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NOTES OF TRAVEL AMONG THE WALLA-WALLA INDIANS.

BY PAUL KANE, TORONTO.

Read before the Canadian Institute, 5th April, 1856.

In former selections from my notes, made during years of travel among the Indians of the North-West, I have communicated accounts of two Tribes presenting the most striking elements of contrast: the Chinooks, one of the numerous Tribes of the Flat Head Indians, inhabiting the tract of country at the mouth of the Columbia River; and the singular tribe of Half-breeds to be found in the Hudson Bay Company's Territory, in the vicinity of the Red River. For the present communication, I have selected from my Journal notes relating to the Walla-Walla and Kye-use Indians, as possessing a peculiar interest, from the fact that I was present at some of the scenes in which the present war between these Tribes and the settlers in Oregon originated.

On the 12th of July, 1847, on my return journey up the Columbia River, I arrived at Walla-Walla, about five hundred miles from its mouth. It is a small Fort, built of *Dobies*, or blocks of mud baked in the sun, which is here intensely hot. Fort Walla-Walla is situated at the mouth of the river of the same name, in the most sandy and barren desert that can well be conceived. Little or no rain ever falls here, although a few miles lower down the river it is seen from hence to pour down in torrents. Owing to its being built at the mouth of a gully, formed by the Columbia River through high mountainous land, leading to the Pacific Ocean, it is exposed to furious gales of wind, which rush through the opening in the hills with inconceivable violence, and raise the sand in clouds so dense and continuous as frequently to render travelling impossible. I was kindly received by Mr. McBain, a clerk in the Hudson Bay Company's service, who, with five men, had charge of the Fort. The establishment is kept up solely for the purpose of trading with the Indians from the interior, as those about the Post have few or no peltries to deal in.

The Walla-Walla Indians live almost entirely upon salmon throughout the whole year. In the summer season they inhabit lodges made of mats of rushes spread on poles. Owing to the absence of trees in their vicinity, they have to depend for the small quantity of fuel which they require, upon the drift wood which they collect from the river in the spring. In the winter they dig a large circular excavation in the ground about ten or twelve feet deep, and from forty to fifty feet in circumference, and cover it over with split logs, over which they place a layer of mud collected from the river. A hole is left at one side of this roofing, only large enough for one person to enter at a time. A stick with notches reaches to the bottom of the excavation, and serves as a ladder by means of which they ascend and descend into the subterranean dwelling. Here twelve or fifteen persons burrow through the winter, having little or no occasion for fuel, their food of dried salmon being most frequently eaten uncooked, and the place being excessively warm from the numbers congregated together in so small and confined a space. They are frequently obliged, by the drifting billows of sand, to close the aperture, when the heat and stench become insupportable to all but those accustomed to it. The drifting of the sand is a frightful feature in this barren waste. Great numbers of the Indians lose their sight, and even those who have not suffered to so great an extent, have the appearance of labouring under intense inflammation of these organs. The salmon, while in the process of drying, also become filled with sand to such an extent as to wear away the teeth of the Indians, and an Indian is seldom met with over forty years of age whose teeth are not worn quite to the gums.

The day after my arrival at the Fort I procured three horses and a man, for the purpose of travelling into the interior of the country, and visited the Pavilion and Néz-perces Indians. The weather was excessively hot, and we suffered much from the want of water. About two o'clock P. M. on the evening of the eighteenth, in our circuitous route back to the Fort, we arrived at Dr. Whitman's Presbyterian Mission, situated about twenty-five miles up the Walla-Walla River, where I was received very kindly by the Missionary and his wife. Dr. Whitman's duties included those of Superintendent of the American Presbyterian Missions on the West side of the Rocky Mountains. He had built himself a house of unburnt clay, for want of timber, which, as stated above, is here extremely scarce. He had resided at this locality, on the banks of the Walla-Walla River, upwards of eight years, doing all in his power to benefit the Indians in his mission. He had brought forty or fifty acres of land, in the vicinity of the river, under cultivation, and had a great many head of domestic cattle, affording greater comfort to his family than one would expect in such an isolated spot. I remained with him four days, during which he kindly accompanied me amongst the Indians. These Indians, the Kye-use, resemble the Walla-Wallas very much. They are always allies in war, and their language and customs are almost identical, except that the Kye-use Indians are far more vicious and ungovernable. Dr. Whitman took me to the lodge of an Indian called To-ma-kus, that I might take his likeness. We found him in his lodge sitting perfectly naked. His appearance was the most savage I ever beheld, and his looks by no means belied his character. It was only a short time before my arrival at the mission that he killed an Indian out of mere wantonness. His victim was taking care of some horses for another Indian, when he rode up to him and enquired why he was hiding them. The Indian denied that he was doing so, when Tomakus, without further remark, sent an arrow through his heart. He was so cruel and merciless in his revenge, and so greatly dreaded, that no one dared resent the murder. At another time he attempted the life of one of the Doctor's servants for the most trifling cause, and was only prevented by the man's escaping, while the Doctor, who was a powerful man, forcibly held him. He was not aware of what I was doing, until I had finished the sketch. He then asked to look at it, and enquired what I intended doing with it, and whether I was not going to give it to the Americans, against whom he bore a strong antipathy, superstitiously fancying that their possessing it would put him in their power. I, in vain, told him I should not give it to them; but, not being satisfied with this assurance, he attempted to throw it in the fire, when I seized him by the arm and snatched it from him. He glanced at me like a fiend, and appeared greatly enraged, but before he had time to recover from his surprise, I left the lodge and mounted my horse, not without occasionally looking back to see if he might not send an arrow after me, a circumstance which would not have been at all pleasant, considering that the Kye-use Indians are most unerring marksmen.

Usually, when I wished to take the likeness of an Indian, I walked into the lodge, sat down, and commenced without speaking, as an Indian under these circumstances will generally pretend not to notice. If they did not like what I was doing they would get up and walk away; but if I asked them to sit they most frequently refused, supposing that it would have some injurious effect upon themselves. In this manner I went into the lodge of Til-aw-kite, the Chief, and took his likeness without a word passing between us.

Having enjoyed the kind hospitality of Dr. Whitman and his lady for four days, I returned to Fort Walla-Walla. On the day after my arrival at the Fort, a boy, one of the sons of Peo-Peo-mox-mox, the Chief of the Walla-Wallas, arrived at the camp close to the Fort. He was a few days in advance of a war party headed by his father, and composed of Walla-Walla and Kye-use Indians, which had been absent for eighteen months, and had been almost given up by the tribes. This party, numbering two hundred men, had started for California, for the purpose of revenging the death of another son of the Chief, who had been killed by some California emigrants; and the messenger now arrived, bringing the most disastrous tidings not only of the total failure of the expedition, but also of their suffering and detention by sickness. Hearing that a messenger was coming in across the plains, I went to the Indian camp and was there at his arrival. No sooner had he dismounted from his horse, than the whole camp, men, women and children, surrounded him, eagerly enquiring after their absent friends, as they had hitherto received no intelligence beyond a report that the party had been cut off by hostile tribes. His downcast looks and silence confirmed the fears that some dire calamity must have happened, and they set up a tremendous howl, while he stood silent and dejected, with the tears streaming down his face. At length, after much coaxing and entreaty on their part, he commenced the recital of their misfortunes. After describing the progress of the journey up to the time of the disease (the measles) making its appearance, during which he was listened to in breathless silence, he began to name its victims one after another. On the first name being mentioned, a terrific howl ensued, the women loosening their hair and gesticulating in a most violent manner. When this had subsided, he, after much persuasion, named a second, and a third, until he had numbered upwards of thirty. The same signs of intense grief followed the mention of each name, presenting a scene which, accustomed as I was to Indian life, I must confess affected me deeply. I stood close by them, on a log, with the interpreter of the Fort, who explained to me the Indian's statement, which occupied nearly three hours. After this the excitement increased, and apprehensions were entertained at the Fort that it might lead to some hostile movement against the establishment. This fear, however, was groundless, as the Indians drew the distinction between the Hudson's Bay Company and the Americans. They immediately sent messengers in every direction, on horseback, to spread the news of the disaster among all the neighbouring tribes, and Mr. McBain and I both considered that Dr. Whitman and his family would be in great danger. I therefore determined to go and warn him of what had occurred. It was six o'clock in the evening when I started, but I had a good horse, and arrived at his house in three hours. I told him of the arrival of the messenger and the excitement of the Indians, and advised him strongly to come to the Fort, for a while at least, until the Indians had cooled down; but he said he had lived so long amongst them, and had done so much for them, that he did not apprehend they would injure him. I remained with him only an hour, and hastened back to the Fort, where I arrived at one o'clock, A. M. Not wishing to expose myself unnecessarily to any danger arising from the superstitious notions which the Indians might attach to my having taken some of their likenesses, I remained at Fort Walla-Walla four or five days, during which the war party had returned, and I had an opportunity of taking the likeness of the great Chief Peo-peo-mox-mox, or the Yellow Serpent. Nothing of consequence occurred whilst I remained at the Fort, and in a few days I resumed my journey to the mountains.

It was about two months afterwards that I first heard news from Fort Walla-Walla, by some men of the Hudson's Bay Company, who had overtaken me; and my grief and horror can be well imagined when they told me the sad fate of those with whom I had so lately been a cherished guest. It appeared that the war party had brought the measles back with them, and that it spread with fearful rapidity through the neighbouring tribes, but more particularly amongst the Kye-uses. Dr. Whitman, as a medical man, did all he could to stay its progress; but, owing to their injudicious mode of living, which he could not prevail on them to relinquish, great numbers of them died. At this time the Doctor's family consisted of himself, his wife, and a nephew, with two or three servants, and several children whom he had humanely adopted, left orphans by the death of their parents, who had died on their way to Oregon, besides a Spanish half-breed boy, whom he had brought up for several years. There were likewise several families of emigrants staying with him at the time, to rest and refresh themselves and cattle. The Indians supposed that the Doctor could have stayed the course of the malady had he wished it, and they were confirmed in this belief by the Spanish half breed boy, who told some of them that he had overheard the Doctor and his wife conversing after they retired for the night, and that he heard him say he would give them bad medicine, and kill all the Indians, that he might appropriate their land to himself. They accordingly concocted a plan to destroy the Doctor and his wife and all the males of the establishment. With this object in view, about sixty of them armed themselves and came to the house. The inmates, having no suspicion of any hostile intention, were totally unprepared for resistance or flight. Dr. and Mrs. Whitman, and their nephew, a youth about seventeen or eighteen years of age, were sitting in their parlour in the afternoon when Til-aw-kite the Chief, and To-ma-kus entered the room, and addressing the Doctor, Til-aw-kite told him very coolly that they had come to kill him. The Doctor, not believing it possible that they could entertain any hostile intentions towards him, told them as much. But while in the act of speaking, To-ma-kus drew a tomahawk from under his robe and buried it deep in his brain. The unfortunate man fell dead from his chair. Mrs. Whitman and the nephew fled up stairs, and fastened themselves into an upper room. In the meantime Til-aw-kite gave the war whoop as a signal to his party outside to proceed in the work of destruction, which they did with the ferocity and yells of so many fiends. Mrs. Whitman, hearing the shrieks and groans of the dying, looked out of the window, and a son of the Chief shot her through the breast, but did not kill her at the moment. A party then rushed up stairs, and despatching the nephew on the spot, they dragged her down by the hair of her head, and taking her to the front of the house they mutilated her in a shocking manner with their knives and tomahawks. There was one man who had a wife bedridden. On the commencement of the affray he ran to her room, and, taking her up in his arms, carried her, unperceived by the Indians, to the thick bushes that skirted the river, and hurried on with his burden in the direction of Fort Walla-Walla. Having reached a distance of fifteen miles, he became so exhausted, that, unable to carry her further, he concealed her in a thick hummock of bushes on the margin of the river and hastened to the Fort for assistance. On his arrival, Mr. McBain immediately sent out men with him, and brought her in. She had fortunately suffered nothing more than the fright. The number killed, including Dr. and Mrs. Whitman and nephew, amounted to fourteen. The other females and children were carried off by the Indians, and two of them were forthwith taken as wives by Til-aw-kite's son and another. A man employed in a little mill, forming part of the establishment, was spared to work the mill for the Indians.

The day following this awful tragedy, a Catholic Priest, who had not heard of the massacre, stopped on seeing the mangled corpses strewn round the house, and requested permission to bury them, which he did with the rites of his own Church. The permission was granted the more readily as these Indians are friendly towards the Catholic Missionaries. On the Priest leaving the place, he met, at a distance of five or six miles, a brother Missionary of the deceased, a Mr. Spalding, the field of whose labours lay about a hundred miles off, at a place on the River Coldwater. He communicated to him the melancholy fate of his friend, and advised him to fly as fast as possible, or in all probability he would otherwise be another victim. He gave him a share of his provisions, and Mr. Spalding hurried homeward full of apprehensions for the safety of his own family; but unfortunately his horse escaped from him in the night, and after a six days' toilsome march on foot, having lost his way, he at length reached the banks of the river, but on the opposite side to his own house. In the dead of the night, and in a state of starvation, having eaten nothing for three days, everything seeming to be quiet about his own place, he cautiously embarked in a small canoe and paddled across the river. He had no sooner landed than an Indian seized him and dragged him to his house, where he found all his family prisoners, and the Indians in full possession. These Indians were not of the same tribe with those who had destroyed Dr. Whitman's family, nor had they at all participated in the outrage, but having heard of it, and fearing that the whites would include them in their vengeance, they had seized on the family of Mr. Spalding for the purpose of holding them as hostages for their own safety. The family were uninjured, and he was overjoyed to find that things were no worse. Mr. Ogden, the Chief Factor of the Hudson's Bay Company on the Columbia, immediately on hearing of the outrage, came to Walla-Walla, and although the occurrence took place in the Territory of the United States, and of course the parties could have no further claim to the protection of the Company than such as humanity dictated, he at once purchased the release of all the prisoners, and from them the particulars of the massacre were afterwards obtained. The Indians, in their negotiations with Mr. Ogden, offered to give up the prisoners for nothing, if he would guarantee that the United States would not go to war with them, but this, of course, he could not do. Immediately on the receipt of the news in Oregon, four hundred volunteers started for the Walla-Walla River to punish the Indians, but they met with very bad success, losing more men than they killed of the enemy. Since that time a sanguinary war has been kept up without a prospect of any other result but that of extermination to the Indians. From time to time the newspapers furnish some stirring or bloody incidents of the Oregon war, and this winter I read in an American paper an account of the death of my old acquaintance, Peo-peo-mox-mox, the Chief of the Walla-Wallas, who had been taken prisoner, and was shot while attempting to escape.

THE SUPPOSED SELF-LUMINOSITY OF THE PLANET NEPTUNE.

BY COLONEL BARON DE ROTTENBURG.

Read before the Canadian Institute, 29th March, 1856.

The following observations upon the Planet Neptune are offered for consideration, in compliance with the request of the Council of the Canadian Institute for communications from the general body of the members. They refer more especially to ideas advanced regarding the supposed luminous atmosphere of that recently discovered planet, on which so many circumstances have combined to confer a peculiar scientific interest. These views regarding the self-luminosity of Neptune may not have fallen under the notice of the members generally, as they appeared originally in the "British Quarterly Review,"—a periodical not re-printed, or generally circulated on this continent,—and have not, even at home, attracted the attention they might seem to merit. They are to be found in that Review, for the month of August, 1847, in an article on "Recent Astronomy." After referring to the remarkable series of labours and deductions which finally revealed the unseen, yet known planet, to the eye of astronomers, the reviewer thus proceeds:—

"There are two facts connected with the newly-discovered planet, —the one certain, and the other all but certain, which merit particular attention. The first of these is its deviation to a far greater extent than any one of those bodies heretofore known, from what is known as Bode's law of the distances. According to this law—or rather rule, seeing it simply expresses a fact of which no explanation whatever can be given,—the various planets are placed at distances bearing a certain and uniform relation to each other: this proportion being that, the interval between Mercury and Venus being assumed as unity, the intervals between the successive orbs each double upon the one before it. Had the newly-discovered orb conformed to this rule, it would have been found at a distance of 3,600,000,000 miles from the sun. Its actual distance is about seven-ninths of this amount. And such a deviation, important and interesting in itself, as the first example of departure from a rule hitherto found universal, derives additional interest from the fact, that, chiefly on it, conjectures have already been founded relative to the possible existence of a second unknown orb, situated as much beyond the distance indicated by the law, as the present one falls within it. This conjecture, however, must be left to time to verify. It is more than probable that, if such an orb exist, the means which have guided our telescopes with such unerring aim towards this one, must again be employed for its discovery: its disturbing action be watched and waited for; and direct observation, almost powerless at such a distance, be guided and led out by theory towards a mind-seen result.

"The second of the two facts we have referred to is one of yet higher interest and importance, and certainly one more unexpected still. It is believed that the planet is self-luminous. This inference has been deduced from its high degree of visibility and great clearness of light, not only as compared, or rather contrasted with Uranus, but beyond what is comprehensible in conformity with the known principles of optics. It is, indeed, conceivable, that the physical organisation of the orb may be such, as shall give to its surface a light-reflective power very far beyond all we have experience of, at least among the other orbs of the system: but it is very questionable whether any amount of this, within the limits of probability, would account for a planet receiving little more than a third of the sunlight which Uranus receives, nearly equalling it in visibility, and far surpassing it in vividness of light. Here, too, at all events, we are called on to 'stand still and see': to rid the mind of every bias, and of all pre-judgment, and to esteem the treasure-house of physical variety still unexhausted, and the phases of physical appearance still not all seen. And should this most unexpected and important fact be hereafter established, we shall then be presented with a startling and striking converse to the fact arrived at by the masterly induction of the lamented Bessel, with regard to the stars Sirius and Procyon—the first, one of the most majestic orbs which our firmament can claim,—that each is associated in binary combination with masses yet mightier than themselves, like our planets opaque and non-luminous; suns of darkness, whose light, if ever they shone, has waned and gone out for ever. And, on the supposition of the planet in question being self-luminous, it becomes an interesting object of inquiry whether, from any adjacent system, our sun can appear with it to constitute a double star."

Such is the reviewer's statement. Now, opinions have lately been set forth with great skill and plausibility tending to the belief that this earth is the only planet fit for the habitation of intelligent beings, and that the other planets of the Solar System being either too near the sun, or too remote from it, receive either too great or too little an amount of light and heat to fit them for the abodes of creatures constituted like ourselves.

If, however, future observation should confirm this statement that Neptune is itself luminous, it must somewhat modify these views, for it will prove that a planet even at the great distance which Neptune is from the sun may after all not be such a dark world, and not quite so miserable as it has been represented. And this self-luminosity of Neptune may also account for its less complicated arrangements for compensation by means of moons for the small amount of light it receives from the sun. For it has only one satellite—at least Mr. Lassel, who has lately moved his celebrated Reflecting Telescope to Malta where the atmosphere is peculiarly well adapted for astronomical observations, states that he is satisfied there is only one satellite belonging to Neptune—or at least if there be others, there is no prospect of discovering them with our present telescopes. The suspicion entertained by Mr. Lassel and Mr. Bond that there is a ring round Neptune has since been abandoned. I may here mention that Mr. Lassel also states as the result of his late observations that he is satisfied there are only four satellites belonging to Uranus.

Now, these facts give rise to some reflections—and it may not be out of place here to offer a few observations upon the varieties which exist amongst the planetary bodies as regards their physical conditions, and to take a cursory view of the Solar System generally; from which examination we shall see that whilst certain general characteristics belong to the two great divisions of the primary planets, yet when these are examined in detail there is by no means an uniform agreement amongst them individually.

The eight primary planets composing the Solar System are divided into two groups of four each, separated by the space which comprises the orbits of the Asteroid planets. The four interior planets, viz: Mercury, Venus, the Earth, and Mars have greater densities than the exterior Planets, are of less size, and with one exception are unprovided with moons. They rotate on their axes in rather more than double the time of the exterior planets—they move round the sun with far greater velocity. Their year varies from about three months, the year of Mercury, to a year and eleven months, the year of Mars, (in round numbers), and their day is about twenty-four hours long.

The four exterior planets, viz., Jupiter, Saturn, Uranus, and Neptune have less densities than the interior ones; but their size is vastly greater. They move round the sun much slower—their year varies from nearly twelve years, which is the length of the year in Jupiter, to one hundred and sixty-four years, which is the length of the year in Neptune; their day, as far as has been ascertained, is about ten hours long. Thus we see that increased velocity of axial rotation, and, consequently, increased centrifugal force, with its corresponding diminished force of gravity at the surface, is a characteristic of the four superior planets.

But these greater bodies have also increased means for compensating the reduced amount of light they receive from the sun, for they are all provided with moons in greater or lesser numbers; Jupiter has four moons; Saturn has eight, and several rings; Uranus four, and Neptune but one. There are many other differences existing between these two groups which I have not time to dwell upon.

But with regard to the differences in density, size, &c., amongst the particular bodies of these two great divisions of the Solar System—although Mercury, the nearest to the sun, is the densest body of the Solar System, yet Mars, which is outside the Earth, is denser than Venus which stands next to Mercury in proximity to the Sun, and Neptune which is the "outsider" of the system is denser than either Uranus or Saturn—Saturn being the lightest body in the System.

Again, the Earth has a moon, but Mars, which is outside the Earth, has none. Venus was long supposed by Cassini, Short, and other astronomers to have a moon, but the fine telescopes of our time have failed to discover it, and, therefore, Venus must be deemed moonless.

The Earth and Venus, which are very nearly the same size, are both larger than Mercury, but Mars, outside the Earth, is much smaller than the Earth, its diameter being only 4,100 miles: the Earth's equatorial diameter being 7925 miles. Jupiter is the largest body in the system, except the Sun; Saturn, next in size, is next in distance; but Uranus and Neptune are much smaller than either Jupiter or Saturn, their diameter in round numbers being severally about 35,000 miles.

We might also naturally expect to see the number of moons belonging to the outside planets increased in proportion to their distances from the Sun—but this is not the case, for although Jupiter has four moons and Saturn eight, and several rings, yet Uranus, which is outside Saturn, is now known to have only four satellites, and Neptune, the most remote body in the system from the Sun, (as far as yet known) being 2,700 millions of miles more distant from the Sun than our Earth, has, like our globe, but one moon. Thus we see that although the denser bodies are nearest the Sun generally, yet they are not uniformly so; that whilst the larger bodies of the system are those most remote from the Sun, yet increase of size is not uniformly proportioned to increase of distance, and that although the planets most distant from the Sun as a general rule are those which have the greater number of moons, still the number of moons belonging to any planet is not necessarily contingent on its distance from the Sun. Variety in physical condition is therefore a characteristic of the planetary bodies, as it is indeed of every other work of the Creator, and in all probability not any two of the planets are in any way similarly constituted.

But if this self-luminosity of Neptune be confirmed by further observation, it will certainly be an unique feature in the Solar System. It has always occurred to me that one great difficulty, of which I have never met any explanation, attends what is called the Nebular Theory. This is—if all the bodies of the system had a common origin, being formed from a rotating Nebula throwing off rings and planets, &c., why in such a case should the luminous atmosphere be confined to one of these bodies only, viz., the central one? and why should the others have very different atmospheres or envelopes?

But if Neptune's atmosphere is self-luminous, it will at any rate shew that it is not incompatible with the conditions of the Solar System, for one body besides the central one to be provided with a Photosphere. I must observe here that I have not seen any confirmation of the self-luminosity of Neptune in astronomical works to which I have access; but the recentness of the discovery of this planet; as well as the difficulties interposed in consequence of its remote distance from our earth, must necessarily render the absolute determination of all its peculiar phenomena a work of time. Meanwhile it may be permitted us to reason that, if Neptune is self-luminous, this condition may enable it, with its solitary satellite, to possess a sufficiency of light for the existence and enjoyment of life by creatures of a higher organization than some feel disposed to accord to it, should life indeed exist upon it at present.

With regard to the temperature of these remote bodies which must necessarily be dependent upon a variety of considerations, I cannot but think some allowance should be made for the greater amount of internal heat which may *possibly* be a condition of the superior planets; for if, as some are disposed to consider, the Solar System had a common origin, and the planets originally were in an incandescent state, then under such circumstances the larger bodies would take longer to cool down than the smaller ones—and if any degree of probability is to be attached to such speculations, our friends on the confines of the system, (if such there be) may still be warmer than we give them credit for.

I am not, however, going to inflict on the members of the Institute any dissertation on the plurality or non-plurality of worlds, which subject has assuredly been sufficiently discussed of late years, leaving us all much of the same opinion still, although some of us may have been convinced against our will. But if any feel disposed to view this vexed question under a new aspect, and see much that is valuable, original and interesting, presented in a very condensed form, I strongly recommend them to peruse a little work called "The Chemistry of the Stars," written by Dr. George Wilson, the recently appointed Professor of Technology, at Edinburgh; and I think they will come to the conclusion, that it contains as much as need be said upon the subject to convince us all, that it is not probable there is any planet in the Solar System adapted for the residence of beings constituted *precisely* as we are.

I may add that when Neptune was discovered by Dr. Galle, it appeared as a star of the 8th magnitude; its apparent diameter is about 2″·8 when in opposition, that of Uranus in the same position is about 4″. If we had a first class telescope attached to this Institute, or to one of the Universities, we might have opportunities of satisfying ourselves by personal inspection of the comparative light given forth by these two planets. The acquisition of such an instrument is, I regret to say, still a consummation devoutly to be wished.

INFLUENCE OF RECENT GOLD DISCOVERIES ON PRICES.

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The general rise in the prices of commodities in the old as well as the new world, within the last four or five years, is one of the most striking and important economic phenomena of the present century.

June, 1848—the date of the first discovery of gold on the Sacramento River in California—may be taken as the commencement of the era of high prices. California and Australia, when they became the centres of cheap gold for the world, became of necessity, at the same time, the centres of high prices. From these centres the tide of gold has flowed over the civilized world in all directions, and wherever it has flowed it has raised in a greater or less degree the level of prices.

Looking to the statistics of prices for the sixty years preceding 1848, we find that the former half of that period is marked by a high, and the latter half, say from 1819 to 1848, by a low level of prices. The causes, however, which kept up a high range of prices during the thirty years preceding 1819, will, I think, be found to differ in some essential features, from those which, since 1848, have operated to produce a similar result.

In the former period, the high prices (as Tooke has conclusively proved in his elaborate work on the History of Prices,) were due to the combined effects of the great war in which Europe was then involved and of a series of unfavourable seasons. Whereas the general advance of prices since 1848, although no doubt in some degree intensified by the recent war and by other causes, is, as I hope to shew, mainly due to the unparalleled influx of the precious metals from California and Australia into Europe and the rest of the civilized world, and to other causes more or less intimately connected with and growing out of the gold discoveries in those countries. That these discoveries are destined to bring about not only great economic and commercial changes, but also materially to affect the social, political, and moral condition of the world, cannot, I think, be questioned. As to the general bearing of these various changes on the well-being and happiness of mankind, thinking men indeed entertain widely different views: while many see in the consequences of the gold discoveries nothing but unmixed good; a few, including among their number the ingenious and acute De Quincey, look more than doubtfully to the future, and seem disposed to believe that it had been better for the world if the gold nuggets had remained for ever buried in the bowels of the earth.

Into the large and tempting field of enquiry which the discussion of the probable moral and social results of the modern gold discoveries would carry us, it is not my design to enter. I shall confine myself exclusively to the economic bearings of the discoveries; and consider only the effect of those discoveries on the prices of commodities. This indeed is only one (doubtless the most important,) of the many interesting phases which the subject presents, considered in an economic point of view.

Strange as it may appear, this subject, although practical and important, has not hitherto received any considerable share of public attention, or been discussed on general principles and with reference to the admitted truths of Political Economy.*

To connect the gold discoveries and high prices together as cause and effect, and to indicate the process by which the rise in prices has been brought about, as well as the probable permanency of their present level, are the principal objects of the present paper.

It can hardly, I conceive, be necessary to adduce elaborate statistics to establish the fact assumed as the ground work of my remarks—that the general level of prices on this continent and in Great Britain as well as in California and Australia has, within the last six or eight years, been considerably raised.

The extraordinary advancement of the prices of the necessaries of life, and of the wages of labour, in the two countries last mentioned, immediately after the first discovery of their mineral treasures, is yet fresh in the recollection of us all. The influence of the golden tide, which then began to set in from those remote lands to Great Britain and the States, soon also made itself apparent in the latter countries.

During the last four years the Congress of the United States, in consequence of the admitted depreciation of the value of money throughout the Union, was compelled to raise, from 25 to 40 per cent, the salaries of the officers and servants of the Government. In England in 1854, the rise of wages and prices according to Mc-

* Sterling's Work on "Gold Discoveries," to which frequent reference is made in subsequent parts of this paper, is certainly an exception to this remark—I may add that I had not seen this work until a large portion of this article had been written.

Culloch was not less than from 12 to 35 per cent., while in Ireland it was much more.*

On the continent of Europe a similar rise in prices, though not perhaps to the same extent, could be shewn to have taken place;† while, as regards Canada, any statistics to prove the advance of prices within the last six years, would be considered, I am sure, as quite superfluous. Six years ago Canada was rightly considered as one of the cheapest countries of the world; now, assuredly, it is one of the most expensive. Here, as in the States, the Legislature has been compelled to interfere to rescue the civil servants and officers of the Government from the ruinous effects of the enhanced prices of labour and of the necessaries of life. Within the last two years, accordingly, the salaries of almost all public officers in this country have been augmented, and the indemnity allowed members of Parliament, the salaries of the Executive Councillors, as well as as the salaries of most of the employés of the Government, have been raised. The scale of increase, however, varies somewhat strangely in the different cases. In the case of Members of Parliament and Executive Councillors, 50 per cent. has been added, while the incomes of the great mass of Government officials, (where any addition whatever has been made to their salaries,) have been augmented at rates varying from 12 to 25 per cent. These several advances being all grounded on the increased cost of the necessaries of life, we might perhaps '*a priori*' have anticipated that the augmentation would have been in the inverse ratio of the salaries, in other words, that the lowest salary should have had the largest per centage, inasmuch as the smaller the whole salary the greater the proportion of it spent in the purchase of mere necessaries. The Legislature however would appear to have judged differently, and from the graduated scale adopted by them, we are forced to conclude that the pressure of high prices is most acutely felt by Executive Councillors and Members of Parliament, and but slightly, if at all, by the subordinate officers and servants of the Government. Had the increase of salaries been made on the ground of the decline in the value or purchasing power of money, as compared with all other commodities, then all salaries large and small should have been raised in the same ratio; assuming of course, that

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* McCulloch's Commercial Dictionary, p. 1055, Edition of 1854, see also "Statistical Journal," for 1854, p. 1055.

† In the "Annuairé de L'Economie Politique"—for 1855, published at Paris, we read at the commencement of the article entitled 'Coup d'œil sur l'année 1854'—

"L'année 1854, a vu sœvir à la fois trois fléaux; la guerre, le Choléra et la cherté des subsistances." In another part of the same article it is stated that the price of meat in France in 1854 was 25 per cent. above the average price of preceding years.

before the decline in the value of money they had been fairly adjusted.

To return, however, from this digression. I think that sufficient has been said to establish the fact that a considerable advance in prices has within the last five or six years taken place not only in California and Australia, but in this country and throughout the Continent generally, as well as in Great Britain and the rest of Europe.

To what causes, then, is this phenomenon due? I answer—firstly, and chiefly, to the recent gold discoveries; secondly, and in a lesser degree, to the war and other local and temporary causes.

It is with the former of these causes only that we have now to do. Before entering, however, on a discussion as to the degree of influence or mode of operation of the gold discoveries in effecting the results which I assign to them, it may not be out of place to make some brief remarks in reference to the general fundamental laws regulating prices.

The relative values of commodities are commonly estimated by referring them to the common measure or standard of value—money; in other words, by their *relative prices*—the price of every commodity being its value in money. The relative prices of different commodities at any given time are of course an accurate index of their relative values at that time. And if our standard of value were (like our standards of weights and measures) invariable, the relative prices of the same commodity, at different times, would also indicate accurately its relative values at those times. The fall or rise in the price of any article would shew precisely the fall or rise in its value. But our standard of value is not thus invariable, nor indeed can it be, inasmuch as the precious metals, which form the standard, are themselves liable (though not to the same extent as most other commodities) to fluctuate in value.

It is obvious then that a change of the price of any article may arise from two distinct classes of causes, either those affecting the intrinsic value of the article itself, or those affecting the value of the money with which it is compared.

Now the values of all commodities (gold and silver included) are determined ultimately and permanently by their cost of production, temporarily and proximately by the relation existing between their demand and supply. The value of any article, considered as determined by the relation existing between the demand and supply, is styled its "market value;" while its value, considered as regulated by its cost of production, is termed its "natural value." The market value of most commodities is constantly changing, now rising above and now sinking below its natural value—which latter is happily described by Adam Smith as that "centre of repose and continuance" which the former is ever struggling to attain. The extent and frequency of these fluctuations of the market value of a commodity must depend on the degree and manner in which the relation of its supply and demand is liable to disturbing influences.

In this respect the precious metals differ from almost all other commodities. While most other commodities are exposed to sudden and very great variations in value, the changes in the value of the precious metals have generally been very slow and gradual.* And it is this quality which eminently qualifies them to act as a general standard of value. So accustomed, indeed, are we to witness continued fluctuations in the market values of most commodities, arising wholly from accidental causes affecting their demand and supply, and so seldom do we witness any change in the value of gold or silver, that when in reality the value of gold and silver is changed and the price of all other commodities thereby affected, we are slow to admit the fact, and persuade ourselves that the change in prices is due to any cause save the real one. And yet a little reflection will serve to convince us that, when the rise or fall of prices is general and affects all commodities to the same extent or ,nearly so, the natural inference is that such a change must be due to an alteration in the value of money and to nothing else.

To resume the argument. It is plain that the rise in the general level of prices of commodities must result either from a general increase of the cost of production of commodities or a reduction in the cost of production of the precious metals—or, again, from some cause or causes increasing the demand for commodities generally, or diminishing the demand for the precious metals. Of these four supposable causes by which (in theory at least) the phenomenon under consideration might possibly be occasioned, it will, I think, be shewn in the sequel that the efficient causes really are—

1st. A reduction in the cost of production of the precious metals consequent on the recent gold discoveries.

2nd. A diminution in the supply and simultaneous increase in the demand for many of the most important staples of commerce—the result partly and indirectly of the gold discoveries, and partly and more directly of the war and other causes.

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* The comparative uniformity and steadiness in the value of the precious metals arises from this, that the existing supply of the metals is so great and the demand for them so universal, that the relation between the demand and supply is not liable to be materially affected by any accidental disturbances of either.

Let us turn now to California and Australia, and briefly examine the leading economic phenomena which have developed themselves in those countries since the commencement of the gold discoveries; a review of these facts will I think enable us to understand the manner in which the depreciation of the metals has taken place there, the measure and extent of that depreciation, and the steps by which similar effects are now being extended in ever widening circles over the whole of the commercial world. The events which followed the first announcement of gold on the banks of the Sacramento are too striking and too recent to be forgotten. From every quarter of the globe, including the Celestial Empire, flocked thither crowds of adventurers. Thousands of excited gold seekers perished miserably before reaching the looked for El Dorado, but their places were soon filled by others, and wave after wave of this living tide of motley pilgrims broke in succession upon the shores of California. In a few months the population rose from a few hundreds to many thousands In less than two years and a half it had reached 200,000; and now it is supposed to number nearly half a million. Meanwhile the prices of all the necessaries of life and the money wages of labour had reached an almost fabulous height, and notwithstanding the efforts made by the States and other countries to meet the sudden and extraordinary demand for goods in this new market, prices maintained an unexampled level. What occurred in 1848 in California, was repeated in 1851 in Australia—the phenomena in both places being essentially the same. I have selected Australia for more particular examination in reference to the present enquiry, inasmuch as all the details regarding Australia are fully given in official documents—which is not the case as respects California.

The Sydney papers of the summer of 1851 brought to England the first intelligence of a new gold region in the Eastern world, and of the delirious excitement with which the discovery was received in the Colony.

The then Lieut. Governor of Victoria, Mr. Latrobe, in a despatch of December of that year, represents the whole structure of society as being disorganized by the effect of the discoveries, and concludes by remarking: "It really becomes a question how the more sober operations of society, and even the functions of Government, may be carried on."

The immediate effects of the discovery on the money wages of labour and on the prices of provisions, points which more immediately concern us in the present enquiry, are also given by the Lieut.

Governor in a paper referred to in a despatch of January, 1852. In this paper it is stated "that the wages of shearers rose from 12s. in 1850 to 20s. in 1851; of reapers from 10s. to 20s. and 25s. per acre; of common labourers, from 5s. to 15s. and 20s. per day; of coopers, from 5s. to 10s.; of shipwrights, from 6s. to 10s.;" and of all others at the same rates.

From December, 1850, to December, 1851, it is added that the prices of provisions had risen as follows: Bread, 4 lb. loaf, from 5d. to 1s. 4d. and 1s 8d.; butter from 1s. 2d. to 2s. or 2s. 6d. Fresh meat doubled in price, and vegetables were raised from 50 to 100 per cent.

Mr. Sterling, from whose admirable work on the gold discoveries I have copied the foregoing extracts, in commenting on them, in 1852, observes:—"The phenomena, in as far as they have yet developed themselves, have occurred exactly in the order that might have been expected. First of all, we have had a rise in the money prices of colonial labour, next in the prices of provisions and the other direct products of that labour, and lastly and after a greater interval, we may expect to witness an elevation of the money value of commodities imported into the Colony, with a corresponding rise of prices in England and the other countries whence those imported commodities are derived."

What Mr. Sterling confidently looked forward to in 1852 has now actually taken place in England, the States, and Canada.

From the figures furnished in Mr. Latrobe's despatches, it appears that the money wages of labour rose more than 100 per cent., and that the rise in the price of provisions was equally great. In other words, the purchasing power, or the value of gold, as compared with the things enumerated in that list, suddenly fell on the average about 50 per cent. The cause and the measure of this fall in the value of gold was the reduction of its cost of production in the Colony. The average quantity of gold which a labourer could earn at the diggings became in an incredibly short time the measure of the value of a day's labour, and that quantity of gold would, therefore, only exchange for the produce of a day's labour applied in any other way—an allowance, of course, being made for the severity and uncertainty of the gold digger's toil.

The average sum gained at the gold fields was estimated, at the period referred to in Mr. Latrobe's despatches at £1 per day, and consequently this sum appears to have been but little above the average amount paid to a common day labourer. It is, indeed, worthy of remark that the wages of common labourers ranged, at least for some time, higher than those of skilled labourers. This probably arose from the fact that at the diggings all labourers, skilled and unskilled, were put nearly upon an equal footing. The mechanic or tradesman could not use the pick, the cradle, or rinsing box, better, probably not as well, as the hardy labourer accustomed to toil in the fields. The natural consequence would be that the gold digging would prove especially attractive to the unskilled labourer, and consequently that very little labour of that kind would be left disposable in the Colony for other necessary purposes. Hence the extraordinary rise in the money wages of common labourers as distinguished from artisans or mechanics.

We have thus shown that the immediate effect of the gold discoveries in Australia, (and the same is true of California,) was a fall in the value of gold in the Colony, as compared with labour and provisions, a fall in value proportioned to and measured by the *reduction of its cost of production.*

When we pass from the gold raising to the gold importing countries and attempt to trace the operation of those discoveries in the latter, the results are not, perhaps, quite so obvious.

The reduction in the cost of production of gold in Australia and California does not immediately and necessarily affect the value of labour and its products in other countries, because the labour of those countries cannot be at once applied to the production of gold on the same terms as the labour in the neighbourhood of the mines. Ultimately, indeed, the value of gold everywhere must be regulated by its cost of production in Australia and California, assuming always, that the latter countries can continue to supply an unlimited quantity of the metal at a lower rate than the mines previously in use.

Those foreign countries, whose commercial relations with the new gold raising countries are the most intimate and extensive, will be the first to feel the effects of the increase of the precious metals.

The immediate and direct effects of the discoveries in those countries, will, it seems to me, be—

To diminish the supply, and consequently raise the value of labour (and therefore of all its products), by withdrawing from those countries to the gold fields a large portion of its available stock of productive labour.

To increase the demand for and consequently "pro tanto" raise the prices of all commodities exported thence to the gold regions.

To lower the value of the precious metals by suddenly increasing the quantity of the currency and consequently the proportion which it bears to the commodities in circulation.

All countries which have contributed a quota of their citizens to swell the number of settlers in the gold regions (and what country has not?) or which supply them with any portion of their goods, must, in greater or less degree, feel the effects of each and all of these processes, all of which are silently but constantly at work, and have already, I feel satisfied, extended much farther and operated much more powerfully than is generally imagined.

England and the United States were, as might have been anticipated, the countries most speedily and directly affected—England from her connection with Australia, the States from their connecnection with California—and through England and the States the effects were necessarily propagated by a species of commercial *conduction* to this country and to others.

We have thus indicated some of the processes by which the influence of the gold discoveries extended itself to foreign countries.

As to the existence of these processes, or as to their tendencies there is no room for doubt. It is, however, absolutely impossible to measure their precise share either individually or collectively in the general result. The forces which come under consideration in the domain of practical political economy (unlike those with which the mechanical philosopher has to deal) refuse to submit to rigid measurement, and we must content ourselves with seeing the general result towards which they severally contribute without hoping to ascertain how much of the effect is due to each force separately.

Within a very few years California has withdrawn from the producing classes of the States probably more than 50,000 able bodied men. Australia in the same way has absorbed in a few years a large portion of the productive labor of Great Britain. The entire emigration from Great Britain to Australia, since the discovery of gold there, is probably little short of a quarter of a million of souls.

In both cases the sudden subtraction from the labour market of the parent states of so considerable portion of the whole stock must have had a direct and obvious tendency to raise the value of labour, and consequently of all the products of labour, in those countries. But more than this, the labourers thus transplanted to the gold countries change their economic character—from being, for the most part, producers of commodities in and for the home market, they suddenly become consumers, and generally extravagant consumers, of those very commodities. They enter the home markets, in fact, as formidable competitors with the consumers they have left behind.

The truth of the last remark is forcibly illustrated by Australian statistics; from official statements of the imports to Sydney, we find that the average amount of the imports for the ten years preceding the gold discoveries was little more than £1,000,000 sterling, while in 1853 and 1854 the annual imports to that port averaged fully £6,000,000.

The prices of labour and of commodities in Great Britain and the States must therefore have been raised in virtue of both the causes which I have pointed out; for whilst the supply of labour and commodities in those countries was reduced, the demand for labour and commodities was actually increased.

We now come to consider the third, and, doubtless, the most influential as well as the most obvious of the assigned causes of the fall of the value of gold in the gold importing countries. I mean the sudden and extraordinary augmentation in the mass of the precious metal as compared with the mass of commodities in those countries. No one can doubt that if the mass of the precious metal in the world became suddenly doubled or trebled, the prices of all commodities would at once be doubled or trebled as the case might be. Such sudden changes in the mass of the precious metals are of course impossible; changes in the amount of the metallic currency when they do occur, are generally, as has already been observed, the gradual result of years, and when this is the case the ultimate effect of the increase of the precious metals on prices may be materially modified by the change which has taken place simultaneously in the value of the aggregate of commodities.

Prices (so far as they are affected by the cause under consideration) would rise or fall according to the relative increase in the mass of metal and commodities. If the mass of the precious metals had outstripped in its growth the mass of commodities, prices would be raised. If, on the other hand, commodities had increased more rapidly than the metals the prices of commodities would be lowered.

There can be little doubt, I imagine, that since the gold discoveries in California and Australia, gold has been increasing much more rapidly than commodities, and consequently (in obedience to the law just stated), the prices of commodities must, as a matter of course, have been raised during that period.

At the beginning of the present century the annual value of the precious metals raised from all the mines of the world, was, according to the calculation of Humboldt, somewhat under £10,000,000 sterling. From 1800 to 1810 (owing to the increasing yield during that period of the American mines), the total annual produce steadily increased until in the latter year it was rather over than under £11,000,000. From 1810 to 1830 the total produce of the precious metals would seem to have fallen off somewhat, but from the latter date up to the time of the discovery of the gold in California (owing mainly to the increased yield of the Russian mines and washings) it again advanced, and at the epoch of the gold discoveries on the Sacramento was about £12,000,000 sterling per annum. In 1850, the second year after the discovery of gold in California, the total produce of the precious metals was, as computed by McCulloch, £27,000,000; in 1851, Australia began to add her treasures to the mass, and in 1853 the combined yield from the new and the old mines was estimated at the enormous sum of £47,000,000. I believe we would be safe in assuming the total produce of the year which has just closed at upwards of £50,000,000 sterling.*

In order to estimate even in a rude way the probable effects of this unprecedented and sudden influx of the precious metals, we should know the whole amount of bullion previously used as currency, and the portion of the annual yield required to supply the wear and tear of coin and bullion, due allowance being made under this latter head for the additional amount of bullion which the reduction of its value would cause to be used in various branches of manufactures and the arts. The surplus portion of the annual yield, which would be forced, as it were, upon the currency of the world, over and above its legitimate wants, would afford an exponent or measure of the depreciation of the whole mass, so far, at least, as that depreciation may not have been counterbalanced by the operation of other causes.

The value of the metallic currency of the world at the epoch of the gold discoveries has been very variously estimated. McCulloch (after a careful comparison of the calculations of Jacob, Humboldt and others,) puts it down at £380,000,000.

The same author estimates the wear and tear and loss of the precious metal at 1½ per cent. of the whole mass, or about £5,700,000 per annum.

The probable annual addition to the currency, required by the rapidly increasing population in the gold countries and elsewhere, he

* The produce of California has been estimated officially at $60,000,000 or upwards of £12,000,000 sterling. The quantity exported from Melbourne alone during the year must have been at least £12,000,000 sterling. From Sydney up to the 10th December it was close on £10,000,000. Taking into consideration the quantity retained in the country and the quantity sent home by private persons and of which no account was taken, we think the total yield of Australia during the past year cannot have fallen short of £20,000,000. The Australian newspapers received since the above note was penned confirm my conjecture as to the last year's yield of gold in that Colony.

calculates at 3 per cent. of the whole, or upwards of £11,400,000 per annum.

Again, the annual consumption of the precious metals in the arts he estimates at £11,200,000.

Wear and tear and loss of coin............	£ 5,700,000
Increase of currency...........................	11,400,000
Used in the arts	11,200,000
Total........................	£28,300,000

In reference to the last item, McCulloch remarks, "this quantity, however great it may appear will be increased with the increase of population and the spread of refinement and the arts; and it will, also, be certainly increased by any thing like a considerable fall in the value of bullion." Indeed I believe there can be little doubt that already the decline in the value of gold bullion has caused it to be employed in various new branches of manufactures and the arts, and the tendency of this increased demand for gold will be of course, "pro tanto" to check the decline in its value.

From a careful examination of all the authorities to which I have had access on the matter, I have arrived at the conclusion that the whole amount of gold raised since 1848 to the beginning of the present year is not much under 300 millions, and that the whole amount coined during the same period may be estimated at upwards of 180 millions.

Had the whole of this enormous amount of coin been suddenly thrown upon the currency of the world, the effect would have been (assuming as before the whole mass of the currency of the world to be £380,000,000,) an average decline in the value of gold throughout the world, of nearly 50 per cent.

But as in reality the rate of influx of the new gold is very different in different countries, and as the effect of this cause in any particular country is directly proportioned to its rate of influx into that country, as compared of course with the amount already in existence there, the decline in the value of gold in some countries would have been above and in others below this average.

The addition to the coin has, however, not been instantaneous, it has been spread over a period of 8 years, and during that time, (owing to the extraordinary impulse given to commerce from the gold discoveries themselves, from free trade and other causes) the production of commodities has been going forward with a constantly increasing energy, so that the whole mass of commodities in the world in 1856 far exceeds in value the mass of commodities in 1848, and therefore the depreciation of the metals or the rise in the prices of the commodities is not so great as, looking merely to the unparalleled augmentation of the metallic medium of exchange, one might have been led to anticipate. It is hardly necessary to state that it is not in my power to verify from authentic returns the calculation I have made as to the probable amount of bullion coined since 1848. The following table, however, giving the gold coinage of Great Britain, France, and the States, from the period in question, has been compiled carefully from reliable sources, and will serve, I think, to shew that I have not over estimated the whole amount of the coinage of the world since 1848:

	Great Britain.	France.	United States.	Total.
	£	£	£	£
1848	2,451,999	1,234,472	786,565	4,473,036
1849......	2,177,000	1,084,382	1,875,158	5,136,540
1850......	1,491,000	3,407,691	6,662,854	11,561,545
1851......	4,400,411	10,077,252	12,919,695	27,397,358
1852......	8,742,270	13,028,160 (1852–1853)	11,641,000	58,23[illegible].521 (1852–1853)
1853......	11,952,391		12,871,700	
1854......	4,152,183	16,594,000	12,171,110	32,917,293
1855......	9,008,663	17,200,000	11,262,500	37,471,163
Total	£44,375,915	62,620,957	70,190,582	177,187,456

The preceding table shews that the gold discoveries did not produce any very marked effect on the gold coinage of the countries enumerated until 1851, when a sudden and unprecedented augmentation took place in the coinage of each of those countries. The average annual coinage of the three countries taken together for the last four years, exceeds, as appears from the foregoing table, thirty-two millions sterling, an amount which appears almost incredible when compared with their average annual coinage before 1848.*

It seems, indeed, not unlikely that the mint recently opened at Sydney will coin this year as much as the total annual coinage of England, France, and the States together, before 1848; for we find from recent Australia papers that the weekly coinage at the Sydney Mint in November last was 45,000 sovereigns, or at the rate of £2,340,000 per annum; and we learn further that the increasing

* According to Mr. Birkmyre, (during at least the first 30 years of the present century,) the average annual united coinage of the three countries was only £3,055,000, or about one-eleventh of their present annual coinage.

pressure of business was such as to render an increase in the engineering staff of the establishment necessary.

A late ingenious writer* on this subject has, it appears to me, needlessly complicated the question as to the effect of the recent increase of gold on prices, by a minute consideration of the processes by which the new gold gets into the currency of a country. That it does so is tolerably plain, nor indeed does there seem to me to be any great mystery as to the processes by which the result is brought about. A recent American writer on this matter truly says that "currency, like water, seeks a level, and the gold of California thus becomes mingled with the metallic currency of the world. If prices rise here, because our gold is falling below its value in Europe, some of it will be taken away to Europe till prices will cease to rise with us." It may, however, be argued that although the gold portion of the currency of a nation or of the world may be shewn to have been considerably increased, yet it by no means follows that the general mass of the currency (bank notes and every other kind of paper money being included in the term) of that nation or of the world at large has been augmented in the same ratio. It is found, however, in practice that the proportion that the metallic part of the currency bears to the paper is in a given country nearly constant; so that, in truth, any increase of the precious metals brings with it a corresponding increase in the whole mass of the currency of the country.†

It is asserted, however, by some, that the influx of the precious metals from the recently opened gold fields, whatever effects on prices they may be destined ultimately to produce, could not possibly in so short a time have made any sensible alteration in the general level of prices. This impression, one very commonly received, seems to be the result of an erroneous view of the consequences which flowed from the discovery of the silver mines of Mexico towards the close of the fifteenth century. It is taken for granted that there is a strict analogy between that case and the present, and that the effects then produced may therefore be expected to be repeated now in precisely the same way and at the same time. A brief review, however, of the facts connected with the influx into Europe of the

* John Lalor.

† In Ireland we find that the circulation of Bank notes in 1849 was only £3,811,445, while in 1854 it had reached £6,846,000. From the August number of "Hunt's Merchants' Magazine," which came into my hands while these sheets were in press, I find that in 1849 the entire currency of the Union was $325,922,038, and in 1856 $635,122,393, an increase of more than 100 per cent. See page 167.

silver of Mexico during the sixteenth and seventeenth centuries, will show that the supposed analogy fails in the only important point. The silver mines of Mexico had been at work for many years before the discovery of the rich mines of Potosi in 1545, and yet it was not until 1574 that the general level of prices was sensibly raised in Europe. From 1574 prices steadily advanced until about 1650, when they reached their maximum, at least for a time, and remained stationary or nearly so for a century, at the end of which time, or about 1750, another marked advance in prices took place. The argument deduced from these facts, by those who assert that the recent discoveries of gold cannot yet have produced a sensible alteration in prices, is this, that if the extraordinary increase of silver which followed the discovery and working of the Mexican mines required a period of more than fifty years to produce a sensible effect on European prices generally, we may from analogy expect that as long a time, or nearly as long a time, must elapse from the opening of the California and Australia mines before any material effect on prices from that cause can be expected.

Mr. Sterling has examined very fully and exposed, I think very ably, the fallacy of this reasoning. The analogy between the cases is only apparent. The value of silver was lowered in 1574 and 1750, and at those epochs *only*, at least to any considerable extent, because at those two epochs, and at those only, the cost of production of silver was sensibly diminished. In 1574 a reduction in the cost of production of silver was effected by the introduction of the principle of amalgamation in place of that of smelting the silver ore, and by the facilities afforded for the adoption of the new method (in which quicksilver is largely employed,) through the discovery of the quicksilver mines of Huancavaleca. Again, in 1750, a still further reduction of the cost of production of silver was caused by the comparative cheapness and abundance of mercury from and after that date.

At both the epochs in question, therefore, the *reduction of the cost of production* of the metal was followed by an *immediate* and a permanent elevation of prices. And so it must be with gold. The law in both cases is the same; a reduction of the cost of production of either must necessarily occasion (provided of course an indefinite supply can be obtained at that cost) a permanent fall in its value as compared with other commodities. But from the different conditions under which the two metals are produced, the *time* required for the development of the phenomena is materially altered. Silver requires for its production the application of extensive capital and skill, and the employment of complicated mechanical and chemical processes. Gold, on the contrary, requires neither capital nor skill, but is, as it were, the immediate and direct result of manual labour. In the case of silver, its cost of production will be reduced by any improvement in the mechanical or chemical processes employed, or by any cheapening of the materials made use of in its manufacture. In the case of gold, there is no room for the operation of these causes. The cost of production, if lowered at all, must be lowered simply because the unskilled labour employed in the gold diggings (the very term implies the rudeness of the operation) is comparatively more productive than the labour previously applied to the same object. The reduction must, therefore, be, at least in the country where it is produced, instantaneous, and so it has been in both California and Australia. "We must not, therefore," says Mr. Sterling, "rashly conclude that because the increase of silver from the Mexican mines did not materially affect general prices in Europe for more than half a century, the same or anything like the same time must elapse before (the present increase of) gold will create a great permanent and universal elevation of prices in all the markets of the world."

As this paper has already extended considerably beyond the limits within which I had hoped to compress it, I shall now briefly recapitulate some of the conclusions which appear to me to be plainly deducible from the foregoing facts and arguments.

That the immediate effect of the gold discoveries in California and Australia was a very great reduction of the cost of production of gold in those countries respectively.

That the value of gold, as compared with labour and the products of labour in those countries, immediately fell, and that the fall in its value was due to and measured by the reduction in its cost of production.

That the surplus gold of California and Australia, being carried by the thousand channels of commerce to other countries, has already produced in the latter a decline in its value proportioned pretty nearly to the extent of their commercial dealings with the new gold producing countries.

That in the gold importing countries the fall in the value of gold is still going on, and that it is not likely to reach its ultimate limit for some years to come.

That assuming, as I believe we may safely do,* that the new gold

* The most recent accounts from Australia and California agree in stating that the supplies of gold in those countries are perfectly inexhaustible. There appears to be, moreover, a great probability that new auriferous regions will ere long be added to the list.

regions are capable of supplying an indefinite quantity of gold, the value of gold will not sink universally to its permanent or natural value, until the whole of the annual yield is merely sufficient to meet the demands of commerce.

That when that time shall arrive the value of gold in any country will be determined solely by the cost of obtaining it in that country, and nothing else.

In the preceding remarks I have not discussed the influence of the late war, (for we may happily now speak of it as past), or of many other circumstances which are admitted by all to have exercised a very considerable effect in raising the prices of many commodities both in Canada and elsewhere during the last two or three years.

As regards particular localities or particular classes of commodities the influence of these causes may no doubt have been considerable. Glancing, however, at those co-operating causes, I may, observe that their influence on prices, whatever its amount may be, is essentially different in its character from that of the gold discoveries, inasmuch as the effects of the former are merely temporary and local, whereas those of the latter are permanent and co-extensive with the commerce of the world.

REVIEWS.

Report on the exploration of Lakes Superior and Huron. By the Count De Rottermund.

(*Printed by order of the Legislative Assembly, April,* 1856.)

In the Report of this exploration, undertaken at the public expense by the Count de Rottermund, we look in vain for a single new fact of any practical or scientific value. This might indeed have been predicted, *a priori:* the ground having been already traversed and reported upon by the Officers of the Geological Commission. When we affirm, however, that the Report of the Count de Rottermund contains nothing new, nothing previously unknown, in the way of facts, we do not mean to imply that it is altogether destitute of new announcements. Some of these, if we are to look upon the work as an exponent of Canadian Science, are not exactly calculated to add to our reputation in the geological world. It is now well known, from the researches of Sir William Logan and Mr. Murray, that the principal rock formations along the northern shores of Lakes Huron and

Superior, belong, apart from the intrusive and overlying traps, to two distinct groups: the Cambrian or Huronian, underlying the Lower Silurians; and the Gneissoid or Laurentian formation of still older date. So far as present researches go, neither of these groups* have yielded a single trace of fossils. The Count in his Report, however, in reference to this, tells us, that "a most important fact is the discovery of fossils about Lake Superior." An important fact it would be, truly, were the fossils discovered there, *in situ;* but when we state that the Count's fossils—and we have seen them—are simply Upper Silurian forms obtained from drifted limestone boulders, the pretended discovery, so ostentatiously announced, might be subjected to a somewhat undignified comparison.

Our mention of the Huronian rocks reminds us of another illustrative trait of a very similar kind, occurring almost at the commencement of the Report. It is there stated, that the rock formations will be divided "for the present into two distinct classes, namely into palæozoic and azoic rocks, following in this, Mr. Murchison. These terms are already in use among the learned of Europe. I shall arrange the palæozoic rocks according to the fossils which I discovered in the different localities, whether of Lake Superior or Lake Huron. This classification demands great attention, and very minute discrimination to avoid the solecism of giving names according to individual fancy, not used in the scientific world. Such are the names applied to formations in Canada, of Huronian, Sillery, Laurentine, Richelieu, peculiar to the localities which they indicate, substituted for Jurassic, Carboniferous, Cambrian, Devonian, &c., which are so well classified, defined and admitted throughout the scientific world." This is, of course, an attempted hit at Sir William Logan. On reading it, a stranger to our Geology would naturally infer that Sir William had substituted the term Huronian for that of Jurassic, Sillery for Carboniferous, and so on; and, perhaps, that is really what the Count means to imply; since by reference to another of his Reports,† we find him quite ready to acknowledge the presence of Jurassic rocks in Canada. The facts were these: Sir Wm. Logan had mentioned the occurrence of an oolitic limestone near Quebec, and the Count—forgetful apparently of the elementary fact that oolitic limestones are not confined to the so-called Oolitic or Jurassic period, but are common to various epochs—jumped at once

* We refer, of course, to the localities now under consideration. It yet remains to be seen if our Huronian rocks be really the equivalents of the European Cambrians.

† Rapport Géologique de M. De Rottermund, addressé à Son Honneur le Maire de Québec, Mars, 1855.

to the conclusion that Sir William's statement respecting the silurian age of the Quebec rocks, must be altogether wrong. It is but fair that we should quote the Count's own words: here they are—"M. Logan avoue qu'il a vu le calcaire oolitique.* Le calcaire oolitique appartient au terrain jurassique, lequel est au-dessous de la formation supercrétacée, et immédiatement au-dessus du terrain carbonifère." We need scarcely say that the graptolites and other fossils in the rocks about Quebec would enable the merest tyro to determine their general Silurian character; and that no Jurassic rocks are known within the province.

But to return to the Count's charge against Sir William, of applying local names to rock groups. Where a rock formation can be strictly paralleled with another well-recognised group in Europe or elsewhere, the original name is, of course, always retained, provided this be not in itself a mere local designation; but, except so far as regards the broader subdivisions, and especially in the case of localities far distant f om one another, it is very rarely that these exact parallels can be determined in anything like a satisfactory manner. Hence, in place of the forced comparisons of former times, which so greatly retarded the progress of Geology, observers are now everywhere agreed as to the desirableness of temporary local names. If the Count de Rottermund had fully comprehended this, and followed a plan so universally adopted, he might have been spared the committal of a very glaring and mischievous error: namely, the announcement in his Report of the occurrence at the north-east corner of Lake Superior, of both Old and New Red Sandstone—that is to say, of formations lying respectively below and above the great Carboniferous system. We search in vain for the data on which this startling announcement is founded. No structural details, no sections are given; and not a single fossil is cited. Little matters of this kind were no doubt unnecessary. The only wonder is, that the entire rock series was not discovered, when proceeding in so convenient a manner. Indeed, now that we think of it, the Count must have come across the Cretaceous system also. He does not mention this, it is true; but then he provides us here with some fossil evidence which admits of no other conclusion. At least if Cretaceous rocks were not met with, all we can say is, that these fossils are inconvenient things, and had better be let alone. In a list of rocks,

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* This is not exactly the case.' Mr. Logan's words, as quoted by the Count himself, were:—"Il s'y rencontre beaucoup de dislocations sur une puissante assise de calcaire gris oolitique, etc. The article makes all the difference.—E. J. C.

metals, minerals, and some half-a-dozen fossils, given at page 5 of the Report, the genus *Hippurites* (or *Hyppurites* according to the orthography of the report) is enumerated. Now, although the true zoological affinities of the extinct hippurite have yet, perhaps, to be determined, the geological age of these characteristic fossils—restricting them entirely to the Cretaceous epoch—is fixed beyond a doubt. Hence on the authority of this Report, issued as it were under the sanction of the Canadian Government, we may expect before long to find some foreign author quoting these rocks as occurring amongst the formations of Lake Huron.

With reference to the Old and New Red Sandstones mentioned above, our author states:—"The sulphurets are found north and north-east from the lake. I discovered in old Red Sandstone, copper in a native state. In coming down Lake Huron [Superior], between Batcheewauanong and Goulais Bay, we find a new red sandstone and variegated sandstone; I should not feel surprised, if on minute search we should find coal in rear of Gros Cap, above Sault Ste. Marie. I discovered no evidence characteristic of the current of polarization; that is to say, of that current, which, passing through the centre of the earth to the Zenith, ensures the existence of deep veins, and I should be therefore slow to affirm that the veins of copper extend to any great depth." We know not, for on that point the Report is dumb, how this last operation was effected; neither, in our scientific darkness, can we venture to guess at the nature of the process employed, unless the whole thing were done off-hand by the same kind of intuitive perception which seems to have been so successfully concerned in the determination of the sandstone ages. But seriously, we ask, in a scientific report of 1856, can such things be? And yet, the curious current of polarization alluded to above, is quite a moderate idea compared with some of the peculiar views enunciated in the more purely theoretical portions of the Report. In one place, for example, we have the following original view of the origin of the copper and other ores of the district in question:—

"Copper ore and ores of all other descriptions are the results of the decomposition of primitive rocks, but on Lake Superior the copper, in its native state is due to the deposit of certain species of organic matters which have a tendency to increase the electro-chemical action, and which decompose the sulphurets, oxides, &c., which the abundant deposit of matter containing traces of talc serpentine and chlorites, has brought together or concentrated in a certain limited space. For nearly all the rocks contain in the crystalline cleavage, and also in the veins, these matters which appear sometimes to be a sort of cementation, if, indeed, it be not the state of combination of detritus, of desintegration of primitive rocks which have arrived at the state of sandstone and greywacke."

In another part of the Report, we find some still more astonishing theories gravely set forth in elucidation of that vexed question, the production of metallic veins. In order to avoid the charge of garbled quotations, and as an example of our author's logic, and peculiar treatment of his subject, we give the extract entire. We quote, as before, from the authorized English version of the Report:—

"Caloric is known to be a species of fluid which in certain bodies generates electricity, and the smallest friction produces heat, and therefore generates electricity. Electricity produces magnetism. Metals are distributed in the direction of the electric and magnetic currents as they assume a position in relation to each other depending on their specific gravity, their bulk and the force to which they are subjected being the same.

"As the terrestrial globe turns from west to east, and the sun's rays therefore travel from east to west, the friction of the atmospheric air, the production of electricity, and the generation of the magnetic fluid towards the north and south poles, cause minerals to assume a direction consentaneous to the influence of these several forces. Taking for granted the earliest epoch of the globe, when its nature must have been homogeneous, all mineral matters must necessarily, after certain periods of electro-magnetic action, assume a position which is the result of the perpetual action of these two forces; and in those periods the globe must have undergone a decomposition more or less homogeneous according to the intensity of these forces, when once the different kinds of matter have found their relative positions according to their power of attraction or repulsion under the influence of the electro-chemical, magnetic and other fluids.

"The body of the globe has therefore undergone a change in its mode of resistance in certain directions, and it is probable that mountains must have been formed either by the force of expansion in gases produced by internal heat, occasioned by the action of electricity and evolved during the combination and decomposition of bodies, or in other places by the action of depressing causes, sometimes even by their own weight, owing at one time to the disappearance of certain bodies, at another to a certain condition of atomic separation, previously incident to rocks; and the formation of mountains must therefore have their greatest dimensions of length in the same direction; nothing could turn them aside; for the matters which offered the greatest power of resistance must have also been the most homogeneous possible, at the period when the revolution of the terrestrial globe on its axes was first established.

"The displacement of bodies, depending on their adaption to the action of fluids (*la nature qu'ils possèdent pour l'action des fluides*) must have produced some effect in changing the centre of gravitation in the globe. This being changed, the direction of the poles must also have been altered ; but in its constant rotation the rays of the sun communicating to the terrestrial globe the generative action of the fluids, the metals must have undergone a new arrangement differing from that of the first era, but ever conformable to the combined result of the forces, *viz:* from east to west, from north to south and occasionally from pole to pole (*celle des polarisations.*) But the fluids meeting in their transit bodies endowed with various degrees of fitness as conductors, the direction of the aggregate power of the active forces, to effect the combination and decomposition of bodies, must necessarily have undergone modification, and have effected combinations, greatly varying in their nature.

"As an effect of the various revolutions which the terrestrial globe has undergone, whether by the alteration of the centre of gravitation and the formation of mountains, by earthquakes, the result of an accumulation of fluid arrested in their transit by an obstruction (*digue*) composed of bodies of various degrees of fitness as conductors, or finally, by the partial action of volcanoes, or by an inundation of greater or less duration contemporaneous with the primitive formation, the decomposition of terrestrial matter must have proceeded irregularly (*a dû subir des lignes brisées*) and the terrestrial globe must therefore in subsequent revolutions have become less and less homogeneous, in regard both to the nature of its component parts, to their power of resisting expansive forces and to the depression produced by the weight of masses. The mountainous formations must have been greatly shortened and of unequal height, and metals must, during subsequent changes have been subjected to many various influences, and have performed an almost exceptional part among the more direct and general operations, acting on the great mass of the terrestrial globe.

"In the present day, after the lapse of many periods characterised by various formations, there is a great difficulty in anticipating the true position, direction and circumstances of combination in which we may expect to find minerals. In order to form a just conclusion, sufficient leisure is necessary to enable the geologist to observe the locality with accuracy, and to study the different action and effect of bodies on each other, in the peculiar circumstances in which they exist. For at different periods, metals must have been arrested by the direct and intense action of certain fluids, and by the proximity of large masses of other substances; and the progress of combination on decomposition in the several stages of varying activity may have impelled them to take a direction more or less partial, or altogether exceptional."

We submit the above, without comment, to the discrimination of the industrious reader. If his powers of endurance have carried him fairly through its perusal, he will be able to form for himself a just estimate of the character and value of this new Report on our mining districts of the West. Before closing, however, the present notice, we wish, in justice to ourselves, to state distinctly, that we have searched the Report again and again, with a view to obtain for quotation in favor of its author, the mention of even a single important fact previously unknown, or any piece of information whatever, of a really useful or scientific character. But we declare in all honesty, that we have been unable to meet with anything of the kind. Our judgment, nevertheless, and we truly hope so, may have been here at fault.

E. J. C.

Memoirs of the Life, Writings and Discoveries of Sir Isaac Newton. By Sir David Brewster, K. H., &c., &c. Edinburgh: Thomas Constable & Co., 1855.

In the year that saw the death of Galileo and the outburst into shot and steel of the quarrel between Charles Stuart and the Commons of England, there was born a premature and weakly infant, little enough to go into a quart mug, and momently expected to die before the gossips could return with tonics; the child of a widow whose husband had died a few months before, having been a well-to-do yeoman in the Lincolnshire hamlet of Woodthorpe, which has lain in its quiet valley from Saxon times till now, within sight of Grantham's tall steeple. Not death, however, but a long and glorious life was this child's destiny, for this was he for whom the world had been waiting some thousands of years to open up the deeps of Philosophy: he of whom in after-time Pope sang,

> "Nature and Nature's laws lay hid in night,
> "God said 'Let Newton be!' and all was light."

The steps of his public career from boyhood to the summit of human greatness may be briefly traced. A quiet dreamy boy, not over-fond of school, but always working in his own way, with a turn for painting, and active fingers to construct all sorts of little knick-nacks and miniature machinery, water-clocks, mill-wheels, Merlin's carriages, kites of out-of-the-way shapes; making a mouse his miller, and driving pegs into the wall to mark out the hours ("Isaac's dial" is quite a lion in that rustic neighborhood;) too sickly to mix much in the rough sports of his playmates, yet not without plenty of spirit on occasion, as witness the big boy whom he thrashes, then rubs the vanquished nose against the church-yard wall; and, not content with this physical triumph, sets vigorously to work in school till he can take down his enemy in the class. At the age of fifteen he is recalled to take charge of his mother's farm, and the next year, when "that wild wind made work" in which Oliver's great soul passed to its account, Isaac was jumping backwards and forwards to measure its velocity. The farm in such hands is not likely to pay; he much prefers lying under a hedge with a mathematical problem while the servant goes on to Grantham market, and so, though the problem proceeds to solution, the farm affairs verge towards dissolution, and it is finally settled that he shall try his fortune at Cambridge, then, as now, the gathering point for the mathematics of England. So in his nineteenth year he enters Trinity as a Sizar and speedily wins golden opinions from his tutors; hardly a record is left of his life as an undergraduate; but it is impossible to doubt that he was a steady hard-worker, yet not without occasional fits of relaxation, if we may judge from such entries in his diary of expenses as the following, *otiose et frustra expensa* "Supersedeas, China ale, cherries, tart, bottled beere marmelot, custards, sherbet and reaskes, beere, cake;" and again, "Chessemen and dial, 1s. 4d.; effigies amoris, 1s.; my bachelors' account, 17s. 6d.; at the tavern several other times, £1; lost at cards twice 15s.," and the like. Most provokingly the Tripos list for the year when he took his degree is missing, but who can doubt that he was Senior Wrangler? Scholar and then Fellow of his College, he succeeded the famous Barrow in the Lucasian Chair in the year 1669, being then twenty-seven years old, and having by that time achieved nearly all his grand discoveries, which, however, were not given to the world for nearly a score of years. The first thing which brought Newton into public notice was the exhibition before the Royal Society of the reflecting telescope invented by him and made with his own hands, which elicited from that body warm approval, and led to his election as a Fellow thereof; this was followed by a short account of his splendid discovery of the composite character of sunlight, read before the Society, and the publication of his treatise on Optics, the substance of which had already been delivered in his lectures from the Lucasian Chair, but do not seem to have previously made their way to the knowledge of the public. These discoveries, now universally accepted, met with attacks from various quarters to which Newton replied with much patience and good temper, but which seem to have aggravated his almost morbid sensitiveness and led him more than ever to shrink from publishing to the world under his own name, so that for many years we find him only writing anonymously, or under cover of correspondence with his friends; yet through this means it now began to be current among the London Philosophers that Mr. Newton of Cambridge, a fine geometer, and who had published an ingenious treatise on Optics, was in possession of some unknown and powerful method by which he had solved the problem of 'curvilinear motion' that had been baffling them all; which coming to the ears of Edmund Halley, who had himself broken his teeth over this hard nut, and suspected that Wren and Hooke were in like case, off he goes to Cambridge to consult Mr. Newton, and asking him the question point-blank, receives an answer which takes away his breath, "Why," says Newton simply, "I have calculated it," and Hailey finds that he has done this and a great deal more, and urges his friend to lay these results before the Society, exacting after some trouble a promise to this effect. Accordingly Newton sets to work at this task, and on April 28th, 1686, the first instalment of his treatise is read before the Society, and thanks being returned to the author, his work is referred to Halley to report on, touching the printing, and at a subsequent meeting it is ordered to be printed forthwith, and, of course, at the Society's expense; but whether from the want of funds, or informality causing delay, Halley is driven to undertake the editing and printing *at his own expense*—all honor be to his name! At length about midsummer of 1687, the work comes out under the modest title of "Philosophiæ Naturalis Principia Mathematica." To attempt any analysis of this work, or even to convey the faintest notion of the grandeur of the discoveries, both physical and analytical, contained in it, would be quite futile within the limits of a review; in the words of Laplace, it is "pre-eminently above all the other productions of human genius;" the lapse of time has only increased the reverence with which succeeding generations regard it, and it stands imperishably the greatest memorial of godlike intellect that has ever been reared on this earth. From the date of this publication Newton's fame rose rapidly; in four years not a copy of the work was to be had; it took time before the age assimilated the new philosophy, but the progress was certain, and before his death Newton had the pleasure of seeing his doctrines triumphant in all schools. Meanwhile his life went on at Cambridge: as one of the Commission of the Senate when James wanted to intrude his monk for a degree, he took the lead in withstanding the browbeating of Jeffreys and the cajoleries of friend William; was returned as member for the University to the Convention Parliament, and ultimately received the appointment of Master of the Mint which he retained till his death, and in which office he carried out successfully that tremendous operation of reforming the coinage, so graphically described by Macaulay; a similar plan for Ireland was defeated by the factious malignity of Swift in the well-known Draper Letters. Thus, then, for the last half of his long life, Newton lived in London attending to the duties of his office, and devoting his leisure to philosophy and kindred subjects, living in ease and affluence, dispensing a golden mean of hospitality, knighted by his Sovereign, President of the Royal Society, (annually re-elected for twenty-five years,) in familiar intercourse with the Princess of Wales (afterwards wife of George II.,) entertaining distinguished foreigners who came on pilgrimage to him, in correspondence with all that was good and great in that age, generously assisting struggling talent, and dying peacefully at the age of eighty-five with that remarkable utterance of his death-bed, "I do not know what I may appear to the world, but to myself I seem to have been only like a boy playing on the sea-shore, and diverting myself in now and then finding a smoother pebble or a prettier shell than ordinary, whilst the great ocean of truth lay all undiscovered before me." His body lay in state in the Jerusalem Chamber, was buried in Westminster Abbey, Dukes and Earls bearing the pall, and the Bishop of Rochester officiating; a splendid monument to him rises in the Abbey with an epitaph which is truthful because for him exaggeration is impossible; a medal to his honor is struck at the Tower; Roubillac carves the glorious statue (his masterpiece) which stands in the ante-chapel of Trinity, and the bust which side by side with that of Bacon, adorns their Library, contrasting with the plaster-cast from the face after death that lies beside it, (in which the phrenologist will note the lumps, like pigeons' eggs, that cluster on the lower brow, and which Roubillac has softened into beauty and vacancy;) the telescopes made by his own hands are cherished by Trinity and the Royal Society as their choicest treasures; his image is familiar in the Pantheons of all countries, and his name is borne alike by a French war vessel and one of the floating palaces of the Hudson, and in connection with that philosophy of which he laid the foundations deep and wide, never to be shaken, has become a household word in all languages and among all peoples.

Of such a man we should be glad to learn even the pettiest details of his every day life—how he looked and lived, and in what way he did all this work; but unfortunately our information is very scanty, for though a bulky correspondence survives, it is mostly on scientific matters, and Boswells as yet were not. We learn, however, that there was nothing remarkable in his person or appearance; his face of no very promising aspect, (though we suspect a phrenologist would have told a different tale,) speaking little in company, seeming full of thought, but languid in look and manner: in disposition, kindly and generous; careless of money though amassing considerable wealth: liberal almost to excess: excessively modest in the height of his greatness: not eager after fame, but on the contrary shrinking from publicity with a bashfulness almost painful, yet jealous of his reputation, and, when roused, standing spiritedly on defence and using his weapon harshly enough. We must also confess that at times he was irritable, peevish and prone to suspicion; as Locke said, "Newton is a *nice* man to deal with." We may also notice the singular and total deficiency of anything like mirthfulness or humour about him: he is said never to have laughed but once, and in all his writings and familiar letters we cannot see the slightest approach to jocosity. The prime of his life was wholly devoted to science; and when engaged in a speculation, he would concentrate himself wholly on this, indifferent to the outer world, forgetting to eat and drink, sleeping little, and immersed for weeks in the "patient thought" to which alone he himself humbly ascribes all his successes: yet he could break off in the midst of his profoundest labours to go to the sick bed of his mother and tend her with assiduous care, and afterwards, when undertaking the drudgery of the Mint, he abandoned his unfinished investigations on the plea of their interfering with his duty to his sovereign. Labour so incessant in his early life produced its natural results in failing health and weariness of spirit, and we find him once complaining of mathematical studies as being "dry and barren," and thinking of betaking himself to law! which can only remind us of the tailor who turned light-house-keeper because "he did not like confinement;" but this distrustful mood did not last long; "his own thought drove him like a goad," and he goes on in his career: *wie das Gestirn, ohne Hast, aber ohne Rast.* His conscientiousness and love of truth were singularly strong, and he carried the same into his scientific researches, abandoning a theory, whatever trouble its construction had cost him, if he found a fact against it. "It may be so," he said, "there is no arguing against facts and experiments," when Molyneux thought he had discovered a phenomenon which would upset the whole Newtonian system, and told Sir Isaac of it; and this only the year before his death. The sum of his moral character may be given by Bishop Burnet's words—"He had the whitest soul I ever knew." Such is Newton as we see him through the mist of a century and a half, the Atlas of Philosophy, and as good as great.

Popular tradition (or rather that pseudo-poetry which sneers at the hard sciences and girds at Newton as the model mathematician) has preserved some anecdotes of him, curiously contradicted by historic fact; thus every one has heard how Newton, having read through the Paradise Lost, only asked, "What does it all prove?" We find, however, that Newton confesses to having been "a capital hand at versifying," and to have had a fondness for poetry when young, which, however, he lost in after-age, this latter being an experience not confined to philosophers. So also we have read much of Newton's utter insensibility to female charms, and how the fair young lady, whom his friends wished him to marry, found her finger used as a tobacco-stopper: in fact, Newton was in love with a Miss Storey, when quite young, and though circumstances prevented their marriage, he behaved very kindly to her in after-life: nay, even we find him at sixty years of age writing a real love-letter and offer of marriage, though whether for himself or a friend has not been ascertained: it is certainly a most curious production, but is not the first nor will it be the last example of "wit turned fool" in such a case. The story about the apple, whose fall on his head is said to have suggested gravitation, seems apocryphal; and so also, we fear, is that other touching story about dog Diamond and the burning of the papers; and indeed we rather suspect that if such an event had occurred, dog Diamond would have been sent flying through the window.

It appears the function of our time to be the iconoclast of brilliant reputations, the whitewasher of stained ones; it was not, therefore, to be expected that Newton should escape. Among his contemporaries and successors, in all the furious controversies that raged about him, none ever disputed the grandeur and originality of his discoveries, the purity of his motives, the uprightness of his conduct; this enviable task has been reserved for some among us, and first stands S. T. Coleridge, who, as usual, plagiarising in the fulness of ignorance from German metaphysicians, thinks Newton much over-rated, that he has unfairly appropriated Kepler's due, and that it would take three Newtons to make one Kepler: and him indeed, dogmatising in this foolish fashion, we may whistle down the wind without more concern.

Not so can we dismiss Professor de Morgan, a profound mathematician and painful investigator, but withal afflicted so with an itch of impartiality as to make him most partial *against* the side to which he might be expected to lean. Certain insinuations against Newton's fairness or truthfulness in the Leibnitzian controversy he has found it necessary to withdraw, and we think it probable that after he has written, *more suo*, half a dozen treatises on the matter, he will find that, after all, the English and foreign disputants on Newton's side are not so thoroughly and utterly disingenuous as he now believes. Touching this celebrated controversy we may observe, that Newton's claim to the original and first invention of the fluxional calculus, (or the Differential, which is the same,) is undoubted; while Leibnitz's claim to the invention at all, is, at the best, doubtful, since he may have had (indeed had many opportunities of getting) the idea from Newton, and the contrary statement rests only on his own assertion, which no one who has read his character would value a straw. The lately discovered exercises on which de Morgan lays so much stress, seem to us rather the attempts of one who is trying to make out a borrowed idea than the track of original thought. No blame, however, can attach to Professor de Morgan for his opinions on this score, but we take leave to think that his revival of Voltaire's forgotten and groundless scandal about Newton's niece and the Earl of Halifax is simply disgraceful. More serious are the charges brought against Newton by Mr. Baily, in his life of Flamstead: for a complete refutation of them we are indebted to Sir David Brewster, in the work which stands at the head of this article, and we presume nothing more will ever be heard of them. In that saddest period of English History, when only not all men were base, it is an inexpressible relief to turn to the lives of men like Locke, Wren, Halley and Newton, shining mirrors which not the breath of all the rattlesnakes in Virginia can dim.

The work above cited, by Sir David Brewster, is professedly an account of the life, writings and discoveries of Newton. In some respects Newton is happy in his Biographer, for Sir David is the "prince of experimenters," and moreover wields a caustic and vigorous pen, and has an enthusiastic love for the great master; but in other respects, we are sorry to say, his performance has deeply disappointed us. In the perfect philosopher there are three distinct characters united: first, the experimenter who has to provide the raw material; next, the natural philosopher, who classifies phenomena and deduces the laws or principles which govern them; and last, the analyst, who has to work out results from such laws, and to invent the machinery for doing this. Seldom, indeed, is it that we find in any one individual more than one of these distinct functions eminently developed, yet Newton takes foremost rank in all. There have been experimenters who have equalled, perhaps surpassed him in fertility ot device and acuteness of observation, but in both the other classes he stands unrivalled; and taken in conjunction, not only is there no one like him, but hardly second to him, perhaps Laplace the nearest, but that only *longo post intervallo.* To write then a full account of the discoveries of such a man would require for the task one who is able to appreciate him in all these departments. Now, Sir David Brewster is undeniably a splendid experimental Philosopher, but we are not aware that he has ever laid claim to eminence in pure, (and, by consequence, in applied) mathematics; accordingly, while a great portion of his bulky volumes is devoted to matter we cannot help considering irrelevant, such as the lives of Tycho Brahe, Galileo, and Kepler, Lord Rosse's Telescope, the discovery of Neptune, and a good deal of ambitious writing, which we could well have spared, there are but about ten pages devoted to an analysis of the Principia, and those disfigured by blunders, (slips we would willingly call them) which we can hardly credit our eyes on reading. Still worse do Newton's inventions and researches in pure mathematics fare, numbers of them being passed over without comment, some not even mentioned. To make up for this omission we have nearly a third of the work taken up by the optical researches of Newton and of others, both before and after him. Now, Newton's discoveries in optics, though enough to make half-a-dozen reputations, are those on which his fame least rests, for, though he discovered the composition of colours in white light, by an accident of manipulation he missed its corollary, the irrationality of dispersion; and though his experiments on the colours of plates and in diffraction and interferences, were beautiful and valuable, yet by an accidental mismeasurement he was confirmed in referring them to a theory which is now universally rejected. The relation between Newton and his Biographer is here somewhat curious. Newton's analysis of the solar spectrum was met at first by much opposition and controversy, though it speedily triumphed over assault, and has been accepted by all down to the present time, (except, indeed, by Göethe, of whom we need not here speak) when it has found an assailant in Sir David himself. The substitute proposed by him he has been unable to persuade his contemporaries to accept, and thus in the present work we find a running parallel implied between Newton and his detractors on the one hand, and Sir David and the present generation on the other. Newton condescended to reply with great temper and patience to his inane objectors, but Sir David flinging his triple spectrum in the face of the world with sarcasms 'peu spirituelles,' as Moigno designates them, reminds us rather of Ajax defying the lightning. Nor is this all the situation. Newton's hypothesis of emission has been abandoned by every philosopher of eminence except Sir David Brewster, who remains its sole and sturdy defender, but there is this difference between them: Newton's objection to the opposite Huyghenian doctrine was a solid and plausible one, to which no answer, in his day, was or could be given; he asks and reiterates the question, why, if light were propagated by undulations like sound, it should not spread in all directions on passing through an aperture, as sound does, instead of only illuminating the space in front. It required higher analysis than Hooke or Huyghens possessed, to give the real answer to this, but the answer has since been given completely, and there is small doubt that if Newton had seen this, he would have discarded his own hypothesis, (as indeed he seems sometimes half inclined to do), in favour of the undulatory. We can willingly excuse Sir David for cutting very short all the circumstances that make in favour of the theory he rejects, but one hardly knows whether most to admire the audacity or feel shame for the infatuation of a sentence like the following, in which, be it observed, the 'disciples of Hooke' are just the whole present generation of philosophers.

"In the present day, the disciples of Hooke, who 'split pulses' with more success than he did, and whose theory of light has attained a lofty pre-eminence, have not scrupled to imitate their master in measuring optical truths by the undulatory standard, and in questioning and depreciating labours that it cannot explain, or that run counter to its deductions. There is fortunately, however, a small remnant in the Temple of Science, who, while they give to theory its due honours and its proper place, are desirous, as experimental philosophers, to follow in the steps of their great master."

In estimating rightly the grandeur of Newton's discoveries, it is just to consider the circumstances under which they were made: the magnificent temple he erected, marvellous in itself, becomes immeasurably so when we consider that he had not only to build, but to make the bricks, find the straw, and fashion the ladder and trowel. From a Mechanics, for which he had to supply the fundamental laws—through the planetary and cometary motions—up to the Lunar Perturbations and universal gravitation; from an Algebra, to which he gave the Binomial Theorem—through the differential and integral calculus which he invented—up to the calculus of Variations

—what gigantic strides are these! It was the fashion of the age to hide processes, and offer results without demonstration: the propositions in the Principia are all geometrical (indeed they would otherwise not have been understood for a century,) but there is little doubt most of them were obtained originally by analysis—singularly unfortunate both for Newton's fame and for the sake of us who should reap the benefit of his labours. One proposition given without demonstration proves that he had mastered the calculus of variations, the invention of which afterwards became the centre-stone of Lagrange's chaplet: in his "rectification of curves" he must have passed through the integrals which now bear Euler's name: a single construction for conic sections would seem to shew that he had anticipated one of the most recent and beautiful processes in analytical geometry invented by M. Chasles. Nothing can be more startling than thus, in the apparently unpenetrated forest, to come across a mighty tree felled, with "Newton—his mark" plain upon it: some of his propositions remain undemonstrated to this day; for instance, the general properties he asserts of curves of the third order, (the classification of which is not the least remarkable of his labours,) and also some strange properties of the roots of algebraic equations. In other cases no one has even guessed at the methods by which he obtained his results; as in the case of that ratio of the oval axes of the moon's orbit, and of the axes of the earth's figure, where he boldly contradicted the then universal opinion that the equatorial was shorter than the polar; or again, consider this sentence from the 23rd proposition of the third book, when speaking of the progression of the moon's perigee: "Diminui tamen debet motus augis sic inventus in ratione 5 ad 9 vel. 1 ad 2 circiter, ob causam quam hic exponere non vacat"—"for a cause which here I have not leisure to explain;"—this very inequality nearly drove subsequent calculators to reject altogether the Newtonian theory of gravitation, and it was not till the third trial that Clairaut in despair carried his process to a closer approximation and found the next term give him the required result. Equally wonderful is the way in which Newton sets about doing things that would seem to require a century of preparation to solve: nothing seems to stop him—his tread is that of a lion:—"Ex ungue leonem," as Leibnitz said: if he wants an equation solved, he invents a method of approximation for it; if he wants an algorithm for annuities, he makes one; if he wants to explain the precession of the equinoxes, and suspects it to arise from solar and lunar action on the earth's equatorial protuberance, he considers this latter a belt of satellites, and does it; if he wants to find an expression for the velocity of sound, he applies a theory "wholly inapplicable in all its parts," (the words are Sir John Herschel's, but we doubt the assertion,) and obtains the right expression, confirmed in after-time. When we reflect also that his analysis and the germs, at least, of his great physical discoveries were all obtained by the time he reached the age of twenty-three, we can only bow in awe and reverence before this intellect, which is more divine than human.

Of Newton's labours in other fields we can only speak very briefly: strange to say, he was an alchemist, and devoted much time to the practical pursuit of this study, keeping his furnace going night and day for six weeks at a time: of the precise nature of his pursuits no trace is left. He also devoted much attention to theology, and concerning his opinions hereon, his biographer treats very tenderly; perhaps it would have been as well to say at once, that, in common with most of the great men of that age, he approximated to Arianism: several theses of his are here published for the first time, but we suspect the most important are still suppressed. He also published on the interpretation of the Prophecies: Coleridge calls his speculations "ravings:" they do not seem to differ much in character from those of other writers on that subject. Many other minor works we have not space to notice, but may refer to his examination of the famous text in the First Epistle of St. John, as a masterpiece of classical criticism.

In conclusion, we may notice the very singular fact that the mantle of Newton's genius did not descend on any of his countrymen; for nearly a century after his death, there is no English name enrolled on the annals of scientific fame, while in France a splendid constellation of illustrious *savans* shone in his wake. This is sometimes attempted to be accounted for by the fact of the English adhering to the geometrical methods of Newton, (which, however, he had used only for dressing up his results for publication,) while the French, discarding these, had betaken themselves to perfecting the analysis he had invented. Sir David Brewster inclines to attribute it rather to the want of encouragement from Government to Science. Neither one nor the other cause seems to us a satisfactory explanation: as to the latter, English science *now* flourishes without the fostering care of paternal Government; and, besides, the splendid endowments of the English Universities have surely offered material help enongh: for the former, we may remark that the tools were not so much in fault as the want of workmen to handle them: what *can* be done with Newton's geometry has been clearly enough shewn latterly by Whewell in his Dissertations on Lib. III.; by Herschel in the Perturbations, and by W. Thomson in Potentials. The fact seems to be that in every nation there are epochs whether of science, literature, statesmanship, even morality. Why have we had no dramatist since Shakspere? Why that long dearth of poetry between Pope and Wordsworth? The fact seems indisputable though the cause may be obscure. In 1830 Sir John Herschel wrote: "In mathematics we have long since drawn the rein and given over a hopeless race." Even then, that assertion was more modest than exact, considering the names of Airy, Peacock, Babbage, Lubbock, and Herschel himself. At the present day, however, a great revival has begun: England supports by voluntary subscription *two* journals devoted exclusively to mathematics, a feat unparalleled in any country: the British Association and the various Societies are displaying great vigour; and a long list of English names could be cited to compare with any continental celebrities: when we say English, we of course include Scotch, for Scotland has contributed far more than her share to this list, though, owing to the poorness of her University prizes, her sons all repair to Cambridge, still, as in the days of Newton, the citadel of science. Our little sister of Dublin, so long silent, now discourses eloquent music, and even Oxford has discovered that great men have lived since Aristotle, and that the voyage of scientific discovery did not end when the ark stranded on Mount Ararat. Many signs combine to lead us to believe that we are on the verge of grand discoveries: the new methods of analysis lately inverted (notably by George Boole and Sir W. Hamilton) seem converging to a machinery which will surpass that of Newton as Newton's surpassed that before him; and the experimental discoveries of Faraday and others remind us of those of Kepler, which only wanted the Newton to give them the breath of life. May we live to hail the advent of one on whose tomb shall be inscribed an epitaph more glorious even than that which we here translate:*

Here lies
ISAAC NEWTON, Knt.,
Who, by an almost divine power of mind,
Was the first to demonstrate
The motions and figures of the Planets,
The paths of Comets, and the tides of Ocean,
Mathematics of his own invention lighting him the way.
The different refrangibilities of the rays of light

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* In his "literal translation" of this epitaph, Sir David Brewster has omitted two sentences, for what reason we cannot conjecture.

And the properties of the colours thence arising,
Which none before had even suspected, he investigated thoroughly.
An assiduous, sagacious, faithful Interpreter
Of Nature, Antiquity, Holy Scripture,
By his Philosophy he vindicated the Most High God in his majesty,
By his life he exhibited the Gospel in its simplicity.
Let mortals congratulate themselves
That there has existed such and so great
An honour of the human race.
Born, 25th Dec., 1642, Died 20 Mar., 1727.

J. B C.

Modern Geography, for the use of Schools. By Robert Anderson, Head Master, and Lecturer on Geography, Normal Institution, Edinburgh. London, and New York: T. Nelson & Sons. 1856.

This constitutes one of a set of works prepared with great care, as an educational series, designed—as the title expressly states—for the use of Schools. The purpose of the volume in question is further defined as furnishing a work calculated to "prove serviceable to the intelligent teacher, in making Geography a more intellectual, and at the same time a more interesting study than it has hitherto generally been in our schools." Such an object is one well deserving of commendation even as an attempt; but, in this compact and carefully condensed volume, the success is unquestionable.

Many features in this work are novel and ingenious; and when we consider the very questionable character of such American works as that of Morse, at present in almost universal use throughout Canada, we do not regard it as the least of the various attractions of this work that it is, more than almost any other we know of, a *British School Book.* These will be apparent from an enumeration of some of its most characteristic peculiarities. For example: what may be designated as a geographical base line is adopted for comparing the latitudes of countries in the Old and New Worlds. This consists of the countries which, lying most nearly in a line north and south of Britain, occupy the western shores of the Old World; and these elements of comparison are rendered still more practically available by an ingenious diagram, appealing to the eye, and greatly assisting the memory of the young student. Using this method of geographical comparison, here are a few of the results:

Newfoundland is shown to be in the same latitude as the South of England and the North of France. New Brunswick is in the same latitude as the middle of France; Nova Scotia, in the same as the South of France; and Canada as from the middle of England to the middle of Spain.

In like manner the sizes of all countries are measured by the British Isles, either in whole or in part: a very definite idea of the sizes of England, Scotland, Wales and Ireland, having been previously given. The direct distances from London of all the capitals in the world add another concise and practical feature: *e. g.* St. John's, Newfoundland, 2,300 miles S. W. of London; Montreal, 3,250 miles S. W., &c. The principal seas of Europe are measured by the like standard; and the relative size of British Colonies and Foreign possessions are brought out by similar comparisons. Thus New Zealand is described as about the size of Britain; Ceylon is stated to correspond very nearly to that of Scotland; and British America, embracing the Hudson Bay Territory, as having an area equal to a square of 1,600 miles: more than three-fifths the size of Europe; Canada, with an area of 400,000 square miles, equal to a square of 632 miles, or four and a half times larger than Great Britain, &c. So also minuter subdivisions find a similar treatment. Thus all the counties of England are measured by the size of Middlesex, and practically the same comparison suffices for the whole British Isles: the counties of Edinburgh and Dublin being so nearly of the same size with the Metropolitan County of England, as to avert all risk of arousing Scottish or Irish jealousies by any undue pre-eminence being given to the ancient area of the Middle Saxons of England.

These are only a few of the peculiar and novel features of the work. In others, countries, and their districts and counties, are classed according to their river basins. The rivers, again, are grouped under the oceans and seas of which they are tributaries; the towns according to certain proximate ratios of population; and in many other ways intelligent aids to memory are substituted for the old unreasoning and laborious method of learning by rote.

When we consider the fashion in which such American School Book manufacturers as Morse or Mitchell convert a geographical manual into a Yankee penny trumpet for the glorification of that one great nation of the universe, and the strong anti-British feeling which so frequently accompanies such fanfaronade, the practical and altogether unboastful British character of this useful school book, ought to commend it for general adoption in Canada, as in other parts of the British Empire.

In Morse's Geography a larger space is devoted to some single States of the Union than to the whole British Isles; and while the glories of "Bunker Hill," and the feats of arms of the "Green Mountain Boys" of Vermont, in the Revolutionary War, find a prominent place, the most characteristic feature that this American trainer of the young idea can discover in relation to the geography (!) of Ireland is "*distraining for rent*," which is accordingly illustrated by means of a wood-cut representation of a policeman driving off a poor peasant's cow; his wife on her knees, his son, nearly naked, and all vainly imploring mercy from the stony-hearted embodiment of British law! Yet this book is to be found in use, we believe, throughout the majority of our Canadian schools. Or, taking into consideration the less objectionable feature of the predominance naturally given by the geographers of the Union to their own Republic, we find in Mitchell's "Manual of Geography"—another American school book, which has displaced that of Morse in some of our Provincial schools—nearly *forty* pages devoted to the United States, while *one page and a half* suffices for all British North America. In the same work more than one State of the Union monopolises a larger space than England, and the whole Geography of Europe actually occupies less than two-thirds of the amount of room devoted to the Great Republic! The object held in view in such teaching is abundantly apparent, so far as Americans are concerned; and its influence on the character and idiosyncracies of the people of the States has already developed itself in a very unmistakable manner. Its true wisdom, as an element of national mental culture, even for them, may well be questioned; but for us, there can be no doubt that such a system of Americanising our youth is the very last thing which any wise or patriotic Canadian would advocate as the training calculated to make them either well instructed geographers, or useful citizens.

We are informed that it is in contemplation to prepare a special edition of Anderson's "Modern Geography" for the use of Canadian and other Colonial Schools: we shall hail such as a contribution of no slight value to the educational materials required to complete the Provincial system of education which already reflects so much credit on Upper Canada.

D. W.

Report on Victoria Bridge. By Robert Stephenson, Esq., M. P.
December, 1855.

Canadians have been so accustomed to look with profound respect upon the achievements of their American neighbours in the art of bridge building, and have been so habituated to consider their railway structures as models of the most successful adaptation of means to the accomplishment of desired ends, that they may be pardoned when they point with exultation to the immense structure now in progress at Montreal, or in a similar spirit claim their full share of credit in the completed one that spans the chasm between the Niagara Frontier and the State of New York; for both surpass in magnitude and in boldness of conception any similar works in America, we may say in the world.

Notwithstanding, however, the natural pride in the material advancement of the country indicated by these works, the expenditure involved in the completion of one of them is not contemplated without misgiving, nor are we justly chargeable with captiousness if we regard with enquiring doubt the soundness of the policy which designed a work of such magnitude as the Victoria Bridge to serve a traffic so little developed as that of the Grand Trunk Railway; and at the same time substituting in its construction, as well as in the construction of lesser bridges and viaducts, a material so expensive as iron, for timber, which is found in such abundance in the vicinity of nearly all the works. To have advanced so far at one bound as to erect in Canada bridges and viaducts equal in cost,—as they doubtless are in durability,—to the best structures in Britain, argues a confidence in the ability of this country to supply a traffic sufficient to justify such expenditures, which many believe will not be borne out by the result; and there are not wanting those who, while admitting that the durable fabrics now drawing to completion on the Grand Trunk Railway are well calculated to endure for ages, and to reduce working expenses; yet point to the structures of the United States as models of works that would be infinitely better suited to the immediate wants and resources of a country so young as Canada.

On the other hand those who have initiated, and support the policy of so building as to require no re-building, argue that a more careful estimate of the cost of maintenance of permanent way as affected by the system of construction adopted, will dissipate these doubts, and teach us that true economy is best subserved by securing a permanent way that shall be, in as far as structures are concerned, that which its name indicates. They argue moreover that as between structures of indestructable material and those of a material obnoxious to all the causes of destruction to which timber is liable, the question is entirely one of finance in the supply of capital and not of dividends in the future.

By way of illustrating this question we will assume that the foundations and masonry for abutments, piers &c., are to be the same whether the superstructure is to be of wood or iron, and base our calculations on a length of 5,000 lineal feet of bridge superstructure, varying in spans of from 50 to 250 feet which may be taken to represent the bridges on a line of 300 miles.

Basing our estimate for wooden superstructures on the known cost of such works built on McCallum's patent, and which, for such spans as we contemplate in this estimate, would average £8 10s. 0d. Cy. per lineal foot, and estimating the cost of the iron superstructure of similar spans at an average of £40 per foot, (that of the Victoria Bridge is set down in Mr. Ross' report at £57 Stg. = £71 5s. 0d. Cy.) the following amounts will represent the first cost of each:

5,000 feet of Timber superstructure at £8 10s. Cy. £42,500.

5,000 lineal feet of Iron superstructure at £40. Cy. £200.000.

The former at 6 per cent. would absorb an annual revenue of £2,550, and the latter a revenue of £12,000. But to the first must be added an amount annually sufficient to cover depreciation, repairs, risk from fire, and the cost of constant vigilant supervision, which would perhaps be not less than 15 per cent. per annum, and under some circumstances might amount to 20 per cent. these contingencies not being applicable to the iron superstructure would bring the annual charge for the wooden bridge up to £8,925 Cy. being within £3,075 of the like charge for the more desirable one; a difference, however, which being capitalized, will represent an item of upwards of £50,000 in the capital account. It is difficult therefore to resist the conclusion that the introduction of Iron Railway Bridges into this country is premature.

The enhanced cost above indicated is still more apparent if we apply the comparison to the Victoria Bridge. Spans of the dimensions adopted in that work have frequently been executed in wood in the most reliable manner at a cost of $35 per foot; and with every provision against fire, for protection against the weather, for ventilation, &c., the cost would not exceed $45 or £11 5s. Cy. the whole cost of the 7,000 feet which Mr. Ross estimates in iron at £400,000 would not therefore exceed £78,750 Cy. it would consequently be cheaper to build in wood even if it demanded an entire *renewal every five years.* Mr. Stephenson, however, has dismissed all thought of a wooden superstructure in a very summary manner, and as it appears to us for no very sufficient reason,—he says in his Report:

"In all that has been said respecting the comparative merits of the different systems of roadway, you will perceive that a *complete wooden structure* has not been alluded to, because, in the first place, when the design for the Victoria bridge was at first being considered, *wood* was deemed not sufficiently permanent; in the second place, the structures alluded to in the report, as being inferior to that now in progress, are proposed to be constructed of stone and iron work; and as a third reason, the construction of the tubular roadway is already so far advanced that any alteration, to the extent of abandoning *iron* and adopting *wood*, must involve monetary questions of so serious a nature as to render the subject beyond discussion, or even being thought of in this report.

From this it would appear that the construction of the tubes has been so far advanced as to preclude all thought of any other description of superstructure now; while wood was discarded in the previous consideration of the subject as not being "*sufficiently permanent*" an assumption perfectly true where it desirable to emulate the builders of the Pyramids, but not entitled to implicit faith when measured by a commercial standard suited to these provinces. Mr. Stephenson has probably omitted to draw the needful distinction between England, where iron and capital are abundant and wood scarce, and Canada, where precisely the reverse of these conditions exists; in fact he appears to have adopted the same reasoning in relation to the Victoria bridge as he did with reference to the Britannia, forgetful of the innumerable opportunities afforded in this country for the employment of capital in a much more productive manner, and more beneficially not only for the railway but for the country at large.

In dealing with questions of stone and iron, however, Mr. Stephenson has shewn himself quite at home; and in comparing the various methods of construction with those materials both he and Mr. Ross leave nothing to be desired. We entirely adhere to the views expressed by them. "The approaches" says, Mr. Stephenson:

"Extending in length to 700 feet on the south, or St. Lambert side, and 1300 feet on the Point St. Charles side,—consist of solid embankments, formed of large masses of stone, heaped up and faced on the sloping sides with rubble masonry. The up-stream side of these embankments is formed into a hollow shelving slope, the upper portion of which is a circular curve of 60 feet radius, and the lower portion, or foot of the slope, has a straight incline of three to one, while the down-stream side, which is not exposed to the direct action of the floating ice, has a slope of one to one. These embankments are being constructed in a very solid and durable manner, and from their extending along that portion of the river only, where the depth at summer level is not more than two feet, six inches; the navigation is not interrupted, and a great protection is, by their means afforded to the city from the effect of the "shoves" of ice which are known to be so detrimental to its frontage.

For further details on this subject, I beg to refer you to the Report made by Mr. Ross and myself on the 6th of June, 1853, to the Honorable the Board of Railway Commissioners, Quebec."

We have not at hand the report referred to, but in his report of 3rd November Mr. Ross goes over the reasons which influenced him in deciding on the dimensions of the abutments, and justifies the manner of their construction. He says of them:

"These it appears, are considered unnecessarily large, and more costly than the tubes, and it is suggested that they may be reduced by making openings in, or by shortening them. These abutments are not in reality what, upon paper, they appear to be, a solid mass of masonry: *they are hollow*—each having eight openings or cells, 48 feet in length, and 24 feet in width, separated by cross walls five feet in thickness. The flank wall on the down stream side rising nearly perpendicular, is seven feet in thickness, and that on the upper stream side is sloping from its foundation upwards to an angle of 45°: its thickness is twelve feet, and presents a smooth surface to facilitate the operations of the ice, on which account its form had thus been determined; and to ensure greater resistance to the pressure of the ice, the cells are filled up with earth, stone and gravel, so that one solid mass is thus obtained at a moderate cost. The subjoined plan and section of this work will better explain its form and proportions.

The idea of introducing any other description into the abutments than those described, is altogether inadmissable; passages through it where ice could accumulate, would ensure its inevitable destruction upon the first hydraulic pressure it had to encounter.

I have observed in this immediate neighborhood the effects of swift currents created by obstructions in the river on a recently formed causeway constructed of timber connecting a small island below the bridge with the shore, having openings about 12 feet in width at intervals of about 30 feet.

In the autumn of last year, these openings were partly covered by heavy timber and planking strongly secured by iron work, and the consequence has been, that during last winter, the first crush of the ice, in forcing its passage through, destroyed every timber, plank, and bolt, that opposed it—having got under, it was immediately blocked up, and the pressure of water still forcing its way, the jam became at length so tight, that it burst with an explosion.

It is stated that the length of the abutments is unnecessary and greatly in excess. Upon paper this may seem so, and a recollection of the idea conveyed to my own mind subsequent to the earlier considerations of this subject which led me to the conclusion of adopting their dimensions, prevents my attaching so much importance to such a view as I otherwise might do. You will recollect that the bridge is approached from the north shore by an embankment 1200 feet, and from the south shore 800 feet in length, the river being thereby narrowed to this extent; the waters thus far embayed, have now to find their way through the bridge, and the current, overcharged with ice, sweeping its way along the front of the embankment into the nearest passage, attains, ere reaching it, a velocity which nothing but the most substantial masonry could resist. This, it will be seen, bears on the question of the length to which such masonry should extend, and I am more than ever convinced that I have not exceeded the limits which prudence dictates—thus confirming my original view in reference to this particular and very important point. I think you will readily admit that I have given ample reasons in justification of the extent of the abutments, bearing in mind that the form of *construction* contributes more to their apparent magnitude than a cursory glance at their appearance upon paper would justify one in supposing."

Proceeding with a description of the masonry of the Piers and of the details of their foundations, Mr. Stephenson continues:

"Advantage has also been taken of the shallow depth of water, in constructing the abutments, which are each 242 feet in length, and consist of masonry of the same description as that on the piers, which I am about to describe, and, from their being erected in such a small depth of water, their foundations do not require any extraordinary means for their construction.

The Foundations as you are aware are fortunately on solid rock, in no place at a great depth below the summer level of the water in the river.

Various methods of constructing the foundations suggested themselves and were carefully considered, but without deciding upon any particular method of proceeding, it was assumed that the *diving bell*, or such modifications of it on a larger scale, as have been recently employed with great success in situations not very dissimilar, would be the most expedient. The contractors, however, or rather the Superintendent, Mr. Hodges, in conjunction with Mr. Ross, after much consideration on the spot, devised another system of laying the foundations, which was by means of floating "Coffer-dams," so contrived that the usual difficulty in applying coffer-dams for rock foundations would be, it was hoped, in a great measure obviated. When in Montreal, I examined a model of this contrivance and quite approved of its application without feeling certain that it would materially reduce the expense of construction below that of the system assumed to be adopted by Mr. Ross and myself in making the estimate. In approving of the method proposed by Mr. Hodges, I was actuated by the feeling that the Engineers would not be justified in controlling the contractors in the adoption of such means as they might consider most economical to themselves, so long as the soundness and stability of the work were in no way affected.

This new method has been hitherto acted upon with such modifications, as experience has suggested from time to time, during the progress of the work, and although successfully, I learn from the contractors that experience has proved the bed of the river to be far more irregular than was at first supposed,—presenting, instead of tolerably uniform ledges of rock, large loose fragments which are strewed about, and cause much inconvenience and delay.

They are therefore necessitated to vary their mode of proceeding to meet these new circumstances; and it may be stated, that all observations up to this time shew the propriety, notwithstanding the difficulty with dams, of carrying the ashlar masonry of the piers, down to the solid rock—and that any attempt at obtaining a permanent foundation by means of concrete, confined in "caissons" would be utterly futile;—however, if it were assumed to be practicable, there would be extreme danger in trusting such a superstructure of masonry upon concrete, confined in cast iron "caissons" above the bed of the river: indeed, considering the peculiarities of the situation and the facts which have been ascertained, this mode of forming foundations is the most inappropriate that can be suggested, as it involves so many contingencies, that to calculate the extreme expense would be utterly impossible.

These considerations lead me therefore to the conclusion that the present design for the foundation is as economical as is compatible with complete security."

A legitimate conclusion, which we apprehend will not be gainsayed.

Mr. Ross gives a graphic description of the difficulty of putting in these foundations:

"Any diminution in these piers (referring to a proposal to reduce the dimensions of the centre piers) which I might according to my own views of the case be induced to adopt, I should treat as some compensation, as far as it went, for the increased depth of the foundations generally, which are found greatly to exceed our anticipations: although every pains had been taken to ascertain what these would be, we find in the progress of the works that the bed of the river in most parts is formed of large boulders heaped together in large masses, the interstices being filled up with gravel, sand and mud, in many instances forming a hard concreted mass, and in others the reverse; beds of quick sand and mud being as frequent as any other. Three thousand tons of such material we had to clear out of the foundation of No. 5 pier, as you will see indicated on the diagram already referred to, below the level at which our previous examination would lead us to expect the foundation we sought. One of the boulders taken out, by admeasurement would weigh about eleven tons; masses of three and four tons are strewed as thickly as pebbles on the sea shore. The shallows in the river are evidently formed by these deposits, and I have no doubt in every instance where these shallows appear we shall have to encounter similar difficulties. In pier No 3 we found a depth of four feet at one end, and nine feet at the other, to clear out ere we ched the rock. These unlooked for contingents have materially retarded our season's operations, otherwise we should by this time have Nos. 3, 5 and 6 nearly completed, as it turns out we require another season to accomplish this. And here I think it well to observe that up to No. 6 inclusive, the expensive outlays have already been incurred; the dams have been completed, and in all except No. 4 the water has been pumped out and the machinery erected for setting the stone, but No. 5 is the only one where we have been able to complete any masonry, owing to the unlooked for causes I have already described. These contingents render it impossible to complete one pier in less than two seasons, though, as in the case of No. 1 pier, where no such unlooked for difficulty arose, the whole was begun and completely finished in one season, thus saving the removal and re-erection of all the machinery and appliances necessary, besides the reparation of such damages as the winter operations may produce."

Of the spans, and the considerations which led to their adoption, Mr. Stephenson says:

"These considerations lead me therefore to the conclusion, that the present design for the foundation is as economical as is compatible with complete security.

We are now brought to the question, as to whether the upper masonry is of a more expensive description than necessary, or whether it can be reduced in quality. This question is exceedingly important, since the cost of the masonry constitutes upwards of 50 per cent. of the total estimated cost of the bridge and approaches. The amount of the item of expenditure for the masonry is clearly dependent upon the number of piers, which is again regulated by the spans between them.

The width of the openings in bridges is frequently influenced, and sometimes absolutely governed, by peculiarities of site. In the present case, however, the spans, with the exception of the middle one, are decided by a comparison with the cost of the piers; for it is evident that so soon as the increased expense in the roadway, by enlarging the spans, balances the economy produced by lessening the number of piers, any further increase of span would be wasteful.

Calculations, based upon this principle of reasoning, coupled to some extent with considerations based upon the advantages to be derived from having all the tubes as nearly alike as possible, have proved that the spans which have been adopted in the present design for all the side openings, viz: 242 feet, have produced the greatest economy. The centre span has been made 330 feet, not only for the purpose of giving every possible facility for the navigation, but because that span is very nearly the width of the centre and principal deep channel of the stream.

The correctness of the result of these calculations obviously depends upon the assumption that the roadway is not more costly than absolutely necessary; for if the comparison be made with a roadway estimated to cost less than the tubular one in the design, then the most economical span for the side openings would have come larger than 242 feet, and the amount of masonry might have been reduced below what is now intended. In considering the quantity of masonry in the design, you must, therefore, take it for granted for the moment that the *tubular roadway* is the cheapest and best that could be adopted, and leave the proof of this fact to the sequel of these remarks."

The Ice Breakers are next considered, and the value of the plans adopted as compared with the unwieldy "*islands*" of timber and stone at first proposed, as well as the comparative economy of the masonry, is made sufficiently apparent:

"It may perhaps appear to some in examining the design, that a saving might be effected in the masonry, by abandoning the inclined planes which are added to the up-side of each pier, for the purpose of arresting the ice, and termed 'Ice breakers.'

In European rivers, and I believe in those of America also, these 'Ice-breaker's are usually placed a little way in advance of, or rather above, the piers of the bridges, with a view of saving them from injury by the ice shelving up above the level of (frequently on to) the roadway.

In the case of the Victoria Bridge, the level of the roadway is far above that to which the ice ever reaches; and as the ordinary plan of "Ice-breakers" composed of timber and stone would be much larger in bulk, though of a rougher character, than those which are now added to the piers, I have reason to believe that they would be equally costly, besides requiring constant annual reparation; it was therefore decided to make them a part of the structure itself, as is now being done."

The comparison which Mr. Stephenson draws (relative to economy) between the "*Boiler Plate Girder*" as adopted for the Victoria

Bridge, and other methods of constructing iron superstructures, is exceedingly interesting:

"At present there may be regarded as existing three methods of constructing wrought-iron girders or beams for railway purposes.

FIRST,—The *Tubular Girder*, or what is sometimes called the *Box Girder*, when employed for small spans, with which may also be named the *Single-ribbed Girder*,—the whole belonging to the class known as '*Boiler Plate Girders*.'

SECOND,—The *Trellis Girder*, which is simply a substitution of iron bars for the wood in the trellis-bridges, which have been so successfully employed in the United States, where wood is cheap and iron is dear.

THIRD,—The *Single Triangle Girder*, recently called 'Warren,' from a patent having been obtained for it by a gentleman of that name.

Now in calculating the strength of these different classes of girders, one ruling principle appertains, and is common to all of them. Primarily and essentially the ultimate strength is considered to exist in the top and bottom,—the former being exposed to a compressive force by the action of the load, and the latter to a force of tension; therefore, whatever be the class or denomination of girders, they must all be alike in amount of effective material in these members, if their spans and depths are the same, and they have to sustain the same amount of load.

On this point I believe there is no difference of opinion amongst those who have had to deal with the subject. Hence, then, the question of comparative merits, amongst the different classes of construction of beams or girders, is really narrowed to the method of connecting the top and bottom *webs*, so called. In the tubular system, this is effected by means of continuous plates riveted together; in the trellis girders, it is accomplished by the application of a trellis-work, composed of bars of iron forming struts and ties, more or less numerous, intersecting each other, and riveted at the intersections; and in the girders of the simple triangular, or 'Warren' system, the connection between the top and bottom is made with bars,—not intersecting each other, but forming a series of equilateral triangles,—these bars are alternately struts and ties.

Now, in the consideration of these different plans for connecting the top and bottom *webs* of a beam, there are two questions to be disposed of; one is—which is the most economical? and the other—which is the most effective mode of so doing? But while thus reducing the subject to simplicity, it is of the utmost importance to keep constantly in mind that any saving that the one system may present over the other is actually limited to a portion, or per centage, of a subordinate part of the total amount of the material employed.

In the case now under consideration, namely, that of the Victoria tubes, the total weight of the material between the bearings is 242 tons, which weight is disposed of in the following manner:

	Tons.	
Top of Tube	76	
Bottom of Tube..................................	92	
		—168
Sides of Tube		84
Total tons		252

Assuming that the strain per square inch, in the top and bottom, is the same for every kind of beam,—say four tons of compression in the top, and five tons of tension in the bottom,—the only saving that can by any possibility be made to take place being confined to the sides, must be a saving in that portion of the weight which is only about 34 per cent. of the whole. How, therefore, can 70 per cent. of saving be realized, as has been stated, out of the total weight, when the question resolves itself into a difference of opinion on a portion which is only 34 per cent. of such weight?

I am tempted to reiterate here much that was said by several experienced Engineers on the subject, during the discussions already alluded to, at the Institution of Civil Engineers; but the argument adduced on that occasion could only be rendered thoroughly intelligible by the assistance of diagrams of some complexity, and I think sufficient has been said to demonstrate that no saving *of importance* can be made in the construction of the roadway of the Victoria Bridge, as it is now designed by the substitution of any other description of girder. Yet, lest this should be considered mere assertion, permit me to adduce one or two examples, where the close-sided tubular system, and the open-sided system, may be fairly brought into comparison with each other in actual practice.

The most remarkable parallel case which occurs to me is the comparison of the Victoria tubes under consideration, with a triangular or 'Warren' bridge, which has been erected by Mr. Joseph Cubitt over a branch of the river Trent, near Newark, on the Great Northern Railway.

The spans are very similar and so are the depths. In calling your attention to the comparison, you must bear in mind that all possible skill and science were brought to bear upon every portion of the details of the Newark Dyke Bridge, in order to reduce the total weight and cost to a minimum.

The comparison stands thus:

VICTORIA BRIDGE AS BEING ERECTED.

Span, 242 feet; weight, including bearings, 275 tons, for a length of 257 feet.

NEWARK DYKE BRIDGE AS ERECTED.

Span, 240 feet 6 inches; weight, including bearings, 292 tons, for a length of 254 feet,

which shews a balance of 17 tons in favor of the Victoria tubes.

The Newark Dyke Bridge is only 13 feet wide, while the Victoria tube is 16 feet, having a wider guage railway passing through it.

This is a very important case, as the spans and depths are all but identical, and it will therefore enable you to form a judgment upon that point which has caused so much controversy at the discussion alluded to. It is true that in the Newark Dyke Bridge a large proportion of the weight is of cast iron, a material I have frequently adopted in the parts of tubular bridges subjected to compression only, but from its brittle character I should never recommend it for exportation, nor for the parts of a structure that are liable to a lateral blow.

It has been suggested that there is much convenience in the arrangement of the trellis, or 'Warren' bridge, as it may be taken to pieces, and more conveniently and economically transported overland than 'boiler plates;' this may be correct under some circumstances, but it cannot hold good for a work like the Victoria Bridge over the St. Lawrence.

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Another example may be mentioned of a tubular beam, somewhat similar in dimensions to the last described, and one which is actually erected on a continuation of the same line of railway, as that on which the Newark-Dyke Bridge is situated, namely, over the river Aire at Ferry Bridge. Although the similarity is not so great with this as with the Victoria tube, yet I believe it is sufficiently so to form another proof that the advantage is in favor of the solid side.

As before:

NEWARK-DYKE BRIDGE.

Span, 240 feet, 6 inches; weight, 292 tons.

FERRY BRIDGE.

Span, 225 feet; weight 235 tons.

The difference between these weights is more than sufficient to compensate for the difference of span; besides which, in the Ferry bridge, made according to my designs and instructions, I was lavish in the thickness of the side-plates, and the bearings which are included in the above weight were stiffened by massive pillars of cast iron.

For a further example, let me compare the Boyne Trellis bridge (held by some to be the most economical) with the present Victoria tubes.

The Boyne Bridge has three spans, the centre one being 264 feet, and the height is 22½ feet. It is constructed for a double line of way, and is 24 feet wide. The total load, including the beam itself, the rolling load at two tons per foot, and platform rails, &c., amount to 980 tons, uniformly distributed.

The bridge is constructed upon the principle of "continuous beams," a term which signifies that it is not allowed to take a natural defection due to its span; but being tied over the piers to the other girders, the effective central span is shortened to 174 feet; in fact, this *principle* changes the three spans into five spans. Now the effective area given for compression in this centre span is 113½ inches, which gives a strain for the 174 feet span of nearly 6 tons to the inch in comparison.

The Victoria tubes are so dissimilar in form and circumstances, to the Boyne bridge, that it is a troublesome matter to reduce the two to a comparative state. However, the Victoria tubes are known to be 275 tons in weight—242 feet in span, and of 19 feet average depth, the strain not being more than 4 tons per inch for compression, with a uniform load of 514 tons, which includes its own weight, sleepers and rails and a rolling load of one ton per foot.

The Victoria Bridge has not been designed upon the principle of continuous beams for practical reasons, including the circumstance of the steep gradient, on each side of the centre span, and the great disturbance which would be caused by the accumulated expansion and contraction, of such a continuous system of iron-work, in a climate where the extremes of temperature are so widely apart; otherwise the principle alluded to, was first developed in tubular beams, namely in the Britannia bridge.

But since we are only now discussing the merits of the sides, let the Boyne bridge be supposed to have sufficient area in its top to resist 4 tons per inch, (the proper practical strain) and let the spans be not continuous; it will be found by calculation that the area required at top will be 364 inches, instead of 113½ inches, and the weight of the span would be found by calculation to come out little short of 600 tons; whereas it is now 386 tons; and if we suppose the Victoria tube to carry a double line of *way* and 24 feet wide with a depth of 22½ feet, even if we double the size in quantity, the whole amount of weight will be certainly very little more than 500 tons for 242 feet span.

It will be necessary to conclude my remarks, with some further observations relative to the comparisons under our notice, which are of vital importance in considering the design of such a bridge as that to be erected for the Grand Trunk Railway of Canada

Independently of the comparative weights and cost, which I believe have been fairly placed before you, the comparative merits as regards efficiency have yet to be alluded to.

You may be aware that at the present time, theorists are quite at variance with each other, as to the action of a load in straining a beam in the various points of its depth, and the fact is not known, that all the received formulæ for calculating the strength of a beam subjected to a transverse load require remodelling; therefore, at present it is far beyond the power of the designers of *trellis* or *triangular* bridges, to say with precision what the laws are which govern the strains and resistances, in the sides of beams, or even of *simple solid beams*, yet one thing is certain, which is, that the sides of all these trellis or "Warren" bridges are useless, except for the purpose of connecting the top and bottom and keeping them in their proper position; they depend upon their connection with the top and bottom webs, for their own support, and since they could not sustain their shape, but collapsed immediately they were disconnected from these top and bottom members, it is evident that they add to the strain upon them; and consequently to that extent reduce the ultimate strength of the beams.

In the case of the Newark Dyke Bridge, when tested to a strain of 6¾ tons to the inch, its deflection was 7 inches in the middle, and when tested with its calculated load of one ton per foot run, the deflection was 4⅜ inches. The deflection of the Victoria tubes by calculation will not be more with the load of one ton per foot, than 1·6 inch; and we have sufficient proof of the correctness of this calculation in existing examples. That of the Boyne bridge with a uniform load of 530 tons, was 1·9 inch with the spans shortened in effect as described.

Much misapprehension has existed in reference to Mr. Stephenson's estimate of the fitness of bridges built on the suspension principles for railway traffic, and opinions have been attributed to him quite adverse to their safety or practicability for railway purposes. The present success of the bridge over the Niagara River is pointed to as a refutation of his supposed opinions, and as evidence that a cheaper structure on similar principles might have been adopted for the Victoria Bridge.

We doubt whether Mr. Stephenson ever entertained opinions such as we have alluded to. He certainly did not express any doubt of their *practicability*, either in his evidence before the Committee of the House of Commons in relation to the Britannia Bridge, nor in his published history of the design for that work. On the contrary, he at one time contemplated using the Menai Bridge for the Railway, and was deterred from so doing by considerations apart from those of safety,* and we do not believe that any of the reasons

* "I thought also that that span (360 feet) could only be exceeded by the adoption of the Chain Bridge, which I do not approve of for the passage of locomotive engines" * * * "I have thought of adopting another plan in connection with suspension which would render the platform quite rigid; and if the platform be quite rigid, then I think the sus-

which influenced his decision on that occasion have been in any degree weakened by the successful use of the Niagara Bridge.

Whatever opinions may be entertained on that point, there can be only one in relation to the superior fitness of the "tubular" plan for the Victoria Bridge, as compared with the suspension principle, after reading the subjoined portion of Mr. Stephenson's report:

"Having given you my views with respect to the comparative merits of the different kinds of roadway, consisting of "beams" that may be adopted in the Victoria bridge, I now proceed to draw your attention to the adaptation of the "suspension" principle, similar to that of the bridge which has been completed within the last few months by Mr. Roebling, over the Niagara River, near the great "Falls."

You are aware that during my last visit to Canada I examined this remarkable work, and made myself acquainted with its general details, since then Mr. Roebling has kindly forwarded to me a copy of his last report, dated May 1855, in which all the important facts connected with the structure, as well as the results which have been produced since its opening for the passage of railway trains, are carefully and clearly set forth.

No one can study the statements contained in that report without admiring the great skill which has been displayed throughout in the design; neither can any one

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pension principle may be applied; but until it is made rigid, I have my doubts about it." In answer to the question, "Do you think the present Menai Bridge could be so altered and improved and strengthened as to be made able to support a Railroad?" Mr. Stephenson replied, "I think it might; but it would leave it merely a Suspension Bridge, which I do not like."—*Minutes of Evidence before the Select Committee on Railway Bills*, 1845.

In his history of the design of the Britannia Bridge, alluding to the difficult position in which he was placed by the requirements of the Admiralty, he says: "In this position of affairs I felt the necessity of reconsidering the question whether it was not possible to stiffen the platform of a suspension bridge so effectually as to make it available for the passage of railway trains at high velocities." * * * * "Amongst a variety of devices for the accomplishment of this object, the most feasible appeared to be the combination of the suspension chain with deep trellis turning, forming vertical sides traversed by the suspension rods from the chains, with cross bearing frames top and bottom to retain the sides in the proper position, thus forming a roadway surmounted on all sides by strongly trussed framework."

"A structure of this kind would no doubt be exceedingly stiff vertically, and has indeed been applied and successfully employed in America on a large canal aqueduct, and is clearly described in the 'Mechanics' Magazine' for 1846."

"The application, however, of this principle to an aqueduct is perhaps one of the most favourable possible, for there the weight is constant and uniformly distributed, and all the strains consequently fixed both in amount and direction: two important conditions in wooden trussing constructed of numerous parts. In a large railway bridge it is evident so far from these conditions obtaining under any circumstances, they are ever varying to a very large extent; but when connected with a chain which tends to alter its curvature by every variation in the position of any superincumbent weight, the direction and amount of the complicated strains throughout the framing become incalculable, so far as all practicable purposes are concerned." * * * * * "It was reverting to this bridge" (a small wrought iron box girder) "that led me to apply wrought iron with a view to obtaining a stiff platform to a suspension bridge, and the first form of its application was simply to carry out the principle described in the wooden suspended structure last spoken of, substituting for the vertical wooden trellis turning and the top and bottom cross beams, wrought iron plates riveted together with angle iron. The form which the iron now assumed was consequently a high wrought iron rectangular tube, so large that railway trains might pass through it, with suspension chains on each side."

who has seen the locality fail to appreciate the fitness of the structure for the singular combination of difficulties which are presented.

Your Engineer, Mr. Alexander Ross, has personally examined the Niagara Bridge since its opening, with the view of instituting, as far as is practicable, a comparison between that kind of structure and the one proposed for the Victoria Bridge; and as he has since communicated to me by letter the general conclusions at which he has arrived, I think I cannot do better than convey them to you in his own words, which are subjoined below:

"'I find from various sources that considerable pains have been taken to produce an impression in England in favour of a Suspension Bridge in place of that we are engaged in constructing across the St. Lawrence at this place. This idea, no doubt, has arisen from the success of the Niagara Suspension Bridge, lately finished by Mr. Roebling, and now in use by the Great Western Railway Company, as the connecting links between their lines on each side the St. Lawrence, about two miles below the great 'Falls,' of the situation and particulars of which you will no doubt have some recollection. I visited the spot lately, and found Mr. Roebling there, who gave me every facility I could desire for my objects. Of his last report on the completion of the work he also gave me a copy, which you will receive with this: I have marked the points which contain the substance of his statement. I also enclose an engraved sketch of the structure. Mr. Roebling has succeeded in accomplishing all he had undertaken, viz.: safely to pass over railway trains at a speed not exceeding five miles an hour; this speed, however, is not practiced,—the time occupied in passing over 800 feet is three minutes, which is equal to three miles an hour. The deflection is found to vary from 5 to 9 inches, depending on the extent of the load, and the largest load yet passed over is 326 tons of 2000 lbs. each, which caused a depression of ten inches. A precaution has been taken to diminish the span from 800 to 700 feet, by building up, underneath the platform at each end, about forty feet in length intervening between the towers and the face of the precipice upon which they stand; and struts have also been added, extending ten feet further. The points involved in the consideration of this subject are, first, *sufficiency*, and second, *cost*. These are, in this particular case, soon disposed of. First, we have a structure which we dare not use at a higher speed than three miles an hour; in crossing the St. Lawrence at Montreal we should thus occupy three-quarters of an hour; and allowing reasonable time for trains clearing and getting well out of each other's way, I consider that twenty trains in the twenty-four hours is the utmost we could accomplish. When our communication is completed across the St. Lawrence, there will be lines (now existing, having their termini on the south shore) which, with our own line, will require four or five times this accommodation. This is no exaggeration. Over the bridge in question, although opened only a few weeks, and the roads yet incomplete on either side, there are between thirty and forty trains pass daily. The mixed application of timber and iron in connection with wire, renders it impossible to put up so large a work to answer the purposes required at Montreal; we must, therefore, construct it entirely of iron, omitting all perishable materials; and we are thus brought to consider the question of cost. In doing which, as regards the Victoria Bridge, I find that, dividing it under three heads, it stands as follows:

First,—the approaches and abutments, which together extend to 3000 feet in length, amount in the estimate to..........................£200,000

Second,—the masonry, forming the piers which occupy the intervening space of 7000 feet between the abutments, including all dams and appliances for their erection £800,000
Third,—the wrought iron tubular superstructure, 7000 feet in length, which amounts to..£400,000
(About £57 per lineal foot.) ————
Making a total of £1,400,000

"By substituting a Suspension Bridge the case would stand thus:—The approaches and abutments extending to 3,000 feet in length being common to both, more especially as these are now in an advanced state, may be stated as above at £200,000.

"The masonry of the Victoria bridge piers ranges from 40 to 72 feet in height averaging 56 feet and these are 24 in number, the number required for a suspension bridge admitting of spans of about 700 feet, would be 10, and these would extend to an average height of 125 feet.—These 10 piers, with the proportions due to their height and stability, would contain as much (probably more) masonry as is contained in the 24 piers designed for the Victoria bridge, and the only item of saving, which would arise between these, would be the *lesser* number of dams that would be required for the suspension piers; but this I beg to say, is more than doubly balanced by the excess in masonry, and the additional cost entailed in the construction, at so greatly increased a height. Next as to the superstructure, which in the Victoria bridge costs £57 per lineal foot.—Mr. Roebling in his report states the cost of his bridge to have been $400,000 which is equal to £80,000 sterling. Estimating his towers and anchor masonry at £20,000 which I believe is more than their due:—We have 60,000 left for the superstructure, which for a length of 800 feet is equal to £75 per lineal foot, giving an excess of £18 per foot over the tubes of which we have 7,000 feet in length.—By this data, we show an excess of nearly 10 per cent. in the suspension as compared with the tubular principle, for the particular locality with which we have to deal, besides having a structure perishable in itself, on account of the nature of the materials; and to construct them entirely of iron, would involve an increase in the cost which no circumstance connected with our local or any other consideration at Montreal, would justify. We attain our ends by a much more economical structure, and what is of still greater consequence a more permanent one; and as Mr. Roebling says, no suspension bridge is safe without the appliances of stays from below, no stays of the kind referred to could be used in the Victoria Bridge,—both on account of the navigation and the ice, either of which, coming in contact with them, would instantly destroy them. No security would be left against the storms and hurricanes so frequently occurring in this part of the world.

"'No one, however, capable of forming a judgment upon the subject, will doubt for one moment the propriety of adopting the suspended mode of structure for the particular place and object it is designed to serve at Niagara. A gorge 800 feet in width and 240 in depth, with a foaming cataract racing at a speed from 20 to 30 miles an hour, underneath, points out at once that the design is most eligible; and Mr. Roebling has succeeded in perfecting a work capable of passing over ten or twelve trains an hour, if it should be required to do so. The end is attained by means the most applicable to the circumstances; these means, however, are only applicable where they can be used with economy, as in this instance.'

"My own sentiments are so fully conveyed in the above extract from Mr. Ross' letter, that I can add no further remark upon the subject, except perhaps that there appears to be a discrepancy in that part which relates to cost.

In dividing the £80,000 into items, Mr. Ross has deducted £20,000 for masonry, and left the residue, £60,000, for the 800 feet of roadway. Now it appears evident that this amount should include the cost of the "land chains;" and assuming their value at about £15,000, there would be only £45,000 left for the 800 feet of roadway, thus reducing the cost per lineal foot to about that of the tube. But in the application of a suspension bridge for the St. Lawrence the item £15,000 for "land chains" would of course have to be added to the cost of the 7,000 feet of roadway, which would swell the amount per foot to a little over that of the tubes."

* * * * * * * * *

"I entirely concur in what Mr. Ross says respecting the propriety of applying the suspension principle to the passage across the Niagara gorge; no system of bridge building yet devised could cope with the large span of 800 feet which was then absolutely called for, irrespective of the other difficulties attended to.

"Where such spans are demanded, no design of beam with which I am acquainted would be at all feasible. The tube, trellis, and triangular systems are impracticable in a commercial sense and even as a practical engineering question the difficulties involved are all but insurmountable.

"Over the St. Lawrence we are fortunately not compelled to adopt very large spans, none so large in fact as have been already accomplished by the simple '*Girder*' system It is under these circumstances that the suspension principle fails, in my opinion, to possess any decided advantage in point of expense, whilst it is certainly much inferior as regards stability for railway purposes. The flexure of the Niagara Bridge, though really small, is sufficiently indicative of such a movement amongst the parts of the platform as cannot fail to augment where *wood* is employed, before a long time elapses.

"I beg that this observation may not be considered as being made in the tone of disparagement; on the contrary, no one appreciates more than I do the skill and science displayed by Mr. Roebling in overcoming the striking enginnering difficulties by which he was surrounded; I only refer to the question of flexure in the platform as an unavoidable defect in the suspension principle, which from the comparatively small spans that are available in the Victoria Bridge may be entirely removed out of consideration."

It may be questioned whether the circumstances of the railway traffic demanded the immediate construction of a railway bridge at Montreal of any description, but it is not our purpose to discuss that question here. We feel confident, however, that the exceedingly expensive structure now being erected cannot be justified while a much less costly one was within reach. While fully admitting the force of all Mr. Stephenson's arguments in favour of the tubular principle, as in comparison with other principles of construction in iron, and as compared with the suspension principle for the particular case in question, we regret that he did not more fully consider the fitness of a wooden superstructure, which we feel convinced would have met every exigency of the case; and under careful supervision and due watchfulness against fire, if properly constructed, would have been free from all the objections as to flexure, and consequent decay, which Mr. Stephenson urges against wood as applied to suspension bridges, and would have endured until a more complete development of the railway traffic might warrant the enormous expenditure now being incurred;—thus saving a present outlay of upwards of £300,000.

A. B.

SCIENTIFIC AND LITERARY NOTES.

GEOLOGY AND MINERALOGY.

NEW CRUSTACEANS FROM THE SILURIAN ROCKS OF SCOTLAND.

The February Number of the Quarterly Journal of the Geological Society of London, contains a series of papers of much interest on several new forms of Crustacea from the Parish of Lesmahago in Lanarkshire. These were discovered by Mr. Robert Slimon. The beds in which they occur have been examined by Sir Roderick Murchison and Professor Ramsay, who consider them to belong to the top band of the Upper Silurians—the equivalents of the "Tilestones" or Upper Ludlow series, previously unrecognised in that part of the country. The fossils discovered by Mr. Slimon have many apparent affinities with Eurypterus or Pterygotus. As shewn by Mr. Salter, however, they constitute no less than five distinct species of a new genus, named by him, *Himantopterus*, from the peculiar thong-like aspect of the swimming feet. The eyes are apparently situated on the extreme lateral margin of the anterior portion of the head-shield: a character serving to distinguish these new forms very readily from Eurypteri, which, otherwise, in general appearance they much resemble. Of the chelate antennæ, however, there appears to have been only a single pair. The largest of the discovered species is considered to have been at least three feet in length. Professor Huxley has appended some very able remarks to Mr. Salter's descriptions, in which he points out many striking relations between this new genus Himantopterus, and a particular section of the Stomapods on the one hand, and certain larval forms of Macroura (the "zoæa" of a few years' back) on the other. Amongst the Lanarkshire specimens also, discovered by Mr. Slimon, were some very complete forms of the genus *Ceratiocaris* of M'Coy, previously very imperfectly known.

ASAPHUS CANADENSIS.

Specimens of *Asaphus platycephalus*—the *Isotelus gigas* of many authors, are well known to abound amongst the trilobites from the Utica Schist of Whitby, Port Hope, &c., in Canada West. After *Triarthrus Beckii*, the species in question is perhaps the most abundant fossil of these localities. The principal feature in *Asaphus platy-*

cephalus, at least in adult individuals, is the comparatively undivided character of the caudal shield. In the Whitby schists, however, trilobites occur, over seven or eight inches in length (if not longer,) with the caudal extremity not only distinctly tri-lobed, but also marked with numerous and distinct pleuræ extending almost to the edge of the striated limb; whilst at the same time, they agree in all other respects with *A. platycephalus*. In the union of the facial suture above the glabella, for example, the two are alike; and in the peculiar character of the body-segments and pleuræ, not the slightest difference is perceptible. As no figure of this trilobite is given in Hall's Palæontology, and as the form appears to differ from the figured European species, we propose to confer upon it provisionally the name of *Asaphus Canadensis*. If it be really new, it may be placed as the type of a particular sub-division of the Asaphidæ, in accordance with the following scheme:—

Asaphidæ with facial sutures united:

§1. *Pygidium, undivided:*—Type, *A. platycephalus.*

§2. *Pygidium with grooved axis:*—Type, *A. expansus.*

§3. *Pygidium with grooved axis and pleuræ:*—Type, *A. Canadensis.* A drawing of this latter species will be given in the second part of our Paper on the Trilobites.

MINERALOGICAL NOTICES.

Dufrenoysite:—Ch. Heusser has communicated to Poggendorff's Annalen (1856, No. 1.) some additional information on the crystallization of Dufrenoysite [2 (PbS) + As^2 S^3] from the dolomite of the Binnenthal. He confirms the Monometric character of the mineral; but, in addition to the forms hitherto discovered, *viz:*—the rhombic dodecahedron, and the leucitoid 2-2, he announces the cube, the octahedron, a second leucitoid 6-6, and a trisoctahedron $\frac{3}{2}$. Hardness, 4·5

Binnite:—Heusser has also subjected to a detailed examination, the steel-grey metallic sulphide which often accompanies the Dufrenoysite at the above locality. This mineral has been known in Switzerland for some time under the name of Binnite. It occurs in very small and longitudinally striated prisms of extreme brittleness. Streak, dark-red, much darker than that of Dufrenoysite; specific gravity (according to an earlier determination of Von Waltershausen on specimens taken by him for Dufrenoysite) = 4·477. These latter specimens, according to Uhrlaub, contained sulphur, arsenic and copper, with a mere trace of lead. The system of crystallization of Heusser's specimens, was apparently Trimetric, but the prism-angle could not be obtained, owing to the striæ on the faces. The measured angles, those of a series of domes, but whether macrodomes or brachydomes not determinable, did not accord with the measurements obtained by Von Waltershausen. An examination of further specimens is consequently desirable

Hyalophane:—The dolomite of this same locality furnished to Von Waltershausen another mineral, which he described as new, under the name of Hyalophane. It was thought to contain: SiO^3, Al^2O^3, CaO, MgO, NaO, BaO, SO^3, and HO. Heusser has shewn, however, that it is simply an adularia variety of Orthoclase, containing accidental particles of Iron pyrites, and interpenetrated by Dolomite and Heavy Spar. Seven distinct crystals carefully freed from these impurities, and tested respectively by the blowpipe, did not yield the slightest trace of sulphur.

Rhodonite:—Crystals of the Silicate of Manganese, or Rhodonite, are, it is well-known, of rare occurrence. From those hitherto met with, and from the cleavage planes of massive specimens, the crystallization of the mineral has been long considered identical with that of Augite or Pyroxene: a supposition apparently confirmed by the similarity of atomic constitution exhibited by these bodies. An examination of some very perfect specimens, however, obtained from Phillipstadt in Sweden, has shewn Mr. R. P. Grey (Phil. Mag. March, 1856) that the crystallization is triclinic. The inclinations of the three assumed pinacoids (or terminal pairs) gave, respectively :—87°20', 86°10', 110°40'.

Voigtite:—Under this name (in honor of Voight, a writer who obtained some notice at the close of the last century, as an opponent of the Wernerian doctrines,) Schmid has described a micaceous mineral from a granitic mass, forming part of the Ehrenberg, in the Duchy of Saxe-Weimar. It occurs in small scales, of a brown colour, and opaque; but is usually much weathered. H. a little over 2·0; Sp. gr. =2·91. Readily fusible. The analysis yielded:—SiO^3 33·83, Al^2O^3 13·40, Fe^2O^3 8·42, FeO 23·01, MgO 7·54, CaO 2·04, NaO 0·96, HO 9·87, = 99·07. It may be regarded, perhaps, as simply a ferruginous variety of Chlorite.

Volknerite:—Rammelsberg has examined the substance originally named Hydrotalcite by Hochstetter—the Volknerite from Snarum in Norway. He confirms Hermann's statement as to the accidental nature of the carbonate of magnesia present in the mineral; but his analysis leads to the formula Al^2O^3, 3 HO + 5 (MgO, 2HO,) or nearer still, to MgO, Al^2O^3+4 (MgO, 3HO,) in place of Al^2O^3, 3HO + 6 (MgO, 2HO) given by Hermann.

Boronatrocalcite or Ulexite:—Rammelsberg has also analysed the supposed Borocalcite from the plains of Iquique in Southern Peru. He finds that soda is really one of its constituents; and that when freed from impurities, its composition may be expressed by the following formula: [NaO, $2BO^3$ + 2 (CaO, $2BO^3$)] + 18HO. This corresponds to BO^3 45·63, CaO 12·26, NaO 6·79, HO 35·32. As the present mineral is thus distinct from Hayesine, Dana's original name of Ulexite should be re-conferred upon it.

Schaumkalk:—This substance has been hitherto regarded as a pseudomorphous variety of calc spar after fibrous gypsum. G. Rose has lately shewn, that it belongs properly to Arragonite; and he calls attention to the fact that it constitutes the first recognized example of an arragonite pseudomorph. Fossil shells converted into arragonite, are, however not unknown.

Torbane-Hill Mineral:—The substance, thus named, still continues to attract, from time to time, the attention of the scientific world. Geuther in his Inaugural Dissertation (Ueber die Natur und Distillationsproducte des Torbanehill-minerals: Gottingen, 1855,) declares, as the result of an elaborate series of experiments, that the matter in question is simply a bituminous shale. This, is the view almost universally adopted in Germany: a view, which in the end we are convinced, will prevail everywhere. It is only by denying altogether the existence of bituminous shale, that the present substance can with any consistency be entitled to the name of coal. Specimens may be seen in the collection of the Canadian Institute.

E. J. C.

ETHNOLOGY AND ARCHÆOLOGY.

CRANIA OF THE ANCIENT BRITONS.

Mr. Joseph Barnard Davis submitted to the British Association at the Glasgow meeting, a series of remarks and deductions relative to the forms of the Crania of the Ancient Britons chiefly founded upon his observations of a skull derived from the

Green-Gate-Hill Barrow, near Pickering. The following abstract of this communication is made from a copy transmitted by Mr. Davis to the Editor, and some portions of it will not be without value in relation to our own Canadian ethnological investigations and deductions. An observant eye, he remarks, is able to discriminate between natives of the different provinces of the same country, therefore a more comprehensive investigation of the bones of the face and head will lead to reliable conclusions respecting their specific forms. By extended observation, by keeping close to the teachings of the physical phenomena, and by regarding the information to be derived from history, philology and antiquities, more as illustrative and accessory, we may hope to obtain more definite and conclusive knowledge. In explanation of the uncertainty in which the subject is at present involved, he remarks:—1. *Data have been inadequate*, and from this scarcity of authentic data, observations have deen disconnected and immature. 2. *Study has been too much separated from that of human skulls in general.* Taken up more as an antiquarian than anatomical or ethnological inquiry. 3. *Little attention has been paid to discrimination of sexes and ages.* Some archæologists of great learning have entirely passed these over, yet the cranium undergoes important modifications in the course of development and growth, not ceasing even in old age. These changes render it necessary to select examples from the middle and mature season of life. Attention to sex is even of greater moment, as, if disregarded, errors may be induced extending to an entire class. The skulls of women seldom exhibit the normal and characteristic ethnic features markedly, and should be employed sparingly. 4. A prolific source of error consists in *overlooking the great diversities of form which present themselves regularly in every family* of the European races, and assuming that we shall find the cranial character more stereotyped as we ascend to primitive times. This assumption has probably led men of great distinction, upon slender evidence for the difference of antiquity of certain skulls, to refer them to a succession of races. 5. *More definite views that prevail on primæval antiquities have dissipated certain preconceptions* concerning cromlechs and kistvaens, and the rites to which they were destined; have proved that cremation and inhumation were practised contemporaneously from the earliest periods; and that the doctrine of the ages of Stone, Bronze and Iron, if not received too exactly and employed too readily in solving difficult problems, is in the main true. Probably until these advances had been made in archæology, the study of ancient crania could not have been profitably undertaken.

From these impediments it must not be inferred there are no fixed principles in the investigation. For,—1. Although it must be admitted there is considerable diversity of form amongst the crania of even one people, *extensive observation enables us to perceive the general characteristic marks which appertain to them.* 2. Whether the origin of the human race is regarded as one of the arcana of nature enshrouded in primæval obscurity, wholly impenetrable, or not, we are constrained to admit that *marked dissimiliarities have existed from the most remote periods.* 3. Another, equally essential, is *the law of permanence of ethnic forms;* that the characters impressed upon races are not transmutable, but constant. This law has been the subject of much controversy, but the facts adduced against it appear too dubious, unimportant, and few, to shake its stability; a stability uniform with that observed in all the other divisions of nature, and not to be successfully assailed by the hypothesis of development.

The best course to be pursued in the study of the ancient British skull is to determine the *normal form*, and then to ascertain the usual deviations from it. This simple method, which has been employed in the elucidation of other natural objects, will reduce the subject to as great order as it admits of, and render description and delineation easy to be understood. A knowledge of the general character of the British skull is not to be obtained from the examination of those belonging to one tribe only, but from a comparative investigation of crania derived from many. It is believed by Mr. Davis that a skull derived from the Green-Gate-Hill Barrow, exhibits the true *typical form* of the ancient British cranium. Its most marked distinctive features are, the shortness of the face, which is, at the same time, rugged with elevations and depressions, the indications of wild passions operating on the muscles of expression; zygomatic arches not unusually expanded; the nose short, projecting at an angle too great to be graceful; immediately above its root rises an abrupt prominence occasioned by the large frontal sinuses, which passes on the sides into the elevated superciliary ridges, and produces a deep depression between the nose and forehead, giving to the profile a savage character; the osseous case for the brain upon the whole not large, rather than small; the occipito-frontal diameter somewhat contracted, and parietal diameter good. It ranges with the *orthognathic* crania, or those having upright jaws, and inclines to the *brachy-cephalic* division. It presents the uncivilized character, but from the mass of the brain it has evidently belonged to a savage possessed of power, and fitted to profit by contact with men of other races.

Having thus enumerated the chief peculiarities of the *typical* British cranium, Dr. Davis remarks; we may advert to its leading *aberrant forms*, which admit of being arranged in a simple intelligible method. They will be easily understood as the *abbreviated*, or strictly *brachy-cephalic*; the *elongated*, or *dolicho-cephalic*; the *elevated*, or, to continue the terms, the *acro-cephalic*; and the *expanded* or *platy-cephalic*.

It must be added, however, such a system as that adopted by Mr. Davis here, of classing under the convenient title of "*aberrant forms*" cranial peculiarities of the widest possible diversity, seems irreconcileable with the law of permanence of ethnic forms. Unless indeed guarded to an extent not at all apparent in the above remarks, it would put an end to all ethnical deductions from cranial or osteological evidence. The grounds, however, on which so comprehensive a statement is based may be looked for in the forthcoming "*Crania Britannica*" of the author. Meanwhile he thus partially alludes to some of them:—

Notwithstanding these aberrant forms, the whole series bears the impress of so many similar features, as to shew that it constitutes one natural group. The dolicho-cephalic has been supposed to indicate an "Allophylian" or "pre-Celtic" race, but it may probably be regarded as more properly a family peculiarity in some cases, and accidental in others, in which it has been met with in the same Barrow, and in a position proving the interment to be equally ancient, with a calvarium of the normal form. Stress has been laid upon the circumstance that it has occurred in *Chambered Barrows*, resembling the famous one of New Grange. The best informed antiquaries accord to these Barrows an extremely early date, but, that they have altogether preceded simpler and ruder sepulchral cairns, and were erected by a distinct antecedent race, appear to stand in need of much confirmatory evidence before they can be admitted with tolerable confidence.

D. W.

CHEMISTRY.

Soft Sulphur.—Baudrimont has found that fresh soft sulphur left for five or six days in contact with oil of turpentine in a closed tube, becomes opaque and covered with small transparent brilliant crystals, which are also deposited on the sides of the tube They are modifications of the symmetrical octohedron. This arises probably from the greater solubility of soft sulphur in oil of turpentine —*Comptes Rendus, Ap.* 28.

Carbonic Oxide.—Grimm and Ramdohr, have found that the Carbonic Oxide gas, prepared by Fownes' process (heating 1 part ferrocyanide of potassium with 9 parts concentrated sulphuric acid,) is not quite pure, containing a small quantity of carbonic as well as of sulphurous acid. It may be perfectly purified by solution of potassa.—*Ann. d. Ch. u. Ph*, *Ap.*, 1856

Bone Earth.—Wöhler has found that bone-dust if left some time in contact with water gives up a certain proportion of the phosphates of lime and magnesia. The same result is obtained if the water be perfectly freed from carbonic acid by long boiling. The quantity dissolved seems to increase, as the organic matter putrifies This fact is of considerable importance in reference to agriculture.—*Ann. d. Ch u. Ph. Ap.* 1856.

Pure Silver.—Wicke dissolves the alloy of copper and silver in nitric acid, precipitates with hot solution of carbonate of soda, boils the precipitate with a solution of grape sugar by which the copper is obtained in the form of suboxide and the silver as metal. The precipitate is treated with a hot solution of carbonate of ammonia, which dissolves the oxide of copper but none of the silver.—*Ann. d. Ch. u. Ph. Ap.*, 1856.

Test for Iodine.—Liebig recommends the addition of a small quantity of an alkalic iodate. followed by sulphuric or muriatic acid to a solution containing so small a quantity of iodide that no coloration is produced by starch and nitric acid; in this case a much deeper colour is produced. Neither iodic acid nor iodide of potassium produces any colour with muriatic acid and starch paste, The mother liquors of some mineral springs produce the colour without the addition of the iodate; they must contain some substance which acts in a similar manner, possibly nitrates.—*Ann. d. Ch. u. Ph. Ap.*, 1856.

Determination of Chlorine.—Level has described a method of determining chlorine by means of a normal solution of nitrate of silver, in which he renders the completion of the precipitation perceptible by an addition of phosphate of soda, the presence of an excess of silver being indicated by the yellow tint of the precipitate. This colour being very faint, Mohr recommends the use of chromate of potash, the red colour of the chromate of silver becomes perceptible when a very minute excess of the silver solution has been employed. The chromate and not the bichromate should be used and the solution must not be acid. Mohr has employed the process in the examination of urine, well water, mineral waters, saltpetre, potashes, soda, and chlorate of potash, and always with concordant results.—*Ann. d. Ch. u. Ph. Ap.*. 97.

Silvering.—Liebig has given valuable directions for silvering glass mirrors in the cold, the silvering is effected by a solution of ammoniacal nitrate of silver. excess of caustic potassa and milksugar.—*Ann. d. Ch. u. Ph., April*, 1856, *Ch. Gaz.* 327.

Furfurine.—Svanberg and Bergstrand have examined the sulphate, phosphates and tartrate. The formula they give to the alkaloid is $C^{30} H^{12} O^{6} N^{2}$.—*Ch. Gaz.* 324.

New Alcohols.—Cahours and Hoffmann have discovered a new alcohol belonging to a new series which they term the Acrylic series. By distilling glycerine Redtenbacher obtained acroleine which with oxide of silver yields acrylic acid, standing therefore in the relation of aldehyde to acetic acid, the formulæ being $C^{6} H^{4} O^{2}$ and $C^{6} H^{4} O^{4}$. Berthelot and DeLuca by acting on glycerine with iodide of phosphorus obtained iodide of propylene (acryle) $C^{6} H^{5} J$, an analogue of the chloride and bromide already known. The researches of Will and Wertheim shewed a connection between acroleine compounds and the oils of mustard and garlic, the latter being $C^{6} H^{5} S$, and the former $C^{6} H^{5} S, NS^{2}$, this same compound has been obtained by Berthelot and De Luca, by the action of iodide of propylene on sulphocyanide of potassium. Cahours and Hoffmann have now succeeded in obtaining the alcohol of this series, $C^{6} H^{6} O^{2}$.

By acting on oxalate of silver with iodide of acryl the oxalate of acryl is obtained, this with ammonia gives oxamide and the alcohol, the latter with potassium gives hydrogen and the potassium-acrylic-alcohol, this with the iodide gives the ether, or with ethylic iodide the double ether; if the alcohol be distilled with chloride, bromide or iodide of phosphorus, the chloride, bromide or iodide is obtained. A coupled sulphuric acid is also easily formed, also a compound corresponding to xanthic acid. The following ethers have been prepared: oxamate, carbonate, benzoate, acetate and cyanate. This latter with ammonia gives acrylic urea, corresponding to the long known sulphur-urea term of this series, viz: thiosinnamine. With aniline a similar compound is generated. With water or with solution of potassa, the cyanate gives diacrylic urea or sinapoline, in the latter case various volatile bases are also formed, viz: methylamine, propylamine and acrylamine.

This new alcohol will therefore be the third term in a series represented by the formula $C^{n} H^{n} O^{2}$, while the ordinary alcohols are $C^{n} H^{n+2} O^{2}$.—*Ch. Gaz* 324.

Berthelot and De Luca in pursuing their investigations above referred to, have arrived at similar results, but do not appear to have obtained the alcohol. By the action of sodium on the iodide they obtained acryl or allyl as they term it, employing the old name originally proposed by Will and Wertheim.—*Ch. Gaz.* 325.

Chlorides and Bromides of Organic Radicals.—Béchamp has obtained the chlorides of cinnamyle, benzoyle, valeryle, butyryle, propionyle, and acetyle, and the bromides of valeryle, butyryle and acetyle, almost in the quantity indicated by theory, by distilling the monohydrated acids with the protochloride or protobromide of phosphorus, in the proportions corresponding to the following equation $2\ RO, HO + P\ Cl^{3} = Cl\ H + PO^{3}, HO + 2\ R\ Cl$.

The mixture is gently heated as long as hydrochloric acid is evolved, the volatile chloride distilled off from the mixture, or if it separates as a distinct layer, it is decanted and rectified by itself. This plan is better as the phosphorous acid is apt to evolve phosphuretted hydrogen towards the end of the distillation. The compounds whose boiling points differ most from that of the chloride or bromide of phosphorus, are most readily obtained.—*Ch. Gaz.* 325.

Anisoic Acid.—By the action of weak nitric acid upon oil of anise, Limpricht has obtained a compound to which he gives the above name, and which seems to be the first product of oxidation, preceding anisaldehyde. Anisoine $C^{20} H^{12} O^{2}$+ 6 HO+4 O=$C^{20} H^{18} O^{12}$. He has examined several of the salts, the silver compound is $C^{20} H^{17} O^{11}$, Ag O.—*Ch. Gaz.* 325.

Anilotic Acid.— Major has examined the acid obtained by Piria by the action of nitric acid upon salicine, to which he gave the above name, and states it to be identical with nitrosalicylic. Piria denies this, and recommends for its formation the following process: Into a stoppered bottle, 1 part of powdered salicine and 6 to 8 parts of nitric acid of 20° B are put, the bottle is closed and placed in a cool place, hyponitrous acid is formed, the fluid becomes green, and after some time crystals of anilotic acid separate. If the process be conducted in an open vessel, the liquid becomes yellow, and helicine is formed. The properties of the acid are described.—*Ch. Gaz.*, 325.

Arachic Acid.—Scheven and Gössmann have described the salts, ether, amide and glyceride of the above acid. Its formula is $C^{40}H^{40}O^{4}$; the acid is obtained from ground nut oil.—*Ch. Gaz.*, 326.

Ethylamine.—Emil Meyer has described various salts and double salts of this base, with phosphoric, sulphuric and molybdic acids, &c., &c.—*Ch. Gaz.* 327.

Acids in the Animal Organism.—Bertagnini finds that camphoric acid passes unchanged into the urine, the anhydrous acid becomes hydrated, anisic acid passes unchanged, salicylic acid rapidly passes into the urine as indicated by the iron test, but a portion becomes converted into a new compound which he calls salicyluric acid, having taken up the elements of glycocine and lost two equivalents of water. The acid can be separated by evaporating the urine, separating from the salts, acidulating with hydrochloric acid, shaking with ether, evaporating, and recrystallizing. The salicylic acid is removed by heating to 284—302 F in a current of air,—the residue is decolorized and crystallized. The formula is $C^{18}H^{9}NO^{8}$.—*Ch. Gaz.*, 325.

Saponification.—Pelouze finds that fats can be readily saponified by the anhydrous oxides or their hydrates in a solid form, if the mixture be heated to 482° F. With suet the soap formed yields from 95 to 96 per cent. of the suet operated on. During the reaction a white smoke is evolved with an odour of burnt sugar, that of acetone is also perceptible. 10 parts of anhydrous lime are sufficient for 100 parts of suet, with 12 or 14 the reaction takes place with much greater facility; but on operating with large quantities it is difficult to keep within bounds so as to prevent decomposition.

Slaked lime in the proportion of 10 to 12 per cent. rapidly saponifies fats at a temperature between 410° 447° F. Two pounds of suet with 120 grammes of slaked lime were saponified in one hour; if the temperature be raised rapidly to 482°, the process may be completed in a few minutes.

This fact promises to be of very great importance to the manufacturers of the so-called stearine candles.

H.

MONTHLY METEOROLOGICAL REGISTER, AT THE PROVINCIAL MAGNETICAL OBSERVATORY, TORONTO, CANADA WEST—MAY, 1856.

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

Day.	Barom. at temp. of 32°.				Temp of the Air.				Mean Temp +or— of the Av'age.	Tens. of Vapour.				Humidity of Air.				Direction of Wind.			Mean Direction.	Velocity of Wind.				Rain in Inches.	Snow in Inches.
	6 A.M.	2 P.M.	10 P.M.	MEAN	6 A.M	2 P.M	10 P.M	ME'N		6 A.M	2 P.M	10 P.M	M'N	6 A.M	2 P.M	10 P.M	M'N	6 A.M.	2 P.M.	10 P.M.		6 A.M	2 P.M	10 P.M	ME'N		
					°	°	°	°	°												°						
1	29.858	29.723	29.556	29.6945	46.7	48.2	45.2	46.10	— 0.32	.193	.228	.279	.236	.62	.74	.94	.77	E N E	E	E	E 4 N	24.8	24.2	16.0	20.89	0.790	...
2	.373	.357	.438	.3907	40.6	46.1	45.3	44.08	— 2.63	.238	.286	.265	.262	.95	.93	.89	.92	E	E b N	E N E	E 23 N	17.8	10.6	7.2	10.25	.195	...
3	.172	.541	.599	.5468	44.5	50.8	43.8	46.30	— 0.75	.226	.233	.226	.216	.78	.64	.80	.70	N N E	S S W	N b W	N 10 W	10.4	11.5	12.4	11.91	...	...
4	.698	.661	—	—	39.2	51.2	—	—	—	.131	.151	—	—	.54	.40	—	—	N W b N	N N W	N	N 22 W	11.8	22 2	12.9	15.62	...	...
5	.810	.898	.969	.8922	41.8	49.2	40.0	44.27	— 3.42	.104	.199	.164	.179	.63	.57	.67	.62	N b W	S b E	E b N	E 9 N	11.1	11.6	3 6	8.77	...	...
6	.950	.815	.697	.8138	41.6	49.8	49.9	48.08	+ 0.05	.126	.150	.225	.175	.48	.42	.64	.53	E b N	E	E N E	E 11 N	9.0	21.6	8.9	12.47	...	...
7	.639	.569	.514	.5705	48.2	58.4	46.5	50.00	+ 1.58	.186	.198	.190	.193	.56	.43	.61	.55	E b N	E	Calm.	E 9 N	10.2	21.8	0.0	10.47	...	...
8	.491	.524	.520	.5133	44.9	45.6	45.4	45.10	— 3.68	.222	.257	.261	.249	.75	.85	.87	.84	E b N	E b N	N E	E 24 N	12.8	14.4	6.5	11.01	.330	...
9	.520	.546	.566	.5442	42.0	46.5	41.3	43.12	— 6.05	.231	.264	.230	.239	.87	.84	.89	.86	E N E	E N E	E	E 22 N	10.5	7.4	3.0	5.28	.095	...
10	.483	.509	.480	.4982	44.3	57.7	57.1	54.47	+ 4.97	.262	.309	.229	.264	.91	.66	.50	.64	N W b N	S S W	N b W	N 29 W	3.2	8.8	8.3	9.43	...	...
11	.499	.455	—	—	55.6	67.5	—	—	—	.361	.356	—	—	.83	.54	—	—	N N W	S W b S	N W b N	W 34 N	11.4	7.2	3.5	5.99	...	...
12	.486	.661	.716	.6262	55.5	45.8	46.8	49.83	— 0.33	.254	.189	.234	.225	.60	.62	.74	.64	N W b W	N b W	N	N 11 W	9.6	14.5	11.4	14.21	.033	...
13	.776	.838	.838	.8298	41.8	47.4	43.4	45.28	— 5.28	.183	.227	.227	.219	.70	.71	.82	.74	N	E	E N E	E 16 N	5.5	9.2	4.7	6.45	...	...
14	.801	.697	.650	.7127	46.0	58.9	51.7	52.73	+ 1.85	.253	.347	.335	.317	.82	.71	.89	.81	E N E	E b S	S S E	E 14 S	6.0	8.9	1.2	4.67	.235	...
15	.590	.488	.533	.5380	51.7	62.1	60.7	58.62	+ 7.33	.345	.383	.444	.391	.91	.70	.86	.81	Calm.	S W b S	N W b N	W 30 S	0.0	16.1	10.5	9.14	.125	.
16	.709	.677	.641	.6700	46.7	57.1	46.0	50.58	— 1.00	.307	.335	.209	.282	.97	.73	.69	.77	N b W	S b W	N	N 11 W	13.6	4.0	13.8	7.25	...	.
17	.608	.494	.369	.4865	45.6	58.1	55.6	54.25	+ 2.27	.206	.284	.392	.302	.68	.60	.90	.72	N N E	E b N	E N E	E 17 N	6.1	10.2	10.5	8.88	2.135	..
18	.364	.433	—	—	56.7	57.6	—	—	—	.423	.417	—	—	.94	.90	—	—	N E b N	E b S	W S W	N 32 W	4.2	0.4	0.6	1.35	.025	..
19	.404	.296	.276	.3210	52.1	61.8	60.0	57.85	+ 5.23	.372	.437	.276	.361	.97	.81	.54	.77	W b N	S	W N W	W 20 S	2.0	14.6	10.3	9.92	...	...
20	.388	.480	.595	.5012	55.8	64.3	49.9	56.50	+ 3.48	.327	.217	.149	.227	.75	.42	.41	.50	N N W	N N W	N b W	N 19 W	15.4	20.5	11.2	13.84	...	...
21	.736	.759	.778	.7613	45.6	51.3	48.5	49.58	— 3.73	.152	.223	.223	.208	.51	.60	.66	.60	N	S b W	N b W	N 28 W	8.4	9.0	10.1	7.70	...	..
22	.856	.775	.874	.7693	46.0	61.6	50.0	53.88	+ 0.18	.209	.310	.240	.251	.68	.58	.68	.62	Calm.	S S E	S S W	S 17 W	0.0	4.8	2.0	3.24	...	..
23	.647	.580	.652	.6100	56.0	74.3	61.4	63.72	+ 9.75	.304	.394	.504	.398	.69	.48	.95	.71	S W b W	S W b S	S W b W	S 41 W	1.5	15.2	10.0	7.23	.110	...
24	.479	.417	—	—	60.7	80.1	—	—	—	.399	.443	—	—	.77	.44	—	—	S W b W	W N W	N N W	N 45 W	1.2	24.0	13.4	14.98	...	..
25	.581	.585	—	—	45.0	54.2	—	—	—	.162	.187	—	—	.55	.45	—	—	W	N N W	N b W	N 32 W	17.8	25.0	10.7	18.46	...	...
26	.694	.624	.539	.6132	51.0	69.3	53.5	57.62	+ 2.63	.267	.256	.345	.293	.73	.36	.86	.66	N N W	N W b N	Calm.	N 28 W	14.7	10.5	0.0	6.65	...	...
27	.436	.307	.186	.2952	49.9	57.4	51.0	53.10	— 2.18	.279	.363	.341	.322	.79	.79	.94	.82	Calm.	Calm.	Calm	E 25 S	0 0	0.0	0.0	1.48	.355	...
28	.125	.201	.342	.2292	54.6	60.1	47.0	53.48	— 2.17	.383	.340	.233	.306	.91	.66	.74	.75	W b N	N N W	Calm.	N 32 W	2.9	24.4	0.0	12.93	Inap	...
29	.320	.354	.446	.3820	45.2	48.4	39.9	42.42	—13.53	.228	.256	.157	.215	.76	.92	.64	.79	N E	N N E	N W	N 1 W	1.6	10.9	7.6	9.87	.030	...
30	.530	.593	.702	.6198	40.2	45.2	37.3	41.02	—15.23	.216	.136	.194	.167	.88	.45	.87	.67	N W b N	N N W	W b N	N 41 W	10.5	20.4	6.8	13.22	...	Inp
31	.786	.697	.692	.7170	39.1	62.3	55.5	51.67	— 4 88	.160	.224	.268	.225	.67	.41	.62	.60	W N W	W	W	W 24 S	11.2	17.3	7.1	10.42	.100	...
M	29.5960	29.5770	29.5760	29.5822	46.82	54 95	48.95	50.52	— 0.96	.242	.264	.263	.259	.75	.64	.75	.71	N 14 E	N 8 W	N 1 W	N 4 E	8.55	13.59	7.23	9.81	4.580	Inp

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR MAY.

Highest Barometer .... 29.969 at 10 p. m., on 5th } Monthly range=
Lowest Barometer .... 29.125 at 6 a. m., on 28th } 0.844 inches.

Highest registered temperature......... 82°2 at p. m., on 24th } Monthly range=
Lowest registered temperature......... 31°2 at a. m., on 4th } 51°0

Mean maximum Thermometer......... 59°56 } Mean daily range = 18°93
Mean minimum Thermometer......... 40°63 }

Greatest daily range .... 44°2 from p. m. of 24th to a. m. of 25th.
Least daily range.......................... 7°0 from p. m. of 8th to a. m. of 9th.

Warmest day......... 23rd ... Mean temperature......... 63°72 } Difference = 22°70.
Coldest day.......... 30th ... Mean temperature......... 41°02 }

Greatest intensity of Solar Radiation ... 96°8 on p. m. of 24th } Monthly range=
Lowest point of Terrestrial Radiation ... 21°5 on a. m. of 30th } 75°3

No Auroral Light observed this month; possible to see aurora on 16 nights; impossible to see aur[illegible] on 15 nights.

Snowing on 30th, time and quantity inappreciable. Raining on 14 days,—depth 4.530 inches—raining 89.4 hours.

Mean of cloudiness =0.59; most cloudy hour observed, 4 p. m., mean =0.61; least cloudy hour observed, 8 a. m., mean, =0.55.

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

North.	West.	South.	East.
3815.24	2096.21	857.29	2318.37

Mean direction of the wind, N 4° E.

Mean velocity of the wind......... 9.81 miles per hour.

Maximum velocity .... 33.7 miles per hour, from 11 a. m. to noon on 25th.

Most windy day......................... 1st...Mean velocity 20.89 miles per hour.

Least windy day ....18th...Mean velocity 1.35 ditto.

Most windy hour ... 1 p. m. ....Mean velocity 13.65 ditto.

Least windy hour ...1 a. m. ....Mean velocity 6.19 ditto.

Mean diurnal variation = 7.46 miles.

4th—Wild Pigeons and Humming Birds first observed.

5th and 6th—Hoar frost on boards at 5 and 6 a. m.

10th—Large Meteor in N. W. at 9.18 p. m., time of flight about 15 seconds.

15th—Wild Strawberries in bloom.

" —Thunderstorm from 6.30 to 8.30 p. m.

" —Very perfect Rainbow at 7.10 p. m.

16th—Large Halo round the Moon from 10 p. m.

19th—Very dense Fog 5 to 8 a. m.

23rd—Thunderstorm 6.30 to 10.10 p. m.

30th—Slight particles of Snow and hail falling during the day.

31st—Hoar frost on boards, and thin Ice on water 6 to 8 a. m.

COMPARATIVE TABLE FOR MAY.

Year.	Temperature.					Rain.		Snow.		Wind.	
	Mean.	Diff. from Aver.	Max. obs'd.	Min. obs'd.	Range.	Days.	Inch's.	Days.	Inch's.	Mean Direc'n.	Mean Force or Velocity.
	°	°	°	°	°						
1840	53.8	+2.4	74.5	30.8	43.7	9	4.150	...	{ not	...	...
1841	50.5	−0.9	76.2	26.6	49.6	11	2.350	1	} Reg.	..	0.35 lbs.
1842	49.1	−2.3	74.3	30.0	44.3	7	1.275	...		..	0.53 "
1843	49.1	−2.3	79.6	28.9	50.7	5	1.570	...	...	...	0.52 "
1844	53.6	+2.2	77.7	29.0	48.7	14	5.670	...	...	..	0.30 "
1845	49.6	−1.8	76.6	29.4	47.2	8	2.300	...	...	..	0.55 "
1846	55.5	+4.1	78.1	34.3	43.8	9	4.375	...	...	...	0.46 "
1847	54.4	+3.0	72.5	27.8	44.7	12	2.040	...	...	...	0.29 "
1848	54.1	+2.7	78.5	31.9	46.6	13	2.520	...	...	N 39° W	4.93 miles
1849	48.0	−3.4	72.5	32.7	39.8	16	5.115	...	...	E 39° N	5.33 "
1850	47.6	−3.8	76.3	31.1	45.2	7	0.545	1	Inapp	W 26° N	6.32 "
1851	51.3	−0.1	73.2	28.7	44.5	12	2.950	1	0.5	N 32° W	6.34 "
1852	51.4	0.0	73.3	34.5	38.8	7	1.125	1	Inapp	W 8° S	4.00 "
1853	50.9	−0.5	78.4	38.4	40.0	17	4.420	1	Inapp	N 20° W	5.14 "
1854	52.2	+0.8	69.0	27.6	41.4	11	4.630	..	...	E 24° S	5.38 "
1855	53.1	+1.7	74.8	33.9	40.9	6	2.565	2	0.9	N 1° W	5.93 "
1856	50.5	−0.9	80.1	35.5	44.6	14	4.580	1	Inapp	N 4° E	9.81 "
Mean	51.45	...	75.62	31.24	44.38	10.5	3.069	0.5	0.1	...	5.91 miles

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Latitude—43 *deg.* 39.4 *min. North.* *Longitude*—70 *deg.* 21 *min. West.* *Elevation above Lake Ontario,* 108 *feet*

Day.	Barom. at temp. of 32°.				Temp. of the Air.				Mean Temp +or— of the Av'age.	Tens. of Vapour.				Humidity of Air.				Direction of Wind.			Resultant Direction	Velocity of Wind.					Rain in inches.
	6 A.M.	2 P.M.	10 P.M.	MEAN.	6 A.M	2 P.M	10PM	ME'N		6 A.M	2 P.M.	10 P.M.	M'N	6 A.M	2 P.M.	10 P.M.	M'N	6 A. M.	2 P. M.	10 P.M.		6 A.M	2 P.M	10 P.M.	Result'.	M'N	
					°	°	°	°	°												°						
1	29.661	29.639	—	—	48.3	65.3	—	—	—	.307	.302	—	—	.92	.64	—	—	E b S	S S E	W b N	N 45 W	3.6	7.4	0.5	1.75	5.39	0.035
2	719	.644	29.607	29.6507	51.7	54 1	56.4	54.80	— 2.47	.325	.347	.415	.364	86	85	.93	.86	Calm	S E b E	S W b S	S 22 E	0.0	5.6	0.4	0.83	3.27	315
3	.648	.577	.588	.5987	53.5	66.2	58.5	61.02	+ 3.47	.376	.524	.434	.470	93	84	91	89	S b W	S E	N b W	E 13 S	3.8	6.0	1.8	4.08	5.29	.015
4	.517	.443	—	—	52.0	58 3	—	—	—	.370	.448	—	—	94	88	—	—	E b N	N b E.	E	E 8 S	6.4	5.4	2.5	4.08	4.79	.160
5	.688	.749	.753	.7313	54.6	60.0	56.4	57.33	— 0.82	.344	.344	.384	.354	82	68	86	78	NE b N	S b E	E b N	E 6 S	0.4	6.0	7.4	4 76	5.59	...
6	.733	.724	.662	.6990	53.1	60.5	56.7	57.17	— 1.28	.380	.404	.386	.396	96	78	86	87	NE b N	E b S	E N E	E 14 N	7.0	10.8	2.6	6.84	6.97	...
7	.590	.534	.454	.5130	49.5	54.9	56.4	53.97	— 4.78	.313	.380	.427	.372	90	90	96	90	NE b E	S E b E	WW N	E 26 N	1.2	1.1	8.4	2.97	5.04	.445
8	.390	.364	—	—	54.6	57.4	—	—	—	.396	.404	—	—	76	63	—	—	E b S	E S E	S W b S	E 31 S	4.0	8.3	2.0	0.66	3.81	.055
9	.391	.424	.465	.4332	55.3	62.1	55.4	58.38	— 1.10	.361	.453	.395	.410	84	83	92	85	W N W	S b W	N E	S 38 W	4.1	5.2	3.8	2.18	3.45	Inap
10	.517	.496	.483	.5015	56.0	71.1	54.6	61.13	+ 1.35	.405	.505	.383	.420	92	69	91	81	Calm	S S E	E b N	S 19 E	0.0	5.6	1.0	2.26	2.98	...
11	.533	.504	.488	.5053	59.2	67.8	58.5	61.57	+ 1.58	.415	.453	.412	.425	84	69	86	80	Calm	S E	N E b E	E 24 S	0.0	9.5	1.2	3.20	3.58	...
12	.438	.302	.460	.4312	59.2	65.0	54.9	59.08	— 1.18	.415	.452	.394	.419	84	75	93	86	E b N	N W	S S W	N 10 E	0.2	15.2	0.6	0.59	4.76	.120
13	.385	.323	.342	.3492	54.6	66.0	56.7	59.10	— 1.48	.374	.473	.349	.383	90	76	76	78	E S E	S W b W	W b S	W 26 S	4.6	8.0	5.8	2.73	5.95	.090
14	.348	.394	.454	.4007	55.3	58.2	52.0	55.18	— 5.65	.394	.384	.313	.357	92	82	82	84	Calm	W b S	W b S	W 25 S	0.0	7.0	5.0	6.68	7.23	.025
15	.443	.482	—	—	53.9	60.0	—	—	—	.311	.322	—	—	86	81	—	—	W N W	W b S	W	W 9 S	7.6	7.5	1.0	5.51	6.22	...
16	.631	.663	.675	.6605	53.5	67.5	52.5	58.15	— 3.20	.330	.355	.335	.348	82	54	86	74	Calm	S	Calm	S 8 W	0.0	6.0	0.0	3.66	3.69	...
17	.683	.626	.535	.6060	54.8	65.5	62.1	60.55	— 1.10	.371	.389	.310	.352	89	63	56	68	Calm	E	E N E	E 1 N	0.0	7.7	7.8	5.62	5.97	...
18	.514	.513	.541	.5235	55.3	64.4	57.6	60.43	— 1.52	.346	.482	.436	.430	81	81	94	83	N E	E	Calm	E 12 S	6.8	10.8	0.0	3.06	4.50	...
19	.577	.559	.551	.5645	59.9	75.0	59.2	65.35	+ 3.22	.452	.592	.425	.487	89	70	87	80	W b N	S	S W b S	S 27 W	1.2	7.5	0.2	5.64	6.10	...
20	.601	.570	.625	.5978	63.2	79.1	72.1	71.13	+ 8.68	.490	.586	.625	.566	87	61	82	78	S W	S S W	W	S 36 W	7.4	14.5	1.6	6.28	6.60	...
21	.731	.676	.639	.6770	68.9	81.8	71.4	74.57	+11.90	.561	.628	.527	.575	82	60	72	70	S b W	S b W	S W b W	S 34 W	0.4	9.9	3.5	4.43	4.75	...
22	.669	.643	—	—	70.7	78.6	—	—	—	.626	.767	—	—	80	73	—	—	W S W	S E	N b W	N 31 W	2.4	3.6	8.5	4.17	7.27	.335
23	.778	.765	.715	.7502	61.7	62.7	53.8	59.42	— 3.73	.490	.386	.311	.364	91	69	76	75	E N E	S E b S	Calm	E 29 S	8.9	3.4	0.0	2.93	3.01	...
24	.688	.600	.439	.5690	57.3	65.0	57.8	60.45	— 2.90	.352	.342	.431	.376	77	56	92	74	Calm	E	W N W	E 6 S	0.0	9.5	4.0	3.71	5.52	.310
25	.486	.489	.513	.4932	61.7	73.9	65.0	66.92	+ 3.37	.509	.672	.434	.544	95	83	72	84	S S W	S W b S	N b E	W 40 S	5.0	6.4	3.8	2.08	3.85	...
26	.520	.448	.503	.4883	64.3	75.5	67.5	69.48	+ 5.60	.461	.627	.481	.534	79	73	74	76	Calm	S S E	N W b W	N 43 W	0.0	0.4	6.6	2.85	4.27	..
27	.633	.654	.591	.6233	60.7	70.5	58.9	64.42	+ 0.35	.326	.362	.376	.366	63	49	77	62	N b W	S W b S	Calm	S 27 E	9.0	5.8	0.0	0.59	2.74	...
28	.508	.328	.247	.3507	62.7	81.8	73.3	73.08	+ 8.80	.421	.671	.667	.582	76	64	83	73	N E b N	S W b S	S W b W	S 35 W	0.9	13.8	5.0	4.59	4.85	...
39	.230	.207	—	—	72.5	74.3	—	—	—	.622	.603	—	—	78	45	—	—	Calm	S W	S W b W	W 41 S	0.0	20.8	3.5	5.24	5.55	1.295
30	.230	.346	.696	.4442	67.8	77.7	56.9	67.82	+ 3.23	.608	.483	.370	.469	92	52	82	71	S W	W N W	N W b W	W 25 N	5.4	22.4	5.9	14.60	16.03	...
M	29.5654	29.5416	29.5428	29.5484	58.07	67.76	59.36	62.11	+ 1.08	.409	.471	.418	.432	.86	.71	.84	.79	....	....	....	....	3.01	8.37	3.15	... ...	5.30	3.200

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR JUNE.

Highest Barometer .... 29.798 at 8 a. m. on 23rd } Monthly range=
Lowest Barometer .... 29.207 at 2 p. m. on 29th } 0.591 inches.

Highest registered temperature .... 89°2 at p. m. on 29th } Monthly range=
Lowest registered temperature .... 42°0 at a. m. on 1st } 47°2

Mean maximum Thermometer......... 71°59 } Mean daily range = 19°20
Mean minimum Thermometer......... 52°39 }

Greatest daily range......................... 28°8 from p. m. of 30th to a. m. 1st July
Least daily range .... 10°4 from p. m. of 8th to a. m. of 9th.

Warmest day........... 21st ... Mean temperature......... 74°57 } Difference = 20°60.
Coldest day.............. 7th ... Mean temperature......... 53°97 }

Greatest intensity of Solar Radiation.. 104°8 on p. m. of 29th } Monthly range=
Lowest point of Terrestrial Radiation 35°0 on a. m. of 1st } 69°8

Aurora observed on 1 night, viz.. on the 10th; possible to see Aurora on 18 nights; impossible to see Aurora on 12 nights.

Raining on 13 days; depth, 3.200 inches; duration of fall, 27.0 hours.

Mean of cloudiness=0.47; most cloudy hour observed, 2 p. m., mean=0.58; least cloudy hour observed, 10 p. m., mean=0.35.

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

North.	South.	East.	West.
732.70	1340.86	1250.01	1477.80

Resultant direction of the wind, S 21° W; Resultant Velocity, 0.90 miles per hour.

Mean velocity of the wind............ 5.30 miles per hour.
Maximum velocity .... 26.0 miles per hour, from 3 to 4 p. m. on 30th.

Most windy day......................... 30th...Mean velocity 16.03 miles per hour.
Least windy day......................... 27th...Mean velocity 2.74 ditto

Most windy hour............... 1 to 2 p. m...Mean velocity 8.52 ditto } Difference
Least windy hour.............. 1 to 2 a. m...Mean velocity 2.74 ditto } 5.78 miles.

This month exhibits no striking examples of abrupt or extensive change, either of the Barometer or of Temperature.

In the Comparative Table, the only deviations to be noticed of the Monthly Means from the Means derived from the aggregate of past years, are shown by the Minimum Temperature, which is the highest on record, save that of 1850 the Range, which is more than 9° less than the Average; and the Mean Velocity of the Wind.

The columns Resultant Direction and Resultant Velocity shews that the total displacement of air produced in the month is equivalent to that which would have been produced by a wind blowing constantly from S 21° W, with a uniform Velocity of 0.9 miles per hour.

The total displacement in the months of June since 1848, inclusive, is equal to that of a constant wind blowing from S 84° W, with a velocity of 0.46 miles.

On June 1st, at 30 min. past noon, a violent Squall occurred, accompanied by violent thunder, lightning and hail. The stones were of an oblate spheroidal form and unusually large, the greater axis amounting, in many cases, to ¼ of an inch. From their hardness, they appeared to have been formed at an extremely low temperature.

COMPARATIVE TABLE FOR JUNE.

YEAR.	TEMPERATURE.					RAIN.		WIND.		
	Mean.	Difference from Average.	Maximum observed.	Minimum observed.	Range.	No. of d'ys	Inches.	Resultant. Direction.	Resultant. Velocity	Mean Velocity.
1840	59.8	−1.6	78.5	37.1	41.4	11	4.860	—	—	—
1841	65.6	+4.2	92.8	45.7	47.1	9	1.560	—	—	0.36 lbs.
1842	55.6	−5.8	73.9	28.0	45.9	15	5.755	—	—	0.31 "
1843	58.4	−3.0	81.3	28.5	52.8	12	4.595	—	—	0.27 "
1844	59.9	−1.5	82.8	33.1	49.7	9	3.535	—	—	0.19 "
1845	61.0	−0.4	83.6	40.9	42.7	11	3.715	—	—	0.27 "
1846	63.3	+1.9	83.3	41.5	41.8	10	1.920	—	—	0.32 "
1847	58.4	−3.0	78.3	36.7	41.6	14	2.625	—	—	0.30 "
1848	62.9	+1.5	92.5	38.3	54.2	8	1.810	W 29° N	1.90	4.51 miles.
1849	63.2	+1.8	84.9	45.2	39.7	7	2.020	E 19 S	0.49	3.32 "
1850	64.3	+2.9	83.2	49.0	34.2	10	3.345	W 30 S	0.38	4.54 "
1851	59.2	−2.2	79.2	41.2	38.0	11	2.695	S 2 W	[illegible]	4.42 "
1852	60.8	−0.6	86.1	43.6	42.5	10	3.160	W 14 S	[illegible]	[illegible] "
1853	65.5	+4.1	86.3	43.3	43.0	9	1.550	N 14 W	0.27	[illegible] "
1854	64.1	+2.7	88.7	47.4	41.3	9	1.460	N 21 E	0.80	[illegible] "
1855	59.9	−1.5	90.7	40.6	50.1	17	4.070	W 21 N	1.32	5.70 "
1856	62.1	+0.7	82.6	48.3	34.3	13	3.200	S 21 W	0.90	5.30 "
Mean	61.41	...	84.04	40.49	43.55	1.09	3.351	—	—	4.41 miles.

MONTHLY METEOROLOGICAL REGISTER AT THE PROVINCIAL MAGNETICAL OBSERVATORY, TORONTO, CANADA WEST, JULY, 1856.

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

Day.	Barom. at temp. of 32°.				Temp. of the Air.				Mean Temp. + or — of the Av'age.	Tens. of Vapour.				Humidity of Air.				Direction of Wind.			Resultant Direction.	Direction of Wind.					Rain in inches.
	6 A.M.	2 P.M.	10 P.M.	Mean.	6 A.M	2 P.M	10AM	ME'N		6 A.M	2 P.M	10 P.M.	M'N	6 A.M	2 P.M.	10 P.M.	M'N	6 A. M.	2 P. M.	10 P.M.		6 A.M	2 P.M.	10 P.M.	Result'.	ME'N	
					°	°	°	°	°												°						
1	29.838	29.817	29.809	29.8178	57.1	64.6	55.1	60.03	— 4.73	.346	.377	.344	.354	.76	.64	.81	.70	N N W	S S W	Calm	S 64 E	4.8	7.6	0.0	0.16	3.94	...
2	739	677	588	.6603	56.4	66.7	54.9	60.18	— 4.82	306	341	370	342	68	53	88	68	Calm	E S E	Calm	S 85 E	0.0	[illegible]	0.0	1.72	2.39	...
3	486	385	419	.4212	64.0	85.1	69.6	73.52	+ 8.37	446	599	470	505	77	51	68	63	W S W	W	W N W	N 72 W	4.2	13.0	1.0	3.57	5.70	...
4	445	528	556	.5152	62.1	67.5	60.3	63.80	— 1 50	394	473	330	394	73	72	64	68	N b D	S	Calm	S 16 E	9.7	9.0	0.0	0 60	3.05	...
5	545	432	391	.4455	56.7	75.6	65.1	66.82	+ 1.43	359	481	508	439	80	56	84	69	Calm	W S W	W b S	S 69 W	0.0	10.2	4.3	6.26	7.83	0 375
6	430	502	—	—	58.9	70.1	—	—	—	381	323	—	—	78	45	—	—	W N W	N b W	N N W	N 18 W	10.8	14.4	8.0	10.63	11 37	...
7	636	656	654	.6413	56.4	65.0	51.4	58.78	— 6.92	301	318	332	318	67	53	88	67	N	S E b D	E	N 76 E	9.7	9.2	3.6	4.76	6.15	..
8	618	640	632	.6415	59.2	67.1	61.7	63.73	— 2.05	311	391	432	394	63	60	81	68	N E	E S E	E b N	N 82 E	9.6	7 0	3.6	7.66	8.10	...
9	662	661	604	.659[illegible]	63.2	68.2	59.2	63.83	— 2.15	454	474	426	456	80	71	87	79	E N E	E S E	Calm	N 86 E	8.4	8.2	0.0	3.85	4.54	...
10	658	652	579	.[illegible]10	63.2	74.3	62.3	67.33	+ 1.25	483	575	482	511	86	70	88	79	Calm	S	E S E	S 20 E	0.0	6.4	0.2	1.22	1.81	...
11	557	478	368	.4583	65.0	75.4	68.9	70.57	+ 4.38	482	601	515	538	80	71	75	74	Calm	E S E	E	S 83 E	0.0	7.6	5.2	3.81	4.04	...
12	297	241	301	.2842	68.9	74.8	68.4	68.93	+ 2.63	538	599	587	560	78	72	88	82	E	E b S	Calm	S 82 E	4.0	9.0	0.0	2.62	3.14	Inap
13	431	495	—	—	67 5	80.4	—	—	—	545	560	—	—	83	56	—	—	N W	S	S W b W	S 31 W	8.0	8.2	1.5	2.54	3.67	...
14	592	531	483	.5277	67.3	82.2	71.8	73.73	+ 7 32	561	639	696	631	87	60	92	79	Calm	S b W	N W	S 33 W	0.0	11.6	1.0	3 42	4.05	0.405
15	544	616	592	.5860	71.5	83.6	66.4	73.52	+ 7.03	648	474	493	516	86	43	78	67	S W b W	N W b N	W b S	N 29 W	2.0	16.8	2.0	5.21	5.52	...
16	696	623	605	.6305	65.3	85.4	77.4	76.56	+ 9.92	506	614	633	589	84	51	69	67	N W b W	S	W S W	S 23 W	0.6	11.3	2.8	5.11	5.52	
17	569	458	406	.4708	74.7	92.0	76.2	81.77	+15.08	663	714	734	691	80	49	84	68	Calm	S S W	S W	S 51 W	0.0	11.0	9.0	7.40	8.38	...
18	469	407	500	.4477	70.8	79.5	64.6	71.60	+ 4.92	440	406	355	423	59	42	60	57	W S W	W b N	N W b W	N 84 W	5.0	20.0	21.0	13.85	15.80	...
19	521	555	640	.5793	61.4	74.3	61.0	65.90	— 0.88	390	544	329	415	73	67	62	66	N W b W	N W b N	N W b W	N 26 W	9.6	20.2	8.8	14.56	14.85	...
20	717	734	—	—	60.7	74.3	—	—	—	378	348	—	—	72	42	—	—	N N W	N	N W	N 12 W	10.4	14.2	8.8	9.26	10.03	...
21	814	787	809	.8050	60.2	70.9	61.2	66.07	— 0.70	361	412	426	412	71	56	81	66	W	S W b S	W b S	S 56 W	0.2	2.2	2.5	2.71	3.52	0 075
22	835	796	783	.8010	58.5	81.1	67.3	69.90	+ 3.03	381	363	442	395	79	35	68	58	Calm	S S W	W S W	S 45 W	0.0	9.2	4.0	3.75	4.41	..
23	812	761	763	.7775	63 5	76.8	71.8	71.38	+ 4.50	463	627	547	542	81	70	72	72	Calm	S S W	N E	S 10 W	0.0	6.2	6.0	0.92	3.56	0 115
24	815	753	713	.7592	66.5	85.9	70.7	75.82	+ 8.95	545	474	508	529	86	40	70	64	N W	S	N W b W	S 37 W	0.2	8.4	2.0	3.71	4.28	...
25	717	641	628	.6622	67.3	87.6	72.2	76.78	+ 9.82	547	588	538	548	84	47	70	63	Calm	S W b S	S W b S	S 50 W	0.0	17.6	7.0	4.42	5.37	...
26	653	598	610	.6168	69.8	89.4	77.5	79.80	+12.83	570	487	549	537	81	36	60	57	Calm	S	W S W	S 50 W	0.0	8.8	4.0	2.77	4.11	...
27	[illegible]	624	—	—	71.1	85.1	—	—	—	576	626	—	—	78	53	—	—	W b N	S	W b S	S 56 W	7.0	5.2	4.0	5 30	6.00	0.085
28	...	614	598	.6145	68.6	83.6	73.1	74.70	+ 7.73	610	595	592	607	90	53	74	74	W N W	S W	W	S 51 W	3.7	6.4	5.8	3.48	3.85	0 050
29	529	413	390	.4317	69.8	75.7	66.8	70.97	+ 4 02	625	711	594	641	89	83	93	87	S W	S S W	S E b E	S 11 W	6.0	9.6	0.2	3.76	4.14	0.015
30	401	468	522	.4707	66.1	82.6	70.4	73.27	+ 6.32	579	470	402	487	93	43	55	63	S b E	N W b N	W b S	N 48 W	0.2	18.5	6.2	7.58	7.92	...
31	592	590	611	.6035	61.8	76.5	64.7	67.97	+. 1.02	432	416	456	440	81	47	76	68	N N W	S b E	E S E	S 44 E	1.8	10.0	5.6	2.01	4.03	...
M	29.6188	29.5844	29.5761	29 591	64.27	77.46	66.30	69.90	+3.66	.472	.510	.485	.489	.79	.56	.76	.69	....		....	....	3.74	10.40	4.13	. .	5.84	1.120

Highest Barometer	29.844 at 8 a. m. on 22nd	Monthly range= 0.603 inches.
Lowest Barometer	29.241 at 2 p. m. on 12th	
Highest registered temperature	96°6 at p. m. on 17th	Monthly range= 47°1
Lowest registered temperature	49°5 at a. m. on 5th	
Mean maximum temperature . .	80°36	Mean daily range = 21°32
Mean minimum temperature . .	59°04	
Greatest daily range	28°7 from p. m. of 30th to a. m. of 31st.	
Least daily range	13°4 from p. m. of 12th to a. m. of 13th.	
Warmest day . . 17th ... Mean Temperature . . .	81°77	Difference=21°74.
Coldest day . . . 1st ... Mean Temperature . . .	60°03	
Greatest intensity of Solar Radiation . .	110°2 on p. m. of 17th	Monthly range= 70°7
Lowest point of Terrestrial Radiation .	39°5 on a. m. of 5th	

Aurora observed on 4 nights, viz.: on the 7th, 9th, 10th and 12th; possible to see Aurora on 26 nights; impossible to see Aurora on 5 nights.

Raining on 8 days; depth, 1.120 inches; duration of fall, 9.8 hours.

Mean of cloudiness=0.39; most cloudy hour observed, 4 p. m., mean=0.49: least cloudy hour observed, 10 p., mean=0.24.

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

North.	South.	East.	West.
1577.03	1355.01	727824	1876.13

Resultant direction of the wind, N 79° W; Resultant Velocity, 1.57 miles per hour.

Mean velocity of the wind	5.84 miles per hour.		
Maximum velocity	28.4 miles per hour, from 5 to 6 p. m. on 18th		
Most windy day	18th—Mean velocity, 15.86 miles per hour.		
Least windy day	10th—Mean velocity, 1.81	do	
Most windy hour . . .	12 to 1 p. m—Mean velocity, 10.17	do	Difference 7.00 miles.
Least windy hour . . .	5 to 6 a. m.—Mean velocity, 3.17	do	

The Mean Temperature of the month, exceeded only in 1854, was 3° above the average of 17 years; the rain that fell was scarcely one-third of the amount that usually falls during the month of July: and the Mean Velocity of the wind which exceeded the average by 1.31 miles is the highest on record, save that of last year. July 1856, therefore, may be characterized as a hot, dry, and windy month.

The total displacement of air during the month, as shewn by the columns of *Resultant Direction* and *Resultant Velocity* of the wind, was equal to that produced by a wind blowing constantly from N 79° W, with a uniform velocity of 1.57 miles per hour.

The total displacement in the months of July since 1848 inclusive, was equal to that of a westerly wind, having a uniform velocity of 0.31 miles.

COMPARATIVE TABLE FOR JULY.

YEAR.	TEMPERATURE.					RAIN.		WIND.		
	Mean.	Difference from Average.	Maximum observed.	Minimum observed.	Range.	No. of dy's.	Inches.	Resultant. Direction.	Resultant. Velocity	Mean Velocity.
	°	°	°	°	°			°		
1840	65.8	— 1.2	79.4	48.2	31.2	6	5.270	—	—	—
1841	65.0	— 2.0	86.3	43.2	43.1	10	8.150	—	—	0.27 lbs.
1842	64.7	— 2.3	90.5	42.0	48.5	4	3.050	—	—	0.33 "
1843	64.5	— 2.5	86.1	40.2	45.9	8	4.605	—	—	9.44 "
1844	66.0	— 1.0	86.1	40.5	45.6	12	2.815	—	—	0.19 "
1845	66.2	— 0.8	94.6	45.6	49.0	7	2.195	—	—	0.30 "
1846	68.0	+ 1.0	94.0	44.9	49.1	9	2.895	—	—	0.29 "
1847	68.0	+ 1.0	87.5	43.8	43.7	8	3.355	—	—	0.19 "
1848	65.5	— 1.5	82.7	46.7	36.0	10	1.890	N 14 W	0.18	4.94 miles
1849	68.4	+ 1.4	89.1	51.0	38.1	4	3.415	S 5 W	0.76	3.52 "
1850	68.9	+ 1.9	84.9	52.8	32.1	12	5.270	N 81 E	0.59	4.56 "
1851	65.0	— 2.0	82.7	52.1	30.6	12	3.625	N 60 W	0.88	4.13 "
1852	66.[illegible]	— 0.2	90.1	49.5	40.6	8	4.025	N 43 W	0.93	3.33 "
1853	6[illegible].6	— 1.4	85.4	49.4	36.0	10	0.915	S 76 E	0.51	3.70 "
1854	[illegible]2.5	+ 5.5	93.6	53.0	40.6	9	4.805	S 58 W	0.34	4.26 "
1855	67.9	+ 0.9	88.4	53.1	35.3	13	3.245	S 10 W	0.73	6.47 "
1856	69.9	+ 2.9	92.0	51.4	30.6	8	1.729	N 79 W	1.57	5.84 "
Mean	66.98	...	87.85	47.49	40.35	8.8	3.567	—	—	4.53

MONTHLY METEOROLOGICAL REGISTER, KINGSTON, CANADA WEST, FEBRUARY, 1856.

BY MR. DONALD M'LENNAN.

Latitude, 44 *deg.* 13.30 *min. North; Longitude,* 76 *deg.* 31.51 *min. West. Height above Sea,* 280 *feet.*

Day.	Barometer at 32°		Thermom.		Thermom. during 24 hours.		Tension of Vapor.		Humidity.		Clouds.		Direction of Wind.		Pressure in lbs avoirdupois.		Rain in inches.	Snow in inches.	REMARKS.
	9 A. M.	3 P. M.	9 A. M.	3 P. M.	Max	Min.	9 A. M.	3 P. M.	9 A. M.	3 P. M.	9 A. M	3 P. M.	9 A. M.	3 P. M.	9 A. M.	3 P. M.			
1	29.350	29.126	16.5	27.2	28	11	.095	.157	.879	.802	10	10	S E	S	.25	2.0	...	...	Stormy and snowy.
2	29.324	29.286	4	7	10	13	.074	.049	1.000	.027	2	0	W by N	W S W	1.5	1.5	...	...	
3	29.373	29.355	-2	5	4	-5	.055	.050	.623	.540	1	1	W N W	W S W	1.25	1.25	...	...	Clouds. Ci. str.
4	29.443	29.400	2	10.5	9.5	-2	.042	.072	.629	.785	5	5	W	W S W	1.	1.25	...	...	
5	29.713	29.788	10	15	15	9	.065	.069	.730	.644	5	10	W S W	W S W	1.	.5	...	...	A solar halo (morning.)
6	30.086	30.039	14	16	16	11	.088	.092	.852	.856	10	10	W S W	S W	.5	1.	...	...	
7	29.319	29.360	21	31	31	14	.098	.158	.736	.817	10	10	S S E	S S W	1.25	1.25	...	...	Flurries of snow. Slight thaw.
8	29.690	29.661	4	12	31	2	.035	.088	.633	.827	1	2	W N W	W N W	25	.5	...	...	Clouds. Ci cu. and str. Mild.
9	29.566	29.567	11	13	12.5	2.5	.065	.087	.730	.847	10	7	W N W	W S W	.0	.5	...	...	Gloomy and cold.
10	29.670	29.628	16	21	21	10.5	.072	.084	.643	.625	10	6	S	S	.25	1.	...	...	Mild.
11	29.469	29.290	30	32	34	21	.129	.170	.669	.848	8	10	S W by S	S S W	1.	.75	...	...	Snow. Slight thaw. Rain.
12	28.960	29.121	21	7	33.5	5.5	.084	.056	.625	.630	10	7	W N W	W S W	1.	1.25	...	...	Clouds. Ci. & cu, Very stormy.
13	29.804	29.784	-13	-2	.5	-18.5	.117	.091	.941	.912	0	0	N W	W S W	.75	1.25	...	...	Cold.
14	29.810	29.695	-5	11	10	-8.5	.0.5	.067	1.000	.731	0	9	W S W	W S W	.5	.5	...	...	Pleasant.
15	29.410	29.204	7	17	17	2	.068	.084	.678	.730	10	10	S by W	S	1.25	1.25	...	...	Flurries of snow.
16	28.947	28.880	24.5	31.5	32.5	16.5	.085	.135	.616	.699	9	10	W S W	N N W	.0	.0	...	1.	Clouds. Str. ci. and str. cu.
17	29.155	29.491	10	13	12	10	.084	.064	.872	.637	7	7	W	W N W	1.5	2.25	...	1.5	Blowing: cold,
18	29.374	29.779	-3	8	12.5	-6	.048	.059	.520	.638	1	5	W S W	W S W	1.	1.25	...	...	Pleasant.
19	29.826	29.725	5.5	16.5	16.5	-1	.064	.071	.641	.680	0	1.5	W by S	S W by W	1.	1.	...	...	Do.
20	29.410	29.424	25	30	30	15.5	.132	.145	.888	.783	9	7	S W by W	W by S	1.	.87	...	...	Clouds. Cu. and str. cu.
21	29.394	29.338	30.5	30.5	32	28.5	.130	.108	.460	.775	6	1	W by S	S W by W	.75	1.2	...	...	Pleasant: a thaw.
22	29.460	29.450	17	31.5	32	11.2	.084	.106	.730	.731	0	7	S W by W	S E	.8	.3	...	...	Do.
23	29.205	29.088	23.5	34.5	35	20	.078	.073	.735	.682	9	3	N N W	S	.3	.2	...	...	A slight thaw.
24	29.430	29.440	19	22.5	33	18	.107	.075	.685	.727	3	1	N N W	S W by W	.0	.5	...	...	Pleasant.
25	29.381	29.338	13	24.5	24	6.5	.085	.096	.886	.686	8	4	N W by W	W by S	.5	.25	...	...	Clouds. Cu. and ci. and ci. cu.
26	29.615	29.573	11	26	26	5.5	.087	.118	.939	.731	0	0	W	S W	.1	.0	...	...	Pleasant.
27	29.686	29.607	10.5	26	26	5	.077	.072	.783	.783	4	4	W N W	E S E	.2	.2	...	...	Cloudy.
28	29.698	29.680	13	21	26	10	.073	.115	.734	.875	1	4	N W	S S W	.2	.2	...	...	Pleasant.
29	29.737	29.763	18	31	30	12	.058	.137	.728	.820	9	8	S	W S W	.0	.5	...	...	Clouds. Ci. cu.
M	29.510	29.479	12.2	19.59	22.3	7.2	.032	.094	.744	.740	5.4	5.6			.66	.84	...	2.5	

MONTHLY METEOROLOGICAL REGISTER, KINGSTON, CANADA WEST, MARCH, 1856.

BY MESSRS. DUNCAN M'MILLAN AND GEORGE S. ROSE.

Latitude, 44° 13' 30'', *North*. *Longitude*, 76° 31' 51'', *West*. *Height above Sea*, 280 *Feet*.

Day.	Barometer at 32°		Thermom.		Thermom. during 24h.		Tension of Vapor.		Humidity.		Clouds.		Direction of Wind.		Pressure in lbs avoirdup.		Rain in inches.	Snow in inches.	Remarks.
	9 A.M.	3 P.M.	9 A.M.	3 P.M.	Max.	Min.	9 A.M.	3 P.M.	9 A.M.	3 P.M.	9 A.M.	3 P.M.	9 A.M.	3 P.M.	9 A.M.	3 P.M.			
1	29.839	29.788	22.5	24.5	29.	18.5	.073	.052	.734	1.000	10	7	N N W	E S E	.2	.2	...	...	
2	28.931	28.971	18.5	28.	25.	16.	.104	.090	.812	.626	10	0	N E by N	W N W	1	.8	...	6	Flurries of snow.
3	29.505	29.583	15.	23.	23.	15.	.094	.090	.868	.626	2	5	W N W	W S W	1	1.	...	...	Mild.
4	29.559	29.185	19	28.5	30.	18.	.077	.129	.648	.725	10	6	S E	S E	3	6.	...	...	Boisterous—snowing.
5	29.621	29.572	16.5	23.5	26.	11.5	.027	.126	.85[illegible]	.840	3	4	W	W S W	1.7	.2	...	..	Solar halo.
6	29.217	29.317	23.	25.	26.	18.	.125	.132	.840	.848	7	9	N W by W	W N W	1.	1.	...	...	Pleasant.
7	29.622	29.479	8.	20.	24.	3.5	.055	.068	.663	.640	8	7	W N W	S	0.	1.5	...	...	Raw—cold.
8	29.597	29.583	6.5	5.5	22.	4.	.045	.064	.495	.637	5	1.	W S W	W S W	1.	1.3	...	4	Aurora bright, visible at 1 a m.
9	29.771	29.738	—5.5	2.7	1.5	—12.[illegible]	.050	.064	.635	.637	0	.5	W N W	S W	.7	.8	...	...	Cold.
10	29.709	29.581	—4.2	8.5	7.5	—12.5	.058	.030	.686	.635	0	2	W	W S W	.8	2.	...	...	Cold.
11	29.402	29.228	12.5	19.	19.2	3.	.049	.077	.544	.783	2	4	W S W	W S W	2.	1.2	...	...	Raw—cold—windy.
12	29.370	29.375	7.5	18.7	19.	4.25	.047	.056	.496	.543	0	4	W	W S W	.8	1.2	...	...	
13	29.716	29.726	11.5	24.5	23.5	5.5	.080	.130	.782	.495	0	0	W	W	.2	.4	...	...	Lunar halo, 9 p.m.
14	29.778	29.764	18.	27.5	27.7	3.	.103	.150	.685	.589	5	1	W	S W	0	0	...	...	Pleasant: thaw.
15	29.784	29.668	28.5	29.5	33.	18.	.113	.130	.657	.780	8	7	W S W	W S W	1.	1	...	2	Gloomy.
16	29.725	29.638	27.7	29.	32.	19.5	.120	.164	.740	.915	7	6	S W	W S W	.8	0	...	1	Gloomy; thaw.
17	29.808	29.789	23.5	32.5	34.	18.5	.091	.153	.634	.756	6	9	W S W	W N W	.2	.5	...	..	Do do.
18	29.968	29.858	20.	31.	34.	12.5	.1[illegible]0	.147	.848	.762	0	1	W S W	W S W	.4	.4	...	...	Pleasant—thaw.
19	29.575	29.414	24.5	33.	34.	17.	.129	.161	.868	.780	7	10	N W	E	.2	0	...	1.5	Snow—inclined to rain.
20	29.454	29.426	30.5	34.	39.	25.5	.147	.178	.762	.834	8	1	S	N E	0.	0	...	3.5	Pleasant—thaw.
21	29.449	29.494	25.5	36.5	37.	22.	.125	.213	.779	.929	8	2	S	S E	0.	0	...	...	Do.
22	29.591	29.583	25.5	34.	38.	15.	.141	.178	.906	.834	4	2	S E	S W	.2	0	...	...	Do.
23	29.622	29.554	27.5	33.5	36.	19.5	.137	.164	.817	.793	10	8	S S W	S W	0	0	...	...	Gloomy; thaw.
24	29.336	29.278	33.	34.	36.	23.	.169	.178	.821	.834	8	8	E	E N E	0	0	...	...	Snow—inclined to rain.
25	29.522	29.514	34.	37.	40.	30.2	.178	.199	.834	.839	5	5	N	S W	0	0	...	...	Thaw.
26	29.461	29.370	32.5	33.5	37.8	28.	.177	.164	.891	.793	5	4	W	W	.2	1.7	...	...	Do.
27	29.342	29.283	25.	20.	33.	22.5	.110	.137	.701	.766	1.5	8	W	N W	.4	.8	...	...	Cold wind.
28	29.418	29.387	15.	22.	28	12.	.09[illegible]	.119	.856	.855	8	6	N W	W	1.2	1.8	...	...	Cold and windy.
29	29.584	29.553	21.	27.	28.	17.	.071	.146	.568	.880	5	0	N W	N W by N	1.3	.5	...	...	
30	29.754	29.706	16.5	25.	27.7	11.	.074	.107	.652	.685	0	1.5	N W	S W	.5	.8	...	...	Raw cold.
31	30.035	30.035	15.8	25.	25.	8.	.073	.135	.680	.867	0	0	N	S W by W	.7	.0	...	...	Pleasant.
M	29.[illegible]82	29.561	19.5	26.1	28.3	13.57	.100	.127	.729	.759	4.9	4.7			.66	.8	...	18	

MONTHLY METEOROLOGICAL REGISTER, KINGSTON, CANADA WEST, APRIL, 1856.

BY MESSRS. HUGH J. BORTHWICK AND ALEXANDER M'LENNAN.

Latitude, 44 *deg.* 13 30 *min. North; Longitude,* 76 *deg.* 31.51 *min. West. Height above Sea,* 280 *feet.*

Day.	Barometer at 32°		Thermom.		Thermom. during 24 hours.		Tension of Vapor.		Humidity.		Clouds.		Direction of Wind.		Pressure in lbs avoirdupois.		Rain in inches.	Snow in inches.	Remarks.
	9 A. M.	3 P. M.	9 A. M.	3 P. M.	Max.	Min.	9 A. M.	3 P. M.	9 A. M.	3 P. M.	9 A. M.	3 P. M.	9 A. M.	3 P. M.	9 A. M.	3 P. M.			
1	30.180	30.055	20.0	30.0	32.5	10.0	.110	.152	.848	.824	0.	9.	S W	S	.0	.0	...	...	Pleasant
2	29.731	29.545	33.0	42.5	43.8	20.0	.173	.259	.841	.795	4.	10.	S S E	S S E	1.3	1.2	...	...	Warm and cloudy.
3	29.320	29.319	41.0	40.0	44.3	35.0	.226	.218	.827	.225	10.	10.	S S E	S S E	1.3	1.0	...	...	Rainy and disagreeable.
4	29.416	29.420	34.0	37.0	40.0	32.3	.186	.191	.874	.802	10.	10.	S S W	S W	1.5	1.8	...	...	Do. do.
5	29.628	29.613	34.2	34.0	38.4	29.5	.181	.195	.847	.913	9.	9.	W N W	N W	.3	.2	...	...	Pleasant.
6	29.682	29.643	37.0	38.5	38.0	30.2	.212	.205	.889	.833	0.	0.	S S W	S S W	.2	.0	...	...	Do.
7	29.100	29.746	34.3	39.7	38.5	29.0	.174	.196	.852	.769	10.	1.	S S W	S S W	.0	.0	...	...	Do.
8	29.066	29.918	35.0	43.0	44.2	28.3	.118	.242	.800	.827	2.	0.	S S W	S S W	.0	.0	...	...	Do.
9	29.808	29.519	43.0	50.0	45.5	32.0	.242	.315	.827	.842	4.	9.	W S W	S	.0	1.8	...	...	Do.
10	29.937	29.928	32.7	41.5	46.0	31.3	.157	.209	.802	.730	0.	0.	N N W	W	.5	.5	...	...	Do.
11	29.861	29.699	34.0	41.0	47.0	27.5	.170	.217	.795	.796	7.	6.	S S W	S	.3	.3	...	...	Do. [in the Bay.
12	29.201	29.189	39.0	44.0	41.0	34.5	.224	.272	.879	.893	10.	10.	W N W	N	.3	.3	.38	...	Rainy. Breaking up of the ice
13	29.937	29.900	21.5	30.0	40.5	21.0	.050	.125	.635	.674	0.	0.	N N E	S S W	1.3	1.8	...	...	Cold and windy.
14	29.784	29.611	32.0	37.0	40.5	28.0	.153	.181	.768	.736	10.	10.	S S W	S	1.3	.8	...	...	Warm and cloudy.
15	29.620	29.659	41.0	49.0	50.3	28.7	.209	.324	.767	.898	6.	10.	N N E	N N E	.0	.0	...	...	Do.
16	29.651	29.590	42.0	49.0	51.3	36.5	.243	.300	.858	.837	10.	8.	E	S S E	.0	.0	...	...	Do. [left Kingston wharf
17	29.566	29.443	44.0	43.0	54.5	36.5	.261	.262	.853	.892	10.	10.	Calm.	Calm.	.0	.0	.11	...	Foggy. Stmr. "St. Lawrence'
18	29.467	29.428	39.0	45.0	54.2	31.5	.205	.253	.804	.802	8.	3.	S S E	S S W	.3	.3	...	...	Pleasant.
19	29.712	29.672	42.0	47.0	53.2	32.0	.225	.261	.797	.716	4.	3.	N N W	Calm.	.0	.0	...	...	Do.
20	29.830	29.762	32.0	44.0	50.5	30.0	.153	.184	.768	.606	4.	8.	N	N N E	2.3	1.75	...	...	Cold and windy.
21	29.674	29.500	34.0	51.0	50.5	32.5	.141	.238	.660	.615	10.	8.	N N E	N E	2.	1.	...	...	Do. [this A.M. for Toronto.
22	29.260	29.257	42.0	47.5	51.0	35.0	.225	.201	.797	.866	10.	7.	E N E	S S E	1.	.0	...	...	Pleasant. Stmr. "Kingston" left
23	29.488	29.460	42.5	51.0	53.0	34.0	.243	.203	.858	.760	3.	0.	S	S S W	.0	.0	...	...	Calm and pleasant.
24	29.560	29.487	51.0	59.0	62.0	34.0	.337	.402	.871	.796	3.	3.	S S W	S S W	.0	.0	...	...	Calm and warm.
25	29.830	29.833	57.0	59.7	65.5	42.5	.434	.454	.867	.695	5.	.5	N N E	N E	.25	.0	...	...	Delightful.
26	29.970	29.864	58.5	64.0	62.2	42.5	.425	.496	.687	.726	1.	1.	N E	N	.125	.125	...	...	Warm and sultry.
27	29.758	29.658	55.0	64.5	66.5	40.5	.372	.515	.843	.708	0.	0.	S	Calm.	.75	.0	...	...	Very hot for the season.
28	29.580	29.490	55.0	61.5	68.5	48.5	.387	.408	.844	.619	6.	2.	W S W	W S W	.75	.0	...	...	
29	29.630	29.630	49.0	51.0	52.0	41.0	.251	.272	.696	.700	3.	0.	Calm.	Calm.	.0	3.	...	...	
30	29.890	29.938	47.5	55.0	63.0	43.0	.647	.222	.647	.537	9.	9.	N N E	E	.5	1.5	...	...	
M	29.688	29.624	39.94	42.31	49.781	32.576	.221	.271	.803	.747	5.6	5.21			.542	.540	.016	...	

MONTHLY METEOROLOGICAL REGISTER, KINGSTON, CANADA WEST, MAY, 1856.

BY MESSRS. HUGH J. BOSTWICK, AND ALEXANDER MCLENNAN.

Latitude, 44 *deg.* 13.30 *min. North. Longitude,* 76 *deg.* 31.51 *min. West. Height above Sea,* 280 *Feet.*

Days.	Barometer at 32°		Thermom.		Thermom. During 24 h.		Tension of Vapour.		Humidity.		Clouds.		Direction of Wind.		Pressure in lbs. avoirdupois.		Rain in inches.	Snow in inches.	REMARKS.
	9 A.M.	3 P.M.	9 A.M.	3 P.M.	Max.	Min.	9 A.M.	3 P.M.	9 A.M.	3 P.M.	9 A.M.	3 P.M.	9 A.M.	3 P.M.	9 A.M.	3 P.M.			
1	30.383	....	48.25	.....	....	.....	.319	.....	1 000	.....	9.	....	E N E	....	1.5	.....	0	...	
2	29.459	29.692	46.00	46.00	62.0	42.0	.278	.278	.825	.852	10.	10.	N N E	N E	1.5	1.5	.65	..	
3	29.529	29.559	42.00	51.00	61.0	37.5	.167	.192	.588	.498	.01	0	N N E	N N E	1.5	0	.125	..	
4	29.659	29.649	40.00	45.00	53.0	33.5	.227	.272	.858	.863	9.	8	N W	N W	1.5	1	0	..	
5	29.896	29.927	42.50	49.00	53.0	33.0	.253	.336	.928	.930	7.	6.	N N E	N N E	0	0	0		
6	30.375	29.103	48.00	55.00	56.0	36.0	.302	.394	.865	.888	0	10.	E N E	S W	0	0	0	.	
7	29.743	29.640	51.25	67.00	63.0	43.0	.337	.504	.871	.897	1.	0	S W	E	0	0	0		
8	29.840	29.723	52.25	52.00	64.0	44.5	.373	.349	.934	.873	5.	10	E N E	O	0	0	0		
9	29.590	29.595	46.00	46.00	54.0	42.5	.303	.262	.931	.803	10.	0	S W	E	0	0	.40	.	
10	29.575	29.494	50.00	64.00	61.0	41.0	.349	.525	.932	.946	8.	10.	N N E	N E	0	1.5	0		
11	29.548	29.431	53.00	50.00	66.0	40.0	.337	.373	.815	1 000	0	6.	N E	S W	0	0	0		
12	29.443	29.640	53.50	52.00	61.0	42.5	.373	.304	.903	.761	0	10.	S W	S W	0	0	0		
13	29.892	29.930	45.50	49.00	54.0	45.0	.282	.312	.864	.867	10.	5.	N	S W	0	0	0	.	
14	29.886	29.760	54.00	68.25	71.0	41.5	.373	.646	.875	.949	3.	0.	S S W	S	0	0	0		
15	29.666	29.382	54.00	60.00	72.0	47.0	.400	.467	.934	.893	10.	10.	S	S W	0	0	0		
16	29.694	29.682	56.00	55.00	64.0	49.0	.420	.418	.927	.914	9	10.	W N W	S W	0	.5	.44		
17	29.679	29.481	55.00	66.00	68.0	45.0	.394	.605	.888	.919	7.	10.	N E	E N E	0	0	0	...	
18	29.557	29.431	55.00	58.50	68.0	54.0	.351	.437	.793	.893	10.	10	S S E	S E	1.5	.5	1.7	..	
19	29.403	29.344	51.50	57.00	65.0	48.0	.357	.376	.871	.796	10.	2.	E N E	S S E	.75	.5	.17		
20	29.355	29.449	55.00	63.00	64.5	44.0	.351	.345	.793	.597	10.	.5	N W	N W	.75	.75	.14		
21	29.708	29.737	47.00	49.00	65.0	38.5	.217	.270	.647	.749	0	.5	N N E	S W	.75	.75	0	.	
22	29.858	29.814	53.00	54.00	58.5	38.5	.274	.246	.662	.576	10.	.5	S	S W	0	.75	0	...	
23	29.676	29.582	54.00	60.50	64.0	39.0	.296	.371	.687	.710	0	.5	S S W	S W	0	.5	0		
24	29.433	29.351	53.00	63.00	65.25	39.0	.337	.423	.815	.731	10.	.1	S S W	S W	.75	.75	0		
25	29.510	29.550	40.00	45.00	74.5	38.0	.210	.202	.793	.643	10.	9.	W	N N W	1.25	.2	0	.	
26	29.588	29.577	56.00	61.50	68.5	40.5	.271	.342	.523	.632	1.	.5	N	N E	1.5	.5	0	.	
27	29.477	29.330	52.00	40.00	67.25	40.0	.304	.361	.761	.584	5.	10.	S S W	S S W	0	0	0	..	
28	29.520	29.112	55.00	30.00	68.5	41.0	.394	.361	.888	.680	10.	9.	S W	W N W	0	.25	.12	.	
29	29.401	29.367	44.00	46.00	62.0	38.0	.207	.218	.682	.669	4.	10.	N N W	S S E	1.	.1	.5	.	
30	29.497	29.523	41.50	44.00	50.0	34.0	.186	.177	.677	.582	10.	8.	N W	N W	.75	.75	0	..	
31	29.741	29.672	42.00	51.00	53.5	34.0	.192	.255	.679	.661	10.	1.	W N W	S W	.25	.5	0		
M	29.668	29.524	49.58	54.25	62.58	40.91	.304	.357	.776	.780	6.06	5.01			.492	.500	.134	..	

REMARKS ON THE KINGSTON METEOROLOGICAL REGISTER FOR APRIL.

Highest Barometer .... 30.180 at 9 A. M. on 1st.
Lowest Barometer .... 29.109 at 9 A. M. on 7th.
Monthly Range .... 1.071 inches.
Highest registered temperature.......... 68°5 on 28th
Lowest registered temperature .... 10° on 1st.
Mean maximum thermometer .... 49°781
Mean minimum thermometer .... 32°576
Mean daily range .... 17°205
Warmest day, 26th, mean temperature.......... 58°5
Coldest day, 1st, mean temperature 21°2 : difference .... 37°3
Raining on 4 days: depth, .49 inches. Most windy day, 20th.

REMARKS ON THE KINGSTON METEOROLOGICAL REGISTER FOR MAY.

Highest Barometer .... 30.383 on 1st.
Lowest Barometer .... 29.103 on 6th.
Monthly Range .... 1.280 inches.
Highest registered temperature.......... 74°5 on 25th.
Lowest registered temperature .... 33°5 on 30th.
Monthly Range.......... 41°.
Mean maximum thermometer.......... 62°58
Mean minimum thermometer.......... 42°91
Mean daily range .... 21°67
Warmest day, 18th, mean temperature .... 61°
Coldest day, 30th, mean temperature 42° ; difference.......... 19°
Raining on 9 days: depth, 4.04 inches. Wind maximum velocity, 27.09 miles per hour. Most windy day, 25th.

MONTHLY METEOROLOGICAL REGISTER, ST. MARTIN, ISLE JESUS, CANADA EAST—JUNE, 1856.

(NINE MILES WEST OF MONTREAL.)

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

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

Day.	Barom. corrected and reduced to 32° Fahr.			Temp. of the Air.			Tension of Vapor.			Humidity of Air.			Direction of Wind.			Mean direction of Wind.	Velocity in miles per hour.			Snow in Inches.	Rain in Inches.	Weather, &c. A cloudy sky is represented by 10; A cloudless sky by 0.		
	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.		6 A.M.	2 P.M.	10 P.M.			6 A.M.	2 P.M.	10 P.M.
1	29.838	29.810	29.902	49.5	62.0	50.1	.251	.421	.335	.69	.75	.88	w s w	s w	s w b s	w 44 s	7.00	2.12	3.60	...	...	Clear.	Cum. Str. 8.	Clear.
2	.849	.783	.780	47.4	[illegible]	61.2	323	559	483	94	74	89	w by s	swbyw	s s w	w 40 s	0.00	1.26	0.70	...	Inp	Fog.	Cir. Cm. St. 4.	Cir. Str. 8.
3	.758	.741	.800	60.0	61.8	52.6	494	322	326	94	59	81	E by s	E N E	s s w	E 34 N	5.00	5.06	0.05	...	0.066	Rain.	Cir. Str. 10.	Str. 2.
4	.731	.699	.815	52.1	51.0	49.0	304	361	336	76	93	92	NE by E	N E	N by E	E 34 N	0.20	4.32	8.55	...	0.136	Do.	Do. 10.	Do. 4.
5	.887	.936	30.010	47.0	68.0	53.9	299	412	315	90	60	76	NE by E	E N E	E N E	E 34 N	5.12	3.05	7.52	...	...	Clear.	Do. 4.	Clear. Aur. Bor.
6	.908	.943	29.977	54.	[illegible]	57.0	373	458	355	87	61	74	s E by s	s s E	s s E	s 33 E	2.52	11.51	8.76	...	...	Cir. Str. 8.	Cum. Str. 6.	Cum. Str. 4
7	.817	.687	.604	56.6	70.4	63.4	385	597	488	84	61	84	E s E	s s E	s E	s 33 E	6.42	0.00	5.25	...	...	Cum. Str. 10.	Clear.	Str. 2.
8	.699	.552	.548	66.0	70.4	63.9	574	597	565	89	82	93	s	E N E	s E by s	s 33 E	0.47	0.42	3.90	...	I p	Cum. Str. 6.	Cir. Str. 10.	Cum. Str. 8.
9	.437	.438	.494	61.0	68.1	60.6	490	496	493	90	72	90	s w	w by s	s w by s	w 34 s	1.54	8.12	7.46	...	0.533	Rain.	Do. 6.	Do. 4.
10	.564	.537	.626	66.4	83.0	67.7	544	619	506	85	57	76	w s w	w by s	w s w	w 31 s	5.21	3.00	5.36	...	...	Cir. Str. 4.	Do. 4.	Do. 8.
11	.687	.594	.685	66.3	86.0	69.9	544	648	541	85	53	75	w s w	s s w	s by w	w 33 s	2.52	4.28	1.30	...	...	Clear.	Clear.	Clear.
12	.629	.490	.565	73.0	89.9	75.2	571	607	670	72	44	78	s by E	s by E	s by E	s 12 E	1.36	1.64	5.21	...	...	Do.	Cir. 2.	Cir. Str. 9.
13	.538	.488	.523	62.7	80.7	67.0	546	648	536	94	64	83	s w	s w by s	s by E	s 22 w	4.45	3.85	3.96	...	0.130	Rain.	Cum. 2.	Do. 9.
14	.511	.455	.539	64.7	69.0	59.2	534	513	402	89	72	79	s by E	w by s	s w	w 11 s	1.24	6.12	6.00	...	Inp	Rain. Dist. Th.	Cir. Str. 10.	Str. 1.
15	.517	.542	.352	57.6	64.9	57.3	398	425	376	84	71	79	s w b w	w s w	w by s	w 34 s	10.10	5.00	3.20	...	...	Cir. Str. 8.	Do. 10.	Cir. Str. 4.
16	.704	.691	.801	57.2	75.1	62.3	398	378	421	84	67	75	w by N	s s w	w s w	w 33 s	7.63	6.42	7.37	...	...	Cir. Str. 9.	Cum. 2.	Clear.
17	.832	.772	.775	60.8	82.1	64.7	416	597	450	79	55	73	w s w	s w	s by E	w 40 s	2.20	3.40	0.42	...	...	Clear.	Cir. 4.	Str. 4.
18	.740	.653	.727	64.6	86.0	61.6	425	617	483	71	50	89	E s E	s by E	s by E	s 28 E	0.02	1.92	5.33	...	...	Do.	Cir. Str. 8.	Do. 8.
19	.671	.731	.733	66.0	85.5	67.6	516	692	534	80	58	81	s E	s by w	s s w	s 14 E	1.02	0.70	1.02	...	...	Cir. Str. 10.	Cir. Cm. Str. 6.	Do. 2.
20	.638	.622	.667	68.0	85.3	74.3	552	729	618	82	60	78	w by s	w s w	w s w	w 34 s	6.06	6.28	7.40	...	...	Light Cir. 4.	Clear.	Str. 4, dist. light.
21	.727	.667	.659	70.3	94.6	77.9	628	854	638	86	51	67	s w by w	s w b w	s w b w	w 34 s	4.21	7.10	6.12	...	...	Clear.	Cir. Cm. Str. 6.	Cum. Str. 4.
22	.643	.675	.703	74.1	74.2	64.3	648	588	450	78	70	75	s w	N E	N w	w 34 s	9.39	9.07	7.10	...	...	Cir. Str. 9.	Cir. Str. 8.	Clear.
23	.902	.820	.876	51.9	76.7	60.3	255	568	410	66	64	76	N w	s	s E by E	N 10 E	7.92	2.11	2.51	...	...	Cir. 4.	Clear.	Do.
24	[illegible]	.715	.611	58.2	77.9	65.4	412	617	497	84	62	80	E by N	s	w by s	E 33 s	2.21	1.92	2.02	...	...	Clear.	Cir. Cm. Str. 4.	Cir. Str. 10.
25	[illegible]	.478	.516	70.4	88.6	73.1	571	801	628	80	62	78	w by s	w s w	s w	w 34 s	10.00	11.39	2.09	...	Inp	Rain	Cir. Str. 4.	Clear.
26	.557	.485	.470	65.0	84.2	69.9	430	679	570	69	58	81	s w by w	s w by w	s w	N 36 w	6.45	9.26	10.71	...	...	Clear.	Clear.	Cir. Str. 2.
27	.662	.663	.683	61.0	73.4	61.8	431	489	407	79	61	75	s w	N w	w N w	s 40 w	7.70	11.30	8.93	...	...	Do.	Cum. 2	Clear.
28	.609	.355	.239	62.0	82.0	79.3	460	541	659	81	50	67	s w	w s w	w by s	s 40 w	0.23	5.31	1.46	...	...	Do.	Cir. Str. 10.	Cum. Str. 9, rain
29	.269	.202	.360	60.0	63.4	57.3	481	516	470	90	89	96	E N E	N E b E	N E b E	E 30 N	2.09	4.00	7.37	...	2.025	Cir. Str. 10.	Rain. Thunder	Do. 9. [at 10 p.m.
30	.420	.485	.384	60.5	71.0	64.6	499	648	556	96	86	89	E s E	N E b N	N w	E 2 N	1.37	1.86	9.70	...	1.433	Do. 9.	Cir. Str. 4.	Do. 6.

MONTHLY METEOROLOGICAL REGISTER, ST. MARTIN, ISLE JESUS, CANADA EAST—JULY, 1856.

(NINE MILES WEST OF MONTREAL.)

BY CHARLES SMALLWOOD, M. D., L.L.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.		
	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.
1	29.779	29.796	29.897	53.1	68.2	54.6	.337	.422	.349	81	.62	.81
2	.893	.800	.748	48.9	83.2	65.1	.302	.648	.558	.86	.58	.89
3	.559	.447	.475	84.2	83.0	70.5	.534	.721	.604	.89	.65	.84
4	.555	.596	.632	56.0	70.7	57.3	.323	.665	.422	.70	.64	.89
5	.601	.500	.474	60.1	81.0	60.1	.467	.523	.494	89	.50	.94
6	.412	.513	.727	61.9	57.4	50.0	.500	.399	.314	.89	.84	.85
7	.794	.712	.862	50.8	71.2	56.5	.326	.563	.343	.87	.75	.74
8	.904	.852	.882	56.5	71.1	62.0	.243	.590	.472	.74	.72	.84
9	.904	.860	.801	66.0	74.9	64.1	.574	638	.534	.89	.74	.89
10	.801	.746	.755	65.2	85.1	66.7	.546	.727	.574	.94	.61	.89
11	.778	.714	.617	73.1	90.7	75.4	.670	776	.739	.86	.56	.86
12	.540	.518	.519	74.4	71.9	64.1	.681	.681	.565	82	.90	.93
13	.540	.513	.620	65.1	87.9	70.5	.586	.896	.628	.94	.71	.86
14	671	.595	.567	69.0	86.0	75.2	.601	.860	.607	.85	.70	.71
15	.544	.557	.665	70.4	81.0	65.5	.659	.704	.555	.90	.68	.88
16	.734	.630	.632	66.5	86.0	72.6	.574	.787	.607	89	.66	.78
17	.744	.633	.507	73 0	92.1	77.8	.739	.840	.829	.89	.71	.90
18	.420	.351	.382	75.1	85.3	70.1	.628	.628	.471	.78	.53	.65
19	.416	.426	.517	62.1	70.4	58.3	.472	.576	.462	.84	.79	.94
20	.588	.630	.756	59.4	74.0	60.6	.478	.681	.467	.94	.82	.89
21	.840	.825	.883	61.2	85.8	65.0	.491	.628	.527	.89	.53	.85
22	.663	.909	.986	67 [illegible]	80.1	66.5	.534	.648	.574	81	.64	.89
23	.974	.824	.850	65.3	84.1	72.0	.555	.617	650	97 0	.54	.84
24	.819	.710	.735	70.5	94.5	80.0	.868	.985	.790	.78	.59	.78
25	.713	.595	.634	74.0	94.1	76.0	.648	.776	.628	.78	.46	.71
26	.677	.602	.634	70.9	96.7	81.1	.659	.986	.670	.80	.56	.64
27	.633	.600	.652	71.6	87.2	75.1	.617	.776	.739	.82	.62	.86
28	.603	.628	.683	74.9	89.9	77.5	.681	.854	.751	.82	.62	.82
29	.632	.627	.545	96.5	97.0	73.3	.692	.986	.736	.78	.51	.91
30	.500	.433	.552	80.2	85.5	71.0	.751	.840	.715	.75	.71	.95
31	.739	.648	.733	70.1	87.1	67.2	.659	.739	.593	.89	.78	.80

Day.	Direction of Wind.			Velocity in miles per hour.			Mean direction of Wind.	Rain in Inches.	Snow in Inches.	WEATHER, &c. A cloudy sky is represented by 10; A cloudless sky by 0.		
	6 A.M.	2 P.M.	10 P.M.	6 A.M.	2 P.M.	10 P.M.				6 A.M.	2 P.M.	10 P.M.
1	s w b w	N W	W S W	26.24	19.22	11.42	W ° 44 N	...	...	Clear.	Clear.	Cir. Aur. Bor.
2	s by w	s w	s	0.40	0.75	1.45	W 44 S	...	...	Cir. Cm. St. 4.	Do.	Cir. Str. 4.
3	sw by w	w	w	3.05	9.83	2.41	W 34 S	1 370	...	Cir. Str. 10.	C. S. S Thun.	Rain.
4	N by N	w by N	NW b w	8.56	4.17	8.77	W 36 N	0.483	...	Clear.	Clear.	Clear.
5	s w	W S W	S S W	1.50	6.79	11.64	W 34 S	...	...	Do.	Cr. Cm. St. 4.	Cir. Str. 10.
6	w	N W b W	W	4.75	5.74	19.05	W 10° N	1.476	...	Cir. Str. 9.	Cir. Str. 10.	Cir. Thun. Stm
7	N W b W	S W	N N W	0.70	2.12	0.11	W 34° W	...	...	Clear.	Cir. Str. 9.	Str. 2.
8	N E by N	E N E	E by N	3.51	6.77	0.05	E 23 N	Inp	...	Cir. Cm. St. 4.	Clear.	Cir. Str. 10.
9	S S E	s by s	E	0.00	0.00	0.00	E 23 N	0.253	...	Cir. Str. 4.	Cr. Cm. St. 9.	Clear.
10	N E by E	s by w	s by w	0.20	0.51	0 21	E 11 N	...	...	Clear.	Cir. Cum. 4.	Do.
11	s b w	S E	S E	0.22	1.40	1.23	S 1 E	...	...	Do.	Cum. Str. 2	Cum. 4.
12	S E	W N W	E by N	0.12	1.32	0.12	E 40 S	0.416	...	Clear.	Rain.	Cir. Str. 10.
13	E N E	w by s	w by s	2.02	0.85	5.12	W 14 S	...	...	Cir. Str. 10.	Cir. 2.	Cl. S't. Light.
14	w by s	W S W	S W	1.63	3.95	8.21	W 34 S	...	...	Do. 4.	Clear.	Do.
15	W S W	N W	W	5.05	8.62	5.62	W 24 N	0.816	...	Nimb. 10.	Do.	Do.
16	sw b w	W S W	w b s	0.12	5.07	5.98	W 14 S	...	...	Cir. Str. 6.	Cr. Cm. St. 4.	Str. 4. S't. L'g.
17	W	S S W	S S W	2 64	0.05	0.74	W 11 S	0.453	...	Rain.	Do. 4.	Cir. Str. 4.
18	w b s	W S W	W N W	4.40	9.32	13 07	W 23 S	0.280	..	Cir. Str. 10.	Cir. Str. 4.	Do 4.
19	W N W	N W	W N W	11.45	14.90	18.62	W 23 N	..	..	Do. 9.	Do. 4.	Rain.
20	W N W	N W	W by N	8.00	15.25	7.42	W 23 N	0.826	..	Do. 8	Do. 4.	Str. 2.
21	w b s	s by E	s	0.12	1.22	2.22	W 23 S	...	..	Clear.	Clear.	Cir. Str. 4.
22	S S W	s by E	s by E	1.40	3.90	0.00	S 40 W	...	..	Do.	Cir Str. 10.	Str. 4.
23	sw by s	S S W	S E	0.20	1.31	3.11	S 22 W	...	..	Cir. Str. 10.	Do.	Do. 2.
24	w	W S W	sw b w	0.60	7.12	5.65	W 34 S	...	. .	Clear.	Clear.	Do. 4 F't. A. B.
25	w b s	w by s	sw b w	6.80	9.00	7.85	W 14 S	...	...	Do.	Do.	Clear.
26	s w	s w b s	w	0.70	1.60	2.62	W 40 S	...	...	Do	Cir. Str. 2.	Cir. Str. 8.
27	sw b w	w	W S W	1 80	6.34	7.35	W 14 S	...	..	Hazy.	Do. 4.	Clear. St. Ligt.
28	w by s	w	w by s	1.02	7.70	3.20	W 10 S	...	...	Clear.	Clear.	Clear. do. do.
29	sw by s	S S W	s by w	0.46	1.95	3.60	W 44 S	Inp	...	Do.	Cum. 4.	Do.
30	s by w	w by s	w by s	1.83	4.81	1.90	S 44 W	Inp	...	Do.	Cir. Str. 8.	Do. Thundr.
31	N N W	W S W	sw by s	1.60	1 87	0.30	W 11 S	...	...	Do.	Clear.	Do. Met. 9.30.

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

Barometer	Highest, the 5th day	30.010
	Lowest, the 29th day	29.202
	Monthly Mean	29.653
	Monthly Range	0.808
Thermometer	Highest, the 21st day	94°.6
	Lowest, the 1st day	41°.0
	Monthly Mean	66°.83
	Monthly Range	53 .6
Greatest Intensity of the Sun's Rays		110°.2
Lowest Point of Terrestrial Radiation		39°.1
Amount of Evaporation		3.74
Mean of Humidity		.754

Rain fell on 10 days, amounting to 4.323 inches—was accompanied by thunder and lightning on 3 days; it was raining 23 hours and 50 minutes.

Most prevalent Wind, the S W by W—1113 miles.

Least prevalent Wind, N N E—1 mile.

Most windy day, the 25th; mean miles per hour, 8.15.

Least windy day, the 2nd; mean miles per hour, 0.65.

Most windy hour, from 2 to 3, p.m., on the 4th—20.10 miles.

There were 168.40 hours calm during the month.

Total distance traversed by the Wind, 3,130 miles; resolved into the Four Cardinal Points, gives, N. 350 miles. S. 768 miles, W. 1430 miles, E. 582 miles.

There was only one day perfectly cloudless.

Aurora Borealis visible at observation hour on one night.

The electrical state of the atmosphere has been marked by rather high tension.

Ozone was in small quantity.

REMARKS ON THE ST. MARTIN, ISLE JUSUS, METEOROLOGICAL REGISTER FOR JULY.

Barometer	Highest, the 22nd day	29.986
	Lowest, the 18th day	29.351
	Monthly Ranger	.635
	Monthly Mean	29.664
Thermometer	Highest, the 29th day	97°.1
	Lowest, the 20th day	51°.0
	Monthly Range	46°.1
	Monthly Mean	72°.15
Greatest Intensity of the Sun's Rays		121°.4
Lowest Point of Terrestrial Radiation		46°.7
Amount of Evaporation		4.39
Mean of Humidity		.784

Rain fell on 12 days, amounting to 6.373 inches—it was raining 21 hours 25 minutes, accompanied by thunder on 3 days.

Five days cloudless during the month.

Most prevalent Wind, S. W. by W.

Less prevalent Wind, S. E.

Most windy day, the 1st; mean miles per hour, 18.96.

Least windy day, the 6th; calm.

Most winday hour, from 8 to 9, a.m., on the 1st, 26 miles per hour.

There were 174 hours and 20 minutes calm during the month.

Total amount of miles traversed by the Wind, 2884.20; which being resolved into the Four Cardinal Points, gives, N. 776 miles; S. 345 miles; W. 1,652.20 miles; E. 111 miles.

Bright Meteor, at 9.30 p.m., on the 31st; passing from the *Scutum Sobieski* to *Xi Sagitarii*

The Electrical state of the Atmosphere has been marked by moderate Intensity—maximum on the 30th, 365°. in terms of Volta's Electronometer, No. 1.

Ozone was in moderate quantity.

MONTHLY METEOROLOGICAL REGISTER, QUEBEC, CANADA EAST, APRIL, 1856.

BY MR. WM. DARLING CAMPBELL.

Latitude, 46 deg. 49.2 min. North; Longitude, 71 deg. 16 min. West. Elevation above the level of the Sea, 200 feet.

Date.	Barometer corrected and reduced to 32 degrees, Fahr.				Temp. of Air.				Tens. of Vapour.				Humid'y of Air.				Direc'n of Wind.			Vel'ty of Wind, miles per hour.			Rain in Inches.	Snow in Inches.	Remarks.
	6 A. M.	2 P.M.	10 P.M	MEAN.	6 A. M	2 P. M.	10 P. M.	M'N	6 A.M	2 P.M	10 P.M.	M'N	6 A.M.	2 P.M.	10 P.M.	M'N	6 A.M.	2 P.M.	10 P.M	6 A.M	2 P.M	10 P.M			
					°	°	°	°																	
1	30.080	29.972	29.954	29.969	13.4	33.4	26.1	25.0	.057	.057	.073	062	.67	27	.51	.48	W N W	W	Calm.	6	9	0	...	..	1st—Auroral light and arch 5° alt.
2	29.892	.653	.512	.686	26.0	44.9	37.5	36.1	084	080	101	088	59	27	45	44	W	Calm.	Calm.	5	0	0	...	..	
3	.493	.426	.365	.428	34.0	49.4	40.5	41.3	207	201	195	202	97	58	74	76	Calm.	E S E	E S E	0	6	9	.256	...	
4	.438	.501	.537	.492	35.3	35.4	32.9	34.5	191	189	194	191	86	84	95	88	Calm.	E N E	E by S	0	4	10	Inap	...	
5	.531	.521	.599	.550	33.0	34.1	32.9	33.3	190	212	206	203	92	99	1.00	97	E by N	E by N	Calm	4	4	0	.053	..	
6	.672	.632	.631	.646	32.6	35.4	32.5	33.5	185	174	183	181	91	79	90	87	E N E	E	E	19	18	11	...	...	
7	.625	.631	.721	.659	31.3	47.7	40.7	39.4	181	184	196	187	95	55	74	75	S W	W S W	Calm	2	4	0	...	...	
8	.824	.850	.938	.871	35.7	51.7	40.2	42.5	175	177	191	181	78	47	73	66	S W	W S W	E S E	5	5	2	...	...	
9	.946	.660	.422	.676	38.6	46.0	39.0	41.2	189	197	197	194	76	62	78	72	S S E	E N E	Calm	4	5	0	...	...	
10	.434	.713	.787	.645	28.8	31.6	31.7	30.7	090	085	071	082	53	44	31	43	W N W	W N W	W N W	19	27	10	...	...	
11	.752	.544	.435	.577	24.8	45.2	37.4	35.4	094	131	138	121	55	44	59	53	W by S	W	Calm.	6	16	0	...	3.1	
12	.286	.112	.511	.303	35.3	29.6	17.2	27.4	141	168	052	121	66	92	48	69	W S W	E N E	N N W	4	15	10	...	...	
13	.776	.634	.633	.681	6.4	23.6	26.8	18.9	053	076	112	080	70	53	69	64	W	W	Calm.	6	18	0	...	...	
14	.637	.510	.544	.564	32.3	39.0	36.5	35.9	145	138	183	155	73	56	79	69	W S W	W S W	Calm.	8	5	0	...	...	14th—8 P. M. to 11 P. M. lunar halo 25° dr.
15	.580	.577	.557	.638	30.1	49.5	34.4	38.0	147	135	156	146	80	39	73	64	Calm.	Calm.	E N E	0	0	10	...	...	
16	.867	.788	.681	.779	32.0	42.3	37.4	37.2	146	152	153	150	75	55	65	65	E N E	E N E	W N W	16	3	10	...	...	
17	.552	.358	.276	.395	41.0	50.3	38.2	43.2	217	265	120	201	82	71	51	68	W S W	W S W	E N E	4	13	32	...	...	
18	.382	.408	.521	.437	29.0	44.9	40.0	38.6	126	159	131	139	71	52	51	58	E N E	W S W	W S	29	6	14	...	...	18th—Auroral arch 4° alt.
19	.643	.613	.730	.662	29.6	52.2	37.7	39.8	130	130	119	126	72	34	51	52	W	W S W	N	5	14	11	...	...	19th—10 P. M. lunar halo 40° dr. and corona.
20	.934	.942	30.001	.959	28.8	34.5	32.5	31.9	120	120	125	122	69	57	63	63	E N E	E N E	E N E	14	10	18	...	...	20th—Auroral light.
21	30.011	29.875	..	. .	31.8	36.3	. .	{34.2	125	145	. .	.. .	65	64	..	..	E N E	N E	.. .. ..	23	32	...	...	...	
22	...	.474	29.391	.692	.	36.7	34.4		...	201	201	164	.	86	93	78	......	E N E	E N E	..	28	20	.416	...	
23	29.471	.537	.601	.536	39.2	48.4	43.7	43.8	241	240	253	245	94	70	85	83	W S W	W S W	Calm	7	14	0	. .	...	
24	.667	.640	.761	.689	40.4	55.3	42.9	46.2	259	243	210	237	97	56	73	75	Calm.	Calm.	E N E	0	0	10	...	...	
25	.893	.981	30.109	.994	39.0	41.9	35.2	38.7	162	119	160	147	65	44	73	61	E N E	E N E	E N E	28	25	12	...	...	
26	30.110	30.010	..	.....	33.4	51.8	39.8	41.7	120	130	139	130	59	35	56	50	E N E	S E	Calm	9	5	0	...	...	
27	..	29.720	29.714	.896	43.4	54.9	49.1	49.1	243	314	318	302	83	79	89	84	W S W	N W	Calm.	6	5	0	.165	...	
28	29.903	.722	.648	.758	37.0	44.9	37.6	39.8	168	192	201	187	72	88	84	81	E N E	E N E	E N E	14	18	15	.541	...	
29	.557	.617	.748	.641	37.4	39.2	34.1	36.9	241	257	215	238	1.00	1.00	1.00	1.00	E N E	Calm.	E N E	7	0	14	.073	...	
30	.877	30.062	30.061	30.000	34.5	41.5	39.5	38.5	175	179	204	186	81	66	.80	76	E N E	E N E	W	18	9	5	...	...	
M	29.7076	29.6594	29.6640	29.673	32.21	42.46	36.15	36.9	1588	1694	1654	1645	.767	.608	.708	698							1.504	3.1	