time by bright starlight, but was able to do it after the heavens were overcast with clouds. Now it has been suggested that these instances of phosphorescence in clouds are the effects and the tokens of their electricity. The meteoric wonders of luminous rain and snow may indicate a high charge of electricity in the air breaking out into a glow. In other cases, as for example, in the moon, the planets, and the comets, where it is known that the bodies shine eminently by reflected light, that small amount of independent light which they may emit from a sort of phosphorescence is liable to be overlooked and over-drenched in the superior brilliancy of other lights; but these independent rays, where they exist, may be the nice traces of electricity.

There are motions among the clouds which are probably caused by the electrical attractions and repulsions. It is no uncommon sight to behold clouds moving contrary to the wind, and also sometimes in different directions with respect to one another. This is properly explained, in many cases, by saying that different currents prevail at different heights, and each cloud obeys, like a balloon, the current in which it happens to be at the time. But it is impossible that the clouds should be electrified, as they sometimes are to a high degree, without exerting their electrical attractions and repulsions, and thus producing motions which may modify, and perhaps materially, such other motions as the winds may start. On the 14th of June, 1842, it was observed that the focus of a thunder-storm in England followed the course of the Thames. There, the electrical forces seemed to impress their own character upon the direction of the motion. The clouds acted by induction upon the earth, and, particularly on those parts which conduct the electricity best, and prepared the way for the attraction which guided their own course.

Another way in which electricity may influence the atmospherical movement is this. When the particles of air are electrified, they tend to fly asunder, as the pith-balls hanging upon the prime conductor of the electrical machine. This tendency of the particles to separate adds to the expansive force of the air, and is equivalent to so much additional heat. A large amount of electricity set free at one place may give a strong explosive force to the air, and produce in this way very grand effects, though they will be local and ephemeral in their character. But in a general view of meteorology this mode of action cannot be paramount to all others. For when it is considered that heat acting by one or another agency, produces the electricity which is in the air, it can hardly be believed that a given amount of heat if exerted directly on the air to expand it.

Faraday once made a remark, based upon his own experiments, which is often quoted and sometimes misconceived, to this effect: that a grain of water gives out by its chemical decomposition as much electricity as might charge a thunder-cloud. Hence many exclaim, philosophers and those who are not, How immense the *quantity* of electricity in a drop water! We might with a good reason cry out, How insignificant the quantity of electricity in the thunder-cloud! And, indeed, if electricity be in reality a fluid, as we at present are constrained to conceive it, the grand effects which are unquestionably produced by it, as those of the thunderbolt, may be attributable to the incomparable freedom, elasticity, and consequently the velocity of the fluid, and not the quantity, which may be no greater than that which binds the oxygen and hydrogen of a particle of water, and which if gradually set free, is insignificant and almost imperceptible. There may be other local effects besides these seen where lightning has struck, as for example, the ravages of the tornado, which are the work of electricity suddenly accumulated and bursting as suddenly out before it has had time quietly to discharge itself by the ordinary channels. In the convulsions of the air, and even of the solid earth, in earthquakes, volcanic eruptions, and hurricanes, electricity finds a congenial atmosphere and contributes to swell the force of destruction. But even here, while its makes it own mark on the phenomena, it is itself the effect of many antecedents, and can be no larger or more terrific than the forces which have been expended in producing it. These other forces, it is true, by taking the guise of electricity, may acquire a degree of centralization and a facility for instantaneous action which do not belong to their own sluggish nature.

Thus, in various ways, such as have been already described, electricity is ascending from the earth to the air, or in other words, the electrical equilibrium holding between the earth and its atmosphere is destroyed. Even while the accumulation is proceeding, some effects, as the electrical attraction and repulsion, and the motions which follow, are produced by these forces, the release of which from the usual balance is the essence of electricity. But in the course of time the clouds will be electrically overloaded, and the forces of which I write will be so strengthened by constant reinforcement as to compel a return to equilibrium. The influences which carry up the electricity into the air cannot hold it there. This must be left for the insulating power of the air itself, which is generally very imperfect. In dry states of the air, the electricity must wait till it is strong enough to break down in luminous beams through the dry air, revealing its motion possibly at these times by the tremulous flashes of the aurora. Sometimes its passage from cloud to cloud is bridged across by the moisture, or its descent to the earth is made very easy by the columns of rainbows or snow-flakes. But whether it creeps slyly from place to place or dashes boldly along, as in the lightning, the most important disturbances are produced by the electricity of the atmosphere, as well as electricity in general when it is in motion, when it is hurrying back to the haunts from which it was enticed. Then it burns, blazes, storms, and tears, then it convulses and sometimes kills. Manifest pains has been taken by the Author of nature to keep down all electrical excesses. The lightning which kills suggests most forcibly the Merciful Hand which generally spares. Even if we are not able to decide whether the development of electricity is incidental merely to other atmospheric movements, or whether it is a most important object of them, certain it is that electricity is crowding into the air, and in quantities that would threaten all the time, did not Infinite Wisdom provide in more ways than one an escape for the redundant energy, and ages before Franklin planted on the earth the first lightning-rod to catch the destructive fluid as it poured down, make the earth bristle all over with his divine protection. The method by which the earth is shielded from the electrical furies, the cases in which the defence is insufficient, the ways by which man has guarranteed to himself greater security, and the effects of lightning when, in spite of all caution, human and divine, it is occasionally allowed to strike the earth with violence, will make a proper subject for another communication.

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**General Meteorological Register of the Provincial Magnetical Observatory, Toronto, for the Year 1853.**

*Read before the Canadian Institute by Prof. Cherriman, Feb. 11th, 1854.*

The mean temperature for the year 1853 has been above the average of the previous 12 years by 0°.55, the months of January, May, July, October, and December having been below, and the remaining months above, the corresponding average temperatures. The hottest month was August, and the coldest January, which is an exception to the normal curve where these months are July and February.

The month of August is the hottest in the whole series of years, except July, 1850. The *climatic difference*, or the difference between the hottest and coldest months, is 45°.6, being 2°.9 greater than the average. The range of temperature during the year has been 104°.6, occurring from —9°.7 on the morning of Jan. 16th to 94°.9 on the afternoon of Aug. 11th, this latter being the highest temperature ever recorded at the Observatory.

The hottest day was Aug. 12th (79°.8), and the coldest Dec. 29th (2°.4), the difference between these being 77°.4. The greatest daily range occurred on Jan. 15th, amounting to 40°.9, while the mean daily range on the average of the whole year is 16°.9.

The present year, therefore, conforms to the law established by Colonel Sabine from the preceding 12 years' observations, that "the climate of Toronto presents a remarkable combination of great regularity in the annual temperature with great variability occurring in the course of the year." Arranging the year into the ordinary seasons, we find the mean temperatures to be as follows:

Winter, 26°.3; Spring, 41°.1; Summer, 66°.6; Autumn, 47°.3;

in each case being above the average.

By an inspection of the thermic anomalies, it will be seen that only two months of the year have been above the normal values of this latitude, all the rest being more or less below. Taking the respective seasons, we find the thermic anomalies to be:

Winter, —8.2; Spring, —8.4; Summer, —0.7; Autumn, —5.5;

and if we increase these temperatures by 1° on account of vertical elevation, the summer will have been 0°.3 above, and the winter 7.2 below, the temperatures due to those seasons from our geographical position.

The most remarkable deviations from the normal curve of temperature have been as follows:

| | |
|---|---|
| From Feb. 1st to 5th inclusive, mean deviation | +9°.8 |
| " Feb. 7th to 9th | —9°.7 |
| " Feb. 28th to March 2nd | +9°.1 |
| " March 14th to 16th | —13°.3 |
| " June 13th to 16th | +12°.7 |
| " Aug. 10th to 13th | +12°.3 |
| " Sept. 2nd to 6th | +9.5 |
| " Nov. 19th to 23rd | +12.5 |
| " Nov. 24th to 25th | —11.6 |
| " Dec. 28th to 31st | —14.6 |



The greatest deviation below the normal was on 29th Dec., 22°.7, and above, on 14th June, 14°.4.

The mean humidity f the year is .79, July having been the dryest, and January and February the most moist months. The extent of clouded sky on the average of the whole year has been .57, so that nearly three-fifths of the sky has been overcast on the mean of the whole. The clouds were least prevalent in July, and most in December, and no less than seven months have been on the average more than half overcast.

The mean direction of the wind has been N. 38° W., with a mean velocity of 5.08 miles per hour. For the first six months the mean direction was steadily from the N.W. quarter, changing very suddenly in July to the E. and S., and returning in December to the N.W. The velocity was greatest in February, diminishing regularly till June, when it was least, and then increasing again.

The amount of rain fallen has been 23.55 inches on the surface, which is 8.076 inches below the average; and if to this we add 5.32 inches for the amount of rain equivalent to the 53.2 inches of snow that fell during the year, we have a total of 28.87 inches. On the whole, this has been the dryest year, with the single exception of 1848, during the last 13 years. The greatest amount fell in September, and the least in December, the summer months being remarkably dry.

The fall of rain was distributed over 109 days, and the snow over 52, leaving 204 perfectly fair days, on which neither rain nor snow fell. Of these, January enjoyed the most (24), and February and November the least (9).

Frost occurred in every month except June, July, and August, the latest in spring being on the 20th May, and the earliest in autumn on the 12th September. The last snow of spring was on the 10th May, and the first of autumn on the 25th October, being about the usual periods. Toronto Bay was clear of ice on March 31st, and frozen over on December 19th, being crossed on foot on the 21st.

The Indian summer was well defined from 12th to 20th October.

The number of thunder-storms during the year has been 34, of which the most occurred in June and September; none at all in November, January, and February. Of these, there were only six remarkable for violence, viz., on 15th, 17th, and 18th of May, all passing from W. to E.; on 15th July, from W. to E., accompanied with heavy hail; on 17th August, from W. to E., passing directly over the Observatory; and the most violent of all on 14th September, during 10 minutes of which the wind attained a velocity of 46.8 miles per hour, the greatest ever recorded here.

During the year there have been 233 nights the state of which would have permitted Aurora to be seen if it existed. On 57 of these Aurora was actually observed. The most brilliant displays occurred from May 28th to June 1st; from July 8th to 12th; on August 25th; and from September 1st to 3rd. This latter was visible not only over most of this continent, but also in Europe, presenting the same characteristics. All these were accompanied by great magnetic disturbance.

**General Meteorological Register for the Year 1853. Provincial Magnetical Observatory, Toronto, C. W.**

*Latitude* 43° 39′·4 *North*; *Longitude* 79° 21′·5 *West. Elevation above Lake Ontario,* 108 *feet Approximate elevation above the sea.* 342 *feet.*

| | Jan. | Feb. | March. | April. | May. | June. | July. | Aug. | Sept. | Oct. | Nov. | Dec. | Mean of Year. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mean Temperature | 22°.98 | 24°.06 | 30°.65 | 41°.92 | 50°.87 | 65°.49 | 65°.60 | 68°.61 | 58°.81 | 44°.40 | 38°.68 | 25°.32 | 44°.78 |
| Difference from Average | —1.09 | +0.66 | +0.42 | +0.78 | —0.31 | +4.44 | —0.81 | +2.45 | +0.79 | —0.53 | +2.17 | —1.43 | +0.55 |
| Thermic Anomaly | —9.8 | —10.6 | —9.5 | —8.3 | —7.2 | +0.9 | —3.1 | +0.1 | —2.7 | —9.4 | —4.5 | —10.7 | —6.2 |
| Highest Temperature | 40.9 | 43.4 | 56.3 | 65.7 | 78.4 | 89.5 | 91.3 | 94.9 | 85.5 | 64.7 | 55.6 | 46.4 | |
| Lowest Temperature | —9.7 | —1.4 | —0.1 | 25.0 | 32.2 | 39.2 | 41.6 | 42.5 | 33.9 | 23.4 | 12.8 | —8.4 | |
| Monthly Range | 50.6 | 44.8 | 56.4 | 40.7 | 46.2 | 50.3 | 49.7 | 52.4 | 51.6 | 41.3 | 42.8 | 54.8 | 48.47 |
| Mean Daily Range | 14.16 | 14.40 | 14.82 | 14.07 | 14.19 | 19.77 | 23.80 | 21.41 | 18.42 | 20.51 | 13.01 | 14.14 | 16.89 |
| Greatest Daily Range | 40.9 | 35.4 | 26.0 | 28.8 | 28.4 | 32.8 | 30.7 | 39.1 | 32.2 | 31.5 | 27.6 | 24.9 | |
| Mean Height of Barometer | 29.7121 | 29.5824 | 29.5533 | 29.5689 | 29.5979 | 29.6175 | 29.6552 | 29.5907 | 29.6421 | 29.6485 | 29.7921 | 29.5984 | 29.6299 |
| Highest Barometer | 30.315 | 29.937 | 30.168 | 29.974 | 30.074 | 29.982 | 29.906 | 29.850 | 29.999 | 30.066 | 30.270 | 29.984 | |
| Lowest Barometer | 28.653 | 29.074 | 28.892 | 28.985 | 29.213 | 29.265 | 29.274 | 29.300 | 28.946 | 28.985 | 29.159 | 28.952 | |
| Monthly Range | 1.662 | 0.863 | 1.276 | 0.989 | 0.861 | 0.717 | 0.632 | 0.550 | 1.053 | 1.081 | 1.111 | 1.032 | 0.986 |
| Mean Humidity | .82 | .82 | .81 | .80 | .80 | .79 | .70 | .74 | .79 | .75 | .81 | .81 | .79 |
| Mean Elasticity | 0.110 | 0.117 | 0.145 | 0.212 | 0.297 | 0.451 | 0.425 | 0.513 | 0.399 | 0.223 | 0.201 | 0.122 | 0.271 |
| Mean Direction of the Wind | N. 27° W. | N. 49° W. | N. 62° W. | N. 12° W. | N. 20° W. | N. 14° W. | E. 14° S. | E. 61° S. | N. 5° E. | W. 2° S. | N. 1° E. | N. 38° W. | N. 38° W. |
| Mean Velocity of the Wind (Miles) | 6.34 | 7.29 | 5.87 | 5.20 | 5.14 | 3.67 | 3.70 | 4.23 | 4.30 | 4.72 | 5.52 | 4.98 | 5.08 |
| Mean of Cloudiness | 0.68 | 0.74 | 0.59 | 0.46 | 0.57 | 0.43 | 0.34 | 0.47 | 0.53 | 0.49 | 0.74 | 0.75 | 0.57 |
| Amount of Rain (Inches) | 0.290 | 1.030 | 1.080 | 2.625 | 4.420 | 1.550 | 0.915 | 2.575 | 5.140 | 0.875 | 2.425 | 0.625 | 23.550 |
| Difference from Average | —1.535 | +0.023 | —0.481 | +0.023 | +1.534 | —1.532 | —2.762 | —0.415 | +0.839 | —2.198 | —0.628 | —0.944 | —8.076 |
| Amount of Snow | 7.5 | 12.6 | 7.1 | 1.0 | Inapp. | | | | | Inapp. | 2.7 | 22.3 | 53.2 |
| No. of Fair Days | 24 | 9 | 17 | 19 | 13 | 21 | 21 | 20 | 18 | 19 | 9 | 14 | 204 |

**Meteorological Observations at Hamilton.**

HAMILTON, *8th Feb.*, 1854.

*To the Editor of the Canadian Journal.*

SIR :—I enclose herewith, for publication in your *Journal*, if you see fit, the mean results of my meteorological observations for the last eight years.

At the time my observations were commenced, I was aware that a daily morning and evening observation would give a near approximation to a correct annual mean temperature. I was also aware that from horary observations at Leith, in Scotland, conducted at the suggestion and under the auspices of Sir David Brewster, it was found that the proper times for the morning and evening observations there, were 9¼ A. M., and 8½ P. M., but that from the examination of a register kept at these hours at Alford, in Aberdeenshire, Sir David calculated that the proper times at that place for giving the mean temperature were 8¾ A. M. and 8 P. M. I selected, therefore, at first, two hours most convenient to myself, marking, at same time, the daily highest and lowest, intending at some future time to calculate the times at which the observations might be made to correspond more nearly with one another, and with the mean temperature. I also made a series of monthly observations on the temperature of a spring of water.

The thermometer used was one by Troughton & Sims, of London, which was tested, and found correct; but, after being used for some time, the steel rod got entangled in the mercury oftener than once, and was with difficulty extricated. I therefore got another thermometer, which, after being used for two or three years, was broken. In 1839, finding that the exclusion of the daily maximum and minimum did not affect the mean temperature by more than from one to two tenths of a degree, I only marked the monthly maximum and minimum, and used the old thermometer, not suspecting that it had become incorrect; nor was this suspected till 1846, when it was found to stand two degrees too high. In the end of that year, I therefore got a new thermometer, by Dunn, of Edinburgh, which has been used since. I mention this to account for the observations of Capt. Lefroy in your *Journal* for Nov., 1852, and for the apparent high temperature of 1846, which should, in consequence, I believe, be reduced two degrees. That the position of the thermometer within the Venetian blind of a window, in a northern exposure, was not improper, was ascertained from frequent comparison with another thermometer, hung under a pine-tree at the same height from the ground.

I will only farther remark that the thermometer is about 8 feet from the ground, and that the column headed "slight showers" implies not exactly what it expresses, but that the rain was not such as to prevent out-of-doors work for more than two hours. The sum of the two first columns gives the number of days on which rain or snow more or less fell.

Should any further explanation be deemed necessary, I shall be happy if you will give me an opportunity of making it.

I am, sir,
Your obedient servant,
W. CRAIGIE.

**Mean Results of Meteorological Observations at Hamilton for Eight Years—1846 to 1853 inclusive.**

1846.

| | Thermometer. | | | | | Barometer. | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean at 9 A.M. | Mean at 9 P.M. | Mean of both | Highest. | Lowest. | Mean. | Highest. | Lowest. | Rainy days. | Slight showers. | Dry days. |
| Jan. ... | 29°.2 | 30°.4 | 29°.8 | 51 | 4 | 29.657 | 30.30 | 29.22 | 3 | 9 | 19 |
| Feb.... | 24.54 | 24.4 | 24.47 | 48 | –4 | 655 | 21 | 28.97 | 5 | 7 | 16 |
| March | 38.16 | 35.32 | 36.74 | 53 | 10 | 66 | 14 | 29.00 | 4 | 9 | 18 |
| April.. | 47.16 | 44.93 | 46.05 | 85 | 26 | 774 | 22 | 17 | 5 | 7 | 18 |
| May... | 62.645 | 57.323 | 59.984 | 85 | 35 | 603 | 29.92 | 25 | 4 | 7 | 20 |
| June .. | 70.43 | 64.13 | 67.28 | 90 | 45 | 704 | 30.10 | 40 | 2 | 8 | 20 |
| July .. | 77.87 | 67.0 | 72.435 | 98 | 49 | 70 | 08 | 37 | 2 | 7 | 22 |
| Aug. .. | 74.74 | 70.52 | 72.63 | 93 | 53 | 73 | 29.90 | 44 | 4 | 2 | 25 |
| Sept. . | 68.24 | 66.00 | 67.12 | 90 | 41 | 716 | 95 | 40 | 4 | 8 | 18 |
| Oct. ... | 48.065 | 48.645 | 48.355 | 76 | 25 | 753 | 30.17 | 30 | 7 | 8 | 16 |
| Nov.... | 44.1 | 45.4 | 44.75 | 60 | 20 | .7255 | 22 | 02 | 4 | 7 | 19 |
| Dec.... | 31.74 | 34.2 | 32.97 | 58 | 16 | .669 | 22 | 05 | 4 | 4 | 23 |
| Mean | | | 50.215 | | | 29.6955 | | | 48 | 83 | 234 |

1847.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Jan. ... | 25.774 | 26.29 | 26.032 | 54 | 2 | 29.65 | 30.17 | 28.90 | 5 | 7 | 19 |
| Feb. ... | 25.786 | 27.678 | 26.732 | 45 | 2 | 594 | 03 | 86 | 4 | 9 | 15 |
| March | 32.42 | 32.48 | 32.45 | 54 | 10 | 69 | 05 | 29.15 | 2 | 3 | 26 |
| April.. | 46.03 | 43.2 | 44.615 | 77 | 20 | 657 | 06 | 18 | 3 | 6 | 21 |
| May... | 59.54 | 55.26 | 57.4 | 84 | 34 | 665 | 00 | 20 | 2 | 7 | 22 |
| June .. | 67.16 | 61.4 | 64.28 | 90 | 41 | 649 | 29.96 | 10 | 3 | 9 | 18 |
| July... | 78.6 | 71.6 | 75.1 | 96 | 46 | 752 | 98 | 50 | 1 | 5 | 25 |
| Aug. .. | 71.19 | 66.13 | 68.66 | 88 | 48 | 75 | 30.02 | 42 | 2 | 7 | 22 |
| Sept... | 60.66 | 58.56 | 59.62 | 86 | 39 | 691 | 04 | 37 | 5 | 10 | 15 |
| Oct. ... | 47.9 | 48.03 | 47.965 | 72 | 24 | 707 | 34 | 07 | 4 | 7 | 20 |
| Nov.... | 41.77 | 41.93 | 41.85 | 71 | 11 | 695 | 19 | 30 | 5 | 8 | 17 |
| Dec. ... | 32.7 | 33.8 | 33.25 | 58 | 10 | 667 | 02 | 28.97 | 5 | 11 | 15 |
| Mean | | | 48.163 | | | 29.681 | | | 41 | 89 | 235 |

1848.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Jan. ... | 30.90 | 30.4 | 30.65 | 60 | –1 | 29.685 | 30.22 | 29.05 | 4 | 7 | 20 |
| Feb. ... | 29.62 | 30 2 | 29.91 | 55 | 5 | 594 | 07 | 00 | 1 | 5 | 23 |
| March | 32.55 | 32·45 | 32.5 | 72 | 6 | 642 | 29.95 | 19 | 4 | 6 | 21 |
| April.. | 46.2 | 45·9 | 46.05 | 84 | 26 | 777 | 30.09 | 38 | 2 | 5 | 23 |
| May... | 61.42 | 58 16 | 59.79 | 91 | 35 | 566 | 29.87 | 27 | 3 | 7 | 21 |
| June. . | 70.83 | 68·2 | 69.52 | 100 | 42 | 615 | 95 | 28 | 1 | 7 | 22 |
| July... | 70.32 | 68·8 | 69.61 | 94 | 51 | 628 | 80 | 23 | 1 | 9 | 21 |
| Aug... | 73.58 | 72·516 | 73.048 | 96 | 53 | 7065 | 88 | 83 | 2 | 5 | 24 |
| Sept... | 58.9 | 57 3 | 58.1 | 80 | 33 | 623 | 93 | 28.99 | 4 | 8 | 18 |
| Oct. ... | 51.096 | 50·77 | 50.933 | 78 | 32 | 677 | 30.13 | 29.22 | 8 | 6 | 22 |
| Nov.... | 37.2 | 37·13 | 37.166 | 51 | 25 | 694 | 09 | 28.90 | 5 | 6 | 19 |
| Dec.... | 34.41 | 34·13 | 34.27 | 60 | 13 | 649 | 12 | 29.05 | 5 | 9 | 17 |
| Mean | | | 49.295 | | | 29.663 | | | 35 | 80 | 251 |

### 1849.

| | Thermometer. Mean at 9 A.M. | Mean at 9 P.M. | Mean of both | Highest. | Lowest. | Barometer. Mean. | Highest. | Lowest | Rainy days. | Slight showers. | Dry days. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Jan. ... | 23°.20 | 24°.50 | 23°.85 | 53 | –6 | 29.83 | 30.47 | 29.20 | 3 | 7 | 21 |
| Feb. ... | 22.714 | 25.142 | 23.928 | 49 | –6 | 29.767 | 30.30 | 29.15 | 3 | 7 | 18 |
| March | 36.71 | 38.03 | 37.37 | 73 | 23 | 29.745 | 30.18 | 29.00 | 2 | 5 | 24 |
| April.. | 42.4 | 42.64 | 42.52 | 77 | 22 | 29.676 | 30.00 | 29.15 | 1 | 8 | 21 |
| May ... | 52.36 | 52.64 | 52.5 | 84 | 35 | 29.7065 | 30.22 | 29.08 | 6 | 8 | 17 |
| June .. | 69.47 | 67.37 | 68.42 | 99 | 45 | 29.735 | 29.98 | 29.42 | 2 | 5 | 23 |
| July ... | 73.16 | 71.9 | 72.53 | 101 | 54 | 29.79 | 30.08 | 29.44 | 2 | 2 | 27 |
| Aug.... | 70.16 | 69.9 | 70.03 | 98 | 53 | 29.728 | 29.90 | 29.26 | 2 | 7 | 22 |
| Sept. .. | 61.93 | 61.66 | 61.8 | 89 | 40 | 29.766 | 30.15 | 29.18 | 1 | 5 | 24 |
| Oct. ... | 48.968 | 49.486 | 49.227 | 75 | 30 | 29.657 | 30.02 | 29.20 | 6 | 8 | 17 |
| Nov.... | 45.966 | 46.5 | 46.233 | 68 | 30 | 29.629 | 29.95 | 29.25 | 5 | 5 | 20 |
| Dec. ... | 29.16 | 28.55 | 28.855 | 55 | 3 | 29.683 | 30.24 | 29.27 | 5 | 10 | 16 |
| Mean temp. of year, | | | 48.105 | M'n h't. | | 29.726. | | | 38 | 77 | 250 |

### 1850.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Jan. ... | 30.61 | 31.35 | 30.98 | 50 | 15 | 29.71 | 30.18 | 28.96 | 6 | 3 | 22 |
| Feb. ... | 29.428 | 31.50 | 30.464 | 59 | 8 | 29.593 | 30.26 | 28.78 | 5 | 5 | 18 |
| March | 33.00 | 33.74 | 33.37 | 60 | 14 | 29.626 | 30.22 | 28.70 | 2 | 6 | 24 |
| April.. | 41.46 | 40.9 | 41.19 | 80 | 21 | 29.614 | 30.05 | 28·95 | 5 | 6 | 19 |
| May ... | 53.60 | 51.4 | 52.50 | 90 | 36 | 29.619 | 30.00 | 29.00 | 1 | 5 | 25 |
| June .. | 70.56 | 68.1 | 69.33 | 95 | 46 | 29.738 | 30.00 | 29.50 | 0 | 8 | 22 |
| July ... | 74.29 | 73.39 | 73.84 | 101 | 56 | 29.691 | 29.88 | 29.48 | 5 | 5 | 21 |
| Aug.... | 71.74 | 70.97 | 71.355 | 100 | 52 | 29.691 | 29.95 | 29.40 | 5 | 7 | 19 |
| Sept... | 61.76 | 60.43 | 61.1 | 86 | 37 | 29.715 | 30.02 | 29.44 | 3 | 5 | 22 |
| Oct..... | 49.30 | 49.7 | 49.5 | 78 | 31 | 29.657 | 30.00 | 29.30 | 3 | 8 | 20 |
| Nov. ... | 42.00 | 43.73 | 42.866 | 74 | 22 | 29.717 | 30.10 | 29.30 | 4 | 5 | 21 |
| Dec. ... | 28.355 | 28.225 | 28.29 | 52 | 0 | 29.70 | 30.22 | 29.10 | 7 | 8 | 16 |
| Mean temp. of year, | | | 48.732 | M'n h't | | 29.673 | | | 46 | 71 | 249 |

### 1851.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Jan. ... | 29°.61 | 32°.16 | 30°.885 | 52° | –6° | 29.665 | 30.42 | 28.88 | 5 | 5 | 21 |
| Feb. ... | 33.00 | 33.20 | 33.100 | 57 | 9 | 29 805 | 30.36 | 29.28 | 5 | 6 | 17 |
| March | 37.774 | 396774 | 387257 | 75 | 21 | 29.693 | 07 | 30 | 2 | 6 | 23 |
| April.. | 44.76 | 45.7 | 45.23 | 77 | 29 | 64 | 30 | 15 | 4 | 6 | 20 |
| May ... | 56.45 | 55.45 | 55.95 | 88 | 31 | 71 | 10 | 24 | 2 | 8 | 21 |
| June .. | 65.83 | 64.16 | 65.00 | 92 | 43 | 65 | 06 | 18 | 3 | 8 | 19 |
| July ... | 69.94 | 70.00 | 69.97 | 97 | 53 | 639 | 29.86 | 40 | 4 | 8 | 19 |
| Aug.... | 68.13 | 67.77 | 67.95 | 91 | 49 | 749 | 30.02 | 50 | 4 | 5 | 22 |
| Sept... | 63.06 | 63.00 | 63.03 | 96 | 36 | 838 | 30.25 | 25 | 5 | 3 | 22 |
| Oct. ... | 50.2 | 50.51 | 50.35 | 77 | 27 | 6375 | 00 | 28 | 2 | 8 | 21 |
| Nov.... | 38.43 | 38.13 | 38.28 | 53 | 26 | 652 | 40 | 02 | 4 | 7 | 19 |
| Dec. ... | 26.16 | 26.80 | 26.48 | 52 | 0 | 68 | 20 | 28.90 | 5 | 9 | 17 |
| Mean temp. of year, | | | 48.756 | M'n h't. | | 29.6882 | | | 45 | 79 | 241 |

### 1852.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Jan. ... | 22.87 | 24.645 | 23.76 | 45 | –6 | 29.59 | 30.00 | 29.05 | 7 | 9 | 15 |
| Feb. ... | 28.00 | 29.20 | 28.60 | 54 | –2 | 579 | 32 | 28.72 | 2 | 9 | 18 |
| March | 32.90 | 33.10 | 33.00 | 58 | 5 | 634 | 32 | 72 | 6 | 5 | 20 |
| April.. | 41.80 | 41.73 | 41.77 | 69 | 26 | 475 | 29.85 | 95 | 6 | 8 | 16 |
| May ... | 57.61 | 56.00 | 56.805 | 88 | 35 | 71 | 30.15 | 29.20 | 2 | 5 | 24 |
| June .. | 66.66 | 65.26 | 65.96 | 98 | 44 | 633 | 00 | 15 | 3 | 8 | 19 |
| July ... | 71.61 | 70.55 | 71.08 | 101 | 52 | 721 | 29.95 | 30 | 2 | 4 | 25 |
| Aug.... | 69.80 | 69.00 | 69.40 | 97 | 52 | 768 | 30.00 | 46 | 2 | 9 | 20 |
| Sept... | 60.70 | 60.30 | 60.50 | 95 | 38 | 764 | 02 | 05 | 5 | 5 | 29 |
| Oct. ... | 52.58 | 52.32 | 52.45 | 76 | 34 | 72 | 10 | 30 | 5 | 4 | 22 |
| Nov.... | 39.16 | 39.73 | 39.45 | 57 | 27 | 645 | 17 | 07 | 3 | 6 | 21 |
| Dec. ... | 35.709 | 36.645 | 6.177 | 59 | 18 | 641 | 20 | 10 | 8 | 6 | 17 |
| Mean temp. of year, | | | 48.248 | M'n h't. | | 29.657 | | | 52 | 78 | 237 |

### 1853.

| | Thermometer. Mean at 9 A.M. | Mean at 9 P.M. | Mean of both | Highest. | Lowest. | Barometer. Mean. | Highest. | Lowest. | Rainy days. | Slight showers. | Dry days. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Jan. ... | 28°.46 | 29°.22 | 28°.84 | 50 | 3 | 29.7525 | 30.28 | 28.97 | 1 | 5 | 25 |
| Feb. ... | 28.14 | 28.82 | 28.48 | 50 | 10 | 636 | 00 | 29.15 | 5 | 5 | 18 |
| March | 35.355 | 36.71 | 36.03 | 66 | 7 | 615 | 18 | 28.95 | 4 | 7 | 20 |
| April.. | 45.9 | 45.9 | 45.9 | 83 | 29 | 6725 | 00 | 29.07 | 4 | 5 | 21 |
| May ... | 56.5 | 54.9 | 55.7 | 92 | 33 | 6775 | 15 | 32 | 4 | 10 | 17 |
| June .. | 70.06 | 68.66 | 69.36 | 98 | 50 | 737 | 05 | 50 | 2 | 5 | 23 |
| July ... | 71.322 | 70.968 | 71.145 | 97 | 52 | 749 | 29.95 | 50 | 1 | 4 | 26 |
| Aug. .. | 72 8 | 72.9 | 72.85 | 101 | 51 | 679 | 90 | 40 | 2 | 6 | 23 |
| Sept... | 63.9 | 63.96 | 63.93 | 96 | 37 | 723 | 30.00 | 20 | 3 | 5 | 22 |
| Oct. ... | 47.26 | 48.26 | 47.76 | 75 | 30 | 718 | 08 | 10 | ( | 6 | 25 |
| Nov.... | 42.9 | 44.22 | 43.56 | 65 | 20 | 834 | 25 | 30 | 4 | 4 | 22 |
| Dec. ... | 30.355 | 29.903 | 30.129 | 53 | 2 | 637 | 04 | 00 | 4 | 8 | 19 |
| Mean | 49.413 | 49.535 | 49.474 | | | 29.7025 | | | 34 | 70 | 261 |

## Meteors and Falling Stars.

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

The subject to which I would invite your attention for a few minutes this evening, is one of an interesting though mysterious character. It is at the same time one which is gradually assuming the form of a science, and, from its connection with other branches of general physics, beginning to awaken a closer and deeper interest. The higher principles of inquiry into nature, the infinite increase of exactness required and obtained in all the methods of research, and the intimate connection established amongst different sciences, which are said to be the peculiar characteristics that designate the physical science of the present time, are strikingly illustrated in the investigations of scientific men, into the various phenomena presented by *aerolites, meteors,* and *falling stars.* The scientific research which has been given to the subject, has broadened the views of the philosopher, who, until lately, agreed with the peasant in ascribing "those fiery shapes and burning crescents" which suddenly kindle into brightness and as suddenly disappear, to inflammable gases or electrical action in the atmosphere. True, there are many questions connected with this subject which have as yet received no very satisfactory solution, still the number of such is gradually diminishing, and the theories adopted to account for the origin of such phenomena, in which much confidence is placed, are now limited to one or two. The truth can only be ascertained by a lengthened process of observation and experiment, not confined to one locality or country, but extending throughout different hemispheres and different latitudes. In a clear and cloudless atmosphere, such as we possess in Canada, good opportunities are afforded for marking the course of the fire-ball as it moves through the blue vault of heaven, or for noticing the point whence issue those showers of "fiery shapes" which periodically visit us. So far as I am aware these favorable opportunities are but rarely embraced; for in the catalogues that have been compiled, shewing the recorded observations of such phenomena, I have not been able to find the name of Canada bearing any very conspicuous position. I trust that this will not continue so much longer; and that the effect of this and similar institutions, in stimulating to increased observation and research in the different departments of physical knowledge, may be visible in this, as I have no doubt it will be, in many other portions of the great field of science.

My object in this paper is not to present any new theory for your adoption, or to invite attention to any original views on the subject to which it refers, but rather to state summarily the leading questions connected with luminous meteoric phenomena, so as to elicit the opinions of those scientific gentlemen whom I have the pleasure to address, and with whom I have the honor to be associated in this Institute.

It may be observed at the beginning that what have been called *shooting-stars, fire-balls* and *meteorites*, are generally regarded as being closely connected in character. Although possessing many distinct characteristics, careful observers tell us that fire balls cannot be considered as entirely separate from shooting-stars. Humboldt observes, that both these phenomena are not only often simultaneous, but often found to merge into one another, the one gradually assuming the character of the other, alike with respect to the size of their discs, the emanation of sparks and the velocities of their motions; but, he adds in a later work, that *relation* is not *identity*, and that much remains to be investigated as to the physical relations of both. Again, the connection of meteorites and fire-balls, and of fire-balls and shooting-stars has been proved by facts of an indubitable character. Whilst most writers, therefore, on these phenomena have, to the great perplexity of the unscientific reader, failed in their attempts to treat of them separately, still a certain classification has been adopted as the basis of inquiry into the causes and physical connections of such phenomena; and although expressive of little more than mere external aspects, irrespective of the physical causes of such appearances, such a classification is useful, and to it I shall adhere as far as possible in what follows.

We have then 1st, balls of light, appearing suddenly, presenting certain physical characters, and as suddenly disappearing; 2nd, shooting-stars, visible at all times and in all countries; and 3rd, aerolites or meteorites, differing in size and form, but possessing certain features indicative of a common origin, and that foreign to the planet on which they fall.

The spirit of inquiry into the nature of these bodies began to awake about the close of last century, and from that time to the present, extensive research has been employed to ascertain the early history of certain aerolites, reports of which were common to all ages, but which have only recently become the subject of historical evidence. The ingenious and fanciful Edward King thinks that he finds a reference to these in the "hailstones and coals of fire" mentioned by David in the 18th Psalm; and also in the "great stones" with which Jehovah discomfited and slew the five kings who made war against Gibeon. For the knowledge of the most ancient falls of aerolites, which are determined with chronological accuracy, we are indebted to the industry of the Chinese. They possess authentic catalogues of the remarkable meteors of all classes, aerolites included, which have appeared in China during a period of 2400 years. Their reports therefore reach back to the time of Tyrtaeus, and the second Messenian war of the Spartans, or 179 years prior to the fall of the large meteoric stone at Aegos Potamos, which Pliny describes as being as "large as a cart," even in his day; and which Humboldt thinks may yet be found, notwithstanding the failure that attended the efforts of the African traveller, Brown. Edward Biot, who has translated these records, has found sixteen falls of aerolites for the epoch from the middle of the seventh century B.C., to the 333rd year of the Christian era; while the Greek and Roman writers mention only four such phenomena, as having occurred during the same space of time. He mentions also, that during the three centuries from A.D. 960 to 1270, not fewer than 1479 meteors are registered by official observers employed for the purpose. In 1794 the celebrated work of Chladni was published, and was the means of arousing general attention throughout Europe to the whole subject. In that book a catalogue is given of all the recorded observations of fire-balls, and other meteors which had been previously made; and by the time that his second work appeared in 1819, containing a full account of aerolites, registered according to the periods and places of their fall, as well as the directions of their line of descent, all scepticism on the subject had vanished, and his statements were received with entire assent by the scientific portion of his readers at least. His work, too, had the effect of calling more general attention to those ferruginous masses which had been found in different countries, and of assigning to them a meteoric character. I refer to such masses as those found in Otumpa and Bahia in Brazil, the former of which weighed about 14,000 pounds, or such specimens as that of the Siberian stone described by Pallas, and which is now in the Imperial Museum, in St. Petersburg. I may notice that the number of aerolites registered by Chladni, as having fallen from the commencement of the Christian era down to 1818, is 165. Between 1600 and 1818, seventeen of these fell in Britain, fifteen in France, and seventeen in Germany. From Chladni's time to the present day, almost every country has supplied not only observers but collectors of these curious stones, of which large quantities are to be seen in every European Museum, and not a few in the cabinets of scientific gentlemen in the United States.

The name of Professor C. U. Shepard, is well known for his enthusiasm in collecting and investigating these extraordinary bodies. He has recently deposited in his magnificent cabinet at Amherst, U.S., a metallic of a most interesting character. "This specimen is entire, of an elongated ovoidal form, and covered with the usual indentations. It appears to be compact malleable iron, exhibiting the characteristic crystalline figures, and weighs 178 pounds. It was discovered in the Great Lion River, in the Nemaqua Land, in South Africa, and, having been transported several hundred miles in wagons to the Cape of Good Hope, was shipped to London. Professor Shepard, being in the city at the time of its arrival, immediately entered into negociations to obtain possession of this miniature world, and, with considerable difficulty succeeded. Besides this prince of meteorites may be seen another stranger, belonging to the same *high-born* noble family, from Newbern, S. C., weighing 58 pounds. This collection of extra-terrestrial substances weighs more than 350 pounds, and includes 200 specimens from more than 100 different localities."

There is also a large mass, weighing about 3000 lbs., in the Natural History Lyceum in New York, which was found at the Red River, in Louisiana. It is stated in the January No. of *Silliman's Journal*, that Prof. Smith has found a meteorite in East Tennessee, which weighed at first over 60 lbs. It is a highly interesting one, having furnished for the first time the solid protochlorid of iron found in a fissure. It is also rich in phosphuret of iron and nickel, and furnishes material for a full investigation of this latter mineral.

During the night, meteorites are generally observed to fall from fire-balls; during the day, from a small, suddenly-formed dark cloud in a clear sky, though sometimes the cloud is wanting. Generally, the fall is accompanied with a very considerable crackling noise, and the stone when found is sometimes in a heated state. Although possessing much general resemblance to each other, to this similarity there are exceptions regarding individual points. Hence, by some mineralogists these meteoric masses have been distinguished as those containing nickeliferous meteoric iron, and those consisting of fine or coarsely-granular meteoric dust. All that have yet been found, with one exception I believe (that of Chantonnay, in La Vendee), have been covered with a thin crust, or rind, only a few tenths of a line in thickness, of a deep, black colour, occasionally veined and sprinkled over with small asperities. This crust is generally divided from the inner light-grey mass by a sharply-defined line of separation, and bears marks of having been subjected to an intensely powerful heat. Amongst the first who instituted the chemical investigation of meteoric stones, were Vauquelin and Berzelius, who examined them only for their constituent elements, which they made to consist of 15 in number, viz., iron, nickel, cobalt, manganese, chromium, copper, arsenic, zinc, potash, soda, sulphur, phosphorus, and carbon. Farther examinations by the Roses of Berlin, Prof. Rammelsberg, and Prof. Shepard of Amherst, have added to the number, so that the actual number of recognized elements are no fewer than 19 or 20. Prof. Rammelsberg, as quoted in Vol. IV. of Humboldt's *Cosmos*, says: "Of the *simple substances* hitherto detected in the meteoric stones, there are 18—oxygen, sulphur, phosphorus, carbon, silicium, aluminum, magnesium, calcium, potassium, sodium, iron, nickel, cobalt, chromium, manganesium, copper, tin, and titanium. The *proximate* constituents are: (1) metallic: nickel-iron, a combination of phosphorus with iron and nickel, sulphuret of iron and magnetic pyrites; (2) oxydized: magnetic iron ore, and chrome iron ore; (3) silicates: olivin, anorthite, labrador, and augite." Cobalt and nickel are the most invariably present, but iron is the ruling ingredient. The specific gravity of some of these stones amounts to as much as 4.28, while in other cases it is as low as 1.94.

### FIRE-BALLS.

We may now briefly notice the peculiar features of fire-balls and falling stars, reserving the theories that have been proposed regarding the origin of meteoric stones as applicable to the whole. These meteors appear to move in the arcs of great circles, and to come from certain particular directions. No movement of rotation has been recognized in them. Their apparent discs are doubtless greatly overrated from optical causes. Occasionally they seem to exceed the circumference of the full moon, which, at the distance of 110 miles, would give a diameter of about a mile. The amount of light given out by them is much less than that of the moon. As to the altitude of meteors, very great difference of opinion obtains. The first series of observations for determining this point, as well as their velocity, were made by Brandes and Benzenberg in Germany, in 1798, and repeated (by Brandes and others) in 1823. The altitude varied from 4 to 80 miles, a few from 180 to 240 miles, and the velocity from 18 to 36 miles in a second. The velocity, as shown by the results of M. Quetelet's observations in Belgium in 1824, was about the same as the translatory velocity of the earth—*i. e.*, 16.4 miles. Heis and Houzeau have lately given the result of observations, making the velocity of some shooting-stars to be between 46 and 95 miles in the second, consequently 2 to 5 times as great as the planetary velocity of the earth. According to the existing measurements, fire-balls appear to move slower than shooting-stars; but, at the velocity stated, it is astonishing that they do not sink deeper into the earth, only one being known to have ploughed up the earth to the depth of 18 feet. The visible duration of meteors seldom exceeds a few seconds, although occasional instances of longer duration are recorded. Capt. Shortrede saw a meteor at Charka, in India, in 1842, which, with its train, was visible for nearly five minutes. The most notable instance of this sort is that of Jenny Lind's meteor, seen from Boston on the 30th Sept., 1850, and which remained visible for an hour. On the 1st April, 1851, a very brilliant one was seen at Aden. It was mistaken by the sentry at the Turkish wall for an alarm-rocket, and he discharged his musket accordingly, giving the usual notice and thus summoning to arms from their midnight slumbers the whole garrison of 4000 men.

Perhaps one of the most extraordinary meteors that ever appeared in England was seen from two independent stations in the parish of Beeston, about the 1st Nov. last, at 3 h. 57 min., p.m, and, of course, in broad daylight. Had this phenomenon occurred at night time, it would have been a glorious object. The following particulars are given in a letter to the *Times* newspaper, by E. J. Lowe, Esq., of the Beeston Observatory: "The meteor moved nearly perpendicularly down, inclining to east. It was first seen as a circular body, of about half the apparent diameter of the sun, being accompanied by a stream of light; afterwards it increased to almost the diameter of the sun, and then burst into fragments with an explosion. The report of the explosion was from 1 sec. to 3 sec. after the meteor had disappeared, and resembled distant thunder. The meteor passed over about 15 deg. of space, disappearing 30 deg. E. of N., at an altitude of about 10 deg.; duration, 3 sec. It was very brilliant, shining with a somewhat yellow light. Soon afterwards, near the spot where it had disappeared, a band of prismatic colours was visible, being 2 deg. wide and 5 deg. in length. This phenomenon when first perceived was as brilliant as a rainbow, but soon faded, finally disappearing in about 5 min. Clouds were dispersed over the sky, from behind one of which the meteor appeared, afterwards vanishing behind another. The prismatic colours were seen upon clouds, or shining through them. Another observer informed him afterwards that the meteor at first moved more obliquely than afterwards; it three times burst into fragments, and was distinctly observed to pass beneath a cloud.

According to Mr. Lowe, meteors may be divided into three classes: 1st. Those with luminous streaks; 2nd. Those with separate stars, and those without any appendage; and 3rd. Those large bodies with well-defined discs. The first class, he thinks, may shine by *inherent light*, or be surrounded by a *luminous atmosphere;* the second class by reflected light, as described by Sir John Lubbock; and the third class may be purely atmospherical. As this kind nearly always move in paths discordant to the direction of the other meteors, they are not always spherical, and sometimes change their form. "I have seen them alter their colour from blue to red, and in one instance I saw a meteor of a blue colour give out orange-red sparks. Mr. Hind tells me he saw a green meteor turn to a crimson colour." From 4000 observations, collected during nine years, it has been inferred by Schmidt that 2-3rds of the shooting-stars are white, 1-7th yellow, 1-17th yellowish-red, and only 1-37th green. As to the curious fact alleged by some observers, that meteors and shooting-stars appear now and then to ascend, or to alternate in ascent and descent, as if new and opposite forces were brought into play, Bessel and others think it improbable. It perhaps requires still further observation and research. Great diversity of opinion prevails as to whether meteors are always associated with some form of matter analogous to that of known aerolites; but the presumption is strong that meteoric elements are present in all of them, whether precipitated or not. The first formal catalogue of remarkable meteors of all kinds was that made by Quetelet, and published first in 1837, and again in 1841. Then followed the catalogue of Mr. Herrick, in the United States, and that of M. Chasles, in

Paris, in 1841. Since then, however, Professor Powell, of Oxford, has collected every recorded meteoric appearance in any portion of the globe, and has published the result of his most extensive researches in the Annual Reports of the British Association for the Advancement of Science, for the years from 1847 to 1852.

(*To be continued.*)

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**On the Duration and Expectation of Life in Canada compared with other Countries.**

*Notice of a Paper read before the Canadian Institute on Saturday, January 28th, 1854, by Geo. H. Dartnell, Esq.*

After giving a brief account of the progress of the doctrine of probabilities, particularly as applied to life contingencies, a history of the various tables now in use among actuaries, and an explanation both of their nature and of the manner in which they are used, Mr. Dartnell proceeded to state that,—

In framing tables of life adapted to Canada, difficulties of no ordinary character have to be surmounted, as, even at the best, a great portion of the data themselves must be deduced from various sources, and only after the most careful calculation. These difficulties chiefly arise from the fact, that, in this Province, no general records of births and mortalities exist, as in the mother country, where the registration of every birth, death, and marriage is rendered compulsory by law. It may be some years before the utility, and, indeed, the necessity of the introduction of such registration may become apparent in Canada; until then, the data on which we have to work is uncertain and liable to error.

In the table which is published with this paper, and arranged in columns are included the tables of life expectation from the following sources, viz.: the Northampton, the Carlisle, Breslau or De Moivres, the French or Des Parcieux, the Belgian, the Swedish, and the Canadian. The expectation of life has only been taken for quinquennial periods, that being quite sufficient for the purposes of comparison with other countries. The expectation of Canadian life for the ages prior to sixteen will not be found in the table. However, it may be here remarked that child life in Canada, except among very young infants, is nearly equal to English or foreign life at the same ages, the great deficiency being found to range between the ages of thirty and forty-five or fifty, after which time Canadian life rapidly improves, and at length in some of the older ages, becomes superior to that of other countries.

A curious fact in connection with Canadian life may here be noted. Almost all tables in which the sexes are distinguished unite in presenting this result, namely, that female life is better than male; and many offices proceed upon this assumption and grant annuities on female lives at lower rates than on males. In Canada this rule holds good in the earlier ages of life as far as the age of thirty, when the figures are for males 19.64, and for females 21.32, being a difference of more than a year and a half in favour of female life. Here, however, this superiority ceases to exist, for at thirty-five the numbers are, males 19.50, females 18.67; at forty the difference is still greater, the average life for females being 17.64, and that for females only 15.59; at forty-five the numbers are, males 15.57, females 13; at fifty the difference is not so great, the figures being for males 13.11, for females 12.50; and at fifty-five female life has regained its former supremacy, the numbers being 11.71 for males, to 14.13 for females. This superiority is retained for the remaining years of existence. In the Canadian table the expectancy of male and female life is combined, the difference not being great enough to warrant separation; besides the contrast between it and other countries will be more readily seen than if the table were divided into two, in addition to the fact that the excess at one period balances the deficiency at another.

A reference to the table will show that, until the higher ages of life are attained, Canadian life is inferior to almost all other countries—that this inferiority diminishes as life advances, and that in old age the chance of survivorship in Canada is something greater than at any of the places named in the tables. At the age of 15, the difference between Canadian life and Silesian and English (as shown by the Northampton table of life) is about 11 years—between the Carlisle 19 years, and between other countries something less. As life advances, this great difference diminishes gradually; for, at 45, life at Northampton is only about 5 years superior to that in Canada. At 50 the line approaches nearer. From 50 to 70 it is equal to some countries, and slightly inferior to others. At 80 it and the Carlisle touch the same point, and from that period till the end of life Canada is superior to the 6 others.

The unfavorable character of Canadian health, as presented by these tables, may be accounted for in various ways. As before remarked, they are purposely taken at as inferior a datum as possible, for the purpose of security. This alone would add throughout a considerable per centage to the table of Canadian expectation of life. Another cause may be assigned—the imperfect manner in which the census is taken in this country; for on two sets of calculations, founded on the census of 1842 and 1848, Canadian life was found to be better in the latter period from 2 to 10 per cent.; and there can be very little doubt that the last census will exhibit an equal improvement on that of 1848, chiefly arising from the greater accuracy with which these periodical "numberings of the people" are made, and that any calculations deduced from the data of the next census will tend to prove that Canadian life is at least equal, if not superior, to life in similar circumstances in England, and, consequently, to that in other countries.

The returns of burials in the cemeteries of this city for the four years ending 1850, afforded a datum upon which some time ago the writer formed a table of expectation of life. This agreed, allowing for fluctuations unavoidable in such a small number of deaths, in the main with those which are here presented. These four years embraced the period in which the cholera, the emigrant fever, and dysentry made serious ravages among the population of our city, and therefore would not be a fair test of the general state of health of Canada. Besides, any deductions made from the records of burials will be liable to an error increasing each year, if due allowance be not made for births and immigration—the latter an important item in our statistics.

The difficulties which attend the formation of a table of expectation for Canada on which dependence can be placed, might suggest a hint which perhaps might be useful at the next census-taking. If, in any one year, a complete census were made, registering the age of every individual, and of the deaths which took place in the 365 days next following the day of the census, were noted, the law of mortality could be deduced. In such case, the numbers living at every age would be so large, that the proportion of deaths among them in a single year could be safely depended on for pointing out, with great nearness, the law which regulates the mortality of large masses.

TABLE OF THE EXPECTANCY OF LIFE.

| | 1. | 2. | 3. | 4. | 5. | 6. | 7. |
|---|---|---|---|---|---|---|---|
| Age. | Northampton. | Carlisle. | Breslau. | France. | Belgium. | Sweden. | Canada. |
| 0 | 32.74 | 44.68 | 43.00 | ...... | 32.02 | 42.95 | ...... |
| 5 | 40.84 | 51.25 | 40.05 | 48.27 | 45.07 | 46.79 | ...... |
| 10 | 39.78 | 48.82 | 38.00 | 46.83 | 43.09 | 45.07 | ...... |
| 15 | 36.51 | 45.01 | 35.05 | 43.51 | 40.05 | 41.64 | 25.38 |
| 20 | 33.43 | 41.46 | 33.00 | 40.22 | 37.03 | 38.02 | 23.67 |
| 25 | 30.85 | 37.86 | 30.05 | 37.17 | 34.07 | 34.58 | 21.49 |
| 30 | 28.27 | 34.34 | 28.00 | 34.06 | 32.00 | 31.21 | 20.48 |
| 35 | 25.68 | 31.00 | 25.05 | 30.88 | 28.09 | 28.03 | 19.09 |
| 40 | 23.08 | 27.61 | 23.00 | 27.48 | 25.08 | 24.66 | 17.38 |
| 45 | 20.52 | 24.46 | 20.05 | 23.89 | 22.07 | 21.61 | 14.24 |
| 50 | 17.99 | 21.11 | 18.00 | 20.38 | 19.05 | 18.46 | 13.66 |
| 55 | 15.58 | 17.58 | 15.05 | 17.25 | 16.04 | 15.53 | 13.31 |
| 60 | 13.21 | 14.34 | 13.00 | 14.25 | 13.04 | 12.63 | 12.16 |
| 65 | 10.88 | 11.79 | 10.05 | 11.26 | 10.08 | 10.10 | 10.62 |
| 70 | 8.60 | 9.18 | 8.00 | 8.64 | 8.04 | 7.72 | 9.31 |
| 75 | 6.54 | 7.01 | 5.05 | 6.50 | 6.04 | 5.91 | 7.37 |
| 80 | 4.75 | 5.51 | 3.00 | 4.69 | 5.00 | 4.28 | 5.60 |
| 85 | 3.37 | 4.12 | .05 | 3.21 | 3.08 | 3.23 | 5.04 |
| 90 | 2.41 | 3.28 | ...... | 1.77 | 3.01 | 2.05 | 3.52 |
| 95 | .75 | 3.53 | ..... | ...... | 2.01 | 1.00 | 1.19 |
| 100 | ...... | 2.28 | ...... | ...... | .05 | ...... | ...... |
| 104 | ...... | .50 | ...... | ...... | ...... | ...... | ...... |

## Robert Stephenson, M.P.

(*Continued from page* 168.)

It increases the expense of the carrying department; the engines are more expensive, so are the tenders; the workshops from their size are also more expensive; the stations also require greater room. I think all the sidings are of a larger radius than those upon the narrower guage, in order to allow the engine to go through without grinding the rails or sliding upon them. In fact everything is upon an increased scale. The time-tables are so cumbrous that they cannot use them. * * * I see no good reason why the expenses of working should be less. There are several items which in my opinion tend to make it more. I believe the resistance of the wide carriages moving along the line of the broad guage to be more than upon the narrow guage."

Mr. Stephenson subsequently gave his evidence to the effect that the narrow guage afforded room for the construction of engines of ample power for working any trains that might be required; and that the power of the engines would in future be limited by the weight which the rails are capable of supporting. "We may build," he says, "engines upon the wider guage no doubt heavier and larger in dimensions and more powerful, but then you must make a road to support it on purpose." And with reference to the comparative speed on the broad and narrow guage, he says, "Every day we are running upwards of fifty miles an hour with our passenger trains, and those engines were not made with a view to attaining a maximum speed, but such a speed as we deemed then advisable to attain. We had never aimed to get our passenger trains upon the narrow guage lines to run more than 30 miles an hour, including stopages, therefore we had rarely if ever attempted a wheel larger than five feet six inches in diameter. On the North Midland I tried some of six feet diameter, and they are there constantly running 50 miles an hour. * * * There is no difficulty whatever in making an engine upon the narrow guage to take forty tons at sixty miles an hour, not the least difficulty, or even more than that." Again he says, "the wide guage engines are not more powerful, but they are heavier in proportion to their power. It is quite clear that every thing in the width of the engine, every thing that is to go across from side to side, is giving the engine no power at all; it is an incumbrance rather than otherwise." And generally on the comparative mechanical and commercial advantages of the two systems he says, "I believe it (the wide guage) is inferior in both ways. I believe it is less convenient because it requires larger stations; you are obliged to have a larger radius and more room for your sidings: at least you ought to have to work with the same facility. Commercially speaking, the advantage of the large truck, I am convinced, in nine cases out of ten is not felt at all, and in cases where the trucks are not filled and loaded to their maximum it is a positive disadvantage to the Company, which must fall upon the public eventually."

To the question of the safety of the two guages, Mr. Stephenson replies generally that, "As an abstract question I do not think there can be any line of difference drawn between the one guage and the other, in that respect they must be both alike."

Of course such decided opinions in reference to this important topic as were expressed by Mr. Stephenson, and which we have briefly quoted, were not left unchallenged; the broad guage interest, though comparatively small, had sufficient at stake in the extension of its lines to urge its representatives to the refutation of the arguments of its opponents, and Mr. Brunel, as the originator of the seven feet guage, entered with confidence upon the defence of his recommendation to the Great Western Company to adopt that guage. In his evidence before the guage commissioners, given subsequently to Mr. Stephenson's, he did not hesitate to claim many advantages for the broad guage. "Looking," says he, "to the speeds which I contemplated would be adopted on railways, and to the masses to be moved, it seemed to me that the whole machine was too small for the work to be done, and that it required that the parts should be on a scale more commensurate with the mass and the velocity to be attained;" and when questioned as to whether his experience of the broad guage had at all shaken his opinion of its advantages, he said, "I should rather be above than under seven feet now, if I had to reconstruct the lines."

The basis on which Mr. Brunel appears to have founded these opposite opinions to Mr. Stephenson appears to have been chiefly the anticipation of largely increased traffic, and a belief that it could be much more cheaply carried by stock of greater lateral capacity, while engines of larger power could be made at a reduced original cost for an equal amount of power, and that the power so obtained could be more cheaply worked. "The first cost," says he, "of the same amount of power is of course less in ten engines than it will be in fifteen, if that were the proportion, but I look rather upon it as to the efficiency of the result of the working of the whole machine than a mere question of economy in the first cost of the machinery, and taking the masses to be moved as varying from 60 to 70 or 80 tons in cases of passenger trains, and say 200 tons and 300 tons in cases of goods trains (and they very much exceed that frequently); but taking those masses, and taking the speeds to be what they will very shortly be, I have no doubt 50 and 60 miles an hour for passenger trains, and 30 for goods trains; I believe that, to carry those weights at those speeds efficiently, it is better to have larger carriages, and larger waggons, and larger wheels, and more powerful engines than those which have hitherto been used." He then goes into the question of comparative cost of construction, which he makes out to be but little increased over the narrow guage, not necessarily in proportion to the increased width of way. He also treats the commercial question of a break in the guage in a very different view to that adopted by Mr. Stephenson, and considers the inconveniences likely to arise therefrom, unless occurring in the line of great through traffic, as of comparatively little importance.

In considering the opinions given on this question by the principal advocates of the rival interests, we are led to the conclusion that both have taken an extreme view of the case—views strengthened, undoubtedly, by the magnitude of the interests involved, and shared to a great extent by the professional gentlemen who gave their opinions before the Commissioners. Some of the latter, and among them Mr. Locke, considered that the most advantageous guage would lay between the two extremes. There can be no doubt that whatever that mean may be, the great extent of roads already constructed in England, and the vast amount of stock employed thereon, prevented any universal change to a wider guage than 4 feet 8½ in. It was also made apparent that such a guage was fully equivalent, both as regards the power and capacity of the rolling stock which the resources of the engineers of Britain had placed upon it, to the accommodation of a traffic as active as was likely to be in existence for many years to come. At the same time, we think strong reasons were offered to show that, where a large amount of traffic was probable, many advantages were offered by an increased width of guage; and especially may we instance the argument, that a given amount of power could be more cheaply created and maintained when developed in "*ten engines than when in fifteen.*" It is true, and was admitted, that engines as powerful, or nearly so, had been constructed on the narrow guage as had been constructed on the broad guage; and perhaps the same may hold true to this time. Yet we think there can be little doubt but a few inches greater breadth would be of great advantage to the narrow guage engines. Increase of length is not all-sufficient to increase of power in the most economical form, inasmuch as the friction of the heated air passing through the tubes requires increased force of blast to create the necessary draft, causing an equivalent increase in the back pressure in the cylinders; and moreover, though as large boilers had been crowded between the narrow guage wheels as had been found necessary, it had been effected by placing the framework outside the wheels, which is, in many respects, prejudicial to the strength and safety of the machine. There is also another consideration affecting this question in America, not so essential on English lines, and therefore less thought of in England. It is the advantage of being able to construct very powerful engines—engines capable of generating steam with great rapidity, and therefore competent to work an active traffic over the heavy grades which the small cost per mile of our roads necessarily involves. At present, this is of minor importance on Canadian railways, but its value is already felt on many lines in the United States, and as being a much cheaper mode of providing for increased carrying capacity on our roads than the reduction of their grades, it is not to be lost sight of. In view, therefore, of all these considerations—especially the latter—and also of the additional one that much of our traffic will, for several years, consist of the products of the forest, which will not bear a high tariff, and yet require a great expenditure of power for their transportation in proportion to their value, we think the railway legislation of Canada has been fortunate in fixing five feet six inches as the uniform guage to be adopted, and have no doubt but the additional width of nine inches between the wheels will be usefully employed in the creation of *cheap* power wherewith to surmount our grades, and bring our lumber and timber to market.



At the general election of 1847, Robert Stephenson was returned to the Imperial Parliament without opposition for the Borough of Whitby, in Yorkshire. He was returned on the conservative and protectionist interest, and as opposed to the endowment of the Catholic clergy, and to the repeal of the navigation laws. In the same year was commenced, under his supervision, the Tweed Viaduct, to which we have previously alluded—a work remarkable for its magnitude (2170 feet in length, and 125 feet in height), as being the largest stone viaduct in the world. Two years were spent on this work in obtaining foundations, for which purpose a fifty horse engine was constantly employed in pumping water from the coffer dams, and in driving piles for the foundations. The amount of masonry contained in this viaduct is upwards of a million cubic feet, and there are two millions and a half of bricks in the inner portion of the arches. This work was completed in August, 1850, and on the 29th of that month was opened by the Queen in person, who named it the "ROYAL BORDER BRIDGE." On this occasion, Mr. Stephenson was presented to her Majesty by Prince Albert, and was shortly after offered the honour of knighthood, which he respectfully declined.

In comparison with the Chester and Holyhead line, all the former works of Stephenson lose their great importance; and whether we consider the magnitude of the engineering works upon it, or its political and commercial importance in affording the means of a rapid communication between the capitals of the two kingdoms, we shall readily understand the feelings of pride with which Mr. Stephenson referred on a recent occasion to its successful completion.

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## Mining Insects.

At a recent meeting of the Entomological Society, London,—Capt. C. J. Cox presented specimens of the bark and wood of Elm and Ash, illustrating the different ways of mining pursued by the lavæ of *Cossus ligniperda*, *Scolytus destructor*, and *Hylesinus Fraxini*. From the vast and rapid increase of the Scolyti, extensive damage had already accrued to the elm trees in the parks and the neighbourhood of London, and also in many other places, and he was certain that unless means were speedily adopted to check the evil, in 60 or 70 years there would not be an elm tree near London. Contrary to the general notion, he had ascertained that sound young trees were attacked, rendered diseased, and ultimately killed by the injuries inflicted on them by Scolytus. By experiments in the gardens of the Royal Botanic Society, Regent's Park, he found that a diseased tree could be rendered sound and healthy by removing the bark from the the part affected, and destroying it :—the Cossus had been removed by cutting out, and the tree operated upon soon recovered. The injurious effect produced both by Scolytus and Cossus he attributed in a great measure to a poisonous quality in the excrement of the larva.—Mr. Westwood said Audouin had shown him, at Paris, that the female Scolytus first attacked a tree for food, and then other females followed and deposited their eggs in the exposed place.—Mr. Curtis had never known young trees attacked, and he doubted if any trees were infested until they were diseased or decaying from age.—Capt. Cox replied, that he had known the eggs laid on sound trees; that the insects eat into dead wood only after the bark and alburnum were exhausted; and that the trees in Regent's Park were growing vigorously when first attacked, and after being operated on recovered their health.

**Paper from Wood Fibre.**

In consequence of the scarcity of rags, and a prohibition of their exportation from various continental states to this country, some alarm has been excited respecting a deficiency in the supply of paper to meet the requirements of the age; and this is not to be wondered at, for the diffusion of knowledge by means of the press has become so vast, that we scarcely know anything short of a bad harvest which would be so much felt by the community as a limited production of this valuable commodity. We have the satisfaction of finding that, by the application of chemical science, the most important results, as regards the fabric of paper, have already been effected; nor do we believe that, since the papyrus was first used for writing, so important a fact has been established as that of the manufacture of paper from wood fibre. This extraordinary and valuable discovery has recently been patented by Messrs. Watt and Burgess, to whom the public is indebted for many valuable discoveries in chemistry. Two specimens of the raw material are before us: the first consists simply of deal shavings; the second of a pure white pulpy substance, very much resembling a piece of cotton when first taken from the pod, only a little harder to the touch. The manufactured article is declared by competent judges equal to any sample of writing paper now selling at 7d. per lb. It presents a beautiful surface, with a pure colourless tint, and is free from defect or blemish of any sort. The cost of production is stated to be somewhat under £25 per ton, which is a saving of more than £12 upon the price per ton of the rag paper now in use.—*Sun.*

CANADIAN INSTITUTE ESTABLISHED 1849

**INCORPORATED BY ROYAL CHARTER.**

**Seventh Ordinary Meeting, February 4th, 1854.**

The names of the following candidates for membership were read:

T. Kellog........................Township of Brock.
Capt. Weatherly-............................Toronto.
Charles Stewart, Junior Member.......... "

The following gentlemen were elected members:

J. E. Ellis..................................Toronto.
A. J. Thibodo..............................Kingston.
G. P. Ure...................................Toronto

A donation from Mr. S. Fleming, C. E., of a conch shell, found on one of the Fishing Islands, Lake Huron, was announced.

A paper was read by Mr. T. Henning on "Meteors and Falling Stars."

**Eighth Ordinary Meeting, February 11th, 1854.**

The names of the following candidates for membership were read:

Collingwood Schrieber.......................Toronto.
William R. Grahame.........................Vaughan.
John Major...................................Toronto.

The following gentlemen were elected members:

T. Kellog........................Township of Brock.
Capt. Weatherly ............................Toronto.
Charles Stewart, Junior Member.......... "

A donation from the Hon. East India Company of a copy of the Magnetical and Meteorological Observations made at Bombay in the year 1849, was announced.

An alteration in the Bye-Law relating to the balloting for members, of which notice was given by Mr. D. Crawford at the sixth ordinary meeting, was brought forward, and it was then

*Resolved:* That in section 8 of the Bye-Laws the words "if black balls to the amount of one-fourth appear" be substituted for the words "if one or more black balls"——

A Lecture was delivered by Professor Wilson "On some Coincidences between the Primitive Antiquities of the Old and New World."

The Meteorological report for the year 1853, containing a summary of the observations made at the Provincial Magnetical Observatory, was read by Professor Cherriman.

**Ninth Ordinary Meeting, February 18th, 1854.**

The names of the following candidates for membership were read:

William B. Heward.........................Toronto.
Benjamin Workman........................Montreal.
Professor W. Andrew...................... "
Archibald Hall, M.D. ...................... "

The following gentlemen were elected members:

C. Schrieber.................................Toronto.
W. R. Grahame..............................Vaughan.
J. Major.....................................Toronto.

A paper was read by the Rev. Professor Irving "On Solar Eclipses."

**Tenth Ordinary Meeting, February 25th, 1854.**

A donation from Mr. Peter Cameron, of Toronto, of a copy of Euclid's Elements, published in 1651, was announced.

The following gentlemen were elected members:

| | |
|---|---|
| W. B. Heward | Toronto. |
| Benjamin Workman | Montreal. |
| Professor W. Andrew | " |
| A. Hall, M.D. | " |

A paper was read by the Rev. Professor Parry "On the Early History of Ancient Rome."

Professor Chapman gave a short account of a specimen of Chlorastrolite from Lake Superior, and afterwards made some observations on the minerals presented to the Institute by Dr. Wilson, of Perth.

**The Canadian Institute and the Toronto Athenæum.**

*Report of the Special Committees of the Canadian Institute and the Toronto Athenæum, appointed to confer on the subject of the union of those Institutions:*

After consultation, it was agreed to recommend—

"That the Athenæum be merged in the Canadian Institute, transferring its books, minerals, and other properties (exclusive of such as may be necessary or are now used in the News Room), together with its present funds derived from Parliament, on condition,

"1. That the Library thus formed by the books of the two Institutions, with such additions as may hereafter be made from their common funds, shall constitute a Library to which the public shall have access for reference, under such regulations as may be adopted in view of the proper care and management of the same.

"2. That the members of the Athenæum shall become members of the Canadian Institute.

"3. That the Governors of the Athenæum shall be elected life-members of the Canadian Institute.

"Whereupon it was further agreed that each Special Committee shall report the above as a satisfactory basis for the proposed amalgamation, reserving matters of detail for future adjustment under renewed authority.

"That on the arrangements in detail being thus completed, a vote shall be taken by each body in Special General Meeting, which, if affirmative, shall provisionally establish the union, pending the passage of such an Act of Parliament (if any) as may be necessary to legalize the same.

(Signed) "THOS. D. HARRIS,
"*Chairman, pro tem.*

"Athenæum Rooms,
St. Lawrence Hall, Toronto,
14th February, 1854."

At a meeting of the Council of the Canadian Institute, held February 18th, it was

*Resolved:* That the Report of the Committee appointed to confer with the Committee of the Toronto Athenæum be adopted, and that they be authorized to complete the arrangements on the basis mentioned in their Report.

**Chemical Composition of the Shells of certain Brachiopods.**

At the close of the Seventh ordinary meeting of the Canadian Institute, Professor Chapman announced the following important discovery lately made by Messrs. Logan and Hunt, of the Geological Commission at Montreal. It is well known that the shells, claws, spines, and other hard parts of Articulated Molluscous and Radiated Animals, have been hitherto universally admitted to consist essentially, so far at least as regards their inorganic constituents, of carbonate of lime; whilst the bones of the vertebrated classes are mainly composed of the phosphate. In his "Cours de Palæontologie," Alcide d'Orbigny remarks on this subject, that the mean per-centage composition of the shells of acephalous molluscs may be thus represented:—carbonate of lime 95 to 96, phosphate of lime 1 to 2, water 1 to 1.5, animal matter 1.0. Messrs. Logan and Hunt, however, have now ascertained that the shells of both fossil and recent species of Lingula and Orbicula—two brachiopodous genera met with in rock formations of every geological age from the lower Silurian inclusive, and still existing in the Phillipine, Mediterranean and other seas—consist, not of carbonate of lime according to the usually received opinion, but of phosphate of lime. Shells of the fossil pteropod, *Conularia*, were also found to have a similar composition; a discovery tending to break down the presumed distinction between the skeletons of the Vertebrata, and the skeleton-analogies, so to say, of the lower types of organization.

In calling the attention of the Institute to these important facts, Professor Chapman mentioned that some time previously, he had himself detected phosphate of lime to the amount of 11.12 per cent., in the guard of a specimen of *Belemnitella mucronata* from the English chalk; but that he had attributed the presence of the phosphate in this particular instance, to metamorphic action during the fossilization of the substance.

In the case, however, of the recent brachiopods examined by Messrs. Logan and Hunt, such an interpretation would be manifestly out of the question. The scientific world will look with much interest for the further developement of this most fruitful discovery.

**Toronto Harbour.**

The following is the Report of the Corporation Committee on Wharves and Harbours. It is not a very encouraging document.

"Your Committee invited the Harbour Master, Hugh Richardson, Esq., and the Chief Engineer of the Esplanade, Kivas Tully, Esq., to accompany them, which these gentlemen kindly did, and from both of them your Committee have derived much valuable information, as to the changes which have been noted by them, from time to time in the Peninsula. Your Committee carefully inspected every part of the

Peninsula from the large gap below Privat's to the Light House point, and they regret extremely to have to report to the Council, that the whole of that barrier, which has formed, and has hitherto protected our noble harbour, is in a most insecure and unsatisfactory state. That part of it lying between the gap before referred to and Privat's Hotel, has been so far reduced in width, that it may be considered a matter of some doubt whether in the event of a succession of heavy easterly storms in the spring, it would continue to resist the encroachments of the Lake, or whether the greater part of it would *not* be swept away.

"That part of the Peninsula lying at the westward of Privat's, although comparatively of a much greater average width, and possessing one decided advantage over the eastern part, in the numerous trees growing upon it, (which serve that most important purpose of fixing and retaining the light and shifting soil,) is yet by no means secure. Although no actual breach has been made through any part of it, there were no less than four places between Privat's and the light house, where the water of the Lake, forced up probably by a heavy south-easterly wind, had flowed across into the Bay, carrying with it the fine sand, and leaving nothing but the course gravel and shingle behind.

"Under these circumstances, your Committee were unanimously of opinion that it would be unwise to permit sand to be taken from any part of the main ridge of the Peninsula; but being at the same time anxious that no restrictions not absolutely required for the safety of the harbour, should be imposed upon the supply of an article so necessary for building purposes, they directed Mr. Sheppard, who attended them on the part of Mr. Howard, the City Surveyor, to stake out a large piece of ground lying a little to the North East of the Light House, bordering on one of the numerous indentures which occur in the Western end of the Peninsula, formed by the small ponds running up between the spurs and projecting points of land, which jut out into that part of the Bay.

"By digging sand from these points no injury could accrue to the Harbour, and your Committee would therefore recommend that permission should be given by the Council to dig sand from the part so staked out. At the same time they would advise that the permission now granted should only be considered as temporary, and not binding on the Council beyond the present year, as the critical state of the whole Peninsula calls for the immediate adoption of some well digested plan for the preservation of that narrow belt of land, upon the safety of which the Harbour of Toronto may be said to depend for its very existence.

(Signed,) "G. W. ALLAN,
*Chairman.*"

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## The Pompeian Court at the Sydenham Palace.

Every dweller in our great city will remember with delight those appointments so often made and so pleasantly kept in the fairy courts of the great edifice in Hyde Park a year or two ago,—when the trysting-place, as fancy or caprice suggested, was at the Crystal Fountain, under the tent of the Arab, in the court of Granada, by the Polar shores or at the source of the Ganges. Memories, almost magical in their variety and novelty, cling about those places, so often visited and revisited; and to the end of life, and far beyond the days of living men, these memories will hang about the world as strange and beautiful traditions,—the fanciful and poetic draperies of solid fact and prosaic purpose. Something like the old conditions may revive at Sydenham. Courts are there rising rapidly from the earth,—less significant, perhaps, in their moral meanings, but in form, embellishment, and contents far more rich and beautiful than the old. It may be well that, as reporters to our readers on the state of Art,—whether it be as to revival, novelty, or mere experiment,—we should render of these doings or misdoings some account.

The Pompeian Court is to most people a novelty. Stepping into it, the visitor steps, as it were, bodily into the first century of the Christian era. We are at once with Tacitus and the two Plinys. The water is idly plashing in the marble basin,—the master of the house appears to have retired for his mid-day sleep, as the dweller on the Bay of Naples does at the present day,—the slaves are probably cooking in the further corner,—and the rich, indolent, southern life is around us on every side. The illusion is perfect. Fancy can almost hear the voice of the great waters heaving through the summer silence,—and in the bright and golden splendour of the interior decoration the very spirit of Imperial Rome looks down in mingled luxury and passion from the walls.

What grace—what luxury—what artistic beauty visible everywhere! Yet Pompeii at its best was only the Worthing or the Dawlish of Italy.

Need we remind our readers that about seventy-nine years after the birth of Christ,—in the reign of the tenth Roman Emperor, Titus, the destroyer of Jerusalem,—Pompeii and Herculaneum, two small towns on the sea-shore near the foot of Vesuvius, and distant about 130 miles from Rome, were destroyed by an eruption? Herculaneum, the nearest to Vesuvius, was completly covered with the boiling lava; but Pompeii, the more distant, being only buried by the dust and stones, was, about a hundred years ago, explored, and the excavations have since been constantly pursued. Most valuable antiquities are discovered in the former place, as might be expected from the suddenness of its destruction.

As only about sixty bodies have been found in Pompeii, it is supposed that nearly all of its 5,000 or 6,000 inhabitants had time to escape with their chief valuables; but fear, duty or avarice detained some few until it was too late to escape. The sentinel has been found at the gate,—the lady at her toilette,—the miser clutching his bag,—the mother with her child,—and the prisoner in his chains.

The houses at Pompeii were small, the little city lying not far distant from those places of fashionable resort, Baiæ and Cumæ, the Bath and Cheltenham of the Roman nobles. The house here reproduced is as large as any yet found in the exhumed city, and is formed of the best portions of several houses. In comparison with the larger dwellings of the period which it represents, it is a Clapham cottage by the side of Buckingham Palace. The kitchen, here no larger than a cupboard, was sometimes 400 feet long in Roman houses; the entire space occupied is that of a villa in St. John's Wood,—while Nero's Golden Palace had triple galleries, each a mile in length. The rich marbles of Egypt and Numidia, the spoils of Grecian Sculpture, and the paintings of Athens and Corinth were reserved for the mansions of the Seven Hills, for Capua, or for Verona.

In general aspect and arrangement, the Pompeian house will remind the Eastern traveller of the houses of Cairo or Damascus. Plain and almost rude without, with few windows and those opening into a narrow street, narrowed that it may be overshadowed, it gives no promise of the splendour within. Opening the door and passing the porter's little cell, you enter a small quadrangle, to be paved with mosaic, with a fountain (and hereafter a statue) in the middle open to the sky and surrounded by the sleeping-rooms, recesses, and various apartments; and passing on through an open room or its side passages, you enter the inner quadrangle, with its garden, also open to the sun and its roof supported by sixteen pillars, and round which are disposed the dining-rooms, baths, and kitchen; and this, rejecting technicalities, is the whole of the ground plan.

It will at once be seen that this house, although unrivalled in interest, can only be taken as one species of Roman habitation, and that not of the richest. In some patrician's houses there were kept 400 slaves, the most trivial daily duty, as in Hindostan, becoming a department in itself. Even in Pompeii many of these houses appear to have had at least one story and terraces above the flat roof of the cloisters below; Juvenal speaks of houses at Rome of ten stories, originating, as in the old town of Edinburgh, from the want of space within the walls, which it was difficult, if not impossible to enlarge.

The walls and ceilings are exquisitely painted, chiefly, as was natural in a place on the shores of the sea, with subjects drawn from the ocean or the mountain. We have no flood of life streaming along the walls, as in a Grecian frieze; no "leaf-fringed legend," as on an Etruscan vase; but, in their stead, flying Cupids, dolphins, sea-bulls, Tritons and sea-Centaurs, with paws branching into sea-weed. In the centre pannel of a recess to the right of the entrance there is a small painting of *Perseus rescuing Andromeda*, a favourite subject at Pompeii. The monster, "a most delicate monster," evidently a small species of shark, lies at the maiden's feet. The background is well chosen, and with much successfully-attempted atmosphere. In one compartment we see a slave bringing a seated bather a flesh-scraper. The style of decoration is light and summary, almost flimsy,—rich blues, deep reds, and black predominate as the grounds. In another room we have *Venus fishing* and in an adjoining chamber we see Cupid pointing to a maiden (perhaps Dido,) her lover's galley lying in the distance. Round this cornice, alive with azure birds and geese and peacocks, a train of Cupids hurry along with an untied garland that streams behind. Here are a group of winged Loves, carrying between them a wine-jar shaped like a strawberry pottle,—and here is a musical party of the brood of Venus, some seated on couches and others applauding a girl who dances to the sound of a flute, keeping time with castanets. Here is an old man drawing a Cupid from a cage full of his rainbow-winged kinsmen, half butterflies, half seraphs;—and here is Venus driving a *biga* or small car.

The roof above the fountain is supported by Fames or winged angelic figures,—the four above the *tablinum*, or state room, leading to the inner court, being gilt. In this open hall in Roman houses were preserved the statues of deceased ancestors, archives, &c. It served as a sort of state reception-room. In many houses the whole of the fountain court was surrounded by statues. Over this opening coloured awnings were frequently drawn, and in small houses vines were sometimes trained, for air and shade are necessaries of life in a southern climate. Rich hangings supplied the place of doors, except to the chief entrance and the bed-chambers. In this particular truth has been necessarily laid aside for convenience, for two doorways have been introduced in addition to the two which should really exist, and doors will not be put to the bed-chambers where they would only hide the decorations.

The rooms are chiefly lit from the two courts, but the sleeping apartments have two windows of the modern size,—two others are lit from the street (probably also for the sake of the public eye,)—and two others are lit by alcove openings in the ceiling.

Against the wall of the outer court stands, in a niche, like that of an Italian Madonna, the altar of the guardian *Lares*,—deities probably of the Etruscan origin. To these incense was burnt and offerings made on certain days,—and indeed, in the latter ages of a universal scepticism, and with the exception of the worship of Isis, the Puseyism or fashionable religion of the day, these rites constituted almost all the ritual of the rich. In the kitchen we find the same twin deities represented by the figures of two snakes approaching an altar. Emblematical paintings of fruit and silver-gilt drinking cups indicate the dining-room.

In such a villa as is here represented, clad in festive robes of purple and crowned with flowers, Cicero may have sat and boasted of Catiline's flight from the senate house,—or the perfumed Cæsar, with his wounds still fresh from the last campaign, may have eulogized the admirable oysters or sneered at the stupid slaves of Britain. Here may have feasted the men who conquered the world only to live at peace on snails, thrushes, flamingoes' tongues, the brains of nightingales, and the udders of sows. In such places and with such surroundings, feasted those gorgeous diners who, as we are told, had at one dinner alone 2,000 different dishes of fish and 7,000 fowls, and who spent hundreds of pounds on a single made dish. Here voluptuaries may have melted emeralds in vinegar or frothed the rich wine of Lesbos with Arabian ointments. Into such luxurious nooks and corners of the Roman world, men weary of the Imperial capital, with its jostling crowds of vagabond Jews, noisy gladiators, Egyptian jugglers, Spanish dancing-girls, Syrian fortune-tellers, Moorish slaves, and Illyrian litter-bearers, may have retreated for a season of repose: seated or reclining in such luxurious bowers, some of the masters of mankind may have looked up dreamily at the clear blue sky, smiling as the sea-breeze wafted the fragrance of the violets from the inner garden, which crept round them as if Venus herself was passing near unseen, or listened in silence to the unceasing splash of the fountain or the song of the female slave at the loom.

A casual glance will show how easily a city of such houses as these would be destroyed by an eruption. They were, in fact, open bowls, into which the lava could be poured by old Vulcan like a stream of wine.—*Athenæum.*

Dr. Church's Breech-loading Cannon.—A final trial was made on Friday of two cannons that have been prepared to be sent to Woolwich. They were fired 50 times with heavy charges of powder and ball with perfect success. No defect in any respect could be pointed out by the best judges. Upon this plan heavy ship guns can be loaded and fired and brought into position by two men five times in a minute, and a field-piece eight times in a minute. The gun heats very little.—*Birmingham Journal.*

### Manufacture of Gold Pens.

The Gold for pens is rolled into thin strips, about the thirty-second part of an inch in thickness. In this state it is black on the surface, and looks like brass. The first operation is cutting it into stubbs—short pieces pointed and angular at one end, and cut square off at the other, this is done in a die; the stubbs are then run through a machine, and each point is indented for the reception of the real pen points. The next operation is pointing the stubbs. The substance used for points is rhodium, a hard brittle metal like steel, unoxidizable. It is to this metal we wish to direct particular attention.

There are various qualities of it, some worth twelve, twenty, thirty, and forty dollars per ounce, and even $120 has been paid for a superior quality. It is found in the ores of platinum associated with irridium, osmium, and palladium. Irridium is used by some for the points of gold pens, but rhodium is the dearest and best. All of this metal used in the United States comes from the Peruvian or Russian mines, but we have been assured that there is plenty of it in California. It is also found there pure, associated with sands, and requiring no chemical manipulation for its separation, as in the platina ores of the Ural. Our gold seekers in California should direct their attention to this metal, as it is far more valuable than gold. It is of a white glassy steel color, and in minute roundish particles like sand; the round globular particles are the best for pen points; in fact, out of one ounce of this metal perhaps not one-seventieth of the granules can be used, the rest are rejected. A fine particle of rhodium is soldered on the indented point of each stub of gold. The solder is mostly composed of gold, for, unless it is gold, ink soon corrodes it, and the rhodium point soon drops off. This is the case with poor pens made by indifferent makers.

After the pen is pointed, it is rolled between rollers with indents in them to save the points until the stub is drawn out to its proper length and correct thickness. The rolling also makes the gold elastic. Many suppose that gold pens can be re-pointed, but such is not the case, for the heat employed to solder on the point renders the gold as plastic as a piece of tin; the heat changes the relative position of the crystals of the metal—thrusts them out as it were—and the gold requires rolling or hammering afterwards to give it elasticity—the spring so requisite for pens. This is the reason why old pens cannot be re-pointed. Some makers do not hammer their pens after being rolled; they are never so good. After being rolled they are cut to the proper form in a finish die, then stamped with the name of the maker, and afterwards turned up to the rounding quill form. After this the point is slit with a thin copper disc revolving at a great velocity; the great speed makes the soft metal disc cut the hard metal rhodium; the gold is slit with another machine; therefore to make a slit in each pen it has to undergo two operations. The point is next ground on a copper wheel revolving at a great velocity. This is a very delicate operation, and a good artist gets high wages. After this the pens are "stoned out," that is, they are ground down on the inside and out by fine Water of Ayr stones, by hand on a bench alongside of a tub of water, the stones are long, thin, roundish slips, and the pens have to be operated so as to make one part more thin than another, to give them the proper spring. They are then polished on swift revolving copper rollers, and afterwards finished with fine powder and soft chamois skin, Thus, to make a gold pen, it undergoes twelve operations. Inferior pens can be made with less labor, but they soon develope their true characteristics.

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### The Railways of the World.

The number of miles of railway now in operation upon the surface of the globe is 34,776, of which 16,180 are in the Eastern Hemisphere, and 18,590 are in the Western; and which are distributed as follows:—

| | Miles. | | Miles. |
|---|---|---|---|
| In the United States...... | 17,317 | In Belgium .................. | 532 |
| In the British Provinces. | 823 | In Russia...................... | 422 |
| In the Island of Cuba.... | 359 | In Sweden .................. | 75 |
| In Panama.................. | 31 | In Italy......................... | 170 |
| In South America......... | 60 | In Spain ...................... | 60 |
| In Great Britain ......... | 6,976 | In Africa ..................... | 25 |
| In Germany ............... | 5,340 | In India....................... | 100 |
| In France .................. | 2,480 | | |

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

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

| Magnet. | Day. | Barom. at tem. of 32 deg. 6 A.M. | 2 P.M. | 10 P.M | Mean. | Tem. of the Air. 6 A.M. | 2 P.M. | 10 P.M. | M'N. | Tension of Vapour. 6 A.M. | 2 P.M. | 10 P.M. | M'N | Humidity of Air. 6 A.M. | 2 P.M. | 10 P.M. | M'N. | Wind. 6 A.M. | 2 P.M. | 10 P.M. | Mean Vel'y in Miles | Rain in Inch. | Snow in Inch. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | ° | ° | ° | ° | | | | | | | | | | | | | | |
| d | 1 | 29.376 | 29.334 | — | — | 18.4 | 25.5 | — | — | 0.096 | 0.117 | — | — | .92 | .82 | — | — | W | SWbW | — | 5.53 | ... | 0.2 |
| c | 2 | .501 | .699 | 29.880 | 29.717 | 16.5 | 19.4 | 14.0 | 16.00 | .083 | .080 | 0.082 | 0.081 | 86 | 74 | 94 | 86 | W | W b S | W S W | 9.48 | ... | ... |
| b | 3 | .863 | .635 | .479 | .646 | 12.3 | 29.8 | 24.4 | 23.88 | ·068 | .154 | .123 | .120 | 81 | 94 | 92 | 88 | W b S | S E b S | E S E | 3.97 | ... | ... |
| b | 4 | .443 | .452 | .664 | .535 | 38.8 | 45.2 | 36.3 | 39.42 | .208 | .252 | .190 | .210 | 89 | 85 | 89 | 86 | SW bW | SWbW | N b E | 8.65 | ... | Inap. |
| a | 5 | .790 | .562 | .391 | .576 | 30.5 | 30.6 | 41.0 | 34.35 | .148 | .154 | .242 | .183 | 88 | 90 | 95 | 91 | N b E | E S E | E b S | 7.02 | 0.255 | Inap. |
| a | 6 | .634 | .841 | .982 | .837 | 28.2 | 19.8 | 14.6 | 20.60 | .124 | .076 | .062 | .086 | 79 | 79 | 69 | 75 | N W | N b W | W S W | 8.21 | ... | ... |
| e | 7 | .903 | .747 | .715 | .785 | 14.7 | 18.2 | 19.5 | 17.60 | .077 | .087 | .077 | .082 | 86 | 83 | 71 | 81 | N b W | W S W | W S W | 6.85 | ... | Inap. |
| da | 8 | .648 | .656 | — | — | 18.3 | 16.4 | — | — | .081 | .072 | — | — | 78 | 74 | — | — | W | N b W | — | 3.90 | ... | Inap. |
| b | 9 | .666 | .691 | .668 | .659 | 5.0 | 20.8 | 18.3 | 14.80 | .051 | .074 | .091 | .076 | 85 | 64 | 88 | 83 | N | W S W | Calm | 5.51 | ... | 0.8 |
| ab | 10 | .491 | .457 | .595 | .525 | 25.5 | 34.0 | 30.1 | 29.60 | .134 | .167 | .153 | .146 | 95 | 86 | 91 | 88 | S S E | S | Calm | 1.78 | ... | Inap. |
| c | 11 | .660 | .619 | .380 | .551 | 24.8 | 34.5 | 35.5 | 30.75 | .115 | .168 | .199 | .156 | 85 | 81 | 96 | 88 | NE b E | NE b E | E N E | 6.27 | 0.485 | ... |
| c | 12 | .002 | 28.706 | 28.929 | 28.889 | 39.5 | 41.2 | 37.2 | 39.40 | .234 | .256 | .196 | .229 | 97 | 1.00 | 89 | 95 | E N E | E N E | W b S | 7.54 | 0.190 | ... |
| b | 13 | .095 | 28.992 | 29.177 | 29.100 | 34.1 | 34.1 | 26.1 | 30.32 | .179 | .158 | .132 | .151 | 92 | 79 | 92 | 88 | W b S | S W | W b S | 10.22 | ... | 0.2 |
| b | 14 | .457 | 29.656 | .806 | .668 | 24.6 | 27.8 | 24.5 | 25.23 | .114 | .115 | .124 | .117 | 84 | 76 | 92 | 84 | NW bN | N WbN | W N W | 5.72 | ... | ... |
| b | 15 | .854 | .758 | — | — | 25.5 | 23.2 | — | — | .119 | .101 | — | — | 85 | 78 | — | — | W | NE b E | — | 3.60 | 0.080 | Inap. |
| c | 16 | .329 | .472 | .690 | .509 | 38.0 | 34.5 | 28.0 | 31.78 | .171 | .175 | .116 | .156 | 91 | 89 | 75 | 86 | Calm | W N W | W | 3.74 | ... | ... |
| c | 17 | .730 | .803 | .619 | .833 | 22.6 | 27.7 | 17.6 | 22.10 | .104 | .111 | .083 | .093 | 84 | 72 | 81 | 76 | Calm | W b N | NWbW | 4.97 | ... | 0.6 |
| b | 18 | .858 | .782 | .929 | .857 | 20.0 | 20.5 | 19.8 | 19,85 | .092 | .093 | .098 | .095 | 82 | 82 | 88 | 85 | N E b E | N E | N N E | 6.29 | ... | 0.4 |
| c | 19 | .884 | .857 | .657 | .778 | 26,0 | 29,1 | 26.3 | 26.90 | .128 | .142 | .130 | .133 | 88 | 88 | 89 | 89 | Calm | N N E | NE b E | 7.18 | ... | 1.8 |
| c | 20 | .354 | 28.998 | 28.991 | .093 | 25.5 | 28.9 | 37.4 | 30.63 | .126 | .157 | .208 | .164 | 89 | 98 | 94 | 94 | E | E S E | W b N | 8.37 | 0.090 | ... |
| a | 21 | .132 | 29.420 | 29.711 | .444 | 29.1 | 14.7 | 9.0 | 15.65 | .141 | .077 | .054 | .086 | 88 | 86 | 76 | 83 | W | W b S | W b S | 15.94 | ... | 1.5 |
| a | 22 | .928 | .974 | — | — | 5.8 | 11.5 | — | — | .058 | .060 | — | — | 92 | 78 | — | — | W b S | W | — | 7.13 | ... | ... |
| b | 23 | .888 | 30.069 | 30.029 | 30.001 | 7.6 | 5.4 | 4.7 | 5.37 | 058 | .044 | .047 | .048 | 87 | 73 | 81 | 79 | W N W | W | W S W | 11.38 | ... | ... |
| a | 24 | .791 | 29.880 | 30.116 | 29.949 | 11.5 | 14.0 | -2.4 | 6.32 | .044 | .058 | .033 | .044 | 57 | 67 | 79 | 71 | W | N W | N E | 8.13 | ... | 0.5 |
| a | 25 | 30.213 | 30.077 | 29.546 | .919 | -4.3 | 13.9 | 23.3 | 11.92 | .024 | .062 | .123 | .074 | 62 | 72 | 95 | 77 | N E | S E b E | E b S | 7.76 | ... | 0.6 |
| a | 26 | 29.265 | 29.295 | .500 | .364 | 30.9 | 39.6 | 26.3 | 32.70 | .158 | .215 | .125 | .169 | 92 | 89 | 86 | 89 | S S E | W b N | NWbN | 8.03 | ... | ... |
| a | 27 | .539 | .467 | .759 | .608 | 19.7 | 20.9 | 12.2 | 17.47 | .094 | .097 | .059 | .082 | 85 | 83 | 73 | 79 | W b S | W b N | N W | 8.89 | ... | 0.2 |
| e | 28 | 30.024 | 30.180 | 30.176 | 30.132 | 0.0 | 5.2 | 0.9 | 1.58 | .036 | .042 | .039 | .038 | 78 | 71 | 81 | 76 | Calm | N | N E bN | 5.47 | ... | 0.7 |
| c | 29 | 30.089 | 30.040 | — | — | 4.3 | 20.8 | — | — | .050 | .102 | — | — | 87 | 88 | — | — | NE b N | E b S | — | 5.96 | ... | Inap. |
| c | 30 | 29.822 | 29.610 | 29.395 | 29.588 | 27.0 | 35.8 | 35.9 | 33.18 | .130 | .154 | .194 | .164 | 87 | 73 | 92 | 86 | N E | S b W | S W b S | 6.83 | 0.060 | ... |
| a | 31 | .312 | .193 | 29.149 | .210 | 34.8 | 35.5 | 35.9 | 35.47 | .187 | .186 | .189 | .189 | 93 | 90 | 90 | 92 | W | S WbW | Calm | 2.71 | 0.110 | ... |
| | | | | | | | | | | | | | | | | | | Miles. | Miles. | Miles. | | | |
| | M | 29.602 | 29.583 | 29.624 | 29.607 | 22.28 | 26.18 | 22.94 | 23.57 | 0.116 | 0.129 | 0.122 | 0.122 | 85 | 82 | 86 | 84 | 6.32 | 9.15 | 7.37 | 6.86 | 1.270 | 7.5 |

Highest Barometer...... 30.219, at 8 a.m. on 25th } Monthly range:
Lowest Barometer ...... 28.693, at 3 p.m. on 12th } 1.526 inches.

Highest temperature.. 46°.4, at p.m. on 4th } Monthly range:
Lowest temperature... –5°.4, at a.m. on 25th } 51°.8.

Mean Maximum Thermometer............. 29°.31 } Mean daily range:
Mean Minimum Thermometer............. 13°.53 } 15°.78.

Greatest daily range............... 39°6, from a.m. 25th to a.m. of 26th.

Warmest day...... 4th. Mean temperature...... 39°.42 } Difference,
Coldest day......... 28th. Mean temperature...... 1°.58 } 37°.84.

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

| North. | West. | South. | East. |
|---|---|---|---|
| 1293.42. | 2915.87. | 921.64. | 1116.82. |

Mean direction of Wind W b N.

Mean velocity of the Wind... 6.86 miles per hour.

Maximum velocity ........... 23.1 miles per hour, from 10 to 11 a.m. on 21st.

Most windy day...... 21st; Mean velocity... 15.94 miles per hour.

Least windy day..... 10th; Mean velocity... 1.78 ditto.

Raining on 7 days. Raining 39.5 hours.

Snowing on 11 days. Snowing 42.2 hours.

Aurora observed on 3 nights. Possible to see Aurora on 10 nights. Impossible to see Aurora, 21 nights. Solar Halo and Parhelia on the 2nd at 7.45 a.m.

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**Comparative Table for January.**

| Year. | Temperature. Mean. | Max. obs'vd. | Min. obs'vd. | Range. | Rain. D's. | Inch. | Snow. D'ys | Inch. | Wind Mean Vel'y. | |
|---|---|---|---|---|---|---|---|---|---|---|
| | ° | ° | ° | ° | | | | | | |
| 1840 | 17.0 | 40.6 | —13.8 | 54.4 | 4 | 1.395 | 11 | Not Regis'd. | Not Regis'd. | |
| 1841 | 25.6 | 41.7 | —4.1 | 45.8 | 2 | 2.150 | 14 | | | |
| 1842 | 27.9 | 45.8 | +1.3 | 44.5 | 5 | 2.170 | 9 | | | |
| 1843 | 28.7 | 54.4 | +1.5 | 52.9 | 6 | 4.295 | 12 | 14.2 | 0.69 | lb. |
| 1844 | 20.2 | 44.6 | —7.7 | 52.3 | 7 | 3.005 | 11 | 24.9 | 0.70 | lb. |
| 1845 | 26.5 | 43.0 | —3.4 | 46.4 | 5 | Imp. | 9 | 22.7 | 0.70 | lb. |
| 1846 | 26.7 | 41.2 | +0.3 | 40.9 | 5 | 2.385 | 10 | 6.0 | 0.55 | lb. |
| 1847 | 23.3 | 42.6 | —2.2 | 44.8 | 7 | 2.135 | 5 | 7.5 | 1.09 | lb. |
| 1848 | 28.7 | 51.5 | —12.0 | 63.5 | 7 | 2.245 | 8 | 7.1 | 5.82 | Miles. |
| 1849 | 18.5 | 40.1 | —15.2 | 55.3 | 4 | 1.175 | 10 | 9.2 | 6.71 | Miles. |
| 1850 | 29.7 | 46.3 | +10.6 | 35.7 | 5 | 1.250 | 8 | 5.2 | 5.80 | Miles. |
| 1851 | 25.5 | 43.2 | —12.8 | 56.0 | 4 | 1.275 | 10 | 7.8 | 7.69 | Miles. |
| 1852 | 18.4 | 37.3 | —7.0 | 44.3 | 0 | 0.000 | 19 | 30.9 | 7.67 | Miles. |
| 1853 | 23.0 | 40.9 | —6.6 | 47.5 | 1 | 0.290 | 6 | 7.5 | 6.34 | Miles. |
| 1854 | 23.6 | 45.2 | —4.3 | 49.5 | 7 | 1.270 | 11 | 7.5 | 6.86 | Miles. |
| | | | | | | | | | 0.75 | lb. |
| M'n. | 24.22 | 43.89 | —5.03 | 48.92 | 4.6 | 1.785 | 10.2 | 12.54 | 6.70 | Miles. |

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

NINE MILES WEST OF MONTREAL.

BY CHARLES SMALLWOOD, M.D.

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

| Day. | Barom. corrected and reduced to 32° Fahr. | | | Temp. of the Air. | | | Tension of Vapor. | | | Humidity of Air. | | | Direction of Wind. | | | Velocity in Miles per Hour. | | | Rain in Inch. | Snow in Inch. | Weather, &c. A cloudy sky is represented by 10; A cloudless sky by 0. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 6 A.M. | 2 P.M. | 10 P.M. | 6 A.M. | 2 P.M. | 10 P.M. | 6 A.M. | 2 P.M. | 10. P.M. | 6 A.M. | 2 P.M. | 10 P.M. | 6 A.M. | 2 P.M. | 10 P.M. | 6 A.M. | 2 P.M. | 10 P.M. | Inch. | Inch. | 6 A.M. | 2 P.M. | 10 P.M. |
| 1 | 29.302 | 29.505 | 29.283 | 11.0 | 21.0 | 4.0 | .082 | .126 | .055 | .88 | .93 | .95 | N E | N | N W | 7.50 | 0.37 | 0.22 | | 0.21 | Str. 8. | Slight Snow. | Clear. |
| 2 | .320 | .360 | .539 | 12.4 | 24.0 | 19.0 | 085 | 121 | 117 | 88 | 80 | 94 | N W | W S W | W b S | 0.05 | 5.12 | 6.24 | | Inapp | Light Snow. | Cum. Str. 4. | Snow. |
| 3 | .720 | .627 | .530 | 14.3 | 26.2 | 19.8 | 091 | 141 | 114 | 87 | 88 | 87 | W b S | S b W | S E b E | 7.70 | 0.93 | 2.22 | | 1.10 | Cir. Cum. Str. | Do. 10. | Clear. |
| 4 | .819 | .250 | .279 | 19.0 | 44.5 | 42.1 | 117 | 292 | 283 | 94 | 94 | 92 | N E | W S W | S W b W | 8.10 | 0.41 | 10.63 | | | Cir. Str. 8. [8. | Cir. Str. 8. | Cir. Str. 8. |
| 5 | .620 | .540 | .446 | 29.2 | 20.8 | 12.6 | 161 | 101 | 083 | 89 | 77 | 82 | N N W | N E b E | N E b E | 11.26 | 6.25 | 14.02 | | | Do. 8. | Str. 10. | Sleet. |
| 6 | .297 | .437 | .671 | 18.0 | 19.8 | 5.0 | 101 | 117 | 053 | 83 | 94 | 85 | W | W N W | N W | 15.05 | 12.03 | 14.40 | | | Sleet. | Cir. Str. 2. | Clear. |
| 7 | .667 | .558 | .490 | 2.2 | 21.2 | 14.5 | 051 | 081 | 097 | 95 | 60 | 93 | N W | W S W | S W | 6.80 | 3.12 | 2.01 | | | Cir. 3. | Clear. | Cir. 4. [40 am |
| 8 | .476 | 29.415 | .489 | 10.9 | 12.9 | -1.0 | 079 | 068 | 038 | 88 | 67 | 83 | W b N | N W | N W | 4.12 | 5.00 | 8.87 | | | Clear. | Do. | Clear A. Bo. 2. |
| 9 | .501 | .571 | .570 | -13.0 | -1.0 | -11.5 | 019 | 043 | 021 | 63 | 84 | 75 | N W | N W b W | N W b W | 3.00 | 2.40 | 1.55 | | | Do. | Do. [at 6 p.m. | Cum. Cir. Str. |
| 10 | .519 | .530 | .537 | -9.5 | -4.0 | 1.0 | 024 | 033 | 043 | 78 | 83 | 84 | N E b E | N E | N E | 8.63 | 8.91 | 11.15 | | 2.90 | Snow at 5 a.m. | Snow ceased | Cir. Str. 8. [8. |
| 11 | .680 | .647 | .602 | 3.1 | 14.1 | 14.2 | 048 | 086 | 097 | 84 | 82 | 93 | N E b E | N E b E | N E b E | 11.43 | 6.19 | 5.14 | 0.957 | | Clear. | Clear. | Rain at 9.15 p. |
| 12 | .170 | 28.850 | 28.540 | 32.5 | 34.0 | 44.5 | 199 | 210 | 312 | 98 | 99 | 99 | N E b E | N E b E | S E b S | 11.80 | 6.25 | 4.06 | 0.110 | | Rain. | Rain. | Cir. Str. 9. [m. |
| 13 | 28.890 | 28.850 | 28.883 | 37.0 | 36.1 | 33.0 | 221 | 218 | 197 | 95 | 95 | 94 | S W b W | W S W | W S W | 6.38 | 36.26 | 9.15 | | Inapp | Cir. Str. 9. | Cir. Str. 8. | Slight Snow. |
| 14 | 29.132 | 29.389 | 29.878 | 18.1 | 13.5 | 10.0 | 099 | 080 | 075 | 82 | 78 | 84 | N W b W | W | W | 13.33 | 15.55 | 1.02 | | | Do. 8. | Do. 4. [p.m. | Cir. Str. 4. |
| 15 | .787 | .676 | .671 | 0.5 | 6.5 | 4.0 | 042 | 052 | 051 | 89 | 79 | 85 | N W b W | N E b E | N E b E | 5.52 | 2.28 | 3.16 | | 0.34 | Clear. | Snow at 1.45 | Snow. |
| 16 | .204 | .580 | .375 | 5.5 | 17.0 | 21.0 | 058 | 088 | 126 | 92 | 85 | 93 | N N E | N W | W b N | 16.75 | 4.12 | 2.26 | | 3.07 | Snow. | Str. 10. | Str. 10. |
| 17 | .489 | .486 | .665 | -18.0 | 21.0 | 9.1 | 106 | 104 | 060 | 87 | 78 | 80 | W b N | W N W | W | 4.41 | 12.81 | 1.64 | | | Cir. Str. | Cir. Cum. 2. | Clear. |
| 18 | .807 | .725 | .771 | -2.4 | 7.7 | 5.4 | 036 | 056 | 058 | 84 | 80 | 92 | W b N | N E b E | N E b N | 4.50 | 0.20 | 4.98 | | | Str. 8. | Str. 9. | Do. |
| 19 | .759 | .578 | .619 | -2.1 | 12.6 | 6.5 | 041 | 077 | 059 | 96 | 78 | 92 | N E b E | N W b N | S W b W | 1.17 | 0.40 | 0.43 | | | Do. 10. | Do. 8. | Cir. Str. 4. |
| 20 | .525 | .178 | 28.893 | 7.5 | 12.3 | 11.7 | 062 | 078 | 086 | 93 | 93 | 90 | N E b E | N E b E | N E b E | 8.22 | 12.47 | 4.14 | | 5.06 | Snow at 5 a.m. | Snow. | Do. 9. |
| 21 | 28.945 | 29.000 | 29.804 | 16.1 | 18.0 | 0.0 | 098 | 093 | 043 | 88 | 79 | 80 | W b S | W b S | W N W | 3.86 | 4.24 | 15.97 | | | Cir. Str. 4. | Cum. Str. 4. | Clear. |
| 22 | 29.734 | .748 | .779 | -15.2 | 2.0 | -7.5 | 014 | 042 | 028 | 58 | 76 | 80 | W | W | S W b S | 13.34 | 5.53 | 2.12 | | | Clear. | Clear. | Do. [realis. |
| 23 | .541 | .687 | .786 | -6.5 | 6.3 | -9.1 | 036 | 059 | 024 | 90 | 92 | 76 | N E b E | W S W | W S W | 13.37 | 12.09 | 6.85 | | 0.40 | Snow. | Snow. | Clear A. Bo- |
| 24 | .507 | .453 | .821 | 5.1 | 12.5 | -10.9 | 053 | 071 | 023 | 85 | 82 | 77 | S S W | W | N W b W | 6.58 | 6.30 | 21.29 | | 1.60 | Do. | Cir. Cum. 4. | Clear. |
| 25 | 30.054 | 30.059 | .914 | -25.1 | -2.5 | -15.1 | 011 | 084 | 019 | 73 | 73 | 83 | N W b W | S W b S | E b S | 8.62 | 2.22 | 0.62 | | | Clear. | Clear. | Do. |
| 26 | 29.332 | 29.139 | .226 | -8.2 | 4.1 | 6.0 | 033 | 050 | 058 | 90 | 92 | 92 | N E b E | N E b N | W b N | 15.06 | 8.00 | 1.15 | | 2.90 | Snow. | Snow. | Clear. |
| 27 | .359 | .281 | .409 | 5.4 | 14.0 | 2.0 | 058 | 080 | 050 | 92 | 78 | 86 | W S W | W N W | W N W | 11.81 | 8.39 | 1.75 | | | Clear. | Clear. | Do. [lis. |
| 28 | .734 | .892 | .912 | -12.0 | -5.2 | -16.0 | 024 | 030 | 018 | 80 | 80 | 82 | W N W | W N W | W | 8.25 | 15.00 | 4.32 | | | Do. | Do. | Do. A. Borea- |
| 29 | 30.024 | .943 | 30.032 | -34.3 | -3.7 | -19.3 | 005 | 032 | 016 | 55 | 70 | 80 | W | N b E | N b E | Calm | 0.12 | 0.26 | | | Do. | Do. | Do. do. |
| 30 | 29.834 | 29.646 | 29.459 | -11.5 | 2.1 | 6.6 | 021 | 046 | 060 | 75 | 84 | 84 | N E b E | N E | N E | 7.00 | 5.62 | 3.00 | | 0.40 | Str. 10. | Snow. | Str. 10. |
| 31 | .152 | .196 | 28.949 | 29.0 | 36.0 | 33.5 | 161 | 310 | 204 | 89 | 91 | 94 | S | W S W | S S W | 3.68 | 3.00 | 4.91 | | | Sleet. | Str. 10. | Sleet. |

| | | |
|---|---|---|
| Barometer .... | Highest, the 25th day | 30.059 |
| | Lowest, the 12th day | 28.540 |
| | Monthly Mean | 29.516 |
| | ,, Range | 1.519 |
| Thermometer. | Highest, the 12th day | 44°.5 |
| | Lowest, the 29th day | -34°.3 |
| | Monthly Mean | 10°.92 |
| | ,, Range | 78°.8 |
| Greatest Intensity of the Sun's Rays | | 123°.0 |
| Mean Humidity | | .843 |

Rain fell in 2 days amounting to 1.067 inches.
Snow fell on 12 days amounting to 17.98 inches.
Aurora Borealis visible on 4 nights. Might have been seen on 11 nights.
Most prevalent Wind N E b E.
Least do. do. S.
Most Windy Day, the 6th day; Mean miles per hour, 13.82.
Least Windy Day, the 29th day; Mean miles per hour, 0.12.
The Electrical State of the Atmosphere has been marked *generally* by a Moderate Intensity of a Positive character.
The Mean Temperature of the Month is 5°.76 below that of last January.

**Monthly Meteorological Register, Quebec, Canada East.—January, 1854.**

BY LIEUT. A. NOBLE, R.A.

*Latitude, 46 deg. 49.2 min. North; Longitude, 71 deg. 16 min. West. Elevation above the level of the Sea, — Feet.*

| Date. | Barometer corrected and reduced to 32 degree, Fahr. | | | | Temperature of Air. | | | | Elasticity of Air. | | | | Humidity of Air. | | | | Direction of Wind. | | | Velocity of Miles. | | | | Rain in inch. | Snow in inch. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 6 A.M. | 2 P.M. | 10 P.M. | MEAN. | 6 A.M. | 2 P.M. | 10 P.M. | MEAN. | 6 A.M. | 6 P.M. | 10 P.M. | M'N. | 6 A.M. | 2 P.M. | 10 P.M. | M'N. | 6 A.M. | 2 P.M. | 10 P.M. | 6 A.M. | 2 P.M. | 10 P.M. | M'N. | | |
| | | | | | ° | ° | ° | ° | | | | | | | | | | | | | | | | | |
| 1 | 29.748 | 29.642 | 29.496 | 29.595 | 16.0 | 23.5 | 21.0 | 20.2 | .081 | .107 | .111 | .030 | .86 | .82 | .96 | .88 | E S E | E S E | Calm | 12.4 | 10.9 | ... | 7.8 | ... | 3.5 |
| 2 | .641 | .687 | .581 | .672 | 18.3 | 26.5 | 17.5 | 20.7 | 100 | 127 | 095 | 107 | 90 | 86 | 94 | 92 | W N W | W N W | W N W | 3.8 | 6.2 | 6.2 | 5.4 | ... | 1.5 |
| 3 | .970 | .992 | .898 | .953 | 15.4 | 20.0 | 17.5 | 17.6 | 083 | 097 | 082 | 087 | 89 | 87 | 80 | 85 | W S W | W S W | W S W | 6.2 | 5.2 | ... | 3.8 | ... | ... |
| 4 | .591 | .432 | .435 | .486 | 23.5 | 33.8 | 41.0 | 32.7 | 117 | 157 | 183 | 159 | 91 | 80 | 72 | 81 | W b S | W b S | W | 3.8 | 6.2 | 11.3 | 7.1 | ... | ... |
| 5 | .829 | .989 | .866 | .895 | 23.5 | 21.5 | 15.0 | 20.0 | 104 | 090 | 070 | 079 | 80 | 76 | 77 | 77 | N W | W N W | E b S | 8.0 | 6.2 | 13.4 | 9.2 | ... | 3.8 |
| 6 | .482 | .530 | .870 | .627 | 16.4 | 22.2 | -1.0 | 12.5 | 091 | 105 | 041 | 088 | 93 | 86 | 91 | 90 | E b S | W b N | W N W | 14.3 | 8.8 | 8.0 | 10.3 | ... | 0.2 |
| 7 | .914 | .817 | .791 | .851 | -5.0 | 7.7 | 5.8 | 2.8 | 027 | 053 | 054 | 045 | 72 | 79 | 87 | 79 | N N W | W N W | W N W | 12.4 | 10.1 | 6.2 | 9.6 | ... | 1.0 |
| 8 | .799 | .548 | .683 | .676 | 6.0 | 15.2 | 0.0 | 7.1 | 059 | 082 | 034 | 058 | 92 | 89 | 70 | 84 | W b N | W b N | W b S | 7.2 | 8.8 | 6.2 | 7.4 | ... | ... |
| 9 | .681 | .808 | .953 | .815 | -7.4 | -7.0 | -14.5 | -9.6 | 027 | 027 | 016 | 023 | 79 | 80 | 69 | 76 | W N W | W N W | W N W | 6.2 | 6.2 | 3.8 | 5.4 | ... | ... |
| 10 | 30.054 | .979 | 30.020 | 30.018 | -21.4 | 0.0 | 0.0 | -7.1 | 008 | 044 | 045 | 032 | 60 | 93 | 95 | 79 | W N W | E N E | E N E | 3.8 | 3.8 | 3.8 | 3.8 | ... | 1.5 |
| 11 | .123 | 30.073 | 30.075 | .090 | 9.0 | 13.4 | 17.5 | 13.3 | 065 | 067 | 080 | 071 | 93 | 79 | 79 | 84 | E N E | E N E | E N E | 8.8 | 10.1 | 13.9 | 10.9 | ... | 4.0 |
| 12 | 29.622 | 29.377 | 28.892 | 29.297 | 22.0 | 26.0 | 30.3 | 26.1 | 106 | 138 | 164 | 136 | 87 | 97 | 97 | 94 | E N E | E N E | E N E | 27.8 | 34.1 | 30.1 | 30.6 | ... | 3.0 |
| 13 | .028 | .015 | 29.051 | .011 | 33.7 | 37.3 | 34.5 | 35.2 | 182 | 184 | 143 | 173 | 95 | 82 | 72 | 83 | N N W | W b S | W b S | 10.1 | 8.0 | 5.2 | 7.8 | ... | 1.0 |
| 14 | .077 | .460 | .812 | .419 | 29.8 | 17.5 | 7.0 | 18.1 | 140 | 084 | 054 | 096 | 84 | 83 | 83 | 83 | W S W | W b S | W b S | 8.0 | 10.1 | 8.0 | 8.7 | ... | ... |
| 15 | 30.026 | 30.111 | 30.108 | 30.082 | -3.2 | 7.0 | 5.5 | 3.1 | 032 | 052 | 044 | 050 | 78 | 81 | 73 | 77 | W b S | W b S | W b S | 8.0 | 5.2 | 5.2 | 6.1 | ... | 1.0 |
| 16 | 29.825 | 29.515 | 29.665 | 29.678 | 6.3 | 8.3 | 11.5 | 8.7 | 060 | 064 | 061 | 062 | 94 | 95 | 78 | 89 | E b N | E b N | W b S | 25.4 | 22.7 | 13.9 | 20.6 | ... | 3.0 |
| 17 | .688 | .702 | .911 | .767 | 15.3 | 22.8 | 11.3 | 16.5 | 086 | 106 | 063 | 085 | 93 | 84 | 80 | 86 | W b S | W S W | W | 9.4 | 8.0 | 10.1 | 9.2 | ... | ... |
| 18 | .915 | 30.117 | 30.126 | 30.063 | 0.0 | 6.0 | 4.6 | 3.5 | 035 | 050 | 042 | 042 | 75 | 80 | 73 | 76 | W | W | Calm | 6.2 | 6.2 | ... | 4.1 | ... | ... |
| 19 | 30.001 | 29.937 | .106 | .015 | -5.2 | 1[illegible].3 | 4.6 | 3.5 | 033 | 068 | 053 | 051 | 90 | 86 | 90 | 89 | Calm | [illegible] b S | E N E | ... | 3.8 | 8.0 | 3.9 | ... | 1.5 |
| 20 | 29.940 | .707 | 29.465 | 29.701 | 7.5 | 8.[illegible] | 7.5 | 7.8 | 057 | 061 | 061 | 061 | 87 | 93 | 92 | 91 | E N E | [illegible] b N | E | 16.0 | 22.7 | 21.2 | 20.0 | ... | 3.5 |
| 21 | .176 | .137 | .311 | .208 | 11.0 | 21.5 | 7.5 | 13.3 | 070 | 102 | 052 | 075 | 93 | 85 | 79 | 86 | E | S W | W | 8.0 | 8.0 | 11.3 | 9.1 | ... | 3.0 |
| 22 | .861 | 30.035 | 30.103 | 30.000 | -16.0 | -7.[illegible] | -12.6 | -12.0 | 006 | 023 | 018 | 016 | 26 | 61 | 67 | 48 | W | W | W | 13.9 | 11.3 | 8.0 | 11.0 | ... | ... |
| 23 | .995 | 29.920 | .066 | 29.994 | -11.5 | 1.6 | -6.5 | -5.5 | 026 | 031 | 028 | 029 | 93 | 66 | 80 | 80 | E | E N E | E N E | 8.0 | 8.8 | 6.2 | 7.6 | ... | ... |
| 24 | .928 | .676 | 29.981 | .863 | -12.5 | -7.2 | -7.0 | -8.9 | 017 | 020 | 029 | 022 | 61 | 57 | 84 | 67 | W b S | W b S | W | 5.2 | 3.8 | 3.8 | 4.2 | ... | ... |
| 25 | 30.378 | 30.415 | 30.374 | 30.389 | -21.5 | -11.7 | -16.5 | -13.2 | 005 | 019 | 010 | 011 | 24 | 63 | 47 | 45 | W | W | W | 8.8 | 6.2 | 5.2 | 6.7 | ... | 1.0 |
| 26 | 29.816 | 29.461 | 29.418 | 29.565 | -2.5 | 3.5 | 6.5 | 2.5 | 028 | 038 | 055 | 040 | 65 | 68 | 87 | 74 | E b S | E b S | E b S | 10.1 | 8.0 | 6.2 | 8.1 | ... | 5.0 |
| 27 | .519 | .532 | .594 | .548 | 5.6 | 15.5 | 0.0 | 7.0 | 047 | 063 | 035 | 048 | 78 | 67 | 76 | 74 | E | W | W | 10.1 | 8.0 | 5.8 | 8.1 | ... | ... |
| 28 | .886 | 30.060 | 30.294 | 30.080 | -15.7 | -3.0 | -15.4 | -11.4 | 013 | 028 | 016 | 019 | 62 | 66 | 75 | 68 | W | W N W | W N W | 10.1 | 8.0 | 3.8 | 7.3 | ... | ... |
| 29 | 30.383 | .420 | .440 | .414 | -26.8 | -7.3 | -14.2 | -16.1 | 009 | 020 | 012 | 014 | 70 | 57 | 49 | 59 | N N W | W N W | W N W | 6.2 | 6.2 | 6.2 | 6.2 | ... | ... |
| 30 | .254 | .052 | 29.805 | .037 | -22.7 | 5.4 | 13.6 | -1.3 | 008 | 014 | 065 | 039 | 48 | 73 | 76 | 66 | W N W | W | W | 6.2 | 3.8 | 3.8 | 4.6 | ... | ... |
| 31 | 29.503 | 29.301 | .220 | 29.312 | 23.5 | 32.4 | 31.2 | 29.0 | 112 | 161 | 148 | 141 | 86 | 90 | 84 | 87 | W | W | W | 3.8 | 6.2 | 5.2 | 5.0 | ... | 4.0 |
| M | 29.793 | 29.799 | 29.787 | 29.776 | 3.5 | 11.7 | 7.2 | 7.5 | 0.056 | 0.075 | 0.063 | 0.064 | 78 | 79 | 79 | 79 | | | | 9.3 | 9.1 | 7.7 | 8.7 | | 41.5 |

REMARKS.

2nd. Aurora appeared at ¼ to 7 p.m. Was obscured by the clouds at about 10 p.m. Very faint. Luminous circle and dark arch underneath.

4th. A faint light visible in the north at 2 a.m.

5th. Very hazy.

8th. Aurora visible at 5½ p.m. Not visible at 6 p.m. Visible again at 8½ p.m. Commenced to snow at 11 p.m. Aurora again visible at 2¼ a.m.

9th. No Aurora.

12th. Very stormy.

16th. A very dark cloud visible in the north, extending from N.N.W. to N.E. A light shining through the clouds above it.

18th. Lunar halo at 12½ a.m., 50° in diameter. Not possible to see Aurora till 1 a.m. Aurora not visible at that time.

Highest Barometer, at 10 p.m. on the 29th............ 30·440 } Monthly Range, 1·548 in.
Lowest Barometer, at 10 p.m. on the 12th............ 28·892 }

Maximum Thermometer............................................ 43°·0 } Monthly Range, 72°·0
Minimum Thermometer............................................ -29°·0 }

Mean Maximum Thermometer.................................. 15°·1 } Mean Daily Range, 17°·8.
Mean Minimum Thermometer.................................. -2°·7 }

Greatest Daily Range, on the 30th....... ....... ....... 46°·5
Least Daily Range, on the 20th.......................... 3°·5

Warmest Day, the 4th............................................ 32°·7 } Climatic Difference, 48°·8.
Coldest Day, the 29th............................................ -16°·1 }

Possible to see Aurora on 14 nights.
Aurora observed on 9 nights.

SUPPLEMENT

TO THE

CANADIAN JOURNAL

FOR MARCH, 1854.

## The Importance of Scientific Studies to Practical Men.

*A Lecture delivered before the Members of the Peterboro' Library Association, by John Langton, Esq., M.P.P.*

Ladies and Gentlemen:—

I have been most anxious that the Library Association, which we have been forming in this town, should also embrace a Mechanics' Institute; because, although a collection of books is an essential part of such an institution, a Library alone does not meet all the objects which I am desirous of promoting. A Public Library is designed to develope a taste for reading, and to afford facilities for the cultivation of literature generally, without a special preference for any particular department: a Mechanics' Institute, on the contrary, may in one sense be said to have a more confined object, being chiefly intended to promote the study of the Physical Sciences; but in other respects it embraces a larger field, by enabling its members to prosecute those studies, not from books alone, but by the gradual accumulation of a museum of philosophical apparatus, and more especially by means of the delivery of Lectures. This being the end which I have been endeavoring to attain, I have been induced, with some other gentlemen holding similar views, to make a commencement with a short series of lectures; and keeping in mind that, which has been my leading object from the first, I have selecte' for the subject of the present discourse, the *Importance of Scientific Studies to Practical Men.*

It would be a waste of time, and almost an insult to your understandings, to enter into a formal defence of the uses and advantages of scientific knowledge. No such pleading can be required in the middle of the nineteenth century, when the last fifty years have witnessed a crowd of brilliant discoveries which have no parallel in history, except in the equally astonishing intellectual activity which distinguished the seventeenth century. But there are even now prejudices upon the subject, though of a very different kind from those which the first fathers of science had to combat, and which may deserve a word of comment. Within little more than fifty years from the dawn of modern science, the only true method of studying Nature was fully and firmly established, and the foundation of most of the sciences was securely laid. The actual knowledge gained was mostly that of correct theory, and the opposition came from the learned, who had to forget their old doctrines and to begin anew. The practical men hardly meddled at all in the disputes, or were on the side of the new discoveries. Now, on the other hand, the characteristic of the age is the practical application of our knowledge to purposes of immediate and obvious utility: and yet, curiously enough, it is from the practical men that the murmurs are chiefly heard.

One cause of this is, undoubtedly, the difficulty arising from the language of science, and the long and hard names which abound in scientific books. The very appearance of them repels the student, and he is apt to think that, were it not for the pride of learning, they might as well be translated into his native tongue. The difficulty is, however, in a great measure unavoidable. Every trade and craft has its own peculiar technical terms, which are equally unintelligible to the bulk of society. A new fact, a new substance, a new system of classification must have its appropriate name. If you bestow upon it one already in use, and employed to designate something else, instead of rendering yourself more intelligible, you only create confusion. Every accession to our knowledge necessarily requires an addition to our vocabulary, and as science is for all nations, the new names are generally taken from those ancient languages which we have all equally inherited. *Carbon*, for instance, is taken from the Latin word for charcoal, and the chemist uses it as a name for that substance of which, with some trifling impurities, charcoal consists. If you translate it, and call it charcoal, it might seem more intelligible, but would really only lead you astray; for charcoal is only one of the forms in which we know carbon. It exists in almost equal purity in coke and in black lead (into the composition of which, by the way, not a particle of lead really enters), and in an absolutely pure state in the diamond. The element carbon is a new idea, and must have a new name. You cannot say, with truth, that a diamond consists of charcoal or of black lead, but all three consist of carbon. This new nomenclature may be, and is, perhaps, sometimes carried too far, and in such cases, everything that tends to give science an air of unnecessary profundity and obscurity should undoubtedly be amended. But, after all, the difficulty is not so formidable as it may appear, and at any rate it is a necessary evil; for you can no more speak of a science without using its language, than I could converse with a millwright about a saw-mill, without talking of "pitmen," "noddle-pins," "cross-heads," and "dogs," or with a sailor, without using such words as "shrouds," "dead-eyes," and "fids."

A more formidable prejudice is a sort of contempt which practical men sometimes entertain for theory. It is very common to hear a person spoken of as a theorist, in whom you cannot repose the same confidence as in a practical man; but we should not forget that a true theory is, as it were, only the essence of practice, or the generalization of a number of facts. And we cannot close our eyes to the numerous instances in which the greatest improvements in practice have originated in theory. Let us take an instance. There is, perhaps, no class more slow to yield an old prejudice than a sailor. Now it has been known, theoretically, for more than two centuries, that, to obtain the greatest advantage from the wind, a sail should exactly divide the angle between the direction of the wind and the ship's course; and it cannot do this unless the sail sits perfectly flat. If the sail forms a curve, only a part of it can be in the required position, and all the rest must be doing nearly as much harm as good. This was all known, but it was considered only theory, and sailmakers insisted that experience had shown that sails must be made to belly out, to catch, they said, and hold the wind. For two hundred years, practice would not listen to theory, till only the other day the prejudice was so far overcome, that the sails of a yacht were made as flat as canvass could be made to lie, and the consequence was, that the America walked away from all her competitors. Old sailors will no doubt still shake their heads, but in the next generation a "bellying" sail will only be a poetical expression. Theory and practice, in truth, mutually assist each other. They are allies, not rivals; or you may liken them to a general and his soldiers. There were, doubtless, many men at Waterloo who could handle their bayonets, and go through their evolutions better than the Duke could have done; but they could no more have gained the battle of Waterloo without him to direct and combine, than he could have withstood a charge of the enemy without their collective strength.

One other objection to scientific studies I will mention, which always has been, and still is too common, especially among practical men. Where there is an obvious and direct application of some scientific truth or inquiry, the importance of the subject is willingly admitted; but where there appears no immediate prospect of turning it to account, the question is too often asked, What is the use of it? The objection is, in fact, more common now than formerly: for we have been so much accustomed of late years to witness the daily improvements in almost all arts and manufactures, that we are apt to undervalue everything that does not at once come up to our standard of utility. It cannot, however, be too thoroughly impressed upon a student, that no knowledge is without some use. As we say in common life, keep a thing for seven years, and you will find some purpose for it, so in science, a truth once ascertained is an accession to our knowledge, the importance of which can never be known till you can view it in connection with all around it. An anecdote is told of a celebrated sculptor whom a friend visited after the lapse of several days, and found still working at a statue that had appeared almost finished before. The friend wondered what he could have been doing, and the sculptor pointed out that he had scraped a little here and filed a little there, and brought out some feature more prominently in another place. "But these are only trifles," said his friend. "True," replied the sculptor; "but such trifles make the work perfect, and perfection is no trifle." So in science, a fact known is a stone prepared for the temple of knowledge; it may appear unimportant, and it may be idle for years, but time will assuredly show its proper place in the structure, and it *may* prove to be the keystone of an arch.

For instance, more than two thousand years ago the Greek geometricians made a study of that particular class of curves which, because they may be obtained by cutting a cone across in different directions, are called conic sections. In those days there was an exactly opposite prejudice from that which prevails at present, and it was thought rather derogatory to the dignity of science to be mixed up with every day life. They studied these curves, therefore, merely as an intellectual exercise, and for two thousand years conic sections continued to be taught as one of the acknowledged branches of pure geometry, without any attempt at a practical application. But the acquaintance already gained with the curious properties of these curves enabled Kepler, when the state of astronomical observation was otherwise sufficiently advanced, to recognise the fact that all the heavenly bodies move in conic sections, of which discovery Newton's law of universal gravitation, with all its important consequences, was the immediate offspring.

There are hundreds of similar facts to be met with in the history of science. Yet people still continue to laugh at the apparently trifling and useless researches of philosophers! As Swift, in the voyage to Laputa, satirized the contemporaries of Newton, Peter Pindar quizzed those of Watt. Hook's pendulum experiments, in which the measure of the earth originated, were ridiculed under the name of swing-swangs, and Boyle's observations on the elasticity of air, one of the steps towards the steam engine, were the objects of contemptuous sneers. The steam engine itself, the mighty power of the nineteenth century, was, in its first germs, little better than a scientific toy. What, indeed, could appear more useless than experiments consisting of rubbing pieces of amber, or sealing wax, or glass, and remarking the manner in which they attract little straws, or bits of paper? Yet in these the science of electricity took its rise. Even when Franklin had to some extent advanced the study, his practical countrymen thought it but learned trifling, and asked, "What is the use of it?" Franklin answered, "What is the use of a new-born baby?" When we look at the electric telegraph extending its wires all over the globe, and the countless applications of electricity to almost every branch of science and art, we may well exclaim that that baby has, in less than a century, expanded into a full-grown man, whose use no one would dare to question.

The whole history of science abounds in instances of great discoveries founded upon the simplest observations, and mighty effects resulting from unimportant properties of matter. Franklin had the true spirit of an inductive philosopher: he was always inquiring into something or other. In a voyage across the Atlantic he was engaged, as usual, in trying experiments, and, having no other present field of inquiry, he kept dipping his thermometer into the sea as he proceeded. I dare say the sailors and his fellow passengers laughed secretly at the philosopher, but these experiments resulted in ascertaining the fact, that the different ocean currents have very different temperatures, the great Gulf stream being as much as 12° higher than the surrounding ocean, and the thermometer is consequently now a most useful instrument in helping the mariner to shape his proper course.

A soap-boiler finds a peculiar corrosion in his boilers, and applies to a chemist for an explanation. The chemist analyzes the refuse formed by the corrosion, and discovers a new substance, which, from its violet colour, he calls iodine, after a Greek word. He argues, that it must have come there in some of the substances employed by the soap-boiler, and finds it in the alkali which was used. He next traces it in the marine plants from the ashes of which the alkali was extracted, and finally he discovers it in sea water, and almost all marine substances, amongst which are sponges. A physician now remembers that burnt sponge has long been a popular remedy for goitre (a swelling of the neck, accompanied, in the worst cases, by a peculiar form of idiocy, which is a common complaint in Switzerland, and other mountainous countries), and he tries the effect of pure iodine. The consequence is the discovery of an almost certain cure for this most distressing and heretofore nearly intractable disorder.

Antimony is a metal long known, and abundant enough in nature, though of very limited use in the arts: but it has a peculiar property, which might easily escape notice, without a knowledge of which the art of printing would never have attained its present perfection. You know that all substances expand with heat and contract with cold; but this general rule has a very few partial exceptions. The most conspicuous one is water, which follows the general rule in the shape of steam, and as water it continues to follow it till cooled down to 39½° of the thermometer. Beyond that point, every additional degree of cold expands the water instead of contracting it, till, having experienced another sudden expansion in the act of freezing, it continues ever after, in the form of ice, to contract with cold and expand with heat like other bodies. The consequences to us of this exception are most important; for, were it otherwise, water would begin freezing at the bottom, and not on the surface, and no summer's sun could penetrate to thaw the ice once formed: every piece of water would become a solid lump of ice, and the earth would be uninhabitable. It is not, however, of water that I would speak, but of antimony, which is another partial exception, increasing in dimensions like water in the act of becoming solid from a melted state. Now, the types used in printing must be cast: to form them by carving or punching would make printing almost as expensive as writing; but if cast in any ordinary metal, the fine lines of the mould would not be copied, and the impression would be coarse and indistinct. The addition of a little antimony to the lead, of which types are principally formed, makes the whole expand as it becomes solid, sufficiently to force the metal into the sharpest indentations of the die.

But it is said by some that you may leave such studies to the professionally learned, and that working men have no time for them; or if the nature of their occupation requires some knowledge of scientific results, it is sufficient for the mechanic to know the facts, and to work upon the rules which the philosophers have laid down for him. It has even been contended that the true principle of division of labour requires that the philosopher should devote himself to perfecting theory, and that the practical mechanic should confine his attention to attaining mere manual dexterity. To a certain extent this division must necessarily prevail, but if we are to look for much improvement in our present process, or much advance in our actual knowledge, the two branches must also be in a great measure com' ined. Theory and practice, as I have said before, mutually aid each other, and the mechanic cannot hope to attain much eminence without some theoretical knowledge, whilst the theorist must not disdain the aid of practical experience. The working mechanic, it is true, can but rarely become an accomplished philosopher, but he can, at any rate, become familiar with the principles of those sciences more immediately connected with his pursuits; and such is the mutual dependence of all the sciences, that he should at least have some idea of the general bearing and extent of our whole physical knowledge. A mere acquaintance with rules is not enough; for a man can never thoroughly understand, or even remember a rule, unless he knows something of the reason of it, and if he comes to apply it under slightly altered circumstances, he can never be certain that it continues to hold good for the case he has in hand. How many persons have wasted great mechanical ingenuity in attempting perpetual motion, which a slight acquaintance with first principles would have shown to be impossible! How many thousands have been thrown away in sinking shafts for coal, in strata which any geologist knew beforehand could contain none, or in working imaginary gold mines for what a mineralogist would, at a glance, have pronounced to be only mica! Again: if the object sought is possible, science will guide you in ascertaining whether the means used are sufficient for the purpose, or are the easiest, and most direct and economical, which can be employed. But more than all, theory will often suggest, and invite to a new track, which never would have occurred to a person unacquainted with science. In a word, if you are content to go on doing what preceding generations have done, you may perhaps trust to experience and rules alone; but if you wish to attempt anything new, where you can have no guidance from experience or rule, you must recur to first principles, which it is the province of science to teach.

Human nature is so prone to cavil, and it is so true a saying, that a prophet has no honor in his own country, that I can imagine some of my hearers may say (or if they do not like to say it openly, may secretly think) that this would be all very well, if any of us were likely to make new discoveries, or hit upon great inventions, but that it is so improbable that the mechanics of a small village like Peterborough should be going so to distinguish themselves, that it is hardly worth while to make preparation for it. Perhaps we may have no undiscovered geniuses amongst us; but (not to mention that already one of our fellow-townsmen has produced an invention, not yet thoroughly tested, but which is now engaging the attention of persons in England, able and willing to give it a fair trial) we never can know whether we have them or not till it is proved by the event. Hundreds of inventions have been made by simple mechanics, having no greater advantages than many of you, whose achievements would tempt me to lay before you some examples, were we not promised a lecture upon this subject by my friend, Mr. Gemley. But not to mention names of such world-wide reputation as Franklin, Watt, Arkwright, Godfrey, Dolland, Stephenson, consider the numbers who, as improvers rather than inventors, are daily benefiting mankind, and laying the foundation of their own fortunes, without their names ever becoming known to fame. If there is only one of you, or one of your children, who has within him the hitherto undiscovered talent to contribute something new to science or to art, we should be sufficiently rewarded for all our exertions to enable him to acquire that knowledge, without which no opportunity, no ingenuity, no natural talent can be of any avail.

But if no practical mechanic can take full advantage of all the circumstances in which he is placed unless he have also some theoretical knowledge, neither can a mere theorist ever effect much who has not sufficient practical experience to know in what direction there is the greatest room for improvement, and what are the existing means for carrying it into effect. Almost all great discoveries and inventions have been made by men who united theoretical to practical knowledge.

Watt was not only a skillful mechanic, but thoroughly conversant with most of the sciences; and in our own time Scott Russell, who, by a series of beautiful and most ingenious experiments, was the first to demonstrate the true form of vessels offering the least resistance to the water, has become himself an eminent shipbuilder. Even in these branches of study which are in themselves of a less practical character, the assistance of instruments, and various complicated mechanical contrivances, is constantly required, and the investigator must be able to devise and direct, even if he does not himself actually construct them. The ingenious instruments invented by the late Dr. Wollaston, and by Professor Wheatstone, are instances of this union in a high degree of mechanical skill and theoretical acuteness. Newton made with his own hands most of the instruments with which his delicate optical experiments were conducted, and he invented, and himself constructed, the kind of reflecting telescope which bears his name; and after him Herschel and Lord Rosse manufactured themselves those great instruments which have given us a new insight into the heavens.

In these remarks I do not merely confine myself to advocating a scientific training for mechanics, as a means of enabling them to pursue their several callings with greater success; I go a step farther, and recommend it for the sake of science itself. With similar advantages of scientific acquirements, a working mechanic is *more* likely than any other person to strike out something new and useful in practice, or something important in principle. He has the best opportunities of perceiving what is deficient in the existing state of his art, and what is the chief difficulty to be overcome. He is daily handling the tools and materials of his trade, and assisting in processes and operations upon a scale and under circumstances which the experimenter in his cabinet cannot imitate. Indications of the secrets of nature are constantly passing under his eyes of which the mere philosopher can know nothing. Yet all these advantages must be barren and useless, unless some knowledge of principles and a habit of generalizing enable him to seize the hint, and turn it to account. The seed is being liberally scattered, but unless the soil is prepared for its reception, it will bring forth no fruit.

It is not often that we know with any certainty the whole history of a new discovery, but when we do, we very generally find that it originated in a trifling indication such as I have spoken of, which hundreds of people had seen before, without thinking it worthy of attention. Even when the discovery is the result of a laborious investigation for that especial object, the original inducement to commence the inquiry has often been some casual observation, or the final course of reasoning which has led to its success has been dictated by an accident, which has caused the whole mystery to flash across the mind in an instant. Such discoveries are frequently spoken of as accidental, and if they are so, such chances are *more* likely to occur to practical men than to any others; but to call them accidents has a tendency to mislead, and at any rate does not tell the whole truth. Such chances occur daily to us all, but it is only the favored few that can take advantage of them. When a man's mind is deeply intent upon some particular subject, a mere trifle may often give it an impulse which leads to a new view of the question, and ultimately to a new discovery; but the bent of the mind must already exist, and the capacity to turn the new idea to advantage.

It may be interesting to illustrate this by some examples.

The story of Archimedes is well known. Hiero, King of Syracuse, had given a certain weight of gold to a jeweller, from which to manufacture a crown; and when the crown was brought to him, and found to be of full weight, he still wanted to know whether it was all really gold, or whether the weight had been made up with baser metal, and he consulted Archimedes. The question, evidently, was to determine whether the *bulk* of the manufactured crown was the same as that of the gold given out; for, if it were no greater, gold being the heaviest metal then known, it would be clear that it must be all pure gold. Whilst meditating upon this commission, Archimedes went into a bath, and noticed how his body, by displacing a quantity of water equal to its bulk, raised the level of the whole, as if a similar amount of water had been added. The whole secret was seen through in a moment, and he is said to have jumped out of the bath, and to have run home, forgetting even to dress himself, and exclaiming, as he went, that he had found it out. This is a fair specimen of these accidental discoveries. Thousands had seen the water rise in a bath before, but it was only to a man of the attainments of Archimedes—and he, too, in search of the hint he found—that the accident gave rise to the discovery of the hydrostatic balance, of specific gravities, and the whole theory of floating bodies.

It was more purely an accident when Hauy dropped a beautiful crystal, which he was examining, on a marble floor, and, on gathering up the fragments into which it was shivered, discovered that crystals have planes of cleavage differing from their outward forms, and thus created an entire change in that branch of mineralogy. Substances which crystalize, always assume certain definite forms by which they may generally be recognized; but most crystals are subject to great modifications of figure, and some so much so, that they lose even a general resemblance to their usual characteristics. Thus, suppose a common brick to be the primary form in which a substance crystalizes: as fresh additions are made, the whole mass may still keep the shape of the first brick; but from the same materials you may also build up a square tower, or a pyramid. The outward form does not, therefore, necessarily exhibit the interior arrangement of the separate parts; but if you can obtain planes of cleavage, which show the courses of masonry, and the direction of the joints, you can detect the original brick, whether in the pyramid or the tower. This was the nature of Hauy's discovery, arising from a mere accident; but the occurrence would have been fruitless to any but an accomplished mineralogist, who had already directed his attention to the forms of crystalization.

Again: it was by accident that a French officer of engineers, named Malus, was looking at the reflection of the setting sun on the windows of the Luxemburg Palace, through a plate of doubly-refracting crystal, called tourmaline, when he remarked that one of the images disappeared on turning the crystal round. Hundreds might have seen the same thing, but it was only in the case of one already engaged in the study of optical phenomena that the observation gave rise to a most singular and important discovery, that, when reflected or refracted in a certain manner, light attains an entirely new property, and ever after refuses to be reflected or refracted except in certain directions. Light thus modified in its nature, so as to have a definite relation to space, and to affect certain directions in preference to others, is said to be polarized, from a sort of analogy with the magnetic needle, whereas common light traverses transparent bodies in any direction, being only reflected or refracted at their surfaces. When thus changed in character, it meets with somewhat similar obstructions in their interior, giving rise to some most singular and splendid displays of colour, and, what is more important, giving us a deeper insight into the internal constitution of matter than was ever attained before, and we are apparently as yet only on the threshold of the discoveries it may lay open to us.

It is related of Galileo, that, whilst attending divine service in the cathedral at Pisa, he noticed that a chandelier, which had in some way been disturbed, continued to swing in exactly equal intervals of time. No accurate measure of time was known in those days, so he tested the quality of the vibrations by his own pulse. As he was at that time studying for the medical profession, he employed his discovery in a little instrument for counting the pulse of his patients. Afterwards, when he deserted medicine for the physical sciences, he founded upon it many of his new, but just views of the laws of motion; and in later life, when he became an astronomer, the same accidental observation supplied him with the pendulum for his clock. Such occurrences cannot fairly be called accidents. Almost every living man from the commencement of the world must have seen something similar, but it required a Galileo to detect its value, and to trace its important consequences.

In the following century, the astronomer Bradley was engaged in a series of observations on the stars, intended to obtain a decisive proof of the motion of the earth from the known principle of parallax, when, instead of what he was looking for, he observed another, and to him unaccountable, apparent motion of the stars. He had long endeavoured to find some solution of the difficulty, and his mind, no doubt, was full of it at the time, when, in sailing in a boat on the Thames, he noticed that the vane at the mast-head was directed to a different point of the compass at each tack the boat made, though the wind itself had in no respect changed. In fact, a vane under these circumstances, being partly acted on by the wind, and partly by the motion of the boat itself through the air, assumes a position intermediate between the two directions. It immediately struck Bradley that his observed motion of the stars might be similarly accounted for; that the ray of light, the direction of which he had been measuring with his telescope, might be compounded of the real direction in which it was moving from the star, and of the direction which the earth itself was advancing at the time; so that, as the earth kept changing its direction in different parts of its orbit, the apparent direction of the star would vary just as that of the vane did. This supposition he was afterwards fully able to verify, and it forms to the present day, or till within the last few years, at any rate, did form, the only actual, visible proof we have of the motion of the earth round the sun.

The telescope is said to have originated in an accident. The children of a spectacle maker in Middleburgh were playing with some of the glasses, and, happening to look through two of them, placed one behind the other, saw the weathercock on a steeple opposite greatly magnified, but inverted. The father, having his attention called to the singular effect, fixed up two glasses in his shop at the proper distance, and directed to the weathercock. All the passers-by stopped to wonder at the curiosity, till it struck somebody that the glasses might be inserted into a portable tube.

After the telescope, which alone has enabled astronomy to reach its present perfection, perhaps the most important instrument is the sextant, without which our astronomical knowledge could never have been turned to much account in navigation. You know that the object of such observations is to measure the angle between two objects, as the sun above the horizon, or the moon from a particular star. Now, at sea you cannot direct one of your sights towards one object, and one towards the other, and then read off the angle at your leisure. Amidst the incessant rolling and pitching of the vessel, you cannot use any such fixed instruments as you can employ on the shore, but must be enabled to catch an instantaneous sight of both objects at the same time. This is accomplished by viewing one object directly, and the other after a double reflection from two mirrors. One of the little mirrors is fixed, and the other is moved, till you bring both objects exactly to coincide, when the angle between the two mirrors is proved mathematically to be exactly half of that between the two objects. Now, this valuable instrument had certainly two, and perhaps three, independent inventors. The first in order of time was undoubtedly Sir Isaac Newton, though the invention was not made public for some time after. Another, and certainly an independent one, was a glazier of Philadelphia, who is said to have conceived the first idea from noticing the reflection of the opposite houses between two panes of glass, with which he was preparing to mend a window. There have been, without doubt, many as skillful glaziers as poor Godfrey, and certainly many more industrious ones—for he was a sad dissipated fellow—but not very many who had sufficient acquaintance with mathematics to make a profitable use of such a casual observation. We are told that Godfrey was devoted to such studies; so much so, that when the Royal Society voted him £200 for his invention, they laid it out in a present of furniture and linen to his wife, as he spent all his earnings in mathematical books—and drink.

Now in these anecdotes, which I have related as examples of the manner in which discoveries are generally brought about, you will observe that there are two circumstances which are common to them all. The discovery was connected with the practice of the profession of the man who made it, or with the study which then occupied his attention, and there existed beforehand a competent knowledge to turn to account the new idea suggested to his mind. They tend to illustrate and confirm the proposition with which I commenced, and with which I will also conclude: that practical men, working mechanics, are more likely than any other class to encounter those obscure hints and suggestions of nature which are the seeds of great discoveries; that they are the most able of all men to detect the practical application of which the idea is susceptible, but that, without some preparatory training and scientific acquirements, all those advantages must of necessity be thrown away.

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### Great Western Railroad.

The Great Western Railway is two hundred and twenty-eight miles in length, and it forms, with the American roads east and west of it, one of the most important of all the routes between the Atlantic and the Mississippi, Commencing in the West at the head of Lake Erie, where the Michigan roads and daily steamers connect it with all the shores of the great upper lakes and the exhaustless lands of the north-western States—touching with its boundaries Lakes Huron, St. Clair, and Ontario—and terminating in the East on the Niagara river, where two railroads and the Erie Canal connect it with the seaboard—and commanding in the water Communication of Ontario and the St. Lawrence an independent channel to Montreal and Quebec—it certainly possesses extraordinary advantages, and must hereafter serve a most valuable purpose. The road was projected eight years ago, and had to experience its full share of the difficulties usually attendant upon such an enterprise. Its cost has been about eight millions of dollars, about one million of which was subscribed in Canada, about one million in the United States, and nearly a million by the British Government: the remainder has been raised by the sale of stock and bonds, in Great Britain. Its line of location is in some respects remarkably favorable. Ninty-five per cent. of the whole distance is perfectly straight, and the curves on the remaining distance are mostly very slight.

A distance of 183 miles is either entirely level or exhibits inclinations of less than five feet per mile; and the slopes on the remainder are mostly less than 20 feet per mile. The summit is 360 feet above the western terminus, the maximum grade on the west side of which is twenty feet per mile, and on the eastern side forty-five feet per mile, the latter of which is all confined to a distance within twelve miles of Hamilton.

The soil east of London is generally composed of sand and gravel; west it is more mixed with clay. For some twelve or twenty miles west of Chatham the road passes through low wet prairies, and was built at great expense, the material for its grading having been taken from the marshes with dredging machines and by coffer dams, or hauled, over a long distance, from the lake shore. For a mile and a half the track runs over piles.

Near London, and also both east and west of Hamilton, are many heavy excavations and embankments. Over the Twenty Mile Creek is a bridge 1200 feet in length and eighty in height, and not far distant is another eight hundred feet in length of the same height. The road, though the regular traffic upon it has already commenced, cannot yet be considered as complete. A considerable portion of it has not yet been gravelled up to the ties, and many places it runs over temporary tressel work. Still the work has been done with great expedition, for a year ago but very small and detached portions of the grading on any part of the line had been completed. The road appears to be strong and firm enough now, but there are many who think it will not sustain unharmed the severe tests of the coming spring.

The line is laid with a single track, but its culverts and bridges are so constructed as to admit of a double track when one shall be required. The guage is five feet and a half, and therein I believe exclusively Canadian. The engineers of the work, and most of the contractors are Americans. Two or three of the directors of the company have been and still are Americans; but notwithstanding, the common principles of human nature have had play in the doings of the corporation, as the following amusing specimen goes to show: The first chief engineer of the road, after a service of four or five years, resigned to take office at Washington. One of his associates was appointed successor, and the Board heralded the qualifications of the new officer in very emphatic terms.

One of his first duties was to render a detailed estimate of the cost of the line in place of the general estimates of his predecessor. He did this, and, after careful examination, confounded the Board with a result which exceeded the original estimate more than a million of dollars. There was no standing such a wet blanket, and the Chief Engineer was indignantly driven from his post. Another was appointed, an Engineer of high standing in the United States. He, after patient investigation made a report of estimates which exceeded those of the last a million and a half of dollars, those of the first two million and a half! The shock was a terrible one, but human nature had to yield to the nature of things, and the Directors submitted. The result has completely justified the last estimates.

The locomotive engineers are American and English; the conductors Scotch, and also most of the subordinates. The locomotives were mostly built at Shenectady or at Lowel; the cars, which are very spacious and elegant, were manufactured in the province at Hamilton. The rails weigh from sixty-five to eighty pounds to the yard, and not having been subject to tariff dues, cost something like twenty-five dollars per ton less than the price of similar iron in the United States. The fare on the route is three cents a mile, which is one cent more than on most Northern roads in our country. It is expected that the entire two hundred and twenty-eight miles from Niagara to Detroit will be run in eight hours, and the entire distance between Chicago and Albany, 837 miles by nearly a straight line, in twenty-nine honrs.

A suspension bridge connecting the line with the Rochester and Niagara road, is in process of construction. Though it extends directly over the present suspension bridge for general travel, it is not connected with the latter at all, its heavy stone abutments being built outside, and the wire-work some fifteen feet above, being entirely independent. It will have but two cables, one on each side, each of the strongest twisted wire and nine inches in diameter. The present bridge has eight cables, four on each side, each about two inches in diameter. The bridge will be well made, I doubt not, but whether it will be well travelled is another question. Money will suffice for the former, but something more is requisite for the latter, and something which I hardly think the company will supply. I meant *pluck* for the passengers; for however pleasant "riding on a rail" may be on *terra firma*, this flitting on a stick, whether a broom stick or an iron stick, two hundred feet over an abyss blacker and fiercer than Acheron, for a good long furlong or two is a different matter."—*Railway Journal.*

### Opening of the Buffalo and Brantford Railroad.

The Buffalo and Brantford Railroad, as originally designed, has at length been completed and cars are now running over it. This road was projected several years since and a reconnoisance made of the route by Mr. Wallace, who found it to be not only an entirely practical one, but one highly favorable.—For sometime after this the enterprise slumbered, and no steps were taken to enter upon it in earnest. A little over two years since the project was revived, in the first instance, we believe, by the citizens of Brantford. This action on their part was prompted, in a measure, by that of the Directors of the Great Western road in deciding upon Paris, six miles beyond, as the point through which the road should pass. Men of energy took hold of it, and succeeded in obtaining a considerable amount of subscriptions to the stock, principally by the municipalities along the line. They visited Buffalo, and the matter was laid before our citizens, and by them favorably considered. The result was a subscription on the part of the city, of one hundred and fifty thousand dollars to the capital stock. This secured the completion of the road, and the services of our then Mayor, James Wadsworth, Esq., in the Directory, and subsequently as President of the Company.

When the enterprise was first entered upon, it was under a general Plank Road Law—the provisions of which were constructed to authorise the construction of a railroad. This, however, was denied, by some, and the road encountered a powerful opposition from Sir Allan McNab, and others in the interest of the Great Western Road.—Eventually, however, the Provincial Parliament confirmed and enlarged the franchises of the Buffalo and Brantford Company by a special charter. Thus fortified, they went forward. A financial measure of much importance, not only to this road but to all others in the Province, was about this time adopted—a measure of wisdom in its conception, and of great beneficial results in its operation. The municipalities, town and county, had voted to issue the debentures, for internal improvement purposes, to a large amount. These could not be negociated except at a ruinous discount. Parliament passed an act by which these were taken by the government and its debentures to the same amount issued. These commanded a premium. The par value of the municipal debentures was paid over, and the premium transferred to a sinking fund for their redemption. They all bore six per cent. interest; but the municipal authorities raise eight per cent.—The difference going to the sinking fund.—The Buffalo and Brantford company pay their six per cent on the debentures issued for their benefit as they have also done on the bonds issued by the city; and the dividends will go in the same direction when the road is in full operation. This measure enabled them to raise funds; without which it would have been difficult to realize them.

The road from the Niagara River to Brantford is not far from seventy-five miles in length. It is constructed on a guage of five feet six inches—uniform with all the roads in Canada. This is a convenient width—preferable on the whole, to the wider or narrower guage The country through which it passes, is an unusually level one—offering but few engineering obstacles in the whole distance. There are but two considerable gradients in the whole line—one of about forty feet to the mile, west of Dunnville, and another of about thirty feet, between Caledonia and Brantford. Compare this with a single section of the Great Western, as it goes out of Hamilton. For three continuous miles there is a grade of sixty-five feet to the mile, and for the next four miles, of forty-five feet to the mile. It will be seen, therefore, that the grade on the Buffalo and Brantford Road, offers no impediments to high speed or heavy freightage. In addition to this, seventy-one miles of the seventy-five are straight lines, and there is no curve with a radius of less than two miles and a half. There are but a few inconsiderable embankments, so that if a train should happen to run off the track, but little damage could result. The cost of the road, absolutely and comparatively, is much in its favor. With a rolling stock consisting of ten first class locomotives—two of which equal the "Racer" and the "Richmond," on the Central—twelve elegant passenger coaches, and baggage cars sufficient to do a large business —the cost has been but $19,000 per mile. This is much cheaper than any other road that has been constructed;—and the Great Western cost $60,000 per mile. This difference is owing to the nature of the surface over which the roads pass.

That the opening of this road is to be of great benefit to Buffalo, will, we think, soon be shown. The section of Upper Canada which it penetrates and opens to us, is but little known to our citizens. From the difficulty of access, it has hitherto been an almost *terra incognita*. In point of soil or climate it is equal to any part of the State of New York. And, as a wheat growing region the Grand River Valley is not surpassed by that of the far famed Genesee. The country immediately bordering upon the Road, is not a good representative of the district—as it avoids as far as practicable, the improved lands, in order to secure the right of way on more favorable terms. It passes through three large villages between here and Brantford, and six miles beyond is Paris, with extensive hydraulic power, and a population of between three and four thousand. At this point the Brantford road intersects the Great Western—both running into the same depot—thus being in communication with Detroit, and enabled to land passengers here from the west, two or three hours in advance of the Great Western route.

It may be as well to mention here, as a part of the history of the road, that the original plan has been enlarged, and that it is to be extended to Goderich, on Lake Huron, eighty-five miles farther, and one hundred and sixty from Buffalo. The contract for the Western Division has been entered upon and much of the grading already done, and it is contemplated to have the "iron horse" put through from one Lake to the other by the first of November 1854. The gradation is already far advanced, and is in the hands of energetic contractors who will push it forward with all possible despatch. When this is completed, a man may start in New York one morning, and wake up in Makinaw the next. The distance from Buffalo to Goderich, being one hundred and sixty miles, can be easily run in five hours.—*Buffalo Courier.*

### Prizes Awarded at the New York Crystal Palace.

Below we give a list of the prizes awarded to Canadian competitors at the New York Crystal Palace. There were in all one hundred and fifteen silver medals granted, of which the greatest number fell to the United States. France received 51; Great Britain 9; Germany 5, and Switzerland, Australia and Italy one each. Of the bronze medals, the United States has 505, Great Britain 143, France 153, Germany 106, Prussia 30, Belgium 10, Switzerland 29, Holland 12, Austria 18, Italy and Sardinia 44, British America 26, &c. As a contemporary very justly remarks—"Had better arrangements been made, we have no doubt that Canada would have figured much more prominently in the prize list." And we have no doubt, that had sufficient information been diffused to inspire confidence in the undertaking, that Canada would have been very much better represented. The following is the list of the 26 premiums awarded to Canada and the Lower Provinces:—

Bell, Messrs. Quebec, Canada East, for specimens of Earthenware.

Peter, C. H. Riviere Ouelle, Canada East, for general excellence of specimens of Leather, from the Ouelle River, from the skin of the porpoise.

Indians of Loretto, Canada, for general excellence of specimens of dressed and undressed Deer and Moose skins, prepared by themselves.

Van Brocklyn, Winter & Co., Canada West, for a Threshing and Separating Machine.

Globensky, Miss., Lachine, Canada, complete set of Embroidery for Furniture.

Geddes, Rev. J. F. Hamilton, Canada West, Berlin Wool Carpet.

Bouchard, J. B. Madame, St. Villiere, Canada, Counterpane and knitted Linen Curtains.

Knight, Wm. St. John's, Newfoundland, for Model of Seal Fishery.

Thompson, Miss Kate, Toronto, rose point Lace Collar.

Tetu, J. Berthier, Canada, Woollen Night Caps.

Thompson, Mrs. Quebec, Baby's Knitted Dress in Crotchet work.

Saurin. J. J., Quebec, Canada, Two Sleighs.

Dutton, Miss Eliza, Montreal, Knitted Cradle Quilt.

Picton Mines, Nova Scotia, Coal, illustrating veins.

Sydney Mines, Nova Scotia, Coal, illustrating veins.

Ziegler, J. B. Quebec, Cornopeon, ingenious.

Kearney Richd, St John's Newfoundland, for a model of a Ship's Hull.

Reinhart, C. Montreal, Canada, for superior Hams.

Royal Agricultural Society, Prince Edward Island, for samples of Wheat, Oats, Buckwheat, &c., exhibited by Whitman & Wheelock, New York

Patterson J , Elgin Mills, Dundas, Canada, for specimens of Twilled Blankets. With special commendation as the best exhibited.

Upper Canada Provincial Agricultural Society, for a very fine sample of White Wheat, produced by J. B. Carpenter, Townsend, Canada West, weghing 66½ lbs. to the bushel.

Martel, Mlle P., St. Ambroise, Canada, Lace Caps and Collars.

McGrath, James, Toronto, Berlin Wool Carpet.

Hollowell, W. Antrobus, Quebec, C. E., for an ingeniously contrived Fruit Gatherer.

Jobin Mad, J. B., Quebec, Knitted Woollen Over Socks.

Winter, Dr. John, Chairman of Committee of Gentlemen, residents, of St. John, Newfoundland, for specimens of Barley and Oats, and preserved and smoked Meats.

HONOURABLE MENTION.

Madam Lamere, St. Laurent, C. E.—samples of Colored Beans.

——Lambly Quebec—samples of Maple Syrup and Maple Sugar.

J. Muir, Hinchinbrooke, C. E.—cheese.

R. C. McMullen, Toronto—specimens of Irish Lundy Foot Snuff.

M. Pacquet, Quebec— sample of Beans.

John B. Palb, Montreal—Wine Crackers.

Betsey Rousseaux, St. Hilaire, C. E.—Maple Sugar.

Francis Silverthorne, Toronto,—samples of Pot and Pearl Barley.

P. C. Sinclair, Cobourg—superior Cobourg Sauce.

E. W. Thompson, Toronto—samples of Barley.

Asa Westover, Durham, C. E.—samples of Maple Sugar and Syrup.

A. McFarlane, Montreal—samples of Glue.

Caroline Schiller, Montreal—Bark box with Moose Hair, &c.

M. Pacquet, Quebec—Dressed Flax.

John Robertson, Long Point, C. W.— a Seed Sower.

Hypolite Blouin, Berthier, C. E.—Timothy Seed.

Louis Bovin, Cacouna, C. E.—samples of Wheat.

Smith Bartlett, Bellville—samples of Peas.

J. W. Bailey, Megantic, C. E.—Maple Sugar.

Francis Couture, St. Ambroise, C. E.—Skinless Barley and Canadian Oats.

Thomas Moore, Thornhill, C. W. Specimens of Axe Handles.

Quebec Industrial Exhibition Committee—Money Purse, Table Mats, Knife Sheath, Musk-rat and Mink Skin Bags, ornamented Moose Deers and Carriboo Foot, Bark Wood, Card Trays, Baskets, Cigar Cases, prepared, manufactured and ornamented by Loretto Indians.

——McLaren, Yamaska, C. E.—Specimens of Roofing Tiles and Brick.

James Herring, Toronto—White Marrowfat Peas.

L. A. Cummer & Co., Watertown ; A. Griffin, Ranson Mills, Watertown ; J. B. Ewart, Dundas.—Samples of Flour.

Col. Irvine, Quebec—a Maple Table Top, decorated with the Natural Leaves.

James Morgan, Quebec—Design and Cutting Gothic Stone Front.—*Colonist.*

## The "Niagara Mail" on Lord Rosse's Discoveries.

The Niagara *Mail* of the 8th February, in a notice of the January number of the *Canadian Journal*, remarks at length upon the lecture by the Rev. W. Scoresby on the Earl of Rosse's Telescopes and their revelations in the Sidereal Heavens.—We subjoin a portion of the notice of the *Mail*, in which attention is drawn to a curious and interesting passage in the works of Emanuel Swedenborg.

"This discovery of the spiral motion of starry systems among each other is supposed to be original,and as such is styled the "Rossean Configuration."—But it is remarkable, that over a hundred years ago, viz :—in 1755, the celebrated Emanuel Swedenborg in his work on the "Worship and love of God," promulgated the same fact, and showed that the starry systems move round each other, in forms different from those of the planets round the sun ; he styles those higher forms *spiral* and *celestial*—and in fact, asserts the very theory which the Rossean telescopes have recently demonstrated to be true. As this work is very rare, we adduce a passage on this point, and also his general views on the *forms* of celestial motions, which are striking—when considered in connection with the late discoveries in physical astronomy :—"

Around the great system of the sun, and its wandering orbs, and of the moons which accompany them, shine innumerable stars, which constitute our starry heaven, divided into twelve signs, according to the sections of the zodiac, and present its immensity visible. All these stars remain fixed, and as images of the great sun, being immoveable in their centres, they also occupy a kind of a plane, excited by their rays, which they subject and ascribe to themselves as their own proper universe. There are therefore as many universes as there are stars encompassing and crowning our world, according to the virtue and quantity of light emitted from them, greater and lesser. These heavenly circuses mutually press and bind each other by contact, and by continual concatenations enfold together a heavenly sphere, and by infinite orbs complete a form, which, is the examplar of all spheres and forms, in which all and singular the starry orbs harmoniously conspire to one and to the same end, viz: that they may mutually establish and strengthen each other, by virtue of which union resulting from the perfection of the form, this complex of universes is called the firmament ; for in a grand body thus consociated, no member claims anything to itself as its own, unless it be of such a quality that it can flow in from what is general into what concerns itself, and again, as by an orb, can re-flow into what concerns the other universes, or into what is general ; on which account also they do not shut up their lights and torches within their own sphere, but diffuse them even into the opaque bodies of the solar world, and into their earths, and when the setting sun causes night in the hemisphere, they supply his place.

This form, which the stars with their universes determine or co-effect by intermixture and harmony with each other, and which on that account is called celestial, cannot at all be acknowledged as the most perfect of all forms in the world, if we depend only on the view presented to the spectator's eye on this globe of earth ; for the eye does not penetrate into the distances of one star from another, but views them as placed in a kind of expanse, one beside another, hence they appear as without order, like a mass of confusion. Nevertheless, that the form resulting from the connecting series of all the starry universes, is the examplar and idea of all forms, may appear not only from this consideration, that it serves as the firmament of the whole heaven, but also from the consideration, that the first substances of the world, and the powers of nature gave birth to those universes, from which, and their coöperation, nothing but what is perfect flows forth ; this is confirmed also by the distances of the stars from each other, preserved for so many ages, without the least change intervening.—Such forms protect themselves by their own proper virtue, for they breathe somewhat of perpetual and infinite ; nevertheless, they cannot be comprehended as to their quality, except by lower or lowest forms, the knowledge of which we have procured to ourselves from objects which affect the sight of the eye, and further by continual abstractions of the imperfections under which these forms labor. But let us view these forms in their examples ; the lowest form, or the form proper to earthly substances, is that which is determined by mere angular and at the same time by plane subjects, whatsoever be their figure, provided they flow together into a certain form ; this therefore is to be called an Angular Form, the proper object of our geometry. From this form we are enabled to contemplate the next superior form, or the form perpetually angular, which is the same as the Circular or Spherical Form; for this latter is more perfect than the other in this respect, that its circumference is, as it were a perpetual plane, or infinite angle, because totally void of planes and angles; on which account also it is the measure of all angular forms, for we measure angles and planes by sections and sines of a circle: from those considerations we see, that into this latter form something infinite or perpetual has insinuated itself, which does not exist in the former, viz: the circular orb, whose end and beginning cannot be marked. In the circular spherical form, again, we are enabled to contemplate a certain superior form, which may be called the perpetually circular, or simply the Spiral Form; for to this form is added, still further, somewhat perpetual or infinite, which is not in the former, viz: that its diameters are not bounded or terminate in a certain centre, neither are they simple lines, but they terminate in a certain circumference of a circle or superficies of a sphere, which serves it instead of a centre, and that its diameters are bent into a species of a certain curve, by which means this form is the measure of a circular form or forms, as the circular is the measure of the angular. In this spiral form we are enabled to view a still superior kind of form, which may be called the perpetually spiral or Vortical Form, in which again somewhat perpetual or infinite is found which was not in the former; for the former had reference to a circle as to a kind of infinite centre, and from this, by its diameters, to a fixed centre as to its limit or boundary; but the latter has reference to a spiral form as a centre, by lines perpetually circular; this form manifests itself especially in magnetics and is the measure of the spiral form for the reason above mentioned concerning inferior forms. In this, lastly, may be viewed the highest form of nature, or the perpetually vortical form which, is the same with the Celestial form, in which almost all boundaries are, as it were, erased, as so many imperfections, and still more perpetuities or infinities are put on; wherefore this form is the measure of the vortical form consequently the exemplar or idea of all inferior forms, from which the inferior descend and derive birth as from their beginning, or from the form of forms. That this is the case with the formations of things will be demonstrated, God willing, in the doctrine of forms, and the doctrine of order and of degrees adjoined tc it. From this form those of faculties and virtues result, by virtue whereof one thing regards another as itself, nor is there anything but what consults the general security and concord, for in that form there is not given any fixed centre, but as many centres are there as points, so that all its determinations, taken together, exist from mere centres or representations of a centre, by which means nothing can be respected as proper to it, unless it be of such a quality that from what is general, or from all the centres, which taken together produce what is general, it may flow in into itself as a similar centre, and may reflow through an orb for the benefit of all, or into what is general.

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## Natural History in its Relation to Agriculture.

*Abstract of a Lecture delivered before the Toronto Mechanics' Institute by Professor Hincks.*

I proceed to point out some more immediate special applications of the knowledge of natural history to the business of the farmer. Many of the diseases to which cultivated plants and domestic animals are subject, and which sometimes occasion very extensive mischief, depend on the presence of parasitical plants or animals often exceedingly minute. The first step towards remedying the evil is to understand its real cause, and it must be evident that the more that is known of the structure, nutrition, and reproduction of the parasites, the more successfully can we attempt to limit their ravages. The ergot, must, rust, and mould, on the grain producing plants, are minute and very curious fungi whilst serious injuries are caused by plant lice, a tribe of insects of very remarkable characters, which under the names of black fly, green fly, and American blight, given to the different species are well known by their occurrence on wheat, beans, hops, and apple trees, as well as on roses, and other plants. No one of this tribe, indeed, is altogether injurious; writers have attributed some species to the potato blight, but tho' it is well known that the potato, like many other plants, is occasionally infested by aphides, which are either a cause or a symptom of weakness and bad health; it has been abundantly proved that the aphides are present without causing the disease, and the disease exists without the presence of aphides; the species, too, which has been accused of causing the disease, and has in consequence been extensively distributed under Mr. Smee's direction as a microscopic object, turns out to be a common species occurring on many plants, and never before suspected of peculiarly malignant influences. Much better founded is the supposition that an internal fungus is the immediate causes of the potato disease, but until we can determine whether it really produces the decay or only arises out of it, and what are the causes, atmospheric or otherwise, of its prevalence in particular seasons, we cannot acknowledge the resources of science to have been exhausted in vain against this mysterious plague. It deserves consideration, whether all the remedies that have been employed with most appearance of success may not have their efficacy accounted for by their destroying the vitality of the spores of the fungus in the sets, whilst the presence of the spores from other sources would explain their occasional failure. On the whole, I cannot but think the fungoid theory the most rational. We have seen at least that the aphis theory is entirely without foundation; that of the wearing out of the varieties, is disproved by the notorious fact that all varieties, new or old, are about equally liable to the disease, none more so than seedlings, and even seedlings raised from seed brought from the native country of the potato. The theory which attributes the disease to superfluous moisture occurring in particular seasons is disproved by its recurrence with very great variety in the character of the seasons, and in all sorts of situations, whilst the theory of the dependence of the plague on the peculiar atmospheric states, electrical or otherwise, is too vague to be listened to in the absence of specific facts, and is only an indirect acknowledgment of entire ignorance on the subject. I need not now refer more particularly to the injuries suffered by domestic animals from the attacks of various insects, but none, I am sure can possess even a slight acquaintance with the peculiar instincts of certain insect tribes, and the manner in which some of them accomplish such extensive mischief, without perceiving how usefully the knowledge of their nature connects itself with the business of the farmer. Then there is the whole subject of our relations with the wild birds and animals of our country. Probably most country people are indiscriminate destroyers of all the wild creatures that fall in their way, whilst a few influenced by feelings of kindness, or a regard to beauty, are indulgent to all excepting a few of the most obviously and extensively injurious. A little knowledge of Natural History would assist us in judging what creatures are really our enemies, and which we should protect as friends and allies, and would at the same time enable us to carry on the war most successively where it is necessary from a just regard to our interests. If we recall to mind the silly prejudice to which the harmless and even useful hedgehog is as commonly sacrificed in England, or consider the general disposition to destroy birds without much distinction of kinds, we see how beneficial a little knowledge of natural science would be to the dweller in the country. It would thus be decided that the larger and more powerful birds of prey are enemies,because our domestic animals would be among the chief objects of their attack; but the owl tribe, feeding chiefly on small quadrupeds, aid us in our necessary warfare against mice and rats without doing any material damage. The numerous insectivorous birds are all eminently useful, as are those which feed on small seeds, but a few of the frugiverous tribes feeding much on our favorite fruits can only hope for partial indulgence on account of their beauty or their song. In the case of the omnivorous birds which live during a large part of the year on grubs, caterpillars, and other insect prey which they hunt with admirable skill, but which also attack at certain seasons grain and roots, we are obliged to strike a balance between the benefit and injury we receive in which a sense of the happiness of the creatures and admiration for their beauty, and their wonderful instinct, must be allowed some weight in their favor. Such creatures may reasonably have their increase somewhat limited, but if we had the power utterly to destroy them we should soon feel the evil we should thus have brought upon ourselves. We have read of instances in which the extermination of the common European sparrow has been attended with disastrous consequences to the farmer; and although the rook is loudly condemned by some, the sight of numbers of them following the plough, picking up grubs, worms, and insects, should cause the considerate farmer to relent, even though indignant at thefts among his potato set and his ripening grain. Mere illustrations taken from familiar objects in England will show the importance of similar considerations here, and will satisfy every one that the spirit of wanton destruction and persecution often indulged against the inferior animals is as unwise as it is barbarous; that we should destroy only what we evidently perceive to be injurious and unfitted to dwell in any connection with ourselves, and should see with pleasure the various races of animated beings enjoying themselves around us so far as they may be permitted to do so without any serious interference with those pursuits which are essential to our welfare, and which are manifestly designed to exercise our industry and skill. In respect to all the inferior animals we may accept of the decision of the poet:

If man's convenience,
Or health or safety interfere, his rights
Are paramount and must extinguish theirs.
Else they are all, the meanest things that are,
As free to live and to enjoy that life
As God was free to form them at the first,
Who in His sovereign wisdom made them all.

Let me conclude with one word as to the pleasure to be derived from the study of Natural History in connection with a country life. What pursuit can we name in which the charms of beauty, variety, and the exercise of various mental faculties are so united? What can we imagine so well calculated to enliven our interests in the scenes of nature, to make each changing season only a change in our pleasures, and to connect the ordinary occupations, and even the sp rts of rural life with observations and inquiries full of entertainment as well as usefulness.

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### The Late Remarkable Weather in England.

At the last meeting of the British Meteorological Society, January 24, a paper was read, "On the Meteorology of the Past Quarter, in connection with the Fall of Snow at the beginning of the Year," by James Glaisher, Esq., F. R. S. In commencement, Mr. Glaisher spoke of the value of association as afforded by the society, to the members of which he was chiefly indebted for the observations upon which his paper was based. The different elements of investigation were treated singly, that the bearing of each upon the other might be clearly shown. "For," observed Mr. Glashier, "the correctness of the accepted truism that in nature no phenomena is isolated was never better illustrated than at a time when the readings of the barometer and thermometer, the dense fogs, the heavy snow, and the pertinacious east wind formed a combination—one scarcely more abnormal in its departure from the average than the rest."

In October, between Jersey and lat. 51°, the mean temperature declined 4°; between lat. 51° and 53°, there was no difference. In November, south of lat. 51° and north of lat. 53° it declined about 6°; but between these parallels to 9°, forming a band of cold the greatest that was experienced, and which held its ground during the long period of two months. Fog was one of the most remarkable features during the quarter. In November fogs frequently enveloped the whole country at one time, and were of great density. They chiefly occupied the band of cold between lat. 51° and 53° before mentioned.

The first fall of snow took place in the neighbourhood of Chester, in November. After Dec. 15, it fell at nearly every place; but more frequently between lat. 51° and 53° than elsewhere. On December 15 it was, in many places, as deep as six inches. On the following day, the temperature as registered at Manchester, was as low as 6°, but the maximum cold for the season took place on the night common to Dec. 28 and 29. This cold extended as far as our meteorological stations, from Jersey to Arbroath, in the North of Scotland. The extreme severity of Jan. 3rd was not at all felt south of the parallel of Uckfield, in Sussex. About London and its vicinity the reading of the thermometer fell early in the morning to 10°, 11°, 12° and 13°. It had reached the low points at one o'clock in the morning, and did not rise above them till eight o'clock. It was most severely felt in the Midland Counties, where the reading was as low as zero. By Mr. Lowe it was estimated at 4°, this is the lowest reading observed by any one—it was lower, than any in the immediate neighbourhood.

A number of original communications from various observers were read by Mr. Glaisher, on the fall of snow on January 3, which was generally distributed over the country, but lay deepest between the parallels of latitude occupied by the fog and extreme cold. In parts of Cornwall there was none or very little; whilst at Holkham, on the Norfolk coast it was 18 inches on the level At Whitehaven there was scarcely an inch; but at Liverpool, and other places in the same parallel 6, 10, and 14 inches fell. The north was, in parts comparatively clear; and in parts of Northumberland no snow at all fell on the day of the great and general fall. There had been much snow previously, and it then lay on the ground to the depth of several feet. The drifts over England and Wales varied from 3 feet to 10, 12, and 15 feet. They were very deep at Derby and at Grantham, and upon the Norfolk coast.

In conclusion, as connected with the severity of the weather as falling beneath his own observation, Mr. Glaisher remarked that trees were sheathed over with ice for some days, till Jan. 4, when it began to crack, and fall to the ground. Beneath a row of trees in the immediate vicinity of his house it was literally strewn with large fragments, each retaining the curvature of the branch it originally encased. Animals, ordinarily exposed on Blackheath, suffered severely, and two were observed frozen to death; also birds, which had fallen dead from the trees, were picked up in the immediate neighbourhood. The number of crystallised flakes mingled with the snow was another indication of the low temperature under which it had been formed Mr. Glaisher laid before the meeting a number of photographic copies of several he had himself observed on January 1 of the present year.

At the conclusion of the paper, J. C. Whitbread, Esq., rose and commented upon the value of the paper, and the elaborate nature of the work. A vote of thanks was moved to Mr. Glaisher, and unanimously carried. The meeting was numerously attended.

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### The Iron Trade.

The number of iron furnaces in Scotland on Dec. 31, 1853, was in blast, 114; out of blast, 29; total 143. The stock in hand at the 31st December, 1852, amounted to ..... 450,000 tons.
The production during 1852 was equal to .......... 710.000 „

Total..........1,160,000 „

The home demand in founderies and maleable works in 1853 was .......... 300,000 tons.
The exports .......... 650,000 „
950,000

Stock on hand at the close of December last .......... 210,000 „

The reduction of stock is thus 240,000 tons on the transactions of the year; and another season of similar business would entirely sweep it away. The average price of pig iron during the year has been 61s., and the value of the manufacture has therefore been £2,165,000. The average price of bar iron has been 187s.; and if the Scotch makers had turned their pigs into that class of iron, the value would have been £6,638,500. The average prices of bar and pig iron for the last nine years are appended:—

| | Bars. | Pigs. |
|---|---|---|
| | s. | s. |
| 1845 | 190 | 80 |
| 1846 | 195 | 67 |
| 1847 | 165 | 65 |
| 1848 | 110 | 44 |
| 1849 | 117 | 45 |
| 1850 | 109 | 44 |
| 1851 | 107 | 40 |
| 1852 | 210 | 45 |
| 1853 | 187 | 61 |

Bar iron does not invariably follow the rise or fall of pigs, and the great fluctuations in price are more severely felt in the crude than in the finished production. This fact should induce the Glasgow capitalists to manufacture a greater quantity of bars and castings, and sell less of their iron in the first step from ore.

The iron produced in Great Britain is now equal to three millions of tons. In pigs, as Scotch bring lower prices than Staffordshire or Welsh, the total present value is not less than ten and a half millions sterling. In its manufactured form into bars the value must be twenty-eight millions. The value of the metals produced at present within the island is quite fifty millions—a larger sum than was ever formerly extracted from any land in the metallic business. A calculation of the value, with the additions in the cutlery, edge-tool, engineering, and hardware trade, would bring up the aggregate to one hundred millions for 1853.