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## THE ANCIENT MINERS OF LAKE SUPERIOR.

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*Read before the Canadian Institute, January 26th,* 1856.

During the past summer of 1855, it was my good fortune to accomplish a long desired visit to the ancient copper country of Lake Superior, where, more perhaps than on any other spot of this continent, may be witnessed the incipient traces of aboriginal arts and civilization. On that occasion I had an opportunity of exploring part of the rich copper-bearing region of Keweenaw Point and the adjacent country, and witnessing for myself evidences of ancient mining operations, which prove the existence, at some remote period, of the rudiments of native metallurgic arts.

The Keweenaw Peninsula is traversed obliquely by a range of trap rock, rising in some places into magnificent cliffs of several hundred feet in height; and in this igneous rock, which passes in a south-western direction across the Keweenaw Lake into the inland country, are found the rich copper veins which have already conferred such great commercial value on that district of Michigan. In their present state, it is difficult to realize the conception that these copper regions were ever ransacked for their mineral treasures, or explored by any other but the stray hunter of the forest, until the commencement of regular mining operations in very recent years.

Landing at Eagle River, I made my way some miles into the country, through dense forest, over a road, in some parts of rough corduroy, and in others traversing the forest in its gradual ascent, over the irregular exposed surface of the copper-bearing trap. Our track at length lay through a gorge, covered with immense masses of trap and crumbling debris, amid which pine, and the black oak and other hard-wood, had contrived to find a sufficient soil for taking root and growing to their full proportions; while here and there the eye lighted upon some giant pine overthrown by the wind, and turning up its great roots grasping the severed masses of the rounded trap in their convolutions, like the gravel clutched from the ocean's bed in the hands of a drowned seaman. On the summit of the ridge the trap rock rises into a range of cliffs, which, judging by the eye, I should suppose cannot be less than two hundred feet high, and in front of them is a sloping tail, the accumulated debris of ages, on which the trees have in some places attained to an immense size, notwithstanding the apparent poverty of the rocky soil.

In traversing this route the road lies in part along the banks of the Eagle River, and there, some four or five miles from its mouth, I had an opportunity of examining a beaver dam, flooding a part of the river banks, by means of the ingenious structure. No traces, however, gave the slighest indication to the passing traveller that the hand of man had ever wrought any changes on the aspect of a region characterised by features so singularly wild and desolate-looking as those described above. Beyond the cliffs, in a level bottom on the other side of the trap ridge, is the mining settlement of the Cliff Mine, one of the most important of all the mining works yet in operation in this region. The great extent of the works at the Cliff Mine is all the more surprising to the visitor, after finding his way to them through a region where it might seem that human foot had never trod.

I descended the perpendicular shaft by means of ladders, to a depth of sixty fathoms, and explored various of the levels; passing in some cases literally through tunnels made in the solid copper. The very richness and abundance of the metal proves indeed a cause of diminution of the profits arising from working it. I witnessed the laborious process of chiselling out masses from the solid lump, of a size sufficiently small to admit of their being taken to the surface, and transported through such a tract as I have described to the shores of Lake Superior. The floor of the level was strewed with the copper shavings struck off in the effort to detach them, and the extreme ductility of the pure native copper was pointed out to me as a cause which precluded the application of any other force than that of slow and persevering manual labor for separating it from the parent mass. I saw also some beautiful specimens of silver, in a matrix of crystalline quartz, obtained from this mine, and the copper of this district is stated to contain on an average about 3·10 per cent. of silver. One mass of copper quarried from the Cliff Mine has been estimated to weigh eighty tons. It was sufficiently detached from its rocky matrix without injuring its original formation, to admit of its dimensions being obtained with considerable accuracy, and it was found to measure fifty feet long, six feet deep, with an average of about six inches in thickness. The total yield of this mine amounted during the past year to sixteen hundred tons of copper, a quantity exceeding, by nearly five hundred tons, the combined product of the other copper mines—eleven in number—of Keweenaw Point, and surpassing by a still greater amount the yield of the Minnesota Mine, the richest of all the works now in operation in the neighboring district of Ontonagon.

At the Cliff Mine some specimens of the ancient copper tools of the native metallurgists are preserved, but it is to the westward of the Keweenaw Peninsula, that the most remarkable traces of the aboriginal miner's operations are seen. The copper-bearing trap rock, after crossing the Keweenaw Lake, is traced onward in a southwesterly direction till it crosses the Ontonagon River about twelve miles from its mouth; and at an elevation of upwards of three hundred feet above the Lake. At this place the edges of the copper veins appear to crop out in various places, exposing the metal in irregular patches over a considerable extent of country. Here, in the neighborhood of the Minnesota Mine, are traces of the ancient mining operations, consisting of extensive trenches, which prove that the works must have been carried on for a long period and by considerable numbers. These excavations are partially filled up, and so overgrown during the long interval between their first excavation and their observation by recent explorers, that they would scarcely attract the attention of a traveller unprepared to find such evidences of former industry and art. Nevertheless some of them measure from eighteen to twenty feet in depth, and in one of them a detached mass of native copper, weighing nearly six tons, was found resting on an artificial cradle of black-oak, partially preserved by immersion in the water with which the deserted trenches had been filled, in the first long era after its desertion. This large mass had evidently been thus disposed preparatory to an attempt at removing it entire. It appeared to have been raised several feet by means of wedges, and then abandoned on account of its unmanageable weight; and probably portions had afterwards been detached from it, as its surface bore abundant traces of the rude stone implements with which the old miners seem to have chiefly wrought.

The stone hammers, or mauls, by which these ancient workers in metal carried on their operations, consist for the most part of oblong water-worn stones, weighing from ten to twenty pounds. Around the centre of these a groove has been artificially wrought, for the purpose of fastening a handle or withe of some kind, with which to wield them. Some of the specimens that I saw were worn and fractured as if from frequent use; many are found broken, and they are met with in such abundance in the neighborhood of the ancient Ontonagon diggings, that a deep well was pointed out to me, constructed, as I was assured, almost entirely of the stone hammers picked up in its immediate vicinity. I was greatly struck with the close resemblance traceable between these rude mauls of the ancient miners of Ontonagon and some which I have seen obtained from ancient copper workings discovered in North Wales.

In a communication made to the British Archæological Institute by the Hon. William Owen Stanley, in 1850,* he gives an account of an ancient working broken into at the copper mines of Llandudno, near the the Great Orme's Head, Caernarvonshire. In this were found mining implements, consisting of chisels, or picks of bronze, and a number of stone mauls of various sizes, described as weighing from about 2 lbs. to 40 lbs., rudely fashioned, having been all, as their appearance suggested, used for breaking, pounding, or detaching the ore from the rock, and pertaining, it may be presumed, to a period anterior to the Roman occupation of Britain. These primitive implements are stated to be similar to the water-worn stones found on the sea-beach at Pen-Mawr, from which very probably those most suitable for the purpose might have been selected. Mr. Stanley also describes others precisely of the same character, and corresponding exactly with those found on the shores of Lake Superior, which had been met with in ancient workings in Anglesea. Were we, therefore, disposed to generalize, as some of the archæologists of this continent are prone to do, from such analogies, we might trace in this correspondence between the ancient mining implements of Lake Superior and of North Wales, a confirmation of the supposed colonization of America, in the twelfth century, by Madoc, the son of Owen Gwynnedd, king of North Wales, who, according to the Welsh chroniclers, having been forced by civil commotions to leave his native country, set sail with a small fleet in 1170, and directing his course westward, landed, after a voyage of some weeks, in a country

* Archæological Journal, vol. vii, p. 68.

inhabited by a strange race of beings, but producing in abundance the necessaries of life. Leaving behind him a colony of settlers, Prince Madoc, according to the same authorities, returned to Wales, equipped a larger fleet, and again set sail for the new regions of the West; but neither he nor any of his followers were ever more heard of. The general story has nothing improbable in it. If a small colony of Welshmen effected a settlement on the shores of America at that early date, their fate would be like that of the still earlier Scandinavian colonists of Vinland.* But the resemblance between the primitive Welsh and American mining tools, can be regarded as nothing more than evidences of the corresponding operations of the human mind, when placed under similar circumstances, with the same limited means. It supplies an argument, which, if pressed to all its remotest bearings, might rather seem to furnish proof of the unity of the human race, than any direct relations leading to a correspondence in the arts of such widely severed portions of the common family. It might, indeed, in some sense, be fitly classed among the instinctive, rather than the imitative operations of human ingenuity when called into action to accomplish similar purposes—instinctive operations akin to those to which alone we can refer such resemblances as that between the nest of the American blue-bird and the English thrush; and which in like manner, from the first rude arts of the primitive savage, produces the bone-lance, or the flint arrow-head, wherein we trace the same type, whether we look for them in the British barrow of ante-Christian times, or among the recent productions of the Polynesian or Red Indian artificer.

The evidences of ancient mining operations in the Ontonagon district have been observed over an area of several miles in extent, and have evidently been abandoned for unknown centuries. A forest of primeval growth seems to cover the whole region, and the mind realizes with difficulty the conviction that, in the trenches traversed by the roots, and cumbered with the fallen trunks of giant trees, we have the indubitable proofs of an ancient race of miners having wrought for the same mineral treasures which are now once more attracting a population to the solitudes of the forest.

A writer, whose narrative Dr. Schoolcraft has embodied in his His-

* When the poet Southey made the adventures of the Welsh Prince the subject of an epic, the knowledge regarding even the older regions of this continent was sufficiently vague to sanction any theory, and he accordingly wrote in 1805, "Strong evidence has been adduced that Madoc reached America, and that his posterity exist there to this day, on the southern branches of the Missouri, retaining their complexion, their language, and in some degree their arts." Ten years later, however, the poet added a foot-note, to state, that these 'Welsh Indians" had been sought for in vain on all the branches of the Missouri, as well as elsewhere in all the explored regions of America.

tory of the Indian Tribes, remarks of the ancient mining excavations of this region: "The great antiquity of these works is unequivocally proven by the size of the timber now standing in the trenches. There must have been one generation of trees before the present since the mine was abandoned. How long they were wrought can only be conjectured by the slowness with which the miners must have advanced in such great excavations with the use of such rude instruments. The decayed trunks of full grown trees lie in the trenches. I saw a pine over three feet in diameter, that grew in a sink-hole on one of the veins, which had died and fallen down many years since." Above a mass of copper, detached and marked by the rude tools of the ancient miners, there was also noted a hemlock tree, the roots of which spread entirely over it, and a section of the trunk exposed two hundred and ninety annual rings of growth. An uncertain, yet considerable interval must be assumed to have intervened between the abandonment of those ancient works and their once more becoming a part of the wild forest wastes; and when this interval is added to our calculations, we are at once thrown beyond the era of Columbus in our search for a period to which to assign these singular relics of a lost civilization.

When, and by whom, then, were these works carried on? In the early part of the seventeenth century, when the wild regions around Lake Superior were first partially explored by Europeans, the Jesuit missionaries of Canada and others, they appear to have pertained to the Algonquin tribes. But the climate and soil of this region seem alike conclusive as to the improbability of the permanent settlement of any civilized race along the shores of Lake Superior. The soil is affirmed to be, for the most part, little adapted to agriculture, and the length and severity of the winter leave the modern miner entirely dependent on the accumulated stores laid up during the summer. This, therefore, may seem to justify the conclusion that the mining operations have been carried on intermittently by migratory workers, just as the modern Indians are known to explore the detritus and out-cropping veins at the present day, for the readily attainable fragments of the miskopewabik, or red iron, as they call it. But, although the native copper has probably never been altogether unknown to the Indian tribes of the continent, lying south and west of the great lakes, yet many evidences tend to prove an essential diversity of character and operations between the ancient and modern native metallurgists. The very name of *red iron* is clearly post-Columbian, and proves the disseverance of the links which should connect the ancient miners of Lake Superior, with the modern tribes who have found there their hunting grounds.

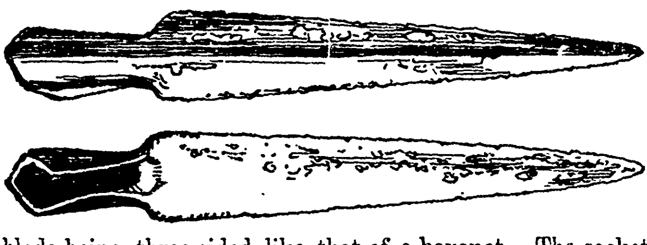
There was a period in the long-past epochs of America's unrecorded history, when the valleys of the Mississippi and the Ohio were occupied by a numerous and settled population, known to the modern Archæologist as the Race of the Mound-builders. Alike in physical conformation and in arts they approximated to the races of Central America, and differed from the Red Indians alone known to Europeans as the occupants, and by them familiarly styled the aborigines, of the whole northern regions of the American Continent south of the Arctic Circle. The Mound-builders were not, to all appearance, far advanced in civilization. Compared with the tribes of Central America, first visited by the Spaniards, their arts and social state were in an extremely rudimentary state. The contrast, however, is no less striking between the evidences of their settled condition, with the proofs of extensive co-operation which their numerous earth-works supply, and all that pertains to the nomade tribes which have been alone known to occupy the American forests during post-Columbian centuries.

The Mounds of the Mississippi Valley abound in copper ornaments and implements, proving the familiarity of their builders with the mineral wealth of the Lake regions; and to just such a race, with their imperfect mechanical skill, their partially developed arts, and their aptitude for continuous combined operations, would we ascribe, *a priori*, such ancient mining works as exist on the shores of Lake Superior, overshadowed with the forest-growth of centuries. The Mounds constructed by the Ancient brachycephalic Race are in like manner overgrown with the evidences of their long desertion; and the condition in which recent travellers have found the long-forgotten cities of Central America, may serve to show what even New York, and Washington, and Philadelphia; what Toronto, Montreal, and Quebec, would become after a very few centuries, if abandoned, like the desolate cities of Chichenitza or Uxmal, to the inextinguishable luxuriance of the American forest growth.

The history of the cities of Central America is known, and the date is well ascertained when the irruption of a new race extinguished their advancing civilization, and threw back into primitive barbarism the remnant of the ancient race which they failed to extirpate. It seems no illegitimate assumption to affirm of the Mound-builders of the Mississippi, and the ancient Miners of Lake Superior, in like manner, that some great catastrophe,—the intrusion it may be of the present Red Indian Race, or more probably the still deadlier influence of pestilence, such as in the seventeenth century, swept away the Messacheuseuks and Narragansetts of New England—appears to have abruptly arrested their labours, and to have restored the scenes of their industrious progression to the silence amid which the later forest-wilderness arose. It is not necessary to assume a very great antiquity for the era of this abortive American civilization. It has been a favourite theory with some, to trace analogies between the arts of Central America and those of Egypt's primitive civilization. But those who do so, forget that the era of Montezuma is known, and that to a past so recent as that we can assign so much of Aztec and Toltec art, that a very few more centuries, at most, may suffice to embrace the utmost that we know of. Assuredly nothing has been observed, as yet, pertaining either to the ethnology or the archæology of the new world, which may not be compatible with its first occupation by a human population subsequent to the Christian era. Much, however, may yet be brought to light, in reference to America's prehistoric centuries; and meanwhile it seems premature to affirm as Dr. Schoolcraft does of the Lake Superior basin: "There are no artificial mounds, embankments, or barrows in this basin, to denote that the country had been anciently inhabited; and when the inquiry is directed to that part of the continent which extends northward from its northern shores, this primitive character of the face of the country becomes still more striking. It is something to affirm that the mound-builders, whose works have filled the West with wonder,—quite unnecessary wonder,—had never extended their sway here. The country appears never to have been fought for, in ancient times, by a semi-civilized or even pseudo-barbaric race. There are but few darts or spear-heads. I have not traced remains of the incipient art of pottery, known to the Algonquin and other American stocks, beyond the Straits of St. Mary, which connects Lakes Huron and Superior; and am inclined to believe that they do not extend in that longitude beyond the latitude of 36° 30′. There is a fresh magnificence in the ample area of Lake Superior, which appears to gainsay the former existence and exercise by man, of any laws of mechanical or industrial power, beyond the canoe-frame and the war-club. And its storm-beaten and castellated rocks however imposing, give no proofs that the dust of human antiquity, in its artificial phases, has ever rested on them."

Observation has already disclosed in these northern regions the trenches of the ancient miners, who supplied to the mound-builders of the south the copper which they are proved to have so abundantly used; and the country has not yet been so thoroughly explored through all its vast unoccupied wildernesses, as to preclude the possibility that there yet may be discovered among the recesses of its forests, grave mounds of the ancient Brachycephalic race, whose physical characteristics seem clearly to prove that the race of the mound-builders of America and the red Indian tribes that succeeded to the forests are distinct.

The numerous ancient implements and weapons of copper already found in the mining regions of Lake Superior, entirely correspond with the other evidences of combined operation protracted over long periods of time, disclosed by the ancient Ontonagon mines; and concerning which no traditions of the present native tribes of the country indicate the slightest knowledge. At the Bigelow House at Ontonagon, I had an opportunity of examining an interesting collection of copper relics found, a few months before in the neighborhood. These consisted of three copper spear-heads, one about fourteen inches, and the others about twelve inches in length; and two singularily shaped copper gouges (?) about fourteen inches long, and two wide, the precise use of which it would be difficult to determine. It was my good fortune to make the acquaintance, while at Ontonagon, of Captain Peck, whose knowledge of the native languages, and residence for years among the red Indians, have given him good opportunities of judging of their habits and arts; and his idea of the copper gouges was that they were designed for cutting holes in the ice for fishing, according to a method still pursued by the Indians for obtaining their winter supply of Lake fish. A different and more probable opinion, however, was advanced by a practical miner, who stated that he had been among the first who opened some of the ancient diggings found at the Minnesota mine, and the copper gouges seemed exactly adapted to produce the singular tool-marks which had then excited his curiosity. Subjoined is a representation of one of the spear-heads, sketched from the original. Its form is singular,



the blade being three-sided like that of a bayonet. The socket has been formed by hammering out the lower part flat, and then turning it over partially at each side. Precisely such a mode of fitting the blade to receive a haft is common in the more primitive forms of bronze implements found in Britain and the north of Europe. In the pure copper spear-heads of Lake Superior, it may be assumed, as a confirmation of the conclusion suggested by numerous other copper relics of this continent, that the ancient miners and mound-builders were ignorant of the arts of welding and soldering, as well as of that of smelting the metallic ores. An indentation made in the inner side of the rude socket closely resembles the device adopted for the same purpose in the class of bronze implements of ancient Europe, known as *paalstaves;* its object evidently being to present a point of resistance to the haft. The European implements, however, are made of a metallic compound, and mostly cast, thus proving a knowledge of metallurgic arts far in advance of the old workers of the metallic treasures of Ontonagon, and the copper regions of Lake Superior.

I was informed by Captain Peck, that a fourth spear-head had been found along with the above. The whole were discovered buried in a bed of clay on the banks of the river Ontonagon, about a mile above its mouth, during the process of levelling it for the purposes of a brick field. Above the clay was an alluvial deposit of two feet of sand, and in this, and over the relics of the ancient copper workers, a pine tree had grown to full maturity. Its gigantic roots gave proof, in the estimation of those who witnessed their removal, of considerably more than a century's growth; while the present ordinary level of the river is such that it would require a rise of forty feet to make the deposit of sand beneath which they lay. It is possible, however, that the original deposition of the relics may have been made in an artificial excavation, above which the pine tree struck its roots in later times, for along with the implements there were also found fragments of copper, the remains, as it might seem, of the operations of the ancient manufacturers, by whose skill these, or similar weapons and tools, were wrought on the spot.

This locality has been celebrated for the traces of its mineral wealth from the earliest date of European exploration of the Lake Superior regions. Alexander Henry, in his "Travels and Adventures in Canada, and the Indian Territories," mentions his visiting the River Ontonagon, in August 1765. "At the mouth, was an Indian village; and at three leagues above, a fall, at the foot of which sturgeon were at this season so abundant, that a month's subsistence for a regiment could have been taken in a few hours. But—he adds—I found this river chiefly remarkable for the abundance of virgin copper which is on its banks and in its neighbourhood. The copper presented itself to the eye in masses of various weight. The Indians showed me one of twenty pounds. They were used to manufacture this metal into spoons and bracelets for themselves. In the perfect state in which they found it, it required nothing but to be beat into shape."* On a subsequent occasion, in the following year, Mr. Henry again visited the same region, "On my way," he says, "I encamped a second time at the mouth of the Ontonagon, and now took the opportunity of going ten miles up the river, with Indian guides. The object which I went most expressly to see, and to which I had the satisfaction of being led, was a mass of copper, of the weight, according to my estimate, of no less than five tons. Such was its pure and malleable state that with an axe I was able to cut off a portion weighing a hundred pounds." † This object, which thus attracted the adventurous European explorer nearly a century ago, has since acquired considerable celebrity, as one of the most prominent encouragements to the mining operations projected in the Ontonagon and surrounding districts. These notices, moreover, are interesting as showing to what extent the present race of Indians were accustomed to avail themselves of the mineral wealth of the great copper regions.

The details of another, and in some respects more interesting discovery, than that which was brought under my notice at Ontonagon, were communicated to me in reply to the inquiries made while there. This took place, at a still more recent date, at a locality lying to the east of Keweenaw Point, in the rich iron district of Marquette. There, not far from the mouth of the river Carp, in what appeared to be the ancient bed of the stream, and about ten feet above the present level of its channel, various weapons and implements of copper have been recently found. Large trees grew over this deposit also, and the evidences of a remote antiquity seemed not less obvious than in that of Ontonagon. The copper relics included knives, spear or lance-heads, and arrow-heads, some of which were ornamented with silver. One of the knives was described as made, with its handle, out of a single piece of copper. It measured altogether about seven inches long, of which the blade was nearly two-thirds of the entire length, and of an oval shape. It was ornamented with pieces of silver attached to it, and was inlaid with a strip of silver from point to haft. Along with these relics were also found numerous fragments, or chips and shavings of copper, some of which were such as, it was assumed, could only have been cut by a fine sharp tool; and the whole sufficed to indicate even more markedly than those at Ontonagon, that not

* Henry's Travels and Adventures, p. 194. New York, 1809.

† Ibid, p. 204.

only was the native copper wrought in ancient times in the Lake Superior Regions: but along its shores, and on the banks of its navigable rivers, there existed manufactories where the native artizan fashioned the metal into tools and weapons for war and the chase.

This would seem to be still further confirmed by the evidences of permanent settlement at some former period described as still visible at the mouth of the Carp river, where those relics of its ancient manufactures were found. The foundations of old structures are still clearly traceble. The outlines of the buildings can be made out by the ridges of clay remaining, and in places the ruined masonry seems to show where the hearth had stood. Such traces, I was assured, suffice to indicate that whole ranges of dwellings must have occupied the site, so that here unquestionably, at some remote period, there existed a settlement of considerable extent, and a town conveniently situated for commanding the Lake. The buildings must have been slight when compared with those which have left their mighty ruins amid the forests of Central America; but the traces which remain correspond with what might be expected of the Mound-builders of the Mississippi, and over their works has waved for unknown centuries the forest, which, by the age it lays claim to, suffices to divide that ancient and unknown past from the era of the new race of workers, who are now ransacking the mineral veins of the copper regions, and turning their metallic treasures to account for the aggrandisement of the intrusive Anglo-Saxon.

A lively interest is felt throughout the Copper regions in the relics of the ancient miners, and the modern occupants of their works manifest an intelligent appreciation of the uses of such antique remains as a means of throwing light on the history of former ages. I found a peculiar importance attached by the miners and others to the hardness of the wrought copper implements. This they contrasted, in more than one case, with the ductility of the chips and fragments of unwrought copper found along with them, as well as with the condition of the native copper when first brought from the mine, and maintained that it afforded proof of a knowledge acquired by the ancient metallurgist of some hardening process unknown to the modern copper-smith. It is well known that copper and bronze chisels are frequently found among the ancient relics of the Nile Valley, and that the paintings of Egypt exhibit her sculptors hewing out the colossal memnons of lime-stone and granite by means of yellow-coloured tools, which may fairly be assumed to be made of the copper wrought by the Egyptians in the mines of Maghara, near Sinai, so early as the reign of Suphis, the builder of the great pyramid. We know, moreover, that iron was equally unknown in Central America, and that by similar tools—untempered by the addition of tin, which the Egyptians early learned to mix with their copper,—the highly sculptured monuments of Mexico and Yucatan must have been wrought by native artists. I have had no opportunity of testing the real hardness of such tools, but I observed the edges of some of the ancient implements found at Ontonagon to be dinted, just as well-hammered copper would be, by a blow of unusual force; and it is not improbable, that when due opportunity for examining into this question is furnished, the art of the ancient metallurgist will be found to have amounted to no more than the inevitable hardening of the copper, consequent on the laborious plying of it with the oft repeated strokes of his stone hammer to bring it to the desired shape. The difference which this makes on the wrought copper is abundantly familiar to the copper-smith, and also to the engraver on copper, though it is less likely to be known to the miner, working with his keen iron tools only upon the virgin metal in its native ductile state.

It seems specially worthy of note that the evidences of various kinds thus adduced to prove the existence at some former period of a mining population in the copper regions of Lake Superior, seem also to indicate that their labours had come to an abrupt termination. Whether by some terrible devastating pestilence, like that which appears to have exterminated the native population of New England, immediately before the landing of the Pilgrim Fathers; or by the breaking out of war; or—as seems not less probable,—by the invasion of the mineral region by a new race, ignorant of all the arts of the ancient Mound-builders of the Mississippi, and of the Miners of Lake Superior: certain it is that the works have been abandoned, leaving the quarried metal, the laboriously wrought hammers, and the ingenious copper tools, just as they may have been left when the shadows of the evening told their long-forgotten owners that the labours of the day were at an end, but for which they never returned. Nor during the centuries which have elapsed since the forest reclaimed the deserted trenches for its own, does any trace seem to indicate that a native population again sought to avail themselves of their mineral treasures, beyond the manufacture of such scattered fragments as lay upon the surface. Such a rude manufacture is, however, traceable among the Indians, even far to the north of Lake Superior. Mr. Henry found the Christinaux of Lake Winipagon wearing bracelets of copper; and such employment of this metal—simple as its manufacture is—may, perhaps, prove to be the remnant of arts pertaining to a higher civilization, once widely diffused over this continent.

# THE CANADIAN GEOLOGICAL SURVEY AND ITS DIRECTOR, SIR WILLIAM EDMOND LOGAN, Kt. F.R.S.

BY SANDFORD FLEMING, C. E.

*Read before the Canadian Institute, February 23rd,* 1856.

Previous to the two great Industrial Exhibitions at London, in 1851, and Paris in 1854, the world at large may be said to have been in total ignorance of Canada's resources. Many people indeed appear to have been scarcely cognizant of her geographical position on the surface of the globe. Even our enterprising neighbors of the United States were but partially aware of what the country was capable of producing; and each member of our own population was too much engaged with his own pursuits to have any defined idea of the character or productiveness of those districts remote from his own immediate neighborhood.

Within these five years, however, through the medium of the above mentioned sources, it has been shewn that, while in various branches of mechanism and manufactures, the mechanics and manufacturers of Canada are in some respects in advance, and in the generality of cases equal to those of other nations—and while Canadian agricultural products are admitted to be of the highest quality—Canada can produce an amount and variety of raw material, equal, in proportion to the extent of area, to any other country in the world.

For the superb collections of minerals, which appear to have been the theme of universal admiration on both occasions, the country is mainly indebted to the Geological Survey of the Province, and the unwearied exertions of its Director, on whom Her Majesty has recently conferred the merited honor of Knighthood. The fruits of his labors are only now beginning to be developed, and his untiring zeal, energy and disinterestedness, cannot be over-estimated; and, with these convictions, it is incumbent on the people of this Province to show that they fully appreciate the great benefits rendered to their country, by a unanimous expression of their approbation of Sir W. E. Logan's services as Director of the Geological Survey, and as one of their principal representatives in London and Paris.

It is scarcely possible, in a brief communication like the present, to convey an accurate idea of the labor and diligence with which Sir W. E. Logan has conducted the Geological Survey of Canada; but to impress the fact upon those who are little aware of the magnitude of his undertaking, it may be well to record as concisely as possible the results of the investigations carried on under his direction, and in doing so I may be permitted to add a few remarks on the position accorded to him by men of science both in Europe and America.

Previous to his engagement with the Canadian Government, the reputation of Mr. Logan (as we shall still call Sir William in referring to his past career,) stood deservedly high, although his merits were then only known and appreciated by the comparatively few scientific men with whom he had direct communication. At an early period he made a very valuable collection of the birds and insects common to Canada, included in which were many species previously unknown, which he subsequently presented to the Institution at Swansea, of which he was one of the founders, and a zealous promoter of its interests during his residence in that locality.

But it was in the field of geology that Mr. Logan was destined to bear a conspicuous part, and it was during his residence in South Wales, that he performed a work which has been declared by the first scientific men in Europe to be "unrivalled in its time, and never surpassed since." This great work was his Geological Map and Sections of the Glamorganshire Coal-field, the minuteness and accuracy of which were such, that when the Government Survey, under Sir Henry de la Beche, came to South Wales, not one single line drawn by Mr. Logan was found to be incorrect, and the whole was approved and published without alteration. Nor was this all:—the system Mr. Logan had pursued in following out the details of the coal-field was so vastly superior to any hitherto adopted, that the principle has been fully adopted by the British Survey. Mr. Logan's map may be said to be the model one of the whole collection. It ought to be borne in mind also, that at this time he was not employed as one of the geological staff, but simply as an amateur, and that —in the same spirit as so many of his Canadian observations have been carried out,—he generously presented the fruits of his labors, without fee or remuneration, to the British Government.

While engaged in the examination of the coal-formation, Mr. Logan contributed many interesting and valuable papers to the Geological Society of London, among which may be specially noticed one on the "Stigmaria beds" or "under clays" which accompany every coal-seam; as from the observations recorded then, the long disputed theory as to the origin of coal was finally set at rest, and the inferences it led to universally acknowledged. Another paper, contributed prior to his connexion with Canadian Geology, also deserves notice here, as it refers to a matter in which a portion of Canada is deeply interested. It is entitled: "On the effect of the *packing of the Ice* in the River St. Lawrence opposite the City of Montreal." The principles laid down in this latter paper appeared so indisputable to Mr. Stephenson, the eminent engineer, that he has been materially guided by it in reference to the construction and site of the great Victoria Bridge.

In 1842 the Canadian Legislature came to the determination of having the Province geologically explored, and it was in the same year that Mr. Logan—having been recommended most strongly by the leading geologists of Great Britain, from each of whom he received the most flattering testimonials—was applied to by Lord Stanley, then Secretary for the Colonies, to undertake the investigation. In the same year he proceeded to Canada, completed a preliminary examination, made arrangements with the Colonial Government and returned to Britain,—the whole expense of which visit he paid out of his own pocket,—and early in the following year (1843) he finally returned to Canada, accompanied by an assistant, to commence the investigation in earnest.

It was in 1842, also, that Mr. Logan examined and accomplished the measurement of the remarkable section of the coal measures at the South Joggins, in Nova Scotia: a work acknowledged to be one of the most important in American geology, as the key to the structure of the whole Eastern coal basin;—and which was published as an appendix to his Report of Progress in 1843.

The first grant of money made by the Canadian Legislature to carry out the proposed survey for two years, was only £1500 currency, so that it will be obvious it was only by the strictest economy that the salaries could be paid, and travelling and other expenses met; indeed, notwithstanding all the care possible, the necessary work could not be effected with this small grant, and, accordingly at the expiration of that time, Mr. Logan found himself out of pocket upwards of £800.

During the summer and autumn of 1843 Mr. Logan was employed in an examination of the coast of the Gaspé Peninsula, while he sent his assistant to make a section of the Upper Province, through the country lying between the Lakes Huron and Erie—one grand object of the expedition being to determine what the probabilities were of the existence of coal measures at either end of the Province. In 1844 both Geologists were occupied in exploring and completing a topographical survey of the Gaspé Peninsula, and in 1845, while the Director made a survey of the Ottawa River up to Lake Temiscameng, and of its tributary the Mattawau to Lake Nipissing—his Assistant continued the examination and topography in Gaspé. In 1845 the Legislature made a farther appropriation to the Survey of £2,000 currency per annum for five years, and the same was renewed in 1850 for five years more. In 1846 the Copper region of Lake Superior occupied the entire attention of the Survey; and since that time an immense amount of country has been examined in various parts of the Province, the greater portion of which being entirely wild and unknown, it was found necessary to survey topographically. Besides the geology,—much of it of the very highest economic importance,—which has been followed out on both sides of the St. Lawrence, both above and below Montreal, in the Eastern Townships, and in the region around the confluence of the Ottawa; the courses of all the main rivers of Lake Huron on the one side of the "Height of Land," and of the Ottawa on the other, have been traced and measured to their sources, the Lakes and principal features of the interior surveyed, and the elevation of every fall and rapid ascertained trigonometrically or by spirit level. Those surveys have since been mapped on a scale of an inch to a mile, with every particular noted thereon.

Moreover, a regular system of measurements has not been confined to the totally wild and unfrequented parts, but has been found absolutely necessary throughout nearly the whole of the settlements, in consequence of the numerous inaccuracies and omissions in the various township plans. Where a more accurate method could not be obtained, all the observations were connected by a registration of each step taken by the observer, the bearings from one point to another being taken by compass. And as an example of the amount of work accomplished by this means—Mr. Richardson (who has been employed as an explorer since 1845) in 1853 registered paces, in his note book, making a total distance during the season of upwards of 1000 miles. The results of this process have also been mapped on a scale of an inch to a mile, and have supplied, on many occasions, much material to fill up deficiencies, and correct discrepancies, on the old published maps.

The result of these investigations is already acknowledged to have been of incalculable benefit to science, as having most essentially thrown light, where there was much misapprehension before, on the whole of American Geology; and they have, moreover, beyond dispute, been productive of the most valuable information as regards the distribution of economic materials. While the position of such useful materials as *do* exist can be readily recognised by reference to the Geological map, in which the various formations are represented by different colors—those that *do not* exist, will be found wanting and, consequently, need not be looked for; such, for example, is the case with regard to Coal—a mineral not likely to be found among rocks recognised as belonging to the Silurian and Devonian epochs.

Having thus glanced over the Field operations of the Survey, let us shortly consider the means the Director has had at his disposal to accomplish what already has been done.

In 1843, Mr. Logan, accompanied by a single Indian with a bark canoe, made a thorough examination of the whole of the Gaspé Coast, counting every step he took from Cape Rosier to Port Daniel, besides making many pedestrian excursions into the interior—and collecting a large quantity of most valuable fossils and other specimens. And while he was thus employed his assistant, Mr. Alexander Murray—frequently entirely alone, and often in parts remote from all settlements—collected sufficient information to give a tolerably correct idea of the structure of the whole Western Peninsula. In 1844 and 1845, a triangulation was effected across the Gaspé Peninsula from Cape Chat to Bay Chaleur, a large portion of the range of the Notre Dame or Shick-Shock Mountains surveyed, most of the principal rivers measured, the geological character of the rocks ascertained, and specimens collected. This service was performed with a party consisting of only four Indians with two canoes. In making the survey of the Ottawa more assistance was found to be absolutely necessary, but, except in few instances, neither Mr. Logan nor Mr. Murray's party have exceeded the complement of *six* altogether—inclusive of four Indians and an assistant.

Since 1845, when the additional appropriation was granted, an explorer has been added to the staff whose labors have been incessant and of great value; but while fully admitting the greatly improved circumstances under which the survey was then placed, and the more extensive scale under which the operations were enabled to be carried on, it must be clear to any one at all acquainted with the nature of the service, and of the difficulties to be encountered in a perfectly new country, that the amount of work performed and reported upon never could have been accomplished but by the most indefatigable perseverance and continued application. Accuracy with Mr. Logan is everything—nothing is allowed with him to be of the slightest value that is not essentially correct. With regard to the office work, we have simply to refer to Mr. Logan's own answer before the Select Committee of the House of Assembly to question 73, on page 26 of the published Report, to show how his time is there employed:

Question 73, page 26 (referred to.)—"Each one on the Survey has so much to do connected with his own individual department, that all the general office work falls upon me. I keep all the accounts, and for that purpose a set of books by double entry, in which I enter no gross sums, with a reference to accounts, but everything in detail for easy and immediate reference if required, and I render an account to the Government with the same detail on the face of it; so that any one who chooses, either publicly or privately, to look at the account, can see at once how every penny has been spent. I used at first to make, with my own hands, four manuscript copies of the annual Report of Progress, often reaching more than one hundred printed pages—one copy for the Government, one for the House of Assembly, one for the Legislative Council, and one for the printer; but of late I have been forced to employ an amanuensis for part. The fittings of the Museum are scarcely yet completed; when they are I *must* employ additional aid, if it should cost me my whole salary. The accumulated materials of eleven years are to be classified and arranged."

Emulating the example of their chief, the assistants have also laboured with diligence and credit to themselves, and have undergone similar fatigue and hardship. In the Chemical Department Mr. Hunt has, since his connexion with the Survey, established a high reputation among the foremost ranks of the men of science both in Europe and America; whilst the others have acquired a fair proportion of merit by their contributions to the Geology and Geography of the Province.

It has frequently been urged by some that the proceedings of the Survey were too *scientific* and not *sufficiently practical*—that great attention has been paid to *fossils*, and to remote and comparatively Northern districts of country—while a partial attention only has been given to certain known Mineral districts, and the more densely settled and more available lands. In answer to this, let us take the concluding portion of Mr. Logan's reply to question 93, page 39 of the Report of the Select Committee.

Question 93, page 39.—"Thus, Economics lead to Science, and Science to Economics. The physical structure of the area examined is, of course, especially attended to, as it is by means of it that the range or distribution of useful materials, both discovered and to be discovered, can be made intelligible. A strict attention to Fossils is essential in ascertaining the physical structure. I have been told that some persons, observing how carefully attentive I endeavour to be to this evidence of sequence, have ignorantly supposed the means to be the end, and while erroneously giving me credit as an authority upon Fossils, have fancied Economics to be sacrificed to them. In their fossil darkness, they have mistaken my rush-light for a sun. I am not a naturalist. I do not describe fossils, but use them. They are geological friends who direct me in the way to what is valuable. If you wish information from a friend, it is not necessary that you go to him, impressed with the idea that he is a collection of bones peculiarly arranged, of muscles, arteries, nerves and skin, but you merely recognise his face, remember his name, and interrogate him to the necessary end. So it is with Fossils. To get the necessary information from them you must be able to recognise their aspect, and in order to state your authority you must give their names. Some tell of Coal; they are cosmopolites; while some give local intelligence of Gypsum, or Salt, or Building Stone, and so on. One of them whose family name is *Cythere*, but who is not yet specifically baptized, helped us last year to trace out upwards of fifty miles of Hydraulic Limestone."

In concluding these observations on the character of Mr. Logan's labors in conducting the Geological Survey, carried on as it has been with unusual earnestness and zeal, I cannot do better than refer to a quotation from the *London Quarterly Review*, October, 1854, which occurs in the Report of the Committee above named—and in doing so, express a hope that in this instance the old adage will not hold good, that "a Prophet has no honour in his own country," for, in fact and in spirit, Canada is Mr. Logan's country. He was at one time applied to by the East India Company to undertake an examination of their territory for Coal; a work for which, by his past investigations, he was peculiarly fitted. The field of research was new, and India was then attracting much more attention than Canada. The emoluments would have greatly exceeded those of his present office; his staff was to be ample, and of his own selection; unlimited aid was to be afforded by the Indian Government; and although he felt quite convinced that the investigation would lead to a very extended reputation, yet being influenced by a rooted attachment to this country, and feeling that he was in some degree pledged to it because he is a native Canadian, the munificent offer of the East India Company was not accepted. The quotation above referred to reads as follows:—"In Canada, there has been proceeding for some years one of the most extensive and important Geological Surveys now going on in the world. The enthusiasm and disinterestedness of a thoroughly qualified and judicious observer, Mr. Logan, whose name will ever stand high in the roll of votaries of his favourite science, have conferred upon this great work a wide-spread fame."

As I have already said, the services rendered to the Province by Sir W. E. Logan in London and Paris would alone suffice to entitle him to the unanimous acknowledgments of his country; may we hope that the Legislature will give substantial expression of its approbation, as well as of its appreciation, of the justly merited distinction which Her Majesty has conferred on the representative of Canadian science; and there is no manner, I feel assured, in which this could be done more acceptably to Sir W. E. Logan himself, and more creditably and lastingly beneficial to the Province, than in extending to the Survey increased support, and in placing at his disposal ample means to enable him to carry on this most important service to a successful termination. By such means the wealth and character of Canada will be equally advanced. Science will receive such valuable contributions as, we believe, no country, at so early a stage of its existence, has ever before rendered to it; while the practical returns will prove a hundred-fold in their additions to the material wealth and resources of the Province.

# NOTES ON THE POPULATION OF NEW ENGLAND.

BY THE REV. A. CONSTABLE GEIKIE.

*Read before the Canadian Institute, February 23rd,* 1856.

On a recent visit to New England, I was led to pay some attention to a matter which has long interested me, viz, the supposed deterioration of the population of that country. My observations and the remarks of others, years ago, called my thoughts in this direction, and finally led me to examine such reliable statistical tables as were within my reach. The results of this investigation I shall now lay before the Institute. I state them with the belief that the people of New England are degenerating, and shall endeavour to prove the accuracy of this opinion.

The last Census of the United States was taken in 1850, and a compendium of this was published in 1854 by Mr. J. D. B. DeBow, Superintendent of the United States Census. From this I shall quote, and presume that its general reliability will not be questioned.

The first point I would notice is the proportion of births among the married inhabitants of Massachusetts, native and foreign. In page 122 of the Compendium are the following statements, contained in extracts from the letters of Dr. Jarvis to the Census Office. I need only add, that I believe the writer to be one of three persons appointed by the Legislature of Massachusetts to draw up the report on the lunacy and idiocy of that State, and which was published in 1855, Dr. Jarvis having been really the compiler of it. His statements above referred to are as follows:—"In Massachusetts and in Boston, where we have the means of making the comparison, there is a much larger proportion both of marriages and births to the population of each kind, among the foreigners than among the natives, within three or four years.................... The marriages were in Massachusetts during the years 1849, 1850, and 1851, Americans 18,286, or 220 in 10,000 of their own race; foreigners, 7,414, or 450 in 10,000. This is 104, 5 per cent. excess of foreign over native ratio. ................. The marriages in Boston in the three and a half years from July, 1849, to December 31st, 1852, were, Americans, 4,078, or 541 in 10,000 of their own race; foreign, 5,073 or 799 in 10,000. This is 84, 8 per cent. excess of foreign over native ratio." So much for the superior uxoriousness of the old world people; now for the results of the two sets of marriages. "The births," continues the Doctor, "were in Massachusetts in the three years 1849, 1850, and 1851, of American parents, 47,982, or

578 in 10,000 of their own race; foreign, 24,523, or 1491 in 10,000 of their own race:" a difference of a most significant character. "In Boston there were, Americans, 7,278, or 966 in 10,000, foreign, 13,032, or 2,053 in 10,000 in three years." He adds,—"These facts certainly show a much greater tendency to marriage, and a more rapid production among the foreign than among the native population here." He says on page 121—"foreigners generally intermarry with each other, so far as we have means of observation; there are comparatively few instances of natives and aliens uniting together; so few are there that they do not militate with the general rule. With the Irish especially, this rule is almost universal, and with all it will be safe to say that there are no more marriages of foreigners than there are foreign marriageable females, the exceptions are so rare as not to destroy any extensive calculations made in regard to it." Dr. Jarvis seeks to weaken the facts thus brought out, by intimating that the children of foreigners dying young are more numerous than those of the natives who die young, and that the rapid increase among the former may thus be partly accounted for. This, however, is not enough. The deaths must indeed be wonderfully frequent among the offspring of emigrants, if they can make 598 births in 10,000, equal to 1,491 in 10,000, or 966 in 10,000 equal to 2,053 in 10,000. The facts I believe must stand, the excess of births among the foreign over the native population indicating one of two things respecting the latter,—either that they are an enfeebled race, or addicted to practices which I will not name.

These figures confirm all my own observations. A large family is comparatively seldom met with in New England. Indeed, the absence of children altogether, appears to be a far commoner thing than any large number of them in a household. The remarks of the old people likewise sustain my view. Such can run over long lists of households, which, during the past generation, were like households at the present day in Britain, crowded with little people; and when they do so, they invariably note the difference between thirty or forty years since and the present time. I am now speaking chiefly of New England, of which Massachusetts is the best State; but the Census returns for the entire Union, show a general decrease, rather than an increase in the number of the young. The following abstract is taken from some remarks which I have already published on this subject:—Thus, "in 1830, there were, *in the whole Union*, a fraction over eighteen per cent. of males, and seventeen per cent. of females umder five years of age; while in 1850, there were under five years, only fourteen and rather more than a half per cent. of the former, and rather less than fifteen per cent. of the latter. In 1830, there were fourteen and a half per cent. of males under ten years, and the same number of females under ten years; in 1850, there were thirteen and a half per cent. of the former, and rather less than fourteen per cent. of the latter. This difference on the whole Union is striking enough, and confirmative of my opinions; but I am certain that if we had any such statistics as to the present number of children in New England, compared with forty years since, we would find the difference far more remarkable."

The second point in proof of the physical degeneracy of New England, is found in the prevalence of insanity and idiocy among its inhabitants.

Let us first look at the statements of the Census on this head, merely premising that, in so far as it is inaccurate, it is so because it understates the matter. From this source it would appear that in 1840, the ratio of white insane persons in Massachusetts was as 1 to 605; in 1850, it was as 1 to 403. In 1840, the ratio of white insane persons in Connecticut was as 1 to 606; in 1850, it was as 1 to 486. In 1840, the ratio of white insane persons in Maine was as 1 to 932; in 1850, it was as 1 to 514. In 1840, the ratio of white insane persons in Rhode Island was as 1 to 520; in 1850, it was as 1 to 449. In 1840, the ratio of white insane persons in Vermont was as 1 to 732; in 1850, it was as 1 to 366.

From these figures it is certain, either that mental disease is on the increase, or else that the Census of 1840 was singularly imperfect. Leaving this question, however, I shall now state, as by the Census of 1851, the ratio of insane and idiotic in the New England, as compared with some other States:

"Massachusetts had, in 1850, 1 insane or idiotic white person, for every 403 sane whites. That same year, the ratio of insane or idiotic whites, to sane whites, was—in Michigan, 1 to 1,242; in Mississippi, 1 to 1,227; in Missouri, 1 to 1,031. Connecticut had, in 1850, 1 insane or idiotic white for every 486 sane whites.—That same year, the ratio of insane or idiotic whites to sane whites was—in Columbia, 1 to 1,649; in Florida, 1 to 1,276; in Illinois, 1 to 1,417; in Iowa, 1 to 1,410. Maine had, in 1850, 1 insane or idiotic white for every 514 sane whites. That same year, the ratio of insane or idiotic whites was—in Arkansas, 1 to 995; in Louisiana, 1 to 1,022; in New York, 1 to 738. Rhode Island had, in 1850, 1 insane or idiotic white, for every 449 sane whites. That same year, the ratio of insane or idiotic whites, to sane whites, was—in Texas, 1 to 1,185; in Wisconsin, 1 to 2,087; in Minnesota, 1 to 3,019; in New Mexico, 1 to 1,118. In 1850, Vermont had 1 insane or idiotic white for every 366 sane whites. That same year, the ratio of insane or idiotic whites, to sane whites, was—in Oregon, 1 to 1,454; and in Utah, 1 to 1,888."

"In all the comparisons made, New England retains a fearful pre-eminence. In comparing her with some other old States, this is not quite so great. Take the following table:—

RATIO OF INSANE AND IDIOTIC, TO SANE, IN 1850.

| | |
|---|---|
| Vermont | 1 to 366. |
| Massachusetts | 1 to 403. |
| Maine | 1 to 514. |
| Connecticut | 1 to 486. |
| Rhode Island | 1 to 449. |
| New Hampshire | 1 to 436. |
| Virginia | 1 to 509. |
| N. Carolina | 1 to 511. |
| Maryland | 1 to 555. |
| S. Carolina | 1 to 580. |
| Delaware | 1 to 583. |
| Kentucky | 1 to 588. |
| New Jersey | 1 to 599. |
| Georgia | 1 to 645. |
| Indiana | 1 to 659. |
| Tennessee | 1 to 666. |
| Pennsylvania | 1 to 685. |
| Ohio | 1 to 738. |
| Alabama | 1 to 784." |

Such are the indications of the Census. It may be supposed, however, that the returns in the New England States were more complete than those of the new settled countries. This is no doubt the case. Still, making every allowance, I cannot doubt but that there is far more cerebral disease in New England than in any other portion of the Union.

We shall now leave the Census tables, and turn to a more complete document, to wit "the Report on Insanity and Idiocy in Massachusetts, by the Commission on Lunacy, under the resolve of the Legislature in 1854." Respecting this authority it seems safe to say that, with regard to "accuracy, completeness and pertinence," it has never been surpassed. The means employed for procuring facts were most efficient, and the chances of error were as greatly reduced as it seems possible to have reduced them. The returns in the British Census for 1851 bear a poor comparison with the fullness of those contained in this Report. It refers to Massachusetts only; but as this is a type of all the other New England States, the facts established respecting it may be taken as a fair indication of the condition of the rest. These are peculiarly striking.

A careful separation of the insane and idiotic is kept up throughout this document. Of the former, Massachusetts contains a total of 2,632; of the latter, a total of 1,087: giving 3,719 as the sum of both classes. A distinction is again made of the mentally diseased among the native and the foreign population, which gives of native insane, 2,007, and of foreign insane, 625; of native idiotic, 1,043, and of foreign idiotic, 44. We have here data of the most reliable kind; but there are different ways of dealing with them. Thus the Commissioners, or rather Dr. Jarvis, in stating the comparative numbers of native and foreign demented, carefully keeps up the distinction hitherto followed, and by doing so shews that insanity is more common among the immigrants than among his own people. By this mode of reckoning he shews the ratio of insane among natives to be as 1 to 445, and the ratio of insane among foreigners to be as 1 to 368. The excess of lunacy among these strangers is unquestionable and noticeable, but it is neither a strange fact, nor an unaccountable one. Their trials explain all. The case is greatly altered, however, when he deals with idiocy. This same comparison shews that among the natives, the idiotic are as 1 to every 889, while among foreigners they are as 1 to every 7,931.

Were we anxious merely to prove great derangement in both classes, this mode of computation might suffice. But as we are anxious to discover the actual amount of mental disease existing amongst a particular class, in common with the writer on lunacy in the North American Review for January last, I cannot help deeming it unsatisfactory, to say no more. I believe that the New Englanders are degenerating, that every kind of mental disease is degeneracy, whether for convenience sake the species be styled lunacy or idiocy; and therefore must, and am entitled to conjoin both classes in order to reach the actual state of the case. The saneness of a country can only be decided on by knowing the *total* of the *unsaneness* found in it. I believe, therefore, that though the Commissioners gave peculiar prominence to the excess of foreign lunatics as compared with native, every one, themselves not excepted, will admit that, in an enquiry like that which I now indicate, we are fully entitled to lay aside their specific distinctions, and so speak of all the demented as comprehended under one genus.

When we do so, the apparent exemption of the natives from cerebral disease disappears at once, and most painful results become manifest. In 1854 the natives in Massachusetts amounted to 894,676, the foreigners to 230,000. The insane and idiotic among the former amounted in all to 3,050; the insane and idiotic among the latter amounted in all to 669. The application is now easy, and the result, that the mentally diseased among the foreigners are in the ratio of 1 to 367, while the mentally diseased among the natives are in the ratio of 1 to 295, giving a difference of 72 in favor of the immigrant population. This is the mode of reckoning adopted by the North American Reviewer, who says that the Report proves one or both of the following results—"either that insanity (using the word generically) is more prevalent in Massachusetts than anywhere else, or that its dimensions have been more accurately guaged."

The insanity then, among the native population in Massachusetts, is as 1 to 293; and that the reader may perceive the value of this ratio, I would state that, about the year 1838, the insane of England were reckoned as 1 to 1,000; in Wales as 1 to 800; in France as 1 to 1,000; in Prussia as 1 to 1,000; in Scotland as 1 to 574; in Norway as 1 to 551. The last Census of our Province gives for Lower Canada 1 in 513, and in Upper Canada 1 in 890. The British Census for 1851, gives the insane of Great Britain as 1 to 1,115, which, however, is probably under the mark.

Another proof and source of degeneracy in New England, is the prevalence of strumous diseases among its native inhabitants. I cannot indeed quote figures in reference to this matter. Every one, however, is aware of the fact that such diseases are alarmingly common. In Britain, people look with dread on such a taint. Among the Scottish peasantry it is almost unknown, and, generally throughout all Scotland, there prevails a fear of intermarrying with parties affected by it. As for the state of feeling in England I cannot confidently speak. I believe, however, that it resembles more or less that of the population north of the Tweed. In New England the case is far otherwise. In town or country, no one makes any secret of being afflicted with such diseases. Contrariwise, people tell you all about it, and discourse on the matter as if it were the measles which ailed them. Such affections seem to be so universal, that no delicacy is felt, or possible in the circumstances.

I need not go on to multiply proofs. People who visit New England will find them if they use their eyes. The men are for the most part lathe-like, angular, and sallow; their shoulders have a most jagged squareness, and their chests a hollowness equal to any which ever troubled Theodore Hook. Then one looks in vain for calf or hip. Such accessories seem by universal consent to have been discarded by the entire population, raising the tailor from the rank of a mechanic to that of a sculptor. When, again, we turn from the men to the women, we find equally striking proofs of degeneracy. Not only are their shoulders narrow to a most unnatural degree, but their chests likewise are hollow and contracted in a manner which helps to explain the marvellous prevalence of consumption among them. That they are pretty in mere girlhood is unquestionable, but in the slight form, blanched cheek, and flat bust, one sees only the beauty of decay. They are ever more and more becoming incompetent to be mothers of children, and I am assured that the number of deaths among young married females is quite remarkable. One looks in vain through any part of New England for the round, full, vigor of glorious health, which, everywhere in Old England, shows a population as replete with sturdy, vital energy, as at any period in the long story of our dear Mother-land.

I would, further, call attention to the portraits painted seventy years since, and those taken at the present day. These, if all else were wanting, demonstrate a great falling off.

The causes of all this seem to be as follows:

I. Climate, possibly, has much to do with it. Even in Canada the children are not so vigorous as their fathers.

II. The thing eaten, and the mode of eating, have much to do with it. Americans eat quantities of unwholesome food, and the bulk of the people never chew what they swallow.

III. The women abjure all out of door exercise.

IV. The men do the same.

V. They live in a perpetual state of excitement, such as no race on earth can endure, or were ever meant to endure.

VI. The population receives little accession of fresh blood, and blood relations frequently intermarry.

VII. It is alleged that vice has no small share in the work of destruction.

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## THE ABORIGINES OF AUSTRALIA.

BY JAMES BROWNE, TORONTO.

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In the following paper I purpose attempting to give an account of the Aborigines of Australia, a subject not without interest to us as relating to a people situated in a remote portion of the British Empire, but on whom its civilization has produced no beneficent influences. On them it is effecting, even more rapidly than on the Aborigines of this continent, the fatal effects which appear inevitably to flow from the contact of savage with highly civilized life, and these notes accordingly refer to a people who are fast disappearing from the earth. Imperfect as they are, they may possess some value from the fact that they are in no degree derived from books, but embody the results of personal observations of the natives of Australia, concerning whom few among the numerous writers on the great southern region of British colonization appear to feel the slighest interest, or to have thought their habits and characteristics worthy of remark.

It was my fortune to pass the greater part of my boyhood at King George's Sound, a settlement on the western coast of Australia. There the Aborigines were my companions and playfellows, and thus the following account embodies facts which came under my own observation, or were related to me by the natives themselves. It narrates principally the result of my observations on those with whom I sojourned; but it may be added that the manners and customs of the Aborigines of the western, southern, and eastern coasts of Australia vary so little that a description of one may answer for all. Of those inhabiting the northern coast I could speak only from report. They are a still more savage race, with whom little intercourse has hitherto been held, and they appear to present a striking contrast in some respects to the natives of other regions of the Australian Continent.

Referring as I do to a people rapidly becoming extinct, it will not detract from any value these notes may possess, that they do not embody a description of Australia of the present time, with its wonderful gold fields, and its vast and multifarious population gathered seemingly from nearly every country of the known world; but they refer to Australia as it was twenty years since, when Melbourne and Port Philip were inhabited only by the savage, when South Australia, as a Colony, was unknown, and Western Australia was only beginning to be settled by the white man.

The entrance to the noble basin of Princess Royal Harbour, on which the town of Albany in Western Australia stands, is formed by two high and rocky hills about half a mile apart, and here, some twenty years since, on a bright morning in the month of May (which be it remembered is the depth of an Australian winter,) I obtained my first sight of the Aborigines of the Southern Continent. The first impression produced by a sight of the grinning native in the bow of the harbour master's boat—black as coal, but with a pair of keen sparkling eyes, and a row of teeth disproportionately prominent from the large size of his gaping mouth,—was that we were looking on a baboon or some strange creature of that new world, rather than on a human being. A short cloak of kangaroo skins, the invariable costume of the natives, as we afterwards found, was his only garment, reaching about half way down his thighs, and exposing the lower limbs, which were disproportionately small and shapeless. His arms were sinewy though lean, but as is invariably the case with the Australian savage, larger and better developed in proportion to his general figure, than the meagre shapeless lower limbs. He was, as I ascertained, about thirty years of age, but looked much older, of low stature and slight figure. His hair, which was thick and curly, grew far down over a low and poorly developed forehead. His eyes were small, deep-set and lively; his nose delicate though somewhat flattened, and his mouth large and protruding. Such was Wan-e-war, the first of the Aborigines of Australia it was my fortune to see, and no unmeet type of his degraded and doomed race. We soon had further opportunities for observing the aboriginal owners of the land in which we proposed to sojourn.

Towards dark on the day of our landing, we heard a great shouting and jabbering amongst the natives, from which we were led to believe that they were preparing for some special festivities. The men were collected round their fires very busy in "getting themselves up,"—plastering their locks plentifully with a pomatum made of grease and red ochre, and beautifying their persons in a variety of other ways. All this preparation was for a corroberry or native dance, which they intended to have in honor of the arrival of the strangers. Accordingly, soon after dark, they assembled round the large fire kindled for the purpose near our dwelling, and the proceedings of the evening commenced. The cloaks of the dancers, instead of being thrown over the shoulders, as usually worn by them, were fastened round their middles, leaving their bodies completely bare, which, with their faces, were painted in the most grotesque manner with red ochre, and shining with grease. Some had bunches of feathers or flowers stuck in their hair, while others completed their head dress with the tail of the wild dog. One or two had a small bone of the kangaroo passed through a hole in the cartilage of the nose; all carried their spears and wameras; and as they thus stood gathered round the fire, which threw a vivid glare on their greasy and shining bodies, the effect was truly picturesque and savage.

Those who intended to take a part in the dance ranged themselves on one side of the fire; on the other side sat the old men and the women and children. The corroberry commenced by the dancers breaking out into a sort of mournful chant, in which the old men and the women occasionally joined. The whole burden of the song consisted in the words "Yunger a bia, mati, mati," which they repeated over and over again, beginning in a loud and shrill tone, the voice gradually dying away as they proceeded, until at last so low and soft was it, as to be hardly distinguishable from the breeze which rustled amongst the bushes.

Whilst thus chanting the dancers remained in a bending posture, and kept time to their voices by lifting their feet with a sort of jerking step from the ground, and at the same time pulling the two long ends of their beards through their hands. Suddenly they would change their music into a loud "Haugh heigh, haugh heigh, haugh heigh," whilst they clashed their spears and wameras together, and stamped their feet with full force against the ground; then drawing themselves up with a sudden jerk, a loud and startling "Garra-wai" was shouted. Then again they would resume their first movement, but in double quick time, the whole rank now moving quickly up and down side-ways, shoulder to shoulder, now going round in a circle, and all to the same music, and with the same stamping steps.

Tiring of this, the sport was changed to the "Kangaroo dance." This dance is very similar to that already described, but with the difference—that, in the midst of the uproar, one of the men came bounding and jumping like a kangaroo between the dancers and the fire; this movement put a sudden stop to the dancing, and one of the party started off as if in pursuit of the game, the two then went through the whole proceeding of hunting down and spearing the kangaroo, which, being at length accomplished, they all once more joined in the dance, and in the midst of the uproar, the stamping of feet, the clashing together of spear and wamera, and their shouting and yelling, the fire died away, darkness covered the scene, and the entertainments of the evening were brought to a close. And thus also closed the first day of my sojourn in Western Australia.

The country in the immediate vicinity of King George's Sound, an arm of the sea on the western coast of Australia, is inhabited by four tribes of the Aborigines. These are the Murray, the Weal, the Cockatoo, and the Kincannup. In saying, however, that this part of Australia is inhabited but by four tribes, it may be necessary to explain that this distinction of people is altogether that of the natives themselves, and the four divisions here mentioned are applied to the relative position of that portion of the country occupied. Thus, for instance, all those natives inhabiting the country to the westward of Albany are called Murray men; those to the northward, Weal men, and those to the eastward, Cockatoo men. Each, therefore, although a distinct division, can hardly be looked upon as one single tribe, but rather as a combination of many small tribes, inhabiting a territory lying in a certain position.

The Murray tribe, the most numerous of all, occupies a territory exceeding in extent that of any of the rest; that is, the whole of the coast running some 300 miles from King George's Sound westward to the Murray River in the Swan River Colony.

The natives belonging to the Weal tribe wander over the country to the northward of Albany. They are, perhaps, not so numerous as the Murray tribe, but they are, I think, physically stronger, and of greater importance in the estimation of the aborigines generally.

The district of the Cockatoo tribe extends a considerable distance along the sea-coast to the eastward of Albany, and runs also from the coast far back into the interior.

The Kincannup tribe inhabits the country in the immediate vicinity of Albany. It is a small and weak tribe, and in comparison with the others, can hardly be looked upon as a distinct one. Kincannup is the native name for that district upon which the town of Albany stands. The natives who generally stayed in and about that settlement, style themselves, therefore, Kincannup men; but they may be regarded, I think, as merely a branch or family of the Weal tribe, those inhabiting the country to the northward of the Sound. Be this as it may, many causes have combined to extirpate the Kincannup people. The white man has driven the kangaroo from the native's grounds; he has therefore to depend principally upon the colonists for a scanty means of existence. These and other causes, which I shall notice hereafter, have rendered this tribe nearly extinct. When we left the colony, they could not probably muster more than from twenty to thirty souls.

Although of the same stock and possessing the same characteristics as a people, it is not difficult to distinguish the individuals of the different tribes by their general appearance, which corresponds in some measure with the nature of the country they inhabit. The men of the Murray tribe, for instance, are short, strong, and hardy looking fellows. Their country, lying on the coast, is scarcely more than a barren waste, with little shelter from the violent storms that sweep over the exposed shores of this part of Australia. From this cause, the kangaroo, which is almost the only animal food these people have, is not so plentiful in the district as farther in the interior, and thus from the insufficient supply of animal food, the people of this tribe do not present so robust an appearance as others more favourably located. This deficiency of animal food, however, is made up in a great measure, by the immense quantities of fish they are enabled to procure in the innumerable bays and inlets on their coast.

The Weal men again are a much finer and stronger race than those inhabiting the coast. They have the advantage of possessing a country lying deep in the interior,—for the most part thickly wooded,—well protected from the cold winds of winter,—and abounding in kangaroo and game of every description. Not being stinted, therefore, in their supply of animal food, they appear to be proportionably stronger and more robust.

Again the Cockatoo men are markedly distinct from either of those mentioned. They are generally tall and large-boned men, with high foreheads and aquiline noses. Their appearance indicates, indeed, a higher degree of intellect than their neighbors, over whom they have contrived to gain a strange and mysterious influence, which will be explained hereafter when referring to their superstitions.

As each tribe is distinct in appearance, so too is it noted for some one article or weapon, in the manufacture or use of which it is famous. The Murray man possesses the best wood for spears;—the Weal man is envied for his long, full, and beautiful kangaroo skin cloak, and also for his hammer of stone;—whilst the Cockatoo man excels in making and throwing that most eccentric and wonderful of all weapons, the boomerang or kilee.

I have already stated that each tribe occupies its own separate division of territory. The district thus occupied is again subdivided into vaguely defined portions, every family or individual of the tribe having its or his recognised tract of country. This property descends in the family, from one to another, and is considered in every way private property, and the proprietors of such are boastful and proud of their hunting grounds in proportion to their extent and nature.

But although thus appropriated, it is difficult to say in what the rights of ownership consist,—for agriculture is altogether unknown amongst them, and the various members of the tribe hunt indiscriminately over each other's grounds. The case, however, is somewhat different in regard to strangers, for should an enemy, or one of another tribe wilfully trespass on these grounds, such a liberty would be immediately noticed, and would in all probability lead to acts of violence and retaliation on both sides. And in this right of taking umbrage when convenient, and in making the subject a matter of quarrel, consist, I think, the sole advantages of proprietorship.

Although thus divided into tribes and families, yet nothing resembling a set form of government exists among the Australian Aborigines; nor have they either chief or ruler to guide or advise them.

Occasionally, however, they might be heard talking of some one great and distinguished individual, who, to judge from their manner of describing him, held a high and influential position in the tribe; and this has induced many to believe that a sort of chieftainship was recognised amongst them. It was always found however, when the subject became thoroughly sifted, that this great personage had acquired his influence over his fellows, as perhaps an expert and ready spearsman, solely from being more bloodthirsty and domineering than his neighbors, and from having killed all,—men, women, and children,—who were unfortunate enough to fall under his anger. And thus knowing, from bitter experience, that to contradict so dangerous a character would be any thing but prudent, the respect paid to him by the rest of the tribe was altogether a matter of policy on their part, induced by fear, and not from his having any distinct right to dictate or command.

I have already stated that each tribe is celebrated for the manufacture of some weapon or other article. In order to exchange these different articles, as well as to have a sort of jollification and grand Kangaroo hunt, the different tribes assemble by appointment at a given spot at certain seasons of the year. The scenes here enacted are exciting and varied; they generally begin in harmony and good fellowship, and end in quarrels and an angry dispersion.

The place of rendezvous is usually in a part of the country where the Kangaroo is plentiful, and in the vicinity of a small Lake. When all are collected, operations commence by the tribes forming an immense circle, having the lake for its centre. The hunters at first are a considerable distance from each other, and extend over a large tract of country. At a preconcerted time, they all gradually draw in towards the Lake, shouting and striking their spears and wameras together. The Kangaroos are thus driven from all quarters into the centre, where they find themselves blocked in and completely surrounded by the natives. The Kangaroos now make a general rush to escape, and a scene of confusion and noise ensues which baffles description. Spears, kilees, and other weapons are thrown in from all sides, and immense numbers of the game are killed in their vain efforts to clear the boundary. Some in desperation take to the water, but these, being out of their element, are soon despatched. The natives return to their bivouac laden with spoil, and do nothing but eat, drink, dance, and sleep, until hunger again drives them forth for a further supply.

All would appear to be going off smoothly and amicably enough at these general assemblies of the various tribes, nevertheless, something most frequently occurs to put an unpleasant stop to these jovial proceedings. There is some old quarrel to be settled, some old sore to be healed, and thus the evil disposed contrive to get up disputes, or to recall wrongs still unsettled and unrevenged. Each party has his friends and relatives about him, who feel themselves called upon to take a part in the matter, and thus the whole camp gets involved in a general quarrel. From wrangling, matters proceed to blows,—the wamera is seen to flourish in the air,—spears begin to fly about; pierced legs and broken heads are the consequence, and the parties separate vowing vengeance against each other.

These fights however rarely prove fatal to any one, for the belligerent parties generally contrive to make a great noise without doing much damage, beyond perhaps one or two wounded legs and a broken head or so, which are looked upon as mere trifles. It is absurd, indeed to witness an affair of this kind. It commences by one of the men jumping up and throwing down his spear somewhere near his opponent, who immediately springs to his feet to revenge the insult. The encampment is immediately in an uproar, and the friends of both rush to hold the combatants. Thus secured the foaming warriors tug and struggle away at a fearful rate, and show great indignation at being prevented, by their unkind friends, from totally exterminating each other; they are careful, however, not to exert themselves to such an extent as to prevent their being held without much difficulty. But other relatives or friends soon appear for the purpose of taking part with the combatants, these in like manner are held by other friends; until at last the whole party are either holding or being held. And thus, giving vent to their feelings in abuse and threats, they gradually calm down from pure exhaustion, and having arrived at this stage, they promise to lay aside their weapons for the time being; they are then released, and return sulkily to their huts, to repeat, probably, the same farce the next day.

The reader must not come to the conclusion, however, from the description of such a scene, that the natives of this part of the world never kill each other. Far from it. When one of the tribe dies, either from natural causes or otherwise, the nearest relation of the deceased is expected to take the life of one of another tribe; they, in their turn, retaliate in the same manner; they are, therefore, in a continual state of dread and warfare. But it is not open warfare; by treachery alone is it carried on, and often does the Australian meet his death from the hands of him he receives as a friend at his fire. Cunningly disguising his base intention, and watching until slumber seals the eyes of all around, the enemy will drive his spear deep into the breast of his victim and then plunging into the woods, return to his tribe, proudly boasting of his crafty deed. Or silently prowling about in search of an oportunity of revenge, he will, probably, come upon the wigwam at a time when the husband is away hunting, and the wives and children are dozing around the fire, unconscious of all danger. Silently and serpent like, the blood-seeker nears his prey, then springing into their midst, drives his spear into all that are unable to escape.

The principal, if not indeed the only, food of the Australian, is that procured in the chase. His life, therefore, is necessarily a wandering one, ever moving, as the scarcity of food, or other circumstances may dictate. Policy has also no inconsiderable share in producing these frequent changes. For in thus roving over the country the Nomades render it a more difficult matter for their prowling enemies to mark their encampment; and to take advantage of an unguarded moment to wreak their vengence. These changes also tend to free them from smaller, but hardly less disagreeable neighbors, which always increase at a prodigious rate, around a spot inhabited for any length of time by a people totally void of everything like cleanliness. Thus influenced by the exigencies of the moment, on breaking up the establishment they may, perhaps, move off for miles from the old position; or they may erect their new wigwams within sight of the old ones. As these huts, however, are of the most simple description, and can be finished in a workmanlike manner in a very short time,—their household furniture, too, being of the smallest quantity known in the economy of house-keeping,—no very great inconvenience is experienced in these constant movements. Their huts are chiefly formed of long grass, rushes, the bark and branches of trees. Each one is sufficiently large to admit of two or three persons curling themselves up inside like so many hedgehogs. Their shape is that of an arch, the highest part of them being about three feet from the ground, with the front completely open, and sloping down gradually in the rear. To give a better idea of one of these establishments, imagine a bowl or tea cup, turned with the bottom upwards and then cut down through the centre, each half will be a minature model of an Australian mansion. At all seasons, summer and winter this is their only shelter; with but a small fire in front, men, women, and children, each one coiled up in the cloak of kangaroo skins, sleep through storm and tempest, and set all weather at defiance. In their ordinary mode of living, and when in their own district, the tribe is usually broken up into small parties or families, each party forming an encampment, of some six or eight of these wigwams. It is seldom that the tribe musters except when about to leave its own territory for a distant part of the country, or when some mighty question, having reference, perhaps to a general expedition against another tribe, has to be discussed and planned.

During the summer months the tribes of the interior generally make towards the sea coast for the purpose of enjoying a feast on the various kinds of fish which are there to be obtained. They have several methods of proceeding in this sport, but that usually adopted is for the whole of the natives in the neighborhood to assemble together near some shoal or sand bank, which at low water is left covered with but a few inches of water. Early in the fine mornings of summer, just as the sun breaks forth, these sand banks may be seen sparkling with innumerable fish which seem to frolic about in sportive glee, now darting along and chasing each other with the speed of an arrow; now flinging themselves far out of the water as if to exhibit their bright armour in the shining rays of the sun. But man, the universal enemy of creation, has to satisfy the cravings of nature; he also is up and stirring, and cannot permit so tempting an opportunity to pass, and so calling to his companions they all pull armfuls of branches from the trees and then hurry to the beach intent upon the sport. The attack is commenced by erecting a sort of weir with the branches and twigs; this is made in a semicircular form with one end touching the beach and the other towards the edge of the shoal. The whole party now wade into the water and spread themselves over the shoal at some distance apart from each other, then gradually drawing in toward the open side of the weir, their splashing and noise cause the fish to rush into the snare laid for them. Thus entrapped, spears pour in from every point, each man trying to outdo his neighbour in shrieking, kicking, and splashing; here some may be seen probing right and left with their spears within the weir, there others are skipping through the shoal water in chase of runaways who have managed to dart through or over the bounds, and thus in a short space of time an immense supply of food is secured. It is astonishing indeed to see the quantities of fish taken in this manner. These fishing parties may number perhaps some forty or fifty men, and it is no unusual thing to see each one come off with as many fish as he can well stagger under. When I add, however, that it is not uncommon to see upwards of five cwt. of a fish called the skipjack taken in a single haul of the seine, what I have related will excite less surprise.

On the approach of winter the tribes draw off from the coast into the interior of the country, where, encamped in the depth of the forest, they lie sheltered from the severe storms with which the Australian shores are then visited. The fact of the kangaroo, their principal source of sustenance also seeking the shelter of the interior at this season, has, of course great influence in attracting them from the coast. I have already endeavoured to describe their mode of capturing this animal when the tribes are mustered in force. When hunting individually, which is the ordinary method, the hunter sallies forth alone, without even a dog, and armed with only one or two spears and his wamera. He is not long in coming upon the track of the game he is seeking. This he follows up, sometimes for miles, with a sharpness of vision and noiselessness of movement which to the white observer is extraordinary; but he is now gaining on the prize, and symptoms of its close vicinity are evident; with breathless caution and with spear poised, he gradually advances upon his victim, taking advantage of every stump or bush to cover his approach; at length a glimpse of the game is gained, which may be quietly grazing, or perchance enjoying a siesta under cover of some thicket unconscious of danger; a sharp and whizzing sound in the air is all the notice it gets, and the next moment it lies transfixed with the spear.

The clothing of these people consists of but one garment, a cloak made of the skins of the kangaroo. This cloak which is worn by both sexes, they contrive to make serve for all weathers and seasons. The usual manner of wearing it is with the fur next to the body; but when exposed to heavy rains it is reversed and the fur turned outside in order to allow the wet to run off without penetrating the skin. During the warmer summer months and when roving in the woods away from the settlements, even this is generally dispensed with; they then wander about unencumbered and free of all restraint as far as artificial covering is concerned, and but seldom use their cloak except merely to wrap about them when sleeping around their fires, to protect them from the dew and cold night air.

The men also wear round their waists, under the cloak, a fine string made of the fur of the opossum, about as thick as common grey worsted, which it much resembles in appearance. This is wound about them in innumerable folds, until it forms a belt about as thick as a man's wrist. When suffering from want of food, which is often the case, this belt is drawn tightly round the body, and by thus compressing the stomach, it tends to alleviate, for a time, the cravings of hunger. It also serves as a depot for their kilees, stone tomahawks, knives, or any thing else that they may wish to carry about them.

On my first landing amongst the savages of Australia on the beach at Albany, I observed that some of the men had small bones, or pieces of wood, passed through a hole in the cartilage of the nose. These I afterwards learned were persons of some consideration in the tribe, men of distinction, who sported this conspicuous badge with no small degree of ostentation. The hole is pierced through the nose when the individual is young, and for the following purpose. The tribe wish to communicate with the neighboring tribes on some particular subject, or to send a complimentary message of peace and goodwill to those around them. The chosen messenger is a boy between 12 and 15 years of age; but before starting on his embassage, it is necessary that the individual thus honored undergo the operation of having his nose bored. This is performed with a small bone of the kangaroo, sharpened and made almost red hot, which being forced through the cartilage just below the nostrils is there allowed to remain until the wound heals. But in the mean time the boy proceeds on his mission, and as long as the wound remains unhealed his person is held sacred, and he is treated with the greatest friendship and respect wherever he makes his appearance. On starting he is accompanied by one or two of his relatives or friends as far as the next tribe, in whose charge he is left;—remaining some short time with these, he is passed on to the next tribe in the same way; and so on until all the . es have been visited, when he is returned to his people in like manner from tribe to tribe. By this time the hole in the nose is pretty well healed, but the bone, or something else of the kind, continues to be worn by way of ornament and as a mark of distinguished services. The same description of ornament is mentioned by Cook as existing amongst the South Sea Islanders, and to it our sailors gave the not inappropriate designation of "sprit-sail yard." It would appear, indeed, that this barbarous fashion of disfiguring the body, in order to decorate it in some such way, is common to many nations. The aborigines of Australia, and the South Sea Islanders have their "sprit-sail yard," others have their nose-ring, whilst the negress of Africa, and the refined and intellectual female of Europe, have their ears pierced to receive the not less becoming and useful ear-ring. But whether it be the bone in the nose of the Australian, or the ring in the ear of the English woman, the custom is the same, and equally civilized or equally barbarous.

In speaking of ornamentation I have to mention another and no less barbarous method of the Australians for beautifying their persons. I allude to the custom amongst the men of lacerating their bodies in order to produce long welts or protrusions of the skin. This is done with a sharp stone or flint, and the incisions are made on the breast, shoulders, and upper part of the arms; they vary in length and thickness, some being about an inch long and raised the thickness of a straw, others perhaps three inches in length and as thick as one's finger. The operation to produce these marks consists simply in cutting the part quickly but slightly with the sharp point of the stone; the blood is allowed to dry on the wound, but the welts soon appear and never diminish in size through life.

From the scantiness of an Australian's wardrobe, he is prevented from exhibiting his taste or expending his vanity in a variety of costume, he consequently falls back to the one course left open to him, that of painting his body and decorating his head. The greater part of the time he devotes to his toilet is altogether taken up in plastering his uncut hair with a thick cement made of red ochre and grease. A diversity of style is adopted in its dressing; some have the head covered with quantities of small and shining red ringlets, some have it bound around with cord, and then covered with a solid mass of stiff and clay-like pomatum, giving the head quite an Asiatic appearance; this is generally surmounted by a bunch of feathers from the emu or cockatoo, or by the tail of the wild dog, and sometimes encircled with a wreath of flowers. Others, again, have innumerable small lumps of clay appended to the ends of the hair, which keep up a rattling accompaniment to the movements of the wearer.

But of all outward adornments the beard is the one most coveted and prized. Indeed, this appendage to the visage appears to be a youthful Australian's highest ambition, and its primary symptoms are regarded by each stripling much in the same light as, amongst us, the school-boy looks on his assumed induction to the honors and privileges of manhood. To the Australian, throughout life, the beard is an object of great pride and care, and the affectionate manner in which it is ever caressed and stroked, evinces the satisfaction felt in its bushy charms. Nor is it merely as an adornment to the outward man that a beard is so much an object of solicitude; there are also certain rights attached to it, not the least important of which is, that no man can get married until in the possession of one, nor is he allowed to kill an emu. In their combats, too, no inconsiderable part is assigned to the beard in producing an effect, and it is next to impossible to make an impression in an affair of this kind without such an accompaniment; then, with its long ends gathered up into the mouth, and there held firmly between the lips—with feet stamping, eyes starting from their sockets, and every muscle of the body quivering with savage rage, it may easily be imagined that the whole appearance of the Australian warrior is ferocious in the extreme.

Thus far I have attempted to give some slight idea of the men of this race. It is now time that something were said of the other sex; and I wish much it were in my power to draw a more pleasing picture of this portion of the Australian population. No where else is it possible to meet with more miseral . and degraded specimens of humanity than the women of Australia. Naturally small in stature, from starvation their bodies and limbs appear shrunken to a degree sometimes frightful to contemplate; and were it not for the glare of the eye, the generality of them would look more like mummied skeletons, from which the soul had parted company for months, than beings possessed of life.

Every bone in the frame is visible—the shapeless arms and legs seemingly destitute of muscle—the sunken eye and hollow cheek—all tend to form a picture of wretchedness which beggars description. And, as if their natural unsightliness were not sufficiently startling, their faces, and heads, from which the hair is cut quite close, are generally covered with scars and scratches, either the tokens of the chastisement of an enraged spouse, or the effects of violence committed on themselves in manifestation of their sorrow for the untimely departure of a child, or some one of their numerous relations or friends; and when, upon these still bleeding wounds, chalk and charcoal are smeared, it can readily be imagined how revolting is the spectacle presented to view.

The dress of the female, like that of the men, consists solely of a Kangaroo skin cloak; but to this is added a large bag, made of the same material, and which hangs at the back by a strap crossing the shoulders. In this bag is generally deposited the smallest child, along with any other portable articles it can hold. For the purpose of digging up roots, upon which they in great measure subsist, the women are armed with a long stout stick, formed into a blunt point at one end. Whatever labor has to be performed in their domestic arrangements devolves entirely upon them. They are the Architects and Artificers in erecting the family mansion. In their journeyings they carry the extra spears and other weapons of the men, in addition generally to one or two children, and perhaps also a young dog. In this plight they are to be seen toiling along under a load seemingly sufficient to bring the frail bodies of the unfortunate creatures to the ground.

Polygamy to the fullest extent is an Australian Institution; the man is allowed to have as many wives as he can manage to take care of, or can possibly beg, steal, or otherwise obtain. There is nothing like a marriage ceremony in any case, a simple bestowal on the part of the girl's father, or other guardian, concludes the transaction. As soon as a female child is born, nay, sometimes for years before that event, she is promised to some one of the tribe, without reference to his age, although his years may exceed those of her own father. She remains with her parents until old enough to be able, in some manner, to shift for herself, when she is transferred to the care of her future husband, under whose protection she is then brought up. But as this, in most cases, is too long a process to go through, the method usually adopted by the Australian native to obtain wives is that of seizing the first favorable opportunity of running off with those of another. It is absolutely necessary to the Australian that the stock of wives on hand should always be considerable, as the whole domestic labour devolves on them, and consequently on their number depend the comforts of his wigwam and fire. The practice of eloping with each other's wives, is so much a matter of course that it furnishes an additional reason for maintaining a large female establishment in order to provide against these frequent contingencies, so that one or two of the number can abscond, without any great degree of anxiety or discomfort being experienced by the deserted one, until the number can again be completed by his helping himself in like manner from the establishment of some of his neighbors.

But although the women are treated by the men with savage brutality, although from the birth to the grave theirs is a life of misery and privation, they, nevertheless, are not deficient in those keen feelings which are the characteristics of the sex in all lands. Their affection for their offspring is strikingly evident on all occasions, and it is sometimes painful to hear the wailing of the bereaved mother as through the long night she sorrows over the loss of her infant. Nor are these feelings less intense in other respects. One might imagine, to judge at least from the manner in which the poor wretches are neglected by their lords, that if any thing like feeling existed on their parts for their partners, it would be that of supreme indifference. The reverse, however, is the case, and in those general mêlées, which so often disturb the peace of the encampment, they are not slow in entering into the spirit of the affair, and raising their voices to vindicate the honor of their belligerent spouses. Absurd to a degree is a scene of this kind. Sitting around their fires, within sight of the combatants, they gradually join in the excitement around them; tauntingly and sneeringly they speak of the insignificant deeds, and contemptible efforts of the opponents of their respective husbands. Suddenly one will spring to her feet, and begin to strut up and down, flourishing her long stick over her head, her cloak thrown back and fluttering out like the tail of an angry cat; in this beligerent state she continues to move about, singing at the same time some sarcastic and insulting words. Irritated and excited by such proceedings, another now starts up with a bound, and in like manner commences to strut, sing, and flourish her stick,—and thus working themselves up to the required pitch of anger, they gradually approach each other until within striking range, when the war of words being changed for a more forcible one of sticks, the engagement becomes warm, and broken heads and bloody faces are the result.

Such is the Australian in life, let us now reverse the picture and view him in death.

In the midst of a tall forest, some four or five wigwams are clustered together, the thread like wreaths of smoke ascending from the small fires alone indicating the spot. In one of these huts lies the emaciated form of a savage, the limbs drawn up to the smallest possible compass under the scanty cloak. Sitting around are the wives and children of the dying man, watching in silence for death to take possesion of his prize. Other women belonging to the camp are also sitting about. One or two men alone remain; these are perhaps sleeping, or quietly sharpening their spears. All is silent, the hard breathing and the convulsive sounds in the throat of the dying man are alone audible, even these gradually cease and the soul has fled.

As soon as the fact is known the wives and children and all those gathered round the body set up a dreadful and startling cry. The women in particular send up a most piteous lamentation, and tear their heads and faces until they are frightfully smeared and disfigured with blood. The male relatives of the deceased also scratch their noses, but do not mutilate themselves to the same extent as the women. But no time is lost in making preparations for the interment of the corpse. On the spot where he drew his last breath is the grave sunk, a shallow and circular hole scooped out, barely deep enough to keep the body below the level of the earth; into this the still warm corpse, wrapped in its cloak, and with the knees bent up to the mouth, is placed, lying on its side; the earth is then thrown lightly and scantily over it; that thrown over the corpse however, is not the earth which has been scooped out of the grave, for that is allowed to remain in a heap on one side, but is cut away from the oposite side. The spear, wamera, and other weapons lately used by the deceased, are now placed upon the grave, and after making a small fire near the feet, the grave and camp are deserted by all, and, far removed from the spot, a new encampment is formed, from which the mournful wailings of the women may be heard floating down on the wind night after night.

On the evening of the death, the wives and relatives of the deceased smear the scars on their heads and faces with white chalk, and on the following day with charcoal, after that again with white chalk, which is allowed to remain on until the wounds are healed. After death the name of the departed is never uttered, and should there be another native with the same name he immediately assumes a new one.

It would appear, however, that the mode of interment differs in some cases; for being on one occasion with an exploring party some ninety miles from the settlement, we came upon three or four native graves, in which it was evident that the bodies had been laid at full length as the graves were long and narrow, presenting indeed much the appearance of our own.

In a letter received from a brother at Perth on the Swan River, in describing the Aborigines of that part of the country, he gives the following account of a death scene:

"Understanding that the native Wattup had died from the effects of a spear wound in the thigh, which he had received about five weeks before, I went up to see the body. I was directed to the spot by the cries of the women, and the scene that presented itself there was very striking, and differing from any that you ever witnessed at King George's Sound. The corpse was stretched out under a large gum tree, and closely around it, an old man and a number of women were crouched on their heels. At times they bent over the body, uttering a mournful chant, and addressing it, apparently in affectionate terms; then again they would burst forth in loud lamentations, tearing their faces and hair, and exhibiting every token of the most violent sorrow; maintaining, however, throughout a regular cadence. Three or four yards from these, sat an old man, probably the father of the deceased, resting his head on his knees in silence. His wife sat beside him with her arms thrown over his shoulders, crying most piteously, and calling (as I understood it) on the dead man to return to her. One or two elderly men stood at a short distance leaning on their spears, attentively watching the proceedings. No other men were present but those I have mentioned; the rest appeared to be collected at the foot of Mount Eliza, where they were holding a noisy deliberation, concerning, I suppose some scheme of revenge. I had not time to remain until the termination of the ceremony, but just as I was leaving, two men came up from Mount Eliza, armed with their spears, and evidently prepared for some conflict,—after exchanging a few words, the mourning party broke up—the men going off to the Council of War, leaving the corpse in charge of the females. In the evening a number of the natives bivouaced on our premises, where they had a Corroberry."

Of the many strange facts that come before us in studying this people, perhaps none is more extraordinary than the paucity of weapons and implements in use amongst them; and still more so is the fact that they are probably the only savages on the face of the earth, inhabiting the sea coasts, who have no means of aquatic transport, and are unacquainted with the art of swimming. When we examine their coast and find it dotted with innumerable Islands or indented with Inlets swarming with fish, we are more struck with this peculiar feature in the habits of the Aborigines of the western, southern, and eastern coasts of Australia. Turn in what direction we will, we find all other savage people excelling in these arts. The New Zealander and the South Sea Islander are noted for the beauty and size of their War Canoes; and men, women and children appear as much at home when diving and swimming about in the sea as any seal or walrus. Again, the Indians of this vast Continent, from the Arctic regions to Florida, are skilful and daring navigators in their bark and other canoes. Let us even visit the northern coast of Australia itself, and we find the Aborigines, much more savage it is true than those I am describing, but at the same time furnished with Canoes and catamarans, or sallying forth even upon rough logs of wood, and quite indifferent whether their bark carries them through the surf, or parts company with them in the attempt, so fearless and expert are they in the water. How is it, then, that those inhabiting the opposite coasts should be thus deficient in arts that instinct itself should force them to acquire? This peculiar feature in their economy, strange as it may appear, will help us, I think, to trace their origin, and that too to a people eminently maritime in their habits. I allude to the Malays.

The proximity of the Malay Islands, and the fact of immense fleets of Malay prows having visited the Northern coast of Australia annually from time immemorial, in search of the Trepang for the Chinese Market, will go far to bear out this opinion. It may not be improbable, therefore, that some of these people were thrown by shipwreck, or other accident, on this coast, or upon one of the Islands on the other side of Torris' Straits, and that thus the North was the first portion of Australia peopled. The race, gradually increasing, spread through the interior of this vast Continent. In their approach to the western and southern shores they necessarily passed over an extensive inland region, without doubt perfectly destitute of Rivers or Lakes of any magnitude. When, therefore, ages after, they had extended to the opposite coasts, they had lost the knowledge of every art connected with water, and were unable to make use of or appreciate the advantages which lay before them on the sea shore. Whilst upon this subject I may mention that I have seen, in the settlement of Albany, natives who had never before gazed on the sea. In thus treating the subject, however, I am merely venturing an opinion; it may be correct, or the reverse.

The extent of the knowledge of the Arts and Sciences existing amongst the Australians may be gaged by their weapons and implements. These are the spear, the wamera or throwing stick, and the kilee or boomerang; a stone hammer or tomahawk, a short and heavy club or stick, and a rude description of stone-edged knife.

The spear is merely a straight rod some nine feet in length, as thick as an ordinary walking stick, rather smaller at one end than the other. The sharp and needle like point, at the heaviest end, is hardened in the fire. Rather more than an inch from the point of some is fixed a neat wooden barb of about two inches in length. Others again have small and sharp pieces of quartz, fastened in gum, extending some six or eight inches from the point. This latter description of spear is dreaded by the natives much more than the barbed one, as its sharp and uneven edge lacerates the flesh dreadfully, besides leaving pieces of the stone in the wound. The wound inflicted by the barbed spear, is hardly less severe, and, unless the spear-head be driven directly through the part struck, is dangerous in the extreme, for the barb once getting buried in the flesh, it is impossible to withdraw it, and the only chance of extrication is to force the whole through the limb: a process, however painful, by no means uncommon.

The trees from which the spears are made, seldom exceed the thickness required, and are found growing in great abundance in the swamps and marshy grounds; the wood is of a hard and dark description, and after being in use for some time assumes the appearance of mahogany.

The spear is thrown by means of the wamera or throwing stick, which is a flat piece of wood hardly thicker than the cover of a book, some two feet in length, about four inches in breadth in the centre, and gradually decreasing in width, and running to a point at either extremity. At the end held in the hand is a lump of hard resinous substance, obtained from the Grass Tree, which prevents the wamera slipping from the grasp when throwing from it the spear; at the other point is fixed a little piece of stick, about an inch in length, forming a sort of hook, and which fits into a shallow hole at the small end of the spear. When fixed for throwing, the spear runs along the length of the Wamera, and passes through the fore-finger and thumb, which, from the manner in which the Wamera is held, are left free for that purpose. The spear is therefore hurled from the wamera somewhat on the same principle as a stone from a sling, and, is sent with much greater force than if merely thrown from the hand. In the use of these weapons the natives exhibit surprising dexterity; it is seldom indeed they fail to transfix their object within a distance of fifty or sixty yards. The wamera is made of a very hard wood, a coarse grained and heavy mahogany, which generally obtains a good polish after being a short time in use.

The wamera never leaves the hand of the native; when his spears are exhausted he makes use of it in close combat, as a sword or battle axe, and its sharp and hard edges lay open gashes in the heads of the combatants hardly less severe than those produced by the sabre of a heavy Dragoon.

But of all weapons the Australian kilee or boomerang is the most wonderful. Its form is nearly that of a crescent. It is made from the crooked limb of a tree curved naturally in the form required,—this is nicely scraped down, and made flat on one side and slightly convex on the other; its size is about fifteen inches from point to point, and nearly two inches in width. Its course through the air is eccentric and very varied, greatly depending upon the skill with which it is thrown. Some have more command over the weapon than others, and an experienced thrower can almost make it take any direction he may please. He will throw it with all his force against the ground, some ten or twelve feet in front of him, when it will rebound, and taking a circular course, will fall at an immense distance to his right or left. Again he will dash it to the earth in the same manner, and it will ascend from it with the speed of an arrow, until almost out of sight, when, remaining poised some instants in the air, it will return with fearful velocity and fall probably some distance behind the thrower. It is used thus in killing birds. For instance; a flight of Cockatoos is seen approaching; the native waits patiently until the birds are nearly over his head, he then throws the kilee in the way I have described in front of the flight; the kilee returning, after having risen a certain height, meets the birds in their course and thus knocks several of them down.

The boomerang is the most dangerous weapon used by the Australian. Its course through the air is so swift that it is with difficulty one can follow it with the eye, and its ever varying movements render it nearly impossible to get out of its way;—it is the only weapon that the natives themselves find a difficulty in avoiding; those who fancy themselves quite safe, and clear of its manœuvres, are not unfrequently the ones hit, and it is no unusual thing to see the native, from whose hands the weapon has sped, obliged to throw himself on the ground, to avoid being struck by it on its return.

The tomahawk or hammer is a rude and shapeless piece of stone fastened on in the centre with the gum of the grass tree to a slight wooden handle; its principal use is to notch the smooth trunks of trees, just sufficient to insert the great toe in, to enable the native to ascend after the oppossum and other small animals.

The only other article is a short heavy stick, rather thicker at one end than the other, and about eighteen inches in length; it is used for throwing at short distances, and it also forms a weapon by no means contemptible when wielded in the hand as a club.

The quickness of vision and dexterity exhibited by the Australian savage in avoiding the different weapons, are truly astonishing. This is particularly the case as regards the spear; so much so, indeed, that it seldom occurs that one is struck by it, if he be at all prepared for the assault. Five or six spears will be thrown at a man in rapid succession, and, without moving from the spot, he will escape them all by a slight bend of the body. From his childhood, practising with the spear and boomerang is the principal pastime of the Australian, and for hours together, mere infants may be seen amusing themselves by throwing their tiny weapons at each other.

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# A REVIEW OF THE TRILOBITES: THEIR CHARACTERS AND CLASSIFICATION.

## PART I.

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Amongst the fossil forms met with in our Canadian rocks, or, indeed, in the palæozoic strata generally, few can compete in interest with the Trilobites. We may cite as some of the more salient points which impart to the study of these extinct crustaceans an attraction of no ordinary kind—the early date of their creation, and the immeasurable periods that have rolled away since their total obliteration as living types. And, again, the wide geographical range of certain species; their varied forms; and, perhaps, as a further incentive to their study, the very obscurity with which, in part, their history is still surrounded. In the present sketch, it is proposed to consider our subject under the following heads:—The general organization of the Trilobites; their probable habits and affinities; their geological relations; and their classification.

1. *General characters.* Viewed both transversely and longitudinally, the trilobite presents a tripartite form. Transversely, we have the head, the body or thorax, and the abdomen, or so-called tail. Longitudinally, the form becomes three-lobed, by the presence of two linear depressions or furrows, extending in general, almost from one extremity of the animal to the other. Occasionally, however, as in the genus *Homalonotus* for example, these longitudinal furrows are but very slighty developed.

We will consider separately the structural characters of the head, the thorax, and the abdomen: or rather of the crustaceous integuments by which the back of these parts was defended; for of the internal conformation of the trilobites, our knowledge is almost entirely conjectural.

2. The anterior portion of the trilobite is covered by a single shield composed of several united pieces. To this shield the term of *buckler* or *head-shield* is commonly applied. The middle division, formed by the anterior prolongation of the two longitudinal furrows mentioned above, is called the *glabella.* In some species the glabella is very strongly pronounced, whilst in others it is scarcely raised above the general level of the head-shield. It is usually lobed or furrowed by short transverse grooves, or variously embossed; although occasionally quite smooth and simple. In some species again, it narrows towards the summit, whilst in others it expands. The separate pieces of which the head-shield is composed, are united by distinct sutures: a character peculiar, amongst crustaceans, to the trilobites. This, as suggested by BARRANDE, probably facilitated the periodic casting of the shell. One of these sutural lines, the great or *facial suture*, is of considerable importance as a classification element. In the majority of instances, it passes on each side of the head-shield, from the angles (*calymene*), or from the lateral or lower border (*phacops, asaphus*) along the inner margin of the compound eyes (where these exist), and either surrounds the glabella, or terminates beyond the anterior margin of the shield. In the latter case, it is said to be open above. The buckler or head-shield is thus divided into three pieces; the middle piece, including the glabella and the "fixed cheeks" or parts between the glabella and facial suture; and the side pieces, or ordinary cheeks. The latter are very commonly wanting in trilobite specimens, or are found separated from the other portions of the

head. The facial suture is, however, in some cases entirely marginal, and hence not apparent on the surface of the shield, as in the genus *Trinucleus*. According to its direction, consequently, the trilobites might be arranged in four groups: 1.—with the facial suture terminating at the base of the head-shield; 2.—at the angles; 3.—at the sides; and 4.—with the suture marginal. A classification of this kind, however, if carried out too exclusively, would tend, as founded on a single structural peculiarity, to various groupings and separations of a more or less artificial character.

The eyes, when present, are situated on each side of the buckler in the line of the facial suture, where this, at least, occurs upon the surface. They are sessile, but more or less elevated above the immediate surrounding parts; and either compound after one of two types, or pseudo-compound: consisting in the latter case of simple stemmata in merely approximate union, as in the genus *Harpes*. The compound eyes in the family of the *Phacopsidæ* are covered by the common cephalic test, but this is pierced with numerous small apertures through which the transparent cornea projects.* This forms the *reticulated* eye, properly so-named. In the other families possessing compound eyes, the cephalic test gives place around the eye to a common cornea, which exhibits, in comparison with the eyes of the *Phacopsidæ*, a very delicate reticulation The reticulated appearance is caused by the underlying facets.

Many species appear to have been entirely destitute of eyes, properly so-called; but it may be questioned whether this deficiency, at least in certain cases, was not compensated by the presence of isolated ocelli, destroyed more or less by the process of fossilization, or perhaps obliterated by age—as in some existing crustaceans—during the lifetime of the animal. In the modern *limulus*, a crustacean type having certain characters in common with the trilobites, a pair of ocelli accompany the compound eyes. Indications of ocelli are, I believe, actually traceable in some of the apparently eyeless trilobites. Two small median points or tubercles, which may perhaps be legitimately attributed to ocelli, occur, for instance, on the glabella of many specimens of *Trinucleus concentricus*. On the other hand, it is well known, that amongst some of the marine parasitic crustacea, to which again the trilobites are in a measure related, only the males

* BARRANDE. Owing to the incompleteness of most specimens, it is rarely that these characters can be observed. If the eye, however, be at all preserved, a common magnifying glass will show a remarkable difference between the strongly-facetted phacopsidæ, and the more delicately reticulated forms. It may not, perhaps, be useless to add, that the aid of the lens is almost invariably required for the proper observation of the facial sutures and other structural details.

are provided with eyes; whilst amongst others, as stated above, these organs become obliterated by age.

The buckler of the trilobite does not terminate immediately at the upper margin or sides, but bends over as in the limulus or apus, and thus forms the margin of an under shield. Directly beneath its termination on this under side of the head, and exactly facing the glabella, is situated a peculiarly shaped organ, called from its general characters and presumed function, the *hypostoma* or *labrum*. With the exception of a second piece, the *epistoma*, found only in a few rare examples, it constitutes all that is known respecting the mouth-organs. In its general form, the labrum somewhat resembles a pointed or rounded glabella, with its attached base, placed in a reversed position, or with the narrower end downwards. From its resemblance to the labrum of the apus, it has been inferred that these creatures were carnivorous: a view sustained by other considerations.

3. The body or thorax of the trilobite is made up of a number of separate rings or segments. By the two longitudinal furrows already mentioned, each segment is divided into three parts: the middle part, called the *rachis* or *axis*, and the sides or *pleuræ*. It is still uncertain whether the pleuræ form a continuous portion of the axis, or whether they are united to it by suture. Basing our observations on those species which have the longitudinal furrows but slightly developed, we might naturally infer the former. In most specimens, if not in all, the shell is certainly continuous. Single, disjointed segments are constantly met with; their three-curved outline is one of the most common markings on the weathered surface of trilobitic rocks. The central rings are sometimes furnished with short spines. The pleuræ also frequently terminate in spines; and they are either grooved in the direction of their length—*id est*, from the axis outwards—or otherwise raised in the same direction into a narrow plait or band. The former modification constitutes BARRANDE's *Type de la plèvre à sillon:* the latter his *Type de la plèvre à bourrelet.* The character in question is brought prominently forward by BARRANDE* as a classification element, and PICTET has also adopted it in the last edition of his "Palæontologie;" but its employment as a leading character, appears to me, for reasons stated in the sequel, to be open to many objections. The well-known power of rolling themselves up into a ball, possessed to a certain extent by probably all trilobites, and by many in an eminent degree, was chiefly due to the mobility of these thoracic segments. Further reference will be made, how-

* See the Appendix to this paper, at the close of Part II.

ever, to this property when discussing the affinities of the trilobites. In the absolute number of their body-segments, a considerable difference is exhibited by different species In fully developed forms, omitting the still doubtful *agnostidæ*, the number varies from five to twenty-eight. Several palæontologists—more especially QUENSTEDT and BURMEISTER—have placed great stress on the relative numbers of these segments: making the character indeed, the basis of their classifications.* That the character is one of considerable value, is undoubtedly true; but its application is beset with much difficulty, since the able researches of BARRANDE have shewn that, in most, if not in all species, the number of the rings, although constant in the adult form, varies with the earlier age of the individual. He has thus traced the metamorphoses of one species (*Sao hirsuta*) from its embryonic condition with merely a head and caudal shield visible, up to its full development, in which successive rings are added to both thorax and abdomen, until, in the former alone, their number amounts to seventeen. The adult form in this small species is frequently under an inch in length.

4. The caudal shield, to which the term of *pygidium* is also applied, consists, like the head-shield or buckler, of a single piece. This, however, as shewn by its divisional markings, is evidently made up of consolidated or united segments. With certain special exceptions, we here recognize, as in the thorax, a middle portion—the caudal axis, tail-rachis, &c.; and sides, or pleuræ. The segment lines in these divisions are often strongly marked, but always undivided, unless at the ends of the pleuræ. In some species the pygidium is very small; in others well developed. The axis also is in some species continued far down, or almost to the extremity of the shield; whilst in others it is extremely short. Occasionally the shield terminates in a point or spine, or is furnished with various spine-like processes. The ends too of the caudal pleuræ are sometimes free, sometimes merged in a continuous limb. According to BARRANDE, the more developed the pygidium, the higher the developement of the animal—in substantiation of which it is pointed out, that in the trilobitic forms of earliest occurrence, this organ is comparatively small; whilst in those of the higher rocks, the contrary is generally the case. To this, however, there are many exceptions; witness, for example, the *Ogygia Minnesotensis* (Dikelocephalus of Owen) of the Potsdam sandstone on the one hand, and the *Harpes macrocephalus* of the Devonian series on the other.

* See the Appendix.

In order to assist the general reader in following the above descriptions, an outline figure with accompanying explanation is annexed.

G—glabella.

E E—eyes.

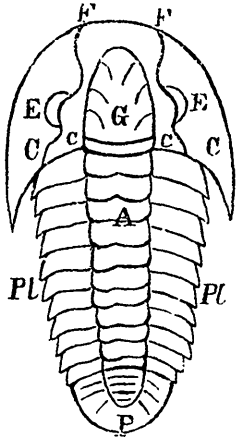
F F—facial suture [see § 2 above.]

C C—cheeks; c c—fixed cheeks.

A—body axis.

Pl. Pl.—pleuræ.

P—pygidium.




5. *Probable habits and affinities.*—Much is here unavoidably conjectural: for the habits and affinities of these extinct forms of life are veiled, to a great extent, in an almost impenetrable obscurity. The following are, perhaps, the only really undebateable points connected with the inquiry. First, the trilobites were marine crustaceans. Their evidently articulated structure and the character of their shelly covering, combined with the compound eyes, which so many of them exhibit, and with their geological conditions of occurrence, are sufficient to establish this. The possession of compound eyes would alone serve to separate them from the oscabrions or chitons, with which they were at one time placed by LATREILLE and other observers. Secondly, the trilobites were gregarious, living in vast communities—as proved by the abundance of their remains in areas of often very limited extent. From this, it has been imagined by the well-known naturalist MacLeay, that they adhered in masses one upon another, after the manner of many of the sedentary mollusks; but the large compound eyes, the ornamented and frequently spine-bearing shells, and the symmetrical habitus, are broadly opposed to this view. Thirdly, feet were either absent, or, if ever present, were of a more or less rudimentary, soft and perishable nature. No traces of these organs, nor of antennæ, have yet been found: although from time to time imaginary discoveries of such have been announced.* Fourthly, the trilobites were able, to a cer-

See more especially plate 2 in Castelnau's Essai sur le Système Silurien de l'Amérique Septentrionale: 1843.

tain extent at least, to roll themselves up into a ball. This property amongst crustaceans, is shared by the terrestrial *oniscidæ*, and by several marine genera; notably by *Sphæroma*, a genus of small isopodous crustaceans inhabiting the Baltic, the Mediterranean, and other seas. These marine isopods possess, however, peculiar swimming appendages attached to their caudal extremity: a contrivance of which the trilobite was apparently destitute.

In accordance with the views of BURMEISTER, the place usually assigned to the trilobites at the present day, is amongst the phyllopods: or, at least, in the section branchiopoda. With certain probabilities in favor of this distribution, there are yet many considerations against it. A more or less constant motion of the branchial feet would seem to be almost essential to the economy of the branchiopods; but, in the case of the trilobites, a function of this kind can hardly be reconciled with the rolled up condition in which so many of them are found. If, as may be reasonably inferred, this condition were assumed as a protection under the influence of fear, it would probably be retained by the animal for a considerable time. Amongst existing branchiopods, not one appears to have the power of thus contracting itself into a ball; whereas, amongst the isopods, both terrestrial and marine, the property is almost universal. The shell again, in branchiopodous crustaceans, if present at all, is delicate and fragile, and scarcely to be compared in any way with that of the trilobites. Finally, the minute size—and size may be here legitimately considered as a not unimportant element in the inquiry—the minute and often microscopic dimensions of the branchiopods, together with their general conditions of existence, offer further points of dissimilarity. The trilobites were certainly as nearly allied to the isopods as to the branchiopods; and, at the same time, they had certain strong analogies, if not homologies, with the limuli: in the position and aspect of the large compound eyes, for instance: in many characters of the shell; and to a certain extent in size, and possibly in mode of life. It seems advisable, therefore, to keep them as a distinct order, and so to frame the classification of the crustacea generally, as to shew their relations to the isopods and phyllopods on the one hand, and to the limuli or xiphosura on the other. The chief difficulty is in the collocation of the latter order. To place the limuli with the suctorial parasitic crustacea, according to a still frequently adopted system, is manifestly in opposition to all natural analogies. And, again, if we place them at the end of the class, as a distinct subdivision, their typical relations become altogether lost. Is this, moreover, their proper place? Are not the limuli far more nearly related than any one of the ordinary entomostracous orders to the decapods? The grand distinction is the well-known character of the mouth-organs. But may we not consider the six pairs of oral feet in the one, to represent an earlier typical condition of the six pairs of foot-jaws in the other? With all their points of difference, at least, a transition from the limuli to the decapoda, may certainly be conceived with far less violence to nature, than one between the last-named group and the phyllopods or other entomostraca. On this view, a distribution of the crustacean orders may be arrived at, as shown in the annexed table. A combined vertical and horizontal reading of the table brings out the affinities of these orders in accordance with the principles discussed above.

| | | |
|---|---|---|
| | I. MALACOSTRACA. | |
| 1. Decapoda.<br>2. Stomapoda. | 3. Amphipoda.<br>5. Isopoda. | 4. Læmodipoda. |
| 6. Xiphosura. | II.<br>7. Trilobita. | |
| | III. ENTOMOSTRACA. | |
| | 8. Phyllopoda.<br>9. Lophyropoda.<br>11. Cirrhopoda. | 10. Siphonostoma. |

We have yet to consider a few other points of inquiry appertaining to this portion of our subject. These are embraced in the following questions:—First, were the trilobites inhabitants of littoral or of deep-sea zones; and secondly, were they of sedentary or of active habits—and if the latter, what were their means of locomotion? For the satisfactory determination of these questions, our data are far from complete. Analogy, and the fact of a very general occurrence in ripple-marked shales and other rocks indicative of a littoral origin, would seem to denote a shelving coast-line, or, at least, a moderate depth of water, as the ancient habitat of the trilobite. Trilobites are found, however, and not unfrequently, in limestone deposits, associated with brachiopods and other forms usually referred to deep-sea types. But the brachiopods are now well-known to range from extreme depths up to the very tide-line: and hence their presence in trilobitic rocks, does not speak against the littoral origin of such deposits. In many instances, it is evident, that the palæozoic limestones, as those of other ages, were derived more or less directly from coral reefs; and these reefs may have afforded shelter to many trilobites. Along the inner edge of the great barrier reef of north-eastern Australia for example, where in many places a depth of no more than ten or twelve fathoms exists, different species of both brachiopods and crustaceans are often met with.

Whilst some observers imagine the trilobites to have been more or less sedentary, others contend that they must have been in constant motion—swimming, back downwards, at or near the surface of the sea. The truth lies probably between the two. As already pointed out, the presence of eyes is a strong argument against a sedentary existence, and the rolled up condition of body (so commonly witnessed) speaks equally, on the other hand, against a state of constant motion. It is difficult to conceive that these extinct forms could have been endowed with strong swimming powers, for no traces, even under the most favorable circumstances for preservation, of floating appendages have been met with; and their branchial feet, allowing such to have been present, could not have constituted swimming organs of any force. The unequally balanced extremities of many species, although in part perhaps compensated by the downward extension of the genal angles of the head-shield, is also an obstacle to the satisfactory adoption of this view. At the same time, it should be observed, that their shell, from its general thinness, must have been comparatively light; and the flattened form of body conducive to a certain degree of buoyancy. A slight movement of the flexible thorax and caudal extremity probably formed a sufficient propelling power for the animal's wants. When alarmed, the contraction of the body would enable it to sink with ease into deeper water; and in its power of adhering by its under side to rocks and to the sea-bottom generally, it possessed a further means of defence against its enemies. By this power of adhesion, moreover, individuals may have been carried on floating bodies over a wide range of coast or across open seas, and thus have given rise to colonies in localities far distant from their normal centres. In this manner the extended geographica limits of certain species may perhaps be accounted for.

Little can be suggested with any certainty respecting the food of the trilobite; but by comparison with existing crustaceans, and from the form of the labrum, it may be inferred that these creatures were carnivorous. Soft-bodied radiata, the coral polyp, decaying matter drifted into sheltered bays—such may have formed, in part at least, the sustenance of the trilobite. A further insight into this question might be obtained, could we trace out the compensating agents in Nature's economy, which served to replace the trilobites after these had passed away.

6. *Geological relations.* The trilobites appear to have been called into existence almost at the earliest dawn of animal life. They die out at the base of the great carboniferous formation, and thus belong entirely to the earlier and middle portions of the palæozoic age. The separate species offer, with few exceptions, admirable test-forms for the various subdivisions of the Silurian and Devonian groups. Even the genera are in many instances restricted to comparatively narrow limits in their upward range. Thus, the genus *Trinucleus* is unknown above the deposits which mark the limit of the lower Silurians. *Asaphus*, *Illænus*, *Paradoxides*, follow the same law; but other generic forms, *Calymene*, *Phacops*, &c., pass upwards, although as a rule with different species, into the higher Silurian and Devonian periods. *Phillipsia*, very rare in earlier groups, becomes, in the Lower Carboniferous, almost the only remaining type of the class. But these characteristics will be found in full under our enumeration of the more common species belonging to each genus. At present, let us briefly glance at the geological relations of the Crustacea generally.

The decapods comprise three well-marked groups:—the brachyura, anomoura, and macroura. The brachyura, or short-tailed decapods, the highest group, are first met with in the Cretaceous rocks; the anomoura in the Jurassic; and the macroura in the Carboniferous. The entire order is on the increase.

The stomapods are scarcely known in the fossil state. A single species has been met with in the upper tertiaries of Monte Bolca, and a few doubtful forms in the Jurassic and Devonian strata.

The amphipods and the læmodipods are also rare in the fossil condition. The only certain examples are from tertiary beds.

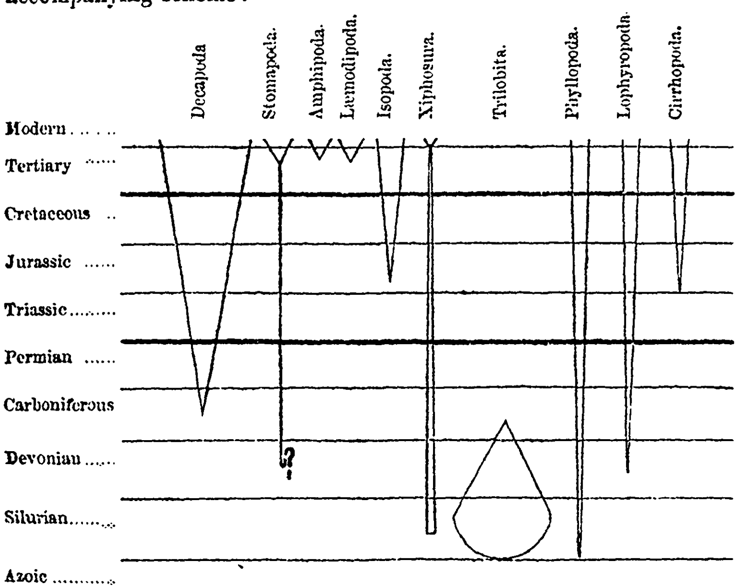
The marine isopods exhibit fossil examples from the Jurassic formations, upwards. Terrestrial species occur only in amber.

The xiphosures—including the pterygotus in this order—date from the upper Silurian. They are on the decline.

The trilobites appear at the base of the Silurian formations, and die out in the lower Carboniferous. They constitute the only order of crustaceans of which we have no living representatives.

The phyllopods appear also at the base of the Silurians. The lophyropods (cyprids, &c.) follow the same law. The cirrhopods commence their existence with the lias—at least, if the doubtful bostrichopus be excluded from the group. Of the siphonostoma, no fossil representatives are known.

These geological relations are presented at a single view in the accompanying scheme:—*




7. *Classification.* The arrangement of the trilobites in natural groups is beset with considerable difficulty. This arises in part from e fragmentary condition in which so many species are commonly met with; and partly from our still imperfect knowledge of the true value of the various organization characters on which we are obliged to base our collocations. Owing to the first source of error, it has often happened that distinct types have been formed into a single species; whilst on the other hand, imperfect specimens of one and the same species have been referred to even different genera. A sys-

* All the fossiliferous rocks below the Devonian group are here included in the term Silurian. The Lophyropoda should be drawn down to the lowest horizontal line.

tem of classification very commonly adopted, is founded on the number of the thoracic segments or body-rings. This was first proposed by Professor Quenstedt, of Tubingen, in 1837. Of the importance of this character there can be no doubt, more especially when we take into consideration its constancy throughout one entire group of crustaceans (the malacostraca), and the results of BARRANDE's researches, shewing its definite nature with respect to *adult* trilobitic forms. It can only be looked upon, however, as possessing a specific value; for there are several well-known types which differ from one another in the number of the body-rings, but which can be readily shewn to be generically alike. Hence, by the adoption of this system, without regard to other characters, many unnatural separations necessarily arise.

In BARRANDE's classification, the trilobites are arranged in two sections, each comprising various families. These sections are founded respectively on the presence of raised or furrowed pleuræ, a character often of difficult recognition even in perfect specimens (*illænus nileus*), and one that appears at the best to be of questionable value. The divisions founded upon it, like all indeed based upon a single character, break through many natural analogies, and place in distant parts of the system, forms which are evidently akin to one another. A single example may suffice to corroborate this assertion. Respecting the existence of a close relationship between *phacops* and *ceraurus*, there can be, I think, but one opinion. The peculiar direction of the facial suture; the anterior expansion of the glabella; the (at least in normal cases) eleven thoracic segments—and other characters—render this sufficiently evident. But in BARRANDE's system, the two are placed widely apart. At the same time it is not intended to deny that *ceraurus* is also related to *acidaspis* (with which it is placed by BARRANDE). It holds undoubtedly a middle place between *phacops* and this latter genus, and such is the order in which it occurs in the classification given below; whereas, by adopting BARRANDE's subdivisions, various unrelated genera would necessarily intervene. Between *bronteus* and *illænus* again, evidently allied types if regard be paid to all their characters, a wide separation occurs in BARRANDE's system.

In the classification now proposed, the trilobites (omitting the agnosti) are arranged in thirteen families. Some of these divisions might be thought perhaps, on a first consideration of the subject, to possess simply a generic value; but their adoption as true families may be sustained, I believe, on really satisfactory grounds. If certain of them exhibit but few genera at present, that need be no obstacle to their assumption, because new forms are being constantly brought to light; and, by widening out the genera as here done, ample space is left for the reception of these new comers, and both generic and specific distinctions rendered far more rigorous and minute. In a linear system of arrangement, like that necessarily employed, it is extremely difficult, if not indeed impossible, to convey a just idea of the relations of these families to one another. An attempt to effect this has been made, however, in the following distribution, in which, with certain unavoidable exceptions, each family will be seen to form a natural transition from that which precedes to that which follows it. The weakest point in the connexion, occurs perhaps between the second family and the third.

ILLŒNIDÆ.
BRONTIDÆ.
LICHASIDÆ.
ACIDASPIDÆ.
CERAURIDÆ.
PHACOPSIDÆ.
TRINUCLIDÆ.
ASAPHIDÆ.
PROETIDÆ.
CALYMENIDÆ.
HARPESIDÆ.
OLENIDÆ.
PARADOXIDÆ.

Here the stream of affinity flows from the *asaphidæ* in an upward and downward direction. Thus, through the genus *stygina*, the *asaphidæ* connect with the *trinuclidæ*. These latter have certain affinities with some of the *phacopsidæ*, and the *asaphidæ* and *phacopsidæ* are still nearer related. The *cerauridæ* and *phacopsidæ*, again, have the same number of body-rings, the same expanding character of the glabella, the same facial sutures. With *acidaspidæ* and *lichasidæ*, the *cerauridæ* have also much in common. *Brontidæ* are but slightly related to the family below them in the list, but in both the tail-rachis is very small, and the pygidium itself of a peculiar character. The *illœnidæ* and the *brontidæ* are closely related by the large buckler and pygidium, the slightly-developed tail-rachis, and the normal number of body-rings, with other characters to be pointed out in the sequel.

On the other hand, the *proetidæ* form a transition group between the *asaphidæ* and the *calymenidæ*, whilst these families are also more or less immediately related by the genus *homalonotus*. Between the last family and the *harpesidæ* and *olenidæ* there might appear, at first sight, to be few connecting points; but we have here the same general tapering form of body, the gradually diminishing pygidium, the increasing segments, and the contracted glabella. The genus *cyphaspis* (usually placed with the *proetidæ*) is undoubtedly related to each of these three types. Finally, the *olenidæ* and *paradoxidæ* have so much in common, that in general they are united into a single family. The opposite character, however, of the glabella (and of the buckler generally) should keep them distinct. If, indeed, it could have been so contrived without breaking through other relations, the *paradoxidæ* would have been placed higher in the series; for I think it will be found that *paradoxides* is related to the genus *Phacops*, much in the same way as *harpes* or *olenus* is related to *calymene*. A certain transition, at least, is presented through the genus remopleurides, with its largely-developed buckler and glabella, its eleven thoracic segments, and its dwarfed and modified pygidium.

Although, when viewed in the manner just pointed out, the above arrangement indicates to a certain extent the relations existing between the families adjacent to one another in the series, it is yet in other respects confessedly of an imperfect character. It is obvious, however, that such must necessarily be the case, where it is attempted to shew these natural transitions in a purely linear system of arrangement. Thus, in the above method, the *asaphidæ*, required as a transition group, are placed in a central position, unavoidably remote from their allied forms, the *illænidæ*. But where complicated relations exist, it is impossible for all to be met in a satisfactory manner in any linear distribution of the kind.

Four type-forms appear to hold a prominent place amongst the trilobites, and indeed, when considered in all their modifications, to constitute centres of classification, as it were, around which the other types may be at least conveniently if not naturally grouped. Admitting this, we obtain the distribution exhibited in the following table:—

| Illœnians. | Asaphians. | Calymenians. | Phacopsians. |
|---|---|---|---|
| Illœnidæ. | Asaphidæ. | Calymenidæ. | Phacopsidæ. |
| Brontidæ. | Trinuclidæ. | Harpesidæ. | Ceraurida. |
| | Proetidæ. | Olenidæ. | Lichasidæ. |
| | | | Acidaspidæ. |
| | | | Paradoxidæ. |

*Phacops* and *calymene* are frequently placed together as members of the same family, but it cannot be too strongly insisted on, that their characters are essentially distinct. Amongst those of a constant value, we may cite—the number of the body-rings; eleven in the one form, thirteen in the other. Secondly, the conformation of the glabella: large and expanding in *phacops*; comparatively small and contracted anteriorly in *calymene*. Thirdly, the direction of the facial suture. Fourthly, the character of the eyes—and so on. Besides which *phacops* (or its kindred genus *dalmannia*) is most intimately connected with *ceraurus*—the character of the glabella, the facial suture, the number of the body rings, are the same in each—a form with which *calymene* has certainly no relations. Hence the two may be legitimately placed apart: each as the type-form of a special group.

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In PART II. a brief analysis of the more important genera and species belonging to these families will be given: shewing more fully the connecting points between the various groups, and the data on which the above arrangement is chiefly founded. In order, however, to render the present PART complete within itself, a rapid enumeration of the essential characteristics of each family is here appended:

*Illœnidæ*—Buckler and pygidium large and smooth. Caudal axis scarcely developed. Glabella feebly raised; simple. Eyes far apart. Body-rings 5–10.

*Brontidæ*—Buckler and pygidium large; the latter with fan-like furrows and very short axis. Glabella slightly raised, furrowed. Eyes far apart. Body-rings 10.

*Asaphidæ*—Buckler and pygidium large; the latter with well-developed axis, and usually with striated limb. Glabella simple (or slightly furrowed). Eyes tolerably near together. Body-rings 8.

*Trinuclidæ*—Buckler large, horned; generally with perforated limb. Glabella oval, strongly pronounced. Pygidium of medium size. Body-rings 5–6.

*Proetidæ*—Buckler and pygidium of good size; the former bordered, the latter with well-developed axis. Glabella large, smooth (rarely furrowed.) Body-rings 8–12.

*Calymenidæ*—Buckler bordered, without horns. Glabella furrowed or smooth, narrowing anteriorly. Facial suture terminating at the angles of the buckler. Pygidium and its axis well-developed. Body-rings 13.

*Harpesidæ*—Buckler large, crescented, with perforated limb. Glabella narrowing anteriorly. Pygidium small. Body-rings 25–26.

*Olenidæ*—Buckler of moderate size, but comparatively short. Glabella small, narrowing anteriorly. Facial suture terminating at the lower margin of the buckler. Body-rings 12–17. Pleuræ spined. Pygidium small.

*Phacopsidæ*—Buckler and pygidium generally large; the latter with well-developed axis, often terminating in a spine. Glabella lobed or pustulated, widening anteriorly. Facial suture terminating at the sides of the buckler, about on a level with the eyes: these latter very visibly reticulated. Body-rings 11–12. Pleuræ rounded or spined.

*Ceraurideæ*—Buckler large, horned. Pygidium with short axis, and with horns or spines. Glabella widening above, furrowed. Facial suture and body-rings as in Phacopsidæ.

*Lichasidæ*—Buckler broad, but short and somewhat pointed. Glabella prominently oval, with several accessory lobes. Facial suture terminating at the lower margin of the buckler. Pygidium with short axis, and denticulated or spined limb. Body-rings 11.

*Acidaspidæ*—Glabella in separate lobes, strongly pronounced. Buckler broad, and somewhat short. Pygidium small, or of moderate size with short axis, and spined or denticulated limb. Body-rings 8–10. Pleuræ spined. Entire shell more or less ornamented.

*Paradoxidæ*—Buckler large, horned. Glabella well-developed, widening above. Pygidium very small. Body-rings 11–20.

APPENDIX.—*Agnosti.* Small inconspicuous forms, exhibiting in general a couple of nearly similar shields (buckler and pygidium) separated by two or three thoracic segments. When more fully studied, the *agnosti* will be found, probably, to comprise a distinct group, embracing several families.

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# ON THE REDUCTION OF THE GENERAL EQUATION OF THE SECOND DEGREE IN PLANE CO-ORDINATE GEOMETRY.

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The general equation of the second degree in plane rectangular co-ordinates, under the form

$ax^2 + 2\,cxy + by^2 + 2\,dx + 2ey + f = 0$, where $a$ is essentially positive, and where the quantity

$$\left\{ (a+b)^2 - 4\,(ab - c^2) \right\}^{\frac{1}{2}}$$

will be denoted by $m$, can always be made identical with the equation

$$(x-h)^2+(y-k)^2=\epsilon^2(x\cos\theta+y\sin\theta-p)^2:$$

for this latter is an equation of the second degree with all its terms complete, and containing the requisite number of arbitrary constants.

Since the left-hand member of this equation is the square of the distance between the points $(x, y)$ and $(h, k)$, $\epsilon$ is a constant, and the other factor of the right-hand member is the square of the distance of the point $(h, k)$ from the line $x\cos\theta + y\sin\theta - p = 0$, it follows that the general equation of the second degree expresses the locus of a point whose distance from a fixed point (real or imaginary) is always proportional to its distance from a fixed, real or imaginary, straight line.

Adopting the usual nomenclature, the point $(h, k)$ is a *focus*, $\epsilon$ is the *excentricity*, and the fixed line $x\cos\theta + y\sin\theta - p = 0$ is a *directrix*.

Multiplying the first equation by an arbitrary quantity $(\lambda)$; arranging the second equation by powers of the variables, and then equating corresponding coefficients, we obtain the six following equations from which to determine the six unknowns, $\epsilon, h, k, \lambda, \theta, p$:

$$\lambda a = 1 - \epsilon^2\cos^2\theta \quad\text{——}\quad (1)$$
$$\lambda b = 1 - \epsilon^2\sin^2\theta \quad\text{——}\quad (2)$$
$$\lambda c = -\epsilon^2\sin\theta\cos\theta \quad\text{——}\quad (3)$$
$$-\lambda d = h - p\epsilon^2\cos\theta \quad\text{——}\quad (4)$$
$$-\lambda e = k - p\epsilon^2\sin\theta \quad\text{——}\quad (5)$$
$$\lambda f = h^2 + k^2 - p^2\epsilon^2 \quad\text{——}\quad (6)$$

By taking (1) × (2) — $(3)^2$, we obtain

$$\lambda^2(ab-c^2) = 1 - \epsilon^2 \quad\text{——}\quad (7)$$

Hence, according as $ab-c^2$ is positive, zero, or negative, $\epsilon$ is less than, equal to, or greater than 1, corresponding respectively to the three varieties of the *ellipse, parabola, and hyperbola.*

Also from (1) + (2) we obtain

$$\lambda(a+b) = 2 - \epsilon^2 \qquad (8)$$

and then $(8)^2$ — (7) × 4 gives

$$\lambda^2\left\{(a+b)^2 - 4(ab-c^2)\right\} = \epsilon^4$$

or, substituting $m$,

$$\lambda m = \epsilon^2$$

from which, by substitution in (8), we have

$$\epsilon^2 = \frac{2m}{a+b+m} \quad\text{——}\quad (9)$$

In this expression for the excentricity, $m$ may bear either sign (+ or —), but we observe that when, as in the ellipse, $ab-c^2$ is positive, which requires $a$ and $b$ to have the same sign, and therefore (since $a$ is essentially positive) $a+b$ to be positive, $m$ is less than $a+b$, and the negative value of $m$ makes $\epsilon$ impossible. So also in the parabola, where $ab-c^2=0$, the positive value of $m$ gives $\epsilon=1$, while the negative value makes $\epsilon$ infinite.

Hence in the ellipse and parabola, the positive value of $m$ must be taken: but in the hyperbola, where $ab-c^2$ is negative, either sign gives possible values to $\epsilon$, one of them referring (as will afterwards appear) to the hyperbola, and the other to its conjugate, and the two values are evidently connected by the relation

$$\frac{1}{\epsilon_1^2}+\frac{1}{\epsilon_2^2}=1.$$

It will be shewn in the sequel how to discriminate between them. We have now

$$\lambda=\frac{\epsilon^2}{m}=\frac{2}{a+b+m};$$

and substituting for $\lambda$ and $\epsilon^2$ in (1), (2), (3), we find

$$2\cos^2\theta=\frac{2}{\epsilon^2}-\frac{2\lambda a}{\epsilon^2}=1+\frac{a+b}{m}-\frac{2a}{m}$$

$$=1-\frac{a-b}{m}$$

$$2\sin^2\theta=1+\frac{a-b}{m}$$

$$\sin\theta\cos\theta=-\frac{c}{m}.$$

Of the four values for $\theta$ determined by either of the first two equations ($m$ bearing a determinate sign) the third equation will shew which of the pairs, namely, $\theta$ and $\pi+\theta$, or $\pi-\theta$ and $2\pi-\theta$, is to be selected, and it is then indifferent which of the angles in that pair we take, due regard being had to the direction in which $p$ is to be drawn from the origin as indicated by its sign; for, the change of $\theta$ into $\pi+\theta$ in our original equation only changes the sign of $p$, and we thus obtain in both cases the same determinate position for the directrix.

There remain now the equations (4), (5), (6), from which to complete the determination by finding $p$, $h$, and $k$. Eliminating $h$ and $k$ from these equations, we have

$$p^2+\frac{2p\lambda}{1-\epsilon^2}(d\cos\theta+e\sin\theta)-\frac{\lambda(d^2+e^2)\lambda f}{\epsilon^2(1-\epsilon^2)}=0$$

From this we perceive that there are two and only two *directrices* corresponding to these two values of $p$, (for $\theta$ is restricted to one of two values differing by 180° which, as before noted, only changes the sign of $p$, and gives for each value the same line), which are also parallel, and to each of which corresponds a single *focus*, given by the corresponding values of $h$, $k$, from equations (4) and (5)*.

These values of $p$ may however in particular cases either coincide, or be both imaginary, or one or both may be infinite or indeterminate: it will however be more simple to deduce from our equations the ordinary constants of the curve, which may be effected as follows:

The equation to a directrix being

$$x \cos\theta + y \sin\theta - p = 0,$$

that to a line drawn through the corresponding focus at right angles to the directrix will be

$$\frac{x-h}{\cos\theta} = \frac{y-k}{\sin\theta}.$$

The length of the perpendicular dropped on this from the origin is

$$h \sin\theta - k \cos\theta$$

which by virtue of (4) and (5) is equal to

$$\lambda\,(d \sin\theta - e \cos\theta)$$

or, denoting this by $K$,

$$K = \tfrac{1}{2}\frac{a+b-m}{ab-c^2}\,(d \sin\theta - e \cos\theta).$$

This expression being the same whichever focus be taken, it follows that the line thus determined (the 'transverse axis') passes through both foci and is at right angles to both directrices; and, from the mode of generation, the curve must be symmetrical with regard to it.

The curve is also plainly symmetrical with regard to a line parallel to both directrices and midway between them: the length of the perpendicular dropped from the origin upon this line (the 'conjugate axis') is the semi-sum of the values of $p$: calling this H we have from the equation for $p$,

$$H = -\frac{\lambda}{1-\epsilon^2}\,(d \cos\theta + e \sin\theta)$$

$$= -\tfrac{1}{2}\frac{a+b+m}{ab-c^2}\,(d \cos\theta + e \sin\theta),$$

Projecting $H$ and $K$ upon the axes of $x$ and $y$ successively, we obtain the co-ordinates $(x', y')$ of the intersection of these two lines

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* These values are as follows

$$p = -\tfrac{1}{2}\cdot\frac{a+b+m}{ab-c^2}\left[-(d\cos\theta + e\sin\theta) \pm \left\{\frac{1}{m}\left(ae^2 + bd^2 - 2cde - \overline{ab-c^2}.f\right)\right\}^{\frac{1}{2}}\right]$$

$$h = \frac{1}{ab-c^2}\left[-(bd-ce) \pm \tfrac{1}{2}\left\{2(m-a+b)\left(ae^2+bd^2-2cde-\overline{ab-c^2}.f\right)\right\}^{\frac{1}{2}}\right]$$

and a similar expression for $k$ by interchanging $a$ and $b$, $d$ and $e$. A discussion of them would lead to the same results obtained more simply in the text.

(the 'transverse' and 'conjugate' axes), a point about which the curve is symmetrical, or the 'centre.' Thus

$$x' = H\cos\theta - K\sin\theta$$

$$= -\frac{1}{2(ab-c^2)}\left\{\begin{array}{l}(a+b+m)(d\cos^2\theta+e\sin\theta\cos\theta)\\ +(a+b-m)(d\sin^2\theta-e\cos\theta\sin\theta)\end{array}\right\}$$

$$= -\frac{1}{2(ab-c^2)}\left\{(a+b)\,d+md\left(-\frac{a-b}{m}\right)+2me\left(-\frac{c}{m}\right)\right\}$$

$$\left.\begin{array}{l} = \dfrac{ce-bd}{ab-c^2}. \\[2ex] y' = \dfrac{cd-ae}{ab-c^2}. \end{array}\right\} \ldots\ldots\ldots\ldots (10)$$

which are the usual expressions.

To find the points in which the curve is cut by the transverse axis, whose equation is

$$\frac{x-h}{\cos\theta} = \frac{y-k}{\sin\theta} = r;$$

substitute these values of $x$ and $y$ in the original equation, and we obtain

$$r^2 = \epsilon^2\,(h\cos\theta + k\sin\theta - r - p)^2$$

and the two values of $r$ are expressed by

$$\frac{\epsilon}{\pm - \epsilon}\,(h\cos\theta + k\sin\theta - p).$$

The difference of these values is the part of the transverse axis intercepted by the curve: calling this length $2A$ we have

$$A^2 = \frac{\epsilon^2}{(1-\epsilon^2)^2}\,(h\cos\theta + k\sin\theta - p)^2 \ldots\ldots\ldots (11)$$

now $(4)\times\cos\theta + (5)\times\sin\theta$ gives

$$h\cos\theta + k\sin\theta - p\,\epsilon^2 = -\lambda\,(d\cos\theta + e\sin\theta)\ldots(12)$$

and $(4)^2 + (5)^2 - (6)$ gives

$$-2p\,\epsilon^2\,(h\cos\theta + k\sin\theta) + p^2\epsilon^2\,(1+\epsilon^2) = \lambda^2\,(d^2+e^2) - \lambda f\ldots(13)$$

Hence by means of $(12)^2 \times \epsilon^2 + (13) \times (1-\epsilon^2)$ we have

$$\epsilon^2\,(h\cos\theta + k\sin\theta - p)^2$$

$$= \lambda^2\left\{\epsilon^2\,(d\cos\theta + e\sin\theta)^2 + (1-\epsilon^2)\left(d^2 + e^2 - \frac{f}{\lambda}\right)\right\}$$

$$= \lambda^2\left\{d^2(1-\epsilon^2\sin^2\theta) + e^2(1-\epsilon^2\cos^2\theta) + 2de\,\epsilon^2\sin\theta\cos\theta - \frac{1-\epsilon^2}{\lambda}f\right\}$$

$$= \lambda^2\left\{\lambda\,bd^2 + \lambda\,ae^2 - 2\lambda\,cde - \frac{1-\epsilon^2}{\lambda}f\right\}$$

$$= \lambda^3\left\{ae^2 + bd^2 - 2\,cde - (ab-c^2)f\right\}$$

and, hence,

$$A^2 = \frac{1}{2}\,\frac{a+b+m}{(ab-c^2)^2}\left\{ae^2 + bd^2 - 2cde - (ab-c^2)f\right\}$$

Again, observing that the semi-sum of the values of $r$ above found is the distance between the focus and centre, and that this semi-sum is $\frac{\epsilon^2}{1-\epsilon^2}$ $(h \cos\theta + k\sin\theta - p)$ and therefore$=A\epsilon$, by (11), we may write for the co-ordinates of the centre,

$$h + A\epsilon\cos\theta,\ k + A\epsilon\sin\theta:$$

and the equation to the 'conjugate' axis becomes

$$(x - h - A\epsilon\cos\theta)\cos\theta + (y - k - A\epsilon\sin\theta)\sin\theta = 0.$$

To find the points where the curve is cut by this axis, we combine this equation, or

$$\frac{x - h - A\epsilon\cos\theta}{\sin\theta} = \frac{y - k - A\epsilon\sin\theta}{-\cos\theta} = r,$$

with the equation to the curve,

$$(x-h)^2 + (y-k)^2 = \epsilon^2 (x\cos\theta + y\sin\theta - p)^2:$$

substituting for $x$, $y$ in terms of $r$, we obtain

$$(r\sin\theta + A\epsilon\cos\theta)^2 + (-r\cos\theta + A\epsilon\sin\theta)^2$$

$$=\epsilon^2(A\epsilon + h\cos\theta + k\sin\theta - p)^2 = \epsilon^2(A\epsilon + \frac{1-\epsilon^2}{\epsilon}A)^2,$$

or,

$$r^2 + A^2\epsilon^2 = A^2.$$

giving two points, which are real in the ellipse, and imaginary in the hyperbola. Hence denoting the intercepted part of the conjugate axis by $2B$, we have

$$B^2 = A^2(1-\epsilon^2)$$

$$= \frac{1}{2}\frac{a+b-m}{(ab-c^2)^2}\left\{ae^2 + bd^2 - 2cde - (ab-c^2)f\right\}.^*$$

We may now go on to discuss the varieties of form which the curve may assume for particular relations among the constants.

I. In the elliptic class, where $ab-c^2$ is positive.

Here $m$ is always to be taken with the positive sign, and $(a+b+m)$, and $(a+b-m)$ are both finite and positive, and $A$ and $B$ are therefore either both real or both imaginary; also they may vanish together, but neither of them can become infinite except by passing into the parabolic class.

Also $ab$ being greater than $c^2$, $ae^2 + bd^2 - 2cde$ is always positive, and therefore if $f$ be negative, the curve is always real: if $f$ be positive, the curve is real or wholly imaginary according as $ae^2 + bd^2 - 2cde$ is greater or less than $(ab-c^2)f$.

If $ae^2 + bd^2 - 2cde = (ab-c^2)f$, then $A$ and $B$ both vanish, and the curve is reduced to a point whose co-ordinates are given by (10) and

* The value of $B$ might have been deduced from that of $A$ by changing the sign of $m$ also $K$ might have been deduced from $H$ by changing the sign of $m$, and writing $(\frac{\pi}{2}+\theta)$ for $\theta$. This might have been inferred from consideration of the imaginary directrices

which is always real and finite. The curve in this case resolves into two imaginary straight lines which have a real point of intersection.

If $A=B$, which requires $m=0$, and therefore $a=b$, and $c=0$, the curve becomes a circle, the co-ordinates of the centre reducing to $(-\frac{d}{a}, -\frac{e}{a})$, and the square of its radius being $\frac{1}{a^2}(d^2+e^2-af)$. As before, this reduces to a point if $d^2+e^2-af$ vanish, and is wholly imaginary if $d^2+e^2-af$ be negative.

II. In the hyperbolic class, where $ab-c^2$ is negative.

Here either sign of $m$ is admissible; $(a+b-m)$ and $(a+b+m)$ are both finite but of different signs, and of the two quantities $A$ and $B$, one is real and the other imaginary: the curve is therefore always real, and *we must take that sign for m which renders A real and B imaginary;* the other sign having reference to the 'conjugate' hyperbola: that is, $m$ must be taken of the same sign as the quantity $ae^2+bd^2-2cde-(ab-c^2)f$. As in the previous class, $A$ and $B$ may vanish together, but neither can vanish separately, nor can they become infinite except by passing into the parabola. When they both vanish, which will be when

$$ae^2+bd-2cde-(ab-c^2)f=0.$$

the curve is reduced to two real straight lines, whose intersection is given by (10), and which are equally inclined to the transverse axis (whose direction remains determinate): in this case, both foci and centre coincide with this point, and both directrices coincide with the direction of the conjugate axis: hence from the mode of generation, the angle of inclination of each of these lines to the transverse axis is $\sec^{-1}\epsilon$ or $\tan^{-1}\left\{\frac{m-a-b}{m+a+b}\right\}^{\frac{1}{2}}$, that sign of $m$ being taken, which makes this quantity real.

If $A=B\sqrt{-1}$, which requires $a=-b$, the hyperbola is known as the 'equilateral.'

III. In the parabolic class, where $ab-c^2=0$.

This may be treated as the limiting case of the foregoing classes. Here $m=a+b$, $A$ becomes infinite, and $B$ takes the form $\frac{0}{0}$ but is really also infinite (since $\frac{a+b-m}{(ab-c^2)^2}=\frac{4}{ab-c^2}\,\frac{1}{a+b+m}$) unless at the same time $ae^2+bd^2-2cde=0$.

Since $ab=c^2$, this requires $ae^2=bd^2$ and therefore $bd=ce$ and $ae=cd$, and then

$$ae^2+bd^2-2cde=ae^2-cde$$
$$=ae^2-\frac{c^2e^2}{b}$$

$$=\frac{e^2}{b}\,(ab-c^2)$$

and therefore

$$B^2=\frac{1}{a+b}\left(\frac{e^2}{b}-f\right)$$

$$=\frac{e^2-bf}{c^2+b^2}\quad\text{or}\quad\frac{d^2-af}{c^2+a^2}$$

In this case the curve reduces to two parallel straight lines, parallel to and equidistant from the transverse axis (which still remains determinate in position), the distance between them being double the foregoing value of B.

If $e^2=bf$ (which is the same as $d^2=af$), these two lines coalesce into the transverse axis, and if $e^2-bf$ be negative, they are imaginary.

In general, however, for the parabola, the elements obtained in the ellipse and hyperbola are insufficient when the co-ordinates of the centre become infinite: the original equations (1)...... (6) admit however in this case of easy solution. For, since $ab-c^2=0$, we have $m=a+b$, $\epsilon^2=1$, $\lambda=\frac{1}{a+b}$, and the equations become

$$\sin^2\theta=\frac{a}{a+b}\,,\ \sin\theta\cos\theta=\frac{-c}{a+b}$$

$$-\lambda d=h-p\cos\theta \qquad (4)$$

$$-\lambda e=k-p\sin\theta \qquad (5)$$

$$\lambda f=h^2+k^2-p^2 \qquad (6)$$

from which we obtain at once by simple equations

$$p=\frac{1}{2(a+b)}\,\frac{d^2+e^2-(a+b)f}{d\cos\theta+e\sin\theta}$$

$$h=\frac{1}{2(a+b)}\,\frac{c(e^2-d^2)+2ade-(a+b)cf}{cd-ae}$$

$$k=\frac{1}{2(a+b)}\,\frac{c(d^2-e^2)+2bde-(a+b)cf}{ec-bd}$$

If we draw a line through the focus parallel to the directrix, the portion intercepted by the curve is double the distance of the focus from the directrix, as is evident from the mode of generation.

If we call this portion $L$ (the 'latus rectum'), we have

$$\tfrac{1}{2}L=h\cos\theta+k\sin\theta-p$$

$$=\lambda(d\cos\theta+e\sin\theta),\ \text{by (4) and (5).}$$

Hence

$$\tfrac{1}{4}L^2=\frac{1}{(a+b)^3}\left\{ae^2+bd^2-2cde\right\}$$

$$=\frac{1}{(a+b)^3}\,\frac{abe^2+b^2d^2-2bcde}{ab+b^2}=\frac{1}{(a+b)^2}\,\frac{(bd-ce)^2}{c^2+b^2}$$

We will now proceed to recapitulate the values of the elements necessary and sufficient for the determination of the curve in the general cases.

For the ellipse and hyperbola, the co-ordinates of the centre are

$$x = \frac{ce-bd}{ab-c^2}, \quad y = \frac{cd-ae}{ab-c^2};$$

the semi-axes, transverse and conjugate, are given by the values

$$A^2 = \tfrac{1}{2}\,\frac{a+b+m}{(ab-c^2)^2}\left\{ae^2+bd^2-2cde-(ab-c^2)f\right\}$$

$$B^2 = \tfrac{1}{2}\,\frac{a+b-m}{(ab-c^2)^2}\left\{\dots\dots\dots\dots\right\}$$

In the ellipse $ab-c^2$ is positive, and $m$ is always to be taken positive: in the hyperbola $ab-c^2$ is negative, and $m$ must be taken of the same sign as the quantity within the $\{-\}$.

The inclination ($\theta$) of the transverse axis to the axis of $x$ is then given without ambiguity by the equations.

$$2\cos^2\theta = 1 - \frac{a-b}{m}, \quad \sin\theta\cos\theta = -\frac{c}{m},$$

$\theta$ being measured by revolution from the positive part of the axis of $x$ to that of $y$.

In the parabola, $ab-c^2=0$; the co-ordinates of the focus are

$$h = \frac{1}{2(a+b)}\,\frac{c(c^2-d^2)+2ade-(a+b)cf}{cd-ae}$$

$$k = \frac{1}{2(a+b)}\,\frac{c(d^2-c^2)+2bde-(a+b)\,cf}{ce-bd}$$

The position of the directrix is given by the angle $\theta$ made by its normal with the positive part of the axis of $x$ ($\theta$ being measured by revolution towards that of $y$) and the length $p$ of this normal, including sign as indicating a direct or backward measurement from the origin. These are given without ambiguity by the equations

$$\sin^2\theta = \frac{a}{a+b}, \quad \sin\theta\cos\theta = \frac{-c}{a+b},$$

$$p = \frac{1}{2\,(a+b)}\cdot\frac{d^2+e^2-(a+b)f}{d\cos\theta+e\sin\theta}.$$

These elements are sufficient to determine the position and dimensions of the curve as well as the direction towards which its concavity is turned;* but the latus-rectum $L$ is also given directly by the value

$$\tfrac{1}{4}L^2 = \frac{1}{(a+b)^2}\cdot\frac{(bd-ce)^2}{b^2+c^2}.$$

In particular cases, the ellipse may degenerate into a point, or be wholly imaginary; the hyperbola may degenerate into two intersecting

* In the ordinary methods of reduction, this direction is undetermined.

straight lines; both curves have for their limiting form the parabola, which itself may degenerate into two parallel straight lines, or into a single straight line, or be wholly imaginary.

## REVIEWS.

*Chemical Method, Notation, Classification, and Nomenclature.* By Auguste Laurent, formerly Professor of Chemistry at the Faculty of Sciences of Bordeaux, &c. Translated by William Odling, M.B., F.C.S., Professor of Practical Chemistry and Natural Philosophy at Guy's Hospital. London: Printed for the Cavendish Society by Harrison & Sons. 1855.

Modern Chemistry can boast of few more persevering and successful cultivators than the late Auguste Laurent, who occupied so prominent a position among the most distinguished chemists of France. Not only did he enrich the science with the discovery, we might almost say, of an infinity of new and interesting compounds, but he was led during their investigation to propose theories respecting their formation and constitution, which, although, most fiercely combatted on their promulgation, and for a long period by no means generally received, have during the last few years attracted a large share of attention, and have been, at least in part, almost universally adopted.

Dumas first put forward the idea of substitution, or rather of the law which regulates it, but it was Laurent who first pointed out the real value of the discovery, and immensely extended the theory. While the greatest credit must be allowed to the many eminent chemists whose labors in organic chemistry are daily enriching the science with most interesting discoveries, it cannot be denied that in many cases they are but following in the path opened by the investigations of Laurent.

The career of the celebrated French chemist is peculiarly interesting as connected with the history of chemistry and of chemical polemics, for his publications drew down upon him the ponderous and gigantic learning of Berzelius, and the acute and cutting irony of the belligerent Liebig. Some of the most learned, but at the same time most polemical papers of the celebrated chemist of Giessen, arose from his discussions with Laurent. Many who have watched the progress of chemistry during the last twenty years will well remember the doubt, not to say ridicule, with which many of Laurent's assertions were received, both in France and Germany, but they will also confess that many of our present theories and assumptions are but echoes of what we once were taught to consider absurd. Chemistry is essentially progressive, and a science of facts; theories and views, founded on a comparatively small number of facts, must necessarily receive alteration when new facts, bearing on these theories, are discovered. We should scarcely be willing to adopt Williamson's explanation of the nature of ether and of its formation, were it not for the discovery of the compound ethers; the discovery of the compound anhydrous acids has led to some remarkable changes in our theories respecting the organic acids generally.

Liebig more than once quizzed Laurent about his spirit of prophecy, but was in himself a remarkable instance of a *true prophet*, having predicted in 1839 the existence and properties of the compound ammonias, which were discovered in 1849 by Wurtz.

The idea of the dualistic nature of the vegetable alkaloids, maintained by several of the older chemists, seems to be entirely refuted, for we can scarcely believe that the composition of the natural products can be different from that of the artificial ones which they so closely resemble. It is not at all extraordinary that those who commenced the study of chemistry when that science was almost in its infancy, and when all organic relations were compared to inorganic, should have been induced to extend to the one department, the dualistic theory so generally adopted in the other; every man has his own peculiar hobby, swears by his own side of the shield, and is very unwilling to admit the arguments of others. For long years the conflict raged among chemists of the different schools, but at the present day there seems to be a fusion between the opposing factions, while portions of the compound radical theory are conceded to be erroneous, parts of the Laurentian hypotheses, and of those of the newer French school, are willingly adopted.

Laurent's papers are diffused through so large a number of journals, and his views have been so imperfectly represented in most manuals of chemistry, that the publication of this excellent translation of his last work (on which he was engaged, as Biot says, even when in the grasp of death,) will prove an exceedingly acceptable addition to the library of every chemist.

Laurent alludes to most of the attacks which have at different times been made upon his theories and researches by Berzelius, Liebig, Wöhler and others, and with no feeble pen makes a fierce onslaught upon the dualistic hypothesis. However ingenious his propositions with regard to chemical nomenclature, we cannot conceive that they will ever be generally adopted; nitronaphthase and nitronaphthise are by no means preferable to nitro, binitro, and trinitro-naphthalide, for when we once assume that the numerical prefix shall indicate the number of equivalents of hydrogen, replaced by $N O^4$ the words nitro, binitro, and trinitro, indicate three numbers much more directly and distinctly than the a, e and i in the final syllable of the Laurentian names. In the present work we meet with an overwhelming mass of new names with which it is sincerely to be hoped chemical nomenclature (already sufficiently confused) will not be deluged. Aplones, Diamerones, Dianhydes, Anames, Anoses, Aziles, Aleses, Alcinyles, Metoyles, Rhizonyles, Diameraies, Synehteres, Dixerides, Udolides, &c., &c., *ad infinitum.* But these are euphonious compared with Gmelin's designations of which the following may serve as specimens: Alan, Alen, Ofun, Apuk, Patakplatek, Patanafintalkanafin, and last, but not least, for simple Alum, Atolantelminojafinweso!!

The work is of such a nature as scarcely to allow of any extracts, but we have appended a note in which Laurent explains the difference between his and Dumas' ideas respecting substitution, which were by many considered to be identical.

"The notion of substitutions, if we understand thereby, as we ought to understand, the replacement of chlorine, by bromine, iodine, and fluorine, or the replacement of silver, by copper, iron, or potassium, is as ancient as are the ideas of Richter and Wenzel upon the decomposition of salts. We have known for a long time that the single bodies displace one another mutually from their combinations, most generally by exchanging equivalent for equivalent, but not unfrequently in a different manner.

We have known that chlorine, by its action upon certain organic substances, as cyanhydric acid, essence of bitter almonds, wax, &c., expels a certain number of atoms of hydrogen, which are replaced by an equal number of atoms of chlorine. We have known that oxygen sometimes comports itself in a similiar manner, and also, that in some bodies the hydrogen set free is not replaced by its equivalent of chlorine.

Two questions present themselves: 1°. Can we know *à priori*, whether the hydrogen set free, will or will not be replaced by its equivalent of chlorine, and how much of it may be liberated without substitution? 2°. What becomes of the chlorine in the new chloro-compounds; what function does it fulfil; of what nature are the compounds into which it enters, either by an equivalent, or a non-equivalent substitution?

These two questions are, we perceive, altogether independent of each other. We might discover the law presiding over substitutions, without knowing what takes place within the chloro-compounds, and *vice versâ.*

Dumas confined himself to the first question, and under the name of the theory of substitutions (he himself remarked that he ought to have said *law* of substitutions) he announced the two following propositions:

1°. *When we treat an organic substance by chlorine, bromine, iodine, or oxygen, these bodies generally set free hydrogen, and for one equivalent of hydrogen liberated, there is retained in the compound one equivalent of chlorine, bromine, iodine, or oxygen.*

2°. *If a part of the hydrogen of the organic substance exists in the state of water (as in alcohol), it will be set free by the chlorine or oxygen, without substitution.*

The law is precise, and void of ambiguity: I do not purpose to inquire whether or not it is correct (*vide* what I have said concerning chlorine and oxygen substitutions in this and the preceding chapter respectively). All that I have to say is, that I have not adopted this law, and that I have myself formulated certain propositions which are altogether different, and are applicable almost solely, to the hydrocarbons. I then have nothing whatever to claim in the above *law* of substitutions. It belongs entirely to Dumas.

With regard to the second question, Dumas never concerned himself with it, unless indeed, after I had done so. It is this subject that I have for a long time had in view in my researches (*vide* my opinion thereon in this chapter); it is in reference to it, that I have advanced the following proposition: *when there is* EQUIVALENT *substitution of chlorine or bromine for hydrogen, the chlorine actually takes the* PLACE *that was occupied by the hydrogen, and to a certain degree, fulfils the functions thereof, consequently the chloro-compound must be analogous with the compound from which it was derived.*

Thus there is but little analogy between my opinion, my propositions—and the law of Dumas. Here is the reply of this illustrious chemist to Berzelius, by whom he had been rendered somewhat responsible for my extravagances. 'Berzelius attributes to me, an opinion precisely contrary to that which I have always maintained, namely, that the chlorine in this case* takes THE PLACE of the hydrogen. I have never said anything of the kind, neither can anything of the kind be deduced from the opinions I have put forward with regard to this order of facts. To represent me as saying that hydrogen is replaced by chlorine, which fulfils the same functions, is to attribute to me an opinion against which I protest most strongly, as it is opposed to all that I have written upon these matters. The law of substitutions is an empiric law and nothing more; it expresses a relation between the hydrogen expelled, and the chlorine retained. I am not responsible for the gross exaggeration with which Laurent has invested my theory; his analyses moreover do not merit any confidence.'

Dumas and I made use of the same word substitution, from which circumstance arose much of the confusion that prevails on this subject. This confusion was still further augmented, by our employment of special terminations in *ase*, *ese*, and *ise*, &c., terminations *conceived by Dumas* as expressive of the relation between the number of hydrogen atoms liberated, and the number of other atoms retained, but *employed by me* to indicate that the chloro-compound *in the case of an equivalent substitution*, must still preserve the constitution of the original substance.

Thus Dumas represented the constitution of essence of canella by this formula: $C^{18}H^{14}O^{2}+H^{2}$; that of chloride of cinnamyl by this: $C^{18}H^{14}O^{2}+Cl^{2}$; and the *composition* of chlorocinnose (=the hydride—$4H^{2}+4Cl^{2}$) by $C^{18}H^{8}Cl^{8}O^{2}$, observing that he called the body *chlorocinnose provisonally*, inasmuch as he did not know how to represent its molecular constitution, nor with what body to compare it.

My opinion was very different. If I had considered essence of canella as forming a unique molecule $C^{18}H^{16}O^{2}$, and had named it cinnamyl, I should have called the

* "I had just made the chlorhydate of chloretherise, and an acetate of chloromethylene. I maintained that the first body had the same constitution as Dutch liquid, and that in the second, the atoms were disposed exactly as in the acetate of methylene. It was in reference to this opinion, that Berzelius chose to render Dumas responsible for my errors."

chloro-compound, *chlorocinnose.* If I had regarded the essence as a hydride $C^{18}H^{14}O^2+H^2$, I should have named the chloro-compound *chloride of chlorocinnise* $C^{18}H^8Cl^6O^2+Cl^2$; If I had considered the essence as a hydrate of cinnamyl $C^{18}H^{14}O+H^2O$, I should have called the chloro-compound *hydrate of chlorocinnose*, &c., &c.

Thus despite the similitude of the terminations, despite the same values ascribed to the same vowels by Dumas and myself, there is not any analogy between the ideas which these two nomenclatures represent, excepting, that they both express the quantity of hydrogen set free, and the quantity of chlorine fixed.

I will adduce the following examples, to show the absolute difference that exists between my opinion and that of Dumas.

Dumas represented alcohol by $C^4H^8+H^4O^2$, and acetic acid by $C^4H^6O^3+H^2O$ and nevertheless saw a case of substitution in the conversion of the first into the second:

$$\text{Alcohol}-2H^2+2O=\text{acetic acid}.$$

Since at that time, Dumas maintained that alcohol contained 2 atoms of water, while acetic acid contained only one, it is clear that in his law of substitutions, he considered only the ratio between the hydrogen liberated, and the chlorine or oxygen fixed, without pretending that the primitive and the derived body, belonged to the *same type.*

This is rendered still more evident by the following examples, which Dumas brought forward in support of his law:

$$\text{Alcohol} \quad -4\,H^2+4O=\text{formic acid},$$
$$\text{Acetic acid} \quad -2\,H^2+2O= \text{"} \quad \text{"}$$

It is certain that Dumas, notwithstanding the equivalent substitution, did not consider alcohol, acetic acid, and formic acid, as belonging to the same type.

It was some considerable time after this, when he had discovered the chloracetic acid, that he adopted my opinion concerning the functions of chlorine in substitution compounds, which view he extended so as include oxygen, although I had myself ceased to apply it to this last body."

We strongly recommend this valuable work to the attentive perusal of all interested in the higher departments of theoretical chemistry.

H. C.

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*A Treatise on Analytical Statics, with numerous examples.* By J. Todhunter, M. A., Fellow and Assistant Tutor of St. John's College, Cambridge. Cambridge: Macmillan & Co., 1853.

In a review of Mr. Todhunter's *Analytical Statics,* which appeared in a late number of the *Canadian Journal,** we pointed out what appeared to us a fallacy in Poisson's proof of the Parallelogram of Forces. Since that review was written we have discovered that the defect lies in a much smaller compass, and may be remedied in much fewer words, than we at first imagined: though Poisson's own wording certainly leaves his reasoning open to the objection laid against it.

We may remind our readers, that Poisson, in the first place, shews

* Ante, Reviews, No. 1, p. 63.

that if $2x$ be the angle between two equal forces, $P$, and $R$ their resultant, we may write

$$R = P f(x);$$

and that if $2z$ be the angle between another pair of equal forces, we shall have

$$f(x)\ f(z) = f(x+z) + f(x-z) \quad \ldots\ldots\ldots (1)$$

and it is from this functional equation that the solution of the problem is to be derived. He notices that the assumption $f(x) = 2\cos cx$ satisfies this equation, and asserts that it is the *only* solution: an assertion which is true only if it be understood that $c$ may be either a possible or an impossible quantity, and which, even with this modification his reasoning does not establish. What he does attempt to shew is this, that if the particular assumption $f(x) = 2\cos x$ is verified in two cases it must be true generally. That it is true when $x = 0$ is apparent from the equation itself by putting $z = 0$: an appeal to mechanical considerations shews that it is also true when $x = 60°$. The proof, then, to which we objected starts from these data: that equation (1) holds: that $f(0) = 2\cos(0)$, and $f(60°) = 2\cos 60°$: and from these data he professes to shew that $f(x)$ *must* be equal to $2\cos x$ for *every* value of $x$. We objected to this, that the very same reasoning might be employed to shew that $f(x)$ must be equal to $2\cos 5x$: and we inferred that the reasoning must therefore be defective, and that the defect could be remedied only by a fresh appeal to mechanical considerations. In effect it is not difficult to point out where this appeal becomes necessary. He first shews that if the relation $f(x) = 2\cos x$ is verified when $x=a$ it will also be true when $x$ is any multiple of $a$: he, then, has to shew that it will also be true when $x$ is equal to $a$ divided by any power of 2. This is *not* generally true: it is true in the particular problem we are solving: but as far as the data go this is not the case. In order to make the proof hold generally, it would be necessary to add the words, "provided that we know from independent sources that $f(\frac{a}{2^r})$ is of the same sign as $\cos \frac{a}{2^r}$". Thus starting with the known fact that $f(a) = 2\cos a$, he arrives at the equation

$$\left\{ f\left(\frac{a}{2}\right) \right\}^2 = 2\cos a + 2$$

whence he at once infers that

$$f\left(\frac{a}{2}\right) = 2\cos\frac{a}{2},$$

taking the upper sign in the ambiguity on extracting the root: in doing which *generally* he is obviously not justified; and the same remark will apply to all the succeeding steps, unless the additional condition which we have indicated be introduced. This condition really is introduced in the question before us, by mechanical considerations—by the assumption, in fact, that the direction of the resultant of two forces necessarily lies in the angle contained by the directions of the forces themselves. From this it will follow that so long as $x$ is not greater than 90°, $f(x)$ is positive: so that $a$ standing for 60°, it will follow that $f(\frac{a}{2^r})$ and $\cos(\frac{a}{2^r})$ being both necessarily positive will have the same sign. Thus for example we should get from the data

$$\left\{f(30^\circ)\right\}^2 = 4\cos^2 30$$

$$\text{or } f(30^\circ) = \pm 2\cos 30$$

and the mechanical considerations justify us in taking the upper sign. And it is easily seen that though it is true that $f(60^\circ) = 2\cos(5\times 60^\circ)$, yet when the additional mechanical considerations are taken in, the above proof will *not* serve to shew generally that $f(x) = 2\cos 5x$. In fact, if these considerations are fairly introduced, the proof becomes perfectly unexceptionable.

G. C. I.

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NOTE ON

*Poisson's Proof of the Parallelogram of Forces.**

The general functional equation, from which Poisson obtains his solution by an indirect process, may be treated *directly* as follows:

The equation is

$$f(x)f(z) = f(x+z) + f(x-z).$$

If we expand in ascending powers of $z$, by Maclaurin and Taylor's theorems, we obtain

$$f(x)\left\{f(0) + f'(0)z + f''(0)\frac{z^2}{1.2} + \dots\dots\right\}$$

$$= 2f(x) + 2f''(x)\frac{z^2}{1.2} + \dots\dots$$

Equating corresponding coefficients of $z$, we have

$$f(x)f(0) = 2f(x);$$

which is satisfied either by $f(x) = 0$, or $f(0) = 2$.

Confining our attention at present to the latter solution only, and proceeding to equate coefficients, we find $f'(0) = 0$, and all the succeeding derivatives of an odd order also vanish. Also we have

$$2f''(x) = f''(0)f(x);$$

* Vide No. 1, Reviews, "*A Treatise on Analytical Statics*," &c., *ante*, p. 63.

and by further proceeding we shall only obtain the same result as by integrating this equation at once. Writing, then, $2c^2$ for $f''(0)$, being any arbitrary constant, real or imaginary, we have

$$f''(x) - c^2 f(x) = 0,$$

the known integral of which is

$$f(x) = a\epsilon^{cx} + b\epsilon^{-cx}.$$

To determine $a$ and $b$, we have

$$2 = f(0) = a + b$$
$$0 = f'(0) = a - b$$

and therefore $a = 1$, $b = 1$, and

$$f(x) = \epsilon^{cx} + \epsilon^{-cx}.$$

Combining this with our former solution $f(x) = 0$, we have for the complete solution,

$$f(x) = \tfrac{1}{2}\left\{ 1 + (-1)^n \right\} (\epsilon^{cx} + \epsilon^{-cx}).$$

where $n$ is an integer, and $c$ any real or imaginary constant. Of this there are four, and only four, forms which make $f(x)$ real, namely,

(1), $n$ odd,...... $f(x) = 0$;

(2), $n$ even, $c = 0$,...... $f(x) = 2$;

(3), ........ $c$ real,...... $f(x) = \epsilon^{cx} + \epsilon^{-cx}$,

(4), ........ $c$ an imaginary of the form $c\sqrt{-1}$ by which we may replace it...... $f(x) = 2 \cos cx$; and from these we have to select by mechanical considerations the particular one which belongs to the case proposed. Now (1) and (2) are plainly inadmissible, and so also is (3) since it makes $f(x)$ increase indefinitely with $x$; hence (4) is the one to be selected. To determine the value of $c$, we observe that $f(x)$, by the mechanical axiom, is always positive between $x = 0$ and $x = \frac{\pi}{2}$; therefore $\cos cx$ must be always positive between these limits, and $c$ cannot therefore be greater than 1. Also $\cos \frac{c\pi}{2} = 0$, for the resultant vanishes when $x = \frac{\pi}{2}$, hence we must have $c = 1$, and our required solution is $f(x) = 2 \cos x$.

J. B. C.

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*The Pilgrimage, and other Poems.* By the Earl of Ellesmere. *With Illustrations.* London: Murray, 1856.

We are tempted to notice this handsomely illustrated addition to those literary productions of "Royal and Noble Authors," catalogued by the Earl of Orford in 1758, mainly by a special mark of distinction it has received from an American critic, which we are disposed to regard as a curiosity in the way of Republican criticism! The New York *Monthly Trade Gazette* for April thus prefaces a borrowed notice, under the heading A 'NOBLE' POET. "The London *Literary Gazette* reviews a recent volume of poems from the pen of the Earl of Ellesmere—*or perhaps from that of his Secretary, as is more likely;* English noblemen having frequently been detected in trickery of that kind. The *Gazette*, however, appears to receive the work as the genuine offspring of the Earl—although the artful manner in which it qualifies its opinion in the second sentence would seem to leave a doubt on this head;* as if it meant by damning the work with qualifying praise to leave a loop-hole through which to escape the charge of having been caught, in case one of less noble (!) blood should yet be found to be the father of the work. Those who are acquainted with the reprehensible practices of English noblemen in this respect, and the servile character of English critics, will need no explanation of this paragraph."

This, it must be owned, is a very pretty little sample of literary criticism, adapted to the latitude of New York; where, it is plain, whatever other republicanisms may be in vogue, there is to be no Republic of Letters tolerated. The rank taken by Francis Leveson Gower is not among the foremost in the literary guild, literature having manifestly been with him only a pleasant pastime,—but his name is no novelty among the authors of England, and this discovery of the anonymous Secretary, of "less noble blood," stowed away in some secret garret of Bridgewater House to manufacture verse for him, should be looked after for the next edition of the "Curiosities of Literature." The present edition of Lord Ellesmere's poems introduces to the reader various new pieces including "Blue Beard," a burlesque tragedy, published for the first time, though not unknown by repute. The verse is generally characterized by a pleasant gracefulness and elegance, though certainly exhibiting no such unwonted force, or striking originality, as to suggest to ordinary minds the impossibility of an Earl being capable of the feat, without having recourse to those "reprehensible practices of English noblemen," so cleverly detected by the Broadway critic.

A stanza or two will suffice to give some idea of the Earl's poetical powers. "The Pilgrimage," from which the main title of the volume is derived, as well as others of the author's larger poems, are written in

* "Lord Ellesmere's poems deserve republication in the handsome form in which they appear in this illustrated edition. Correct taste and good feeling are charcteristic of his writings, compensating largely for the want of striking originality or unusual power in his poetry."—*Literary Gazette.*

the same stanza as "Childe Harold," but they will not otherwise stand comparison with the work of that noble poet, whose "Hours of Idleness," were criticised to such good purpose by the "Scotch Reviewers." An extract or two from the Edinburgh article for January 1808, we should have thought would better have answered our New York critic's purpose—with only a very slight adaptation,—than the "servile" article he borrowed from the London *Gazette*. "He certainly," says the older Reviewer, in reference to the presumptuous lordling then taken to task, "does allude frequently to his family and ancestors—sometimes in poetry, sometimes in notes; and while giving up his claim on the score of rank, takes care to remember us of Dr. Johnson's saying, that 'when a nobleman appears as an author his merit should be handsomely acknowledged.'" And then how much better would the following passage, from the same anti-aristocratic Reviewer's pen, have served as an introduction to the Earl's stanzas than the faint praise of English critics. Who knows but it might have provoked the Earl into setting that invaluable anonymous Secretarial genius of his to work on an ENGLISH BARDS AND YANKEE REVIEWERS! "We must beg leave seriously to assure Lord [Ellesmere] that the mere rhyming of the final syllable, even when accompanied by the presence of a certain number of feet,—nay although (which does not always happen) those feet should scan gularly, and have been all counted accurately on the fingers,—is not the whole art of poetry. We would entreat him to believe that a certain portion of liveliness, somewhat of fancy, is necessary to constitute a poem, and that a poem of fancy in the present day, to be read, must contain at least one thought, either in a little degree different from the ideas of former writers, or differently expressed. We put it to his candour, whether there is anything so deserving the name of poetry in verses like the following:"—and here should follow the sample of stanzas, which, however, we take not from the volume under review,—if indeed ours be not rather the review of a review,—but from a popular selection, culled years ago, as pieces, by various authors, worthy of special note, and before the writer of these pleasing reminiscences of his own Arabian Nights' Entertainments which "The Pilgrimage" supplies, had gone the unpardonable length of becoming an Earl!

Round yonder watch-fire's blaze the muleteers
In circle close.—The leader of the throng,
Fluent and fast, to never sated ears
The tale recites, or chants the Arab song,—
Wild stanzas, strange adventures. Loud and long

The applause resounds, as each invented sleight
Of magic art, or fate of Afrite strong
By Genii quelled in preternatural fight,
Fills, as the story rolls, each breast with fresh delight.

He little thinks, the tale he loves to tell,
Which cheats his willing comrades of their rest,
Through many a midnight hour defrauds as well,
In foreign garb and other language dressed,
Of slumber's boon the children of the West;
How many a sad or vacant mind, the page,
With the same legendary lore impressed,
Has cheered, assuaged life's ills through every stage,
Given youth one smile the more, one wrinkle snatched from age.

For not alone beneath the palm-tree's shade
Amid the nargilé's ascending cloud,
Does Eastern fiction dwell, or Scherezade
Dispense her favours to the listening crowd.
All ranks, all nations at her shrine have bowed;
The pictured forms her lively pencil drew
Please in all climes alike; and statesmen proud
In grave debate have owned her lessons true,
Finding that ancient lamps sometimes excel the new.

Far other task meanwhile for me delays
The needful gift of well-earned sleep's repose;
The beam that from my tremulous crescent plays,
Its light upon the sacred volume throws.
Oh! who in distant climes the rapture knows,
E'en on the spot of which the tale is told,
To mark where Tabor frowns or Jordan flows.
To feel at morn our steps shall print the mould,
Where Gideon pitched his camp or Sisera's chariot rolled!

Such rapture ours, when, on Esdraelon's plain,
Tabor in front and Jezreel left behind,
By Kishon's source we pitched. Oh! ne'er again
Shall joys, of power like these to fill the mind,
Rise in the civilized haunts of human kind.
How went I forth to watch the shivering ray
On Carmel's crest; to hear upon the wind
The jackal's howl; or rippling sounds betray
Where Kishon's ancient stream rolled on to Acre's bay.

How, to our tents when morning's moisture clung,
Our memory turned to that oracular dew
From the full fleece which pious Gideon wrung!
'Twas here perchance that Israel's champion knew
The sign which spoke his high commission true;
Down yonder vale perhaps, by Kishon's ford,

On towards the slumbering heathen's camp he drew
His chosen hundreds, silent—till the sword
Flashed to the frightened skies, of Gideon and the Lord.

From a piece entitled the "Military Execution," which appears, we believe, for the first time, in this new edition of Lord Ellesmere's poems, we select the concluding stanzas as all that our space will allow us to cull from a volume, which will form no discreditable addition to the works of the Royal and Noble Authors of England:

His kindred are not near
The fatal knell to hear,
They can but weep the deed when 'tis done;
They would shriek, and wail, and pray:
It's well for him to-day
That his friends are far away—
All but one.

Yes, in his mute despair,
The faithful hound is there,
He has reached his master's side with a spring;
To the hand which reared and fed,
Till its ebbing pulse has fled,
Till that hand is cold and dead,
He will cling.

What art, or lure, or wile,
That one can now beguile
From the side of his master and friend?
He has gnawed his cord in twain;
To the arm which strives in vain
To repel him, he will strain,
To the end.

The tear drop who can blame?
Though it dim the veteran's aim,
And each breast along the line heave the sigh.
But 'twere cruel now to save;
And together in that grave,
The faithful and the brave,
Let them lie.

Few, we think, will deny that there are traits of force and pathos in these lines; and others of like character—though with more of grace and refinement of thought than any strongly marked individual characteristic or striking originality,—are to be found scattered through the volume, to which the noble author, in imitation of Rogers, has striven to give additional attraction and value by the supplementary aid of artistic illustration.

D. W.

# SCIENTIFIC AND LITERARY NOTES.

## GEOLOGY AND MINERALOGY.

### THE WOLLASTON MEDAL.

At the Aniversary meeting of the Geological Society of London on the 17th of last February, the president, Mr. Hamilton, placed the Wollaston medal in the hands of Sir Roderick Murchison for transmission to our provincial geologist, Sir W. E. Logan. This additional honor, the highest in the power of the Geological Society to confer, must be gratifying to all who wish well to Canada. We are glad to learn that, in accordance with the principles embodied in Mr. Langton's late report, sufficient means will now be placed at Sir William Logan's disposal, to enable him to carry on our Canadian survey with undiminished success. The projected palæontological publications under the partial superintendance of Professor James Hall, whose assistance in this department, Sir William has been so fortunate as to secure, will add still more, if possible, to the reputation already acquired by the Survey in European circles.

### ORIGIN OF THE CARBONATE OF IRON OF THE COAL MEASURES.

At a late meeting of the Boston Society of Natural History, Prof. W. B. Rogers communicated some interesting observations on the probable origin of the ironstone bands and nodules of the coal measures. Assuming that the actual amount of iron in a given thickness of the coal-bearing rocks is not in excess of that present in an equal thickness of the permian or other sandstone strata, Professor Rogers adopts the conclusion, that the originally diffused sesquioxide of iron was converted into the proto-carbonate by the conjoint action of carburetted hydrogen and carbonic acid evolved from the intermixed vegetable matters. And, secondly, that by solution in percolating waters charged with this carbonic acid, the process of segregation into bands and nodules, or the deposition of the ironstone above impermeable layers, was more or less readily effected.

### FOSSIL MUSK OX.

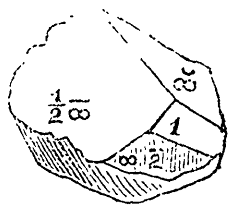
The existing musk ox—*Bos* or *Bubalus moschatus*—it is well known, is a denizen of the inhospitable regions of our American continent, north of the parallel 60°. Fossil remains of this species occur however in the Post-tertiaries of various parts of Europe, and in Siberia. A well characterised cranium, the first British example, was discovered at the close of last year in a gravel bed at Maidenhead in Berkshire, England. Professor Owen in describing the fossil specimen at a meeting of the Geological Society, first offered his reasons for regarding the so-called musk-ox, as having been unnecessarily separated from the buffaloes, and then gave an account of the few fossil skulls of the musk-buffalo yet known—viz, those figured by Pallas, Ozeretskowsky, and Cuvier. A comparison was then made of the fossil remains with recent crania; and, although the skulls somewhat differ in a few points, especially in the relative curvatures of the horn-cores, yet the author was led to conclude that, as far the materials for comparison at his command would serve, the differences between the fossil and recent musk buffaloes are not of specific value; that the *Bubalus moschatus* of the Arctic regions, with its now restricted range, is the slightly modified descendant of the old companion of the mammoth and the Tichorine rhinoceros, which, with them enjoyed a much wider range, both in latitude and longitude, over lands that now form three divisions or continents of the northern hemisphere; and that the circumstances which have brought about the probably gradual extinction of the northern rhinoceros and elephant, have not yet effected that of the contemporary species of Arctic buffalo.

### GRAPHITE IN METEORIC STONES.

An analysis of the meteorites which fell at Mezœ-madaras in Transylvania on the 24th of September 1852, has been communicated to the Philosophical Magazine by Professor Wœhler and Dr. Atkinson. The analysis shews the presence of nickeliferous iron ( Ni 7·4, and Co 0·25 p.c. ) iron pyrites, chrome-iron, schreibersite? olivine, augite, labradorite, and graphite. The latter is of some interest; for although previously announced, and on more than one occasion, the presence of graphite in meteoric stones has been held in doubt by many observers.

### WOLFRAM.

The accompanying figure represents a crystallized specimen of Wolfram—(FeO, MnO) $WO^3$—discovered by the writer in a boulder on the west shore of "Chief's Island," Lake Couchiching, Canada West. The mass of the boulder consisted of gneiss, traversed by a vein of coarse granite, with red orthoclase, in which the specimen was found. Magnetic oxide of iron, in small granular pieces, was also present in the boulder.




Our specimen exhibits the same peculiarity of structure as that observable in the Schemnitz and other crystals. Apart from the proper cleavage directions, it may be readily subdivided parallel to the various planes. The plane 1 is a face of the fundamental octahedron; $\frac{1}{2}\bar{\infty}$, a face of the commonly-occurring macrodome; $\breve{\infty}$, one of the common brachydome; and $\infty\bar{2}$, a face of the prism (or vertical) series, exhibiting the usual striæ. Although the edges between these planes are sharply cut, and the planes themselves exceedingly bright, yet, owing to surface inequalities, no well-defined reflection is obtainable, and hence the measured angles are merely approximative. The following are the means of several measurements, taken under different conditions: $\frac{1}{2}\bar{\infty} : \breve{\infty} = 132° 40'$; $\frac{1}{2}\bar{\infty} : 1 = 148° 16'$; $\breve{\infty} : 1 = 142° 22'$; $\frac{1}{2}\bar{\infty} : \infty\bar{2} = 117° 6'$; $\breve{\infty} : \infty\bar{2} = 104° 24'$; $1 : \infty\bar{2}$ 143° 18'.

Kerndt gives the following values for the ratios of the axes in Wolfram: $a : \bar{a} : \breve{a} = 0·8659 : 1 : 0·8134$; with $\infty : \quad = 101° 45'$, and $\breve{\infty} : \breve{\infty}$ (over the summit) consequently, 98° 13' 17". If the angles of our specimen be calculated from these values as a basis, we obtain the results exhibited in the following table.*

$$\frac{1}{2}\bar{\infty} : \breve{\infty} = 131° 52' 10''$$

$$\frac{1}{2}\bar{\infty} : 1 = 149° 20' 30''$$

$$\breve{\infty} : 1 = 141° 10' 30''$$

$$\frac{1}{2}\bar{\infty} : \infty\bar{2} = 115° 48'$$

$$\breve{\infty} : \infty\bar{2} = 104° 16' 40''$$

Briethaupt subdivides Wolfram into two species: mangano-wolframit and ferro-wolframit. The first has a reddish-brown streak, with G = 6.98–7.17, and the formula 2 ($FeO, WO^3$) + 3 ($MnO, WO^3$). The second exhibits a blackish-brown streak, with stronger metallic lustre, and G = 7.3 – 7.5. Its formula shews: 4 ($FeO, WO^3$)+$MnO, WO^3$. Our specimen* is of the first kind. Breithaupt's angles for $\infty : \infty$ and $\breve{\infty} : \breve{\infty}$, differ considerably from both those of Gustav Rose and Kerndt; and the measurements given above tend to confirm these variations. Descloizeaux also, it must be remembered, obtained still other results, indicating seemingly a monoclinic crystallization. The character of the twin-crystals of Wolfram, however, (as pointed out by Naumann) and its relations to Tantalite (see Dana's Min. 4th edit. ii, 351, for angles), are opposed to this latter view.

Our specimen exhibits the following blowpipe reactions:—*Per se*, it fuses easily, and without intumescence or bubbling, into a dull iron-grey globule, the surface of which is scoriaceous rather than crystalline. The globule is not attractable by the magnet.

It dissolves readily in borax, producing before the OF a dark amethystine glass. Quickly cooled, after exposure to the R F, the glass is yellow. With a sufficient quantity of the assay, the surface of the bead may be enamelled (or rendered milk-white) by the flaming process.

It dissolves also readily in salt of phosphorus. A very small quantity renders the bead opaque, but no effect is produced by flaming.

With carbonate of soda, effervescence takes place, but a very small portion of the assay dissolves, so that no striking manganese reaction is produced. If, however, a minute quantity of borax be added, the greenish-blue enamel is at once obtained. On cooling, the fused mass shoots into crystals.

E. J. C.

## CHEMISTRY.

### NITRIC ACID.

Cavendish proved that nitrogen can be made to unite directly with oxygen by means of the electric spark, if the two gases be moist, and especially if an alkali be present, when a nitrate is formed. In other words, ozone (modified oxygen) is capable of uniting with nitrogen to form nitric acid. Houzeau shewed that nascent oxygen, from peroxide of barium and sulphuric acid, is capable of oxidizing ammonia, and of separating chlorine and iodine from its combinations behaving exactly like ozone. Cloez has shown that the oxygen and nitrogen of the air can be made to combine by the influence of porous bodies.

S. de Luca has obtained nitrate of potassa by passing moist ozonized air over potassium or potassa for several months. It appeared from some experiments, which require confirmation, that this change takes place more readily during the winter and at night than in summer and in the day time.

### PHOSPHORUS.

E. Mitscherlich recommends the following process for the detection of phosphorus in cases of poisoning. The substance to be tested is mixed with sulphuric acid and water and distilled, the vapours are passed through a gas-tube into a vertical cooling tube which is kept cold by passing through a vessel of water. If phosphorus be present, its vapours pass over with the water and produce a luminous

* These calculated angles may be of use to the student in the determination of broken or incomplete crystals. They are not given in any work—English, French, or German—within the writer's knowledge.—E. J. C.

appearance (visible in the dark) at the point where they enter the cooled part of the tube. This luminosity may be observed even when the mixture has been exposed to the air for a long time, one part in one hundred thousand of flour can be readily detected. The liquid which condenses contains small globules of phosphorus; one-third of a grain was detected thus in five ounces of material. When much phosphorus is present, phosphorous and phosphoric acids may be detected in the distillate, which is not the case if the acids themselves are subjected to distillation with sulphuric acid.

### SILICA.

Ludwig has shown that hydrated silica, precipitated from its solution in potash by chloride of ammonium, obstinately retains traces of ammonia and potash, and is soluble in 10,000 parts of water. Also that by treatment of the silicate of potash with hydrochloric acid in excess, the whole of the alkali cannot be removed, but a portion remains, probably as an acid silicate. This even after calcination is somewhat soluble in water, in the proportion of one part of silica to 25,000 parts of water.

### SILICIUM.

Wohler prepares silicium by fusing aluminum with an excess of the double fluoride of silicium and potassium in an ordinary crucible at a heat about that required for the fusion of silver. On breaking there is found in the midst of the fused salt a very brittle ingot of crystalline texture and dark iron colour. This appears to be the compound of silicium and aluminum observed by Deville, containing in this case a very large quantity of silicium in the state of graphite. According to the length of fusion it contains from 75 to 80 of silicium, which is easily obtained by treating the ingot with hydrochloric acid.

Deville has obtained silicium in measurable crystals by passing the vapour of chloride of silicium over aluminum heated to bright redness; the crystals thus formed are treated successively with nitro-hydrochloric acid, boiling hydrochloric acid, and fused bisulphate of soda. When the operation is not complete, siliciuret of aluminum is formed, containing 40 to 50 per cent. of silicium. In this operation the silicium being separated from the chloride is dissolved in the aluminum forming a solution, which when saturated allows the silicium to separate. It appears that boron may be obtained in the same manner, but is very difficult to purify. Carbon, not being soluble in aluminum, cannot be obtained in this way, but if pig iron be employed instead of aluminum the carbon is obtained in a form differing from graphite.

If fluoride of silicium be employed instead of chloride, beautiful crystals of fluoride of aluminum are obtained, having much resemblance to fluor spar. They are not acted upon by sulphuric, hydrofluoric or nitrofluoric acids; the same crystals can be obtained by treating calcined alumina with excess of hydrofluoric acid and heating to whiteness in a tube of platinum in a current of hydrogen.

### SALT OF COBALT.

A. Stromeyer finds that the yellow salt obtained by Fisher on mixing a salt of cobalt with nitrite of potash, has not the formula given by St. Evre but the following: $Co^2 O^3$, $2NO^3 + 3KO\ NO^3 + 2HO$. Its formation may be employed as a test for cobalt if not more than 300 parts of water be present to 1 part of Co O.

A triple salt is formed when lead is present. Stromeyer forms the nitrite of potash by fusing 101 parts of nitre in an iron pan and adding 208 parts of lead, constantly stirring. A yellow powder is soon formed, and the heat is raised to redness. Dissolve in water, precipitate oxide of lead by carbonic acid or by sulphuret of ammonium, evaporate, fuse, and redissolve.

### ANTIMONIAL VERMILION.

Mathieu-Plessy has obtained a sulphide of antimony rivalling vermilion in its colour, by the action of a solution of hyposulphite of soda upon chloride of antimony, aided by heat.

### SULPHATE OF SODA.

Marguerite prepares this salt by heating sulphate of lead with chloride of sodium, sulphate of soda and chloride of lead are formed, which latter is evaporated by the heat and condensed in a cooling apparatus. On being triturated and kept suspended in a solution of sulphate of magnesia or other soluble sulphate, it is reconverted into sulphate of lead; this can be effected with very little loss, and the original quantity of sulphate can be made to convert a large amount of the chloride of sodium.

Processes are also described for obtaining caustic soda and its carbonate directly from common salt, and sulpuric acid from sulphate of lime and other sulphates; but the methods do not appear to be very available.

### CHEMICAL AFFINITY, ETC.

Calvert has shown that sulphate of baryta is not so insoluble in nitric acid as was supposed, its solubility being affected in a much higher degree by the bulk of the acid than by its strength, and that its non-formation in a mixture is influenced not only by the respective bulks of an acid of specific gravity 1.167, and the respective quality of salts employed, but that the relative quantity of matter put in presence has a decided influence on chemical affinity. These observations are of considerable importance as affecting quantitative determinations of baryta and sulphuric acid.

### URANIUM.

Peligot has obtained this metal by acting on the proto-chloride with sodium or aluminum; it resembles nickel or iron in colour, acquires a yellowish tint from partial oxidation, burns brilliantly when heated, forming a black oxide, and possesses the remarkably high specific gravity of 18.4.

### SANGUINARINE.

The principle contained in the Sanguinaria Canadensis has been supposed to be identical with Chelerythrine obtained from Chelidonium majus. The identity has been proved by Dr. Shiel.

### HŒMATOIDINE.

Hœmatozine, the red colouring matter of the blood globules, is uncrystallizable, but when blood is effused into the tissues of an organism, microscopic crystals are formed in from four to twenty days; these were called Hœmatoidine by Virchow in 1847. (See Lehmann's Chemistry and Funke's supplementary plates, in publications of Cavendish Society.) M. Robin obtained three grammes of this substance in a crystalline form from a cyst of the liver. Its properties were investigated and its composition determined to be the same as Hœmatozine, with the substitution of one equivalent of water for the one equivalent of iron.

PHLORETINE.

Hlasiwetz has resolved this body by the action of potash, into *phloretic acid* and *phloroglucine*. a compound much resembling orcine. (See Chemical Gazette No. 321.)

ACETATE OF MAGNESIA.

Karl von Hauer has prepared this salt in a crystallized form although generally described as amorphous, and gives the formula Mg O, $\overline{Ac}$+4 H O. The salt loses 32.73 per cent of water after long heating. The formula requires 32.29. [In my note-book I find an (unpublished) analysis of a commercial crystallized acetate of magnesia, made in 1839 in Rammelsberg's laboratory.

| | | |
|---|---|---|
| The salt consisted of | Acetate of Magnesia ...................... | . 64.77 |
| | Acetate of Potassa.......................... | 2.65 |
| | Water and loss.............................. | 32.58 |
| | | 100.00, |

from which I deduced the same formula as Von Hauer. H. C.

NAPHTHALAMINE.

W. H. Perkin has examined the action of chloride of cyanogen upon naphthalamine (naphthalidine,) and has obtained a base analogous to melaniline, and various compounds resulting from the action of cyanogen upon it, similar to those derived from aniline.

NITHIALDINE.

Arppe has obtained a body having the formula $C^{12}H^{8}N^{2}S^{4}O$ by the action of sulphuretted hydrogen upon a solution of nitraniline saturated with ammonia; hyposulphite of ammonia is formed at the same time. Nithialdine does not seem to possess either basic or acid properties.

CAFFEINE.

Puccetti prepares caffeine from the inspissated extract of tea, by adding to the extract 2 oz. of finely powdered pearlash for every pound of tea. the mixture is well stirred, and when effervescence is over, is either dried into cakes, powdered, or is at once treated with alcohol for several days, the alcohol being often renewed; on evaporation a caffeine is obtained which can be readily purified by means of animal charcoal. In this manner he obtained 2.55 per cent. from Congou tea.

ANILIDES.

Arppe has examined the anilides of malic acid: the malanilide is converted by potash into tartanilide.

STIBAMYLE.

F. Berlé has examined the products of the action of potassium-antimony $Sb^{2}K$, upon iodide of amyle. He has prepared Stibtriamyle, Sb, $(C^{10}H^{11})^{3}$, its oxide, chloride, bromide, iodide, with two equivalents of oxygen, &c., and the compounds of nitric and sulphuric acids with the oxide, these bodies containing two equivalents of the acid. Several other compounds have also been obtained, resulting apparently from Stibbiamyle.

TAURINE.

Dr. A. Cloetta has found Inosite, uric acid, taurine, and leucine in the tissue of the lungs; Verdeil's Pulmonic acid seems to have been nothing but taurine.

### ACETYLE.

H. Ritter prepares the protochloride of acetyle by acting upon glacial acetic acid with perchloride of phosphorus, the proto-bromide is obtained in the same way; during its formation a quantity of oxy-bromide of phosphorus is generated, which can be separated in a pure state. Gladstone's oxy-bromide was not pure. It is crystalline fuses at 113°F, boils at 383°F, spec. grav.=2,822.

### ALCOHOL VAPOURS.

Reinsch has observed that a spiral of copper wire fastened on to the wick of a spirit lamp, remains incandescent for two or three minutes after the flame has been extinguished. If a small piece of coke be placed in the spiral, the incandescence continues, and if the coke be removed the wire still continues to glow having apparently acquired some peculiar property by contact with the coke.

### ALLOXANIC ACID.

Staedeler prepares the lime salt by saturating the mother liquor from the preparation of alloxan with chalk, crystals are formed which may be readily separated from the excess of chalk by suspension. It is advisable to use a considerable excess of chalk, and to purify the crystals by solution in boiling water, &c. The acid can be obtained from the lead salt.

### METHYLOTETRASULPHURIC ACID.

By the action of fuming sulphuric acid on acetonitryle, Buckton and Hoffmann have obtained sulphacetic acid and a new body to which they have given the above name. Its composition is $C^2H^4$, 4 $SO^3$; in the salts $H^2$ are replaced by $M^2$.

### NEW METALLIC ALLOY.

Mr. François Joseph Auger has invented a new alloy, which is remarkable in its resemblance to gold, not changing colour by use, and being dense, malleable, ductile, homogeneous, and sonorous to a marked degree. The following is his process: In a crucible the patentee first melts 100 parts of good copper, to which, whilst in a state of perfect fusion, he adds 17 parts of zinc, 6 parts of magnesite or substance of a like nature, though possibly differing in name, 3.60 parts of ammonia or salts of ammonia, 1.80 parts of quicklime or other calx, and nine parts of crude tartar. The crucible is covered, and the whole is made to come to a complete state of fusion, when the metal may be be poured into moulds, or made into ingots. According to the ductility or shade of colour which may be desired in the metal, the proportions of the zinc and other added substances are varied. Tin may be substituted for zinc if the metal is sought to be more tenacious in character.

### IMPROVED APPARATUS FOR PURIFYING AND CARBONISING GAS.

Mr. S. Rowlands, of Birmingham, has taken out a patent for a new mode of treating gas, consisting of a vessel or chamber, through which gas is made to pass, and brought into contact with a large surface of the liquid to the action of which it is intended to be subjected. In this chamber is a float of cork, or other light material, having a spiral channel, which gives it a slow rotary motion. When it is wished to impregnate coal gas with the vapour of naptha, the vessel is partly filled with the liquid, which is kept in a state of agitation by the rotation of the float as it sinks. Other carbonaceous fluids may be employed with like effect.

H. C.

# MATHEMATICS AND NATURAL PHILOSOPHY.

## NEW PLANET.

A new planet, of great brilliancy has been recently discovered by M. Chacornac, of the Paris Observatory.

## THE COMET OF 1856.

M. Rabinet, an eminent French astronomer, and member of the Academy of Sciences, in an article recently published, has given some interesting details respecting the comet which is expected to make its appearance about the year 1856:— "This comet is one of the grandest of which historians make mention. It was seen in the years 104, 392, 683, 975, 1264, and the last time in 1556. Astronomers agreed in predicting its return in 1848, but it failed to appear. Already the observatories began to be alarmed for the fate of the beautiful wandering star. Sir John himself had put a crape upon his telescope, when a learned calculator of Middleburg, M. Bomme, reassured the astronomical world of the continued existence of the venerable and magnificent comet. Disquieted, as all other astronomers were, by the non-arrival of the comet at the expected time, M. Bomme, aided by the preparatory labors of Mr. Hind, has revised all the calculations, and estimated all the actions of all the planets upon the comet for three hundred years of revolution,— the result of this patient labor gives the arrival of the comet in August, 1858, with an uncertainty of two years, more or less; so that from 1856 to 1860 we may expect the great comet which was affirmed to be the cause of the abdication of the Emperor Charles V., in 1556."

## COLORS SEEN THROUGH THE STEREOSCOPE.

At a recent meeting of the Manchester Photographic Society, Mr. Dancer read an interesting paper on the stereoscope and its application to photography. A practical discussion followed, in the course of which Mr. Sidebotham drew attention to the results produced by looking at two different colors through the stereoscope. Blue and yellow, he said, produced (to his sight) green; red and green produced a dirty white; a blue spot and red bars produced purple bars and white; and the two colors that seemed most readily to combine were blue and red, producing a bright purple. Blue and yellow did not form a good green in the first instance, and required looking at a short time.—Mr. Dancer said that to some persons' sights different colours combined more easily than to other persons', to whom each colour seemed to predominate alternately; and the eye, he thought required some education, as it was only by looking steadily that the colours were re-composed and the result seen.—In one instance, Mr. Sidebotham stated that bars of different colors produced a check of one colour, the other being entirely lost; and the solution of this singularity, it was suggested, might be arrived at by throwing the prismatic colors upon paper.

## AMERICAN TELESCOPE.

The Telescope recently procured for the Observatory at Ann Arbor, Michigan, is the third in size in the world. The object glass is thirteen inches in diameter Few persons have a correct idea of the time, the toil and the skill requisite to prepare one of these glasses. First, there are the manufactures of the rough disks. A mass of glass weighing about 800 lbs. is melted together. When in a state of perfect fusion, the furnace is walled up, and the whole is left to cool gradually. The cooling process occupies some two months. By this process the glass is annealed.

Afterwards the furnace walls are removed. The entire mass is then fractured, the manner of doing this is a secret with the manufacturers; but it is accomplished in such a way that every piece is homogeneous in refractive power. The pieces are next softened by heat and pressed into moulds, giving disks of different sizes. The telescope-makers purchase these and grind them into the required thickness and lens form. Two separate disks, one of crown, and the other of flint glass, are necessary to form an object glass. One of these is concave, the other convex. It is by the union of the two that the object glass is made achromatic. The grinding is a slow and most difficult process as the utmost exactitude must be attained. First the edge is ground to enable the maker to see whether the glass is clear and without air bubbles. It not unfrequently happens that many disks have to be rejected. When a very superior glass is finished, it is of great value. The twelve-inch of the Cincinnati Observatory alone cost $6,000.—*Chicago Journal.*

## CANADIAN INSTITUTE.

SESSION 1855-56.

FOURTH ORDINARY MEETING—*Saturday, 19th January,* 1856.

Professor BOVELL, M. D., Vice President, in the Chair.

*The following gentlemen were elected Members:*

VISCOUNT BURY, Toronto.
ALFRED ROACH, Esq., Toronto.
GEORGE DESBARATS, Esq., Toronto.
CAPT. ALEXANDER CREE MEIK, Toronto.
JOHN SHAW, Esq., Toronto.
JAMES FISKIN, Esq., Toronto.

*Junior Members:*

Mr. CLARENCE MOBERLY, Toronto.
Mr. C. W. PATTERSON, Toronto.

On the motion of Professor Wilson, seconded by Sanford Fleming, Esq., it was resolved:

That the Canadian Institute knowing the persevering and valuable efforts which have been made by its first President, W. E. Logan, Esq., to bring the Geological resources of the country prominently forward, and observing with much satisfaction the honorable position in which Canada has been placed in England, and more recently in Paris, in a great measure through his endeavors: it is the opinion of this Institute that some acknowledgment of Mr. Logan's valuable services is richly due to him—and with that view it is resolved that the following gentlemen constitute a Special Committee to report at the next meeting, on the best manner in which the object should be carried out:—Messrs. G. W. Allan, F. W. Cumberland, and S. Fleming.

The donation was announced from the Hon. J. M Brodhead, Washington, of the "United States Astronomical Expedition," vols. 1 and 2, quarto; and the thanks of the Institute were voted to the Donor.

*The following Papers were read:*

1. By the Rev. Professor Young, M. A., "Examination of Professor Ferrier's Theory of Knowing and Being."

2. By Professor Hind, M. A., "Communication from Major Lachlan, relative to a simultaneous system of meteorological observations throughout the Province, including a letter on the subject from Professor Henry, Secretary of the Smithsonian Institute."

On the motion of F. W. Cumberland, Esq., seconded by T. Henning, Esq., it was resolved:

That the communication of Major Lachlan be referred to the Editing Committee, with the request that if the same be published in the Journal, it may be accompanied by an explanatory statement of the present position of the subject in Canada, and the action hitherto taken in the matter by this Institute.

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FIFTH ORDINARY MEETING—*26th January*, 1856.

G. W. ALLAN, Esq., President, in the Chair.

*The following Gentlemen were elected Members:*

GEORGE RYEBURN, Esq., Toronto.
F. W. JARVIS, Esq., Toronto.
I. F. TAYLOR, Jun., Esq., Toronto.

*The following Donations were announced, and the thanks of the Institute voted to the Donors:*

1. From George W. Moneypenny, Esq., Commissioner of Indian Affairs, U. S. per the Hon. J. M. Broadhead, of Washington:

"Schoolcroft's History of the Indians in the United States." Part 5th.

2. From the Rev. A. C. Geikie, of Toronto:

"Grammoire Raisonnée de la Langue Russe," by Ch. Ph. Reiff, St. Petersburg; 1828-29. 2 vols.

The President intimated that the Special Committee appointed to consider the most proper measures to be taken in acknowledgment of the public services of W. E. Logan, Esq., had the subject still under consideration, and would report to the Institute at its next meeting.

George William Allan, Esq., President, then read the Annual Address.

On the motion of the Rev. Thomas Schreiber, seconded by Oliver Mowat, Esq. Q. C., the thanks of the Institute were voted to the President for his Address, and ordered to be entered on the minutes.

Dr. Wilson presented the Report of the Committee to which was referred the Communication of Major Lachlan on the subject of a system of Meteorological Observations throughout the Province.

The Report having been read and adopted, was ordered to be printed in the Journal, along with Major Lachlan's communication.

*The following Papers were then read:*

1. By J. G. Hodgins, Esq., Deputy Superintendent of Schools:

"Memorandum on the steps which have been taken by the Educational Department to establish a system of Meteorological Stations throughout Upper Canada."

Resolved, That Mr. HODGINS' communication be printed along with the other papers relative to Meteorological Observations in Canada, and that it be accompanied by a reduced copy of an illustrative map exhibited by Mr. Hodgins.

2. By W. D. C. CAMPBELL, Esq., of Quebec.

"On a Method of Determining the Errors below 32° Ft. of Mercurial Thermometers which have been compared and corrected above the freezing point."

Ordered, That the thanks of the Institute be conveyed to Mr. Campbell for his communication.

3. By PROFESSOR WILSON, LL.D.:

"On the Traces of the Ancient Miners of Lake Superior."

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SIXTH ORDINARY MEETING—*February 2d*, 1856.

G. W. ALLAN, Esq., President, in the Chair.

*The following Gentlemen were elected Members:*

W. R. ROSS, Esq., Toronto.
J. R. WILLIAMS, Esq., Bond Head.
R. H. BRETT, Esq., Toronto.
A. J. PELL, Esq., Toronto.
R. J. GRIFFITH, Esq., Toronto.
R. S. WOODS, Esq., Chatham.
JOHN GLASS, Esq., Toronto.
HON. J. A. MACDONALD, Toronto.

The donation from John Fisk Allen, Esq., of Salem, Mass., was announced, of his illustrated account of the *Victoria Regia*, or Great Water Lily of America.

Ordered, That the thanks of the Institute be conveyed to the donor for his valuable gift.

The President, on behalf of the Special Committee appointed with a view to some fitting recognition of the services rendered to Canada by W. E. Logan, Esq., the First President of the Canadian Institute, reported as follows:

REPORT.

The Special Committee appointed to consider the best means to be adopted to mark the sense the Institute entertain of the very valuable services rendered to Canada by W. E. Logan, Esq., both in his capacity of Provincial Geologist, and as Commissioner to the great Exhibitions of London and Paris, beg respectfully to recommend:

That immediately upon Mr. Logan's arrival in Canada, a communication be ad dressed to him by the Secretary on behalf of the Institute, requesting that he would be pleased to sit for his portrait, to be painted at the expense of the Institute, and hung up thereafter in their Hall: That as soon as possible after Mr. Logan's arrival in Toronto, a special general meeting should be convened, at which that gentleman should be invited to attend, to receive an address to be presented to him by the Institute, expressing the high sense they entertain of the services rendered by Mr. Logan to the cause of science generally, and more especially acknowledging the very great obligations all Canadians are under to him, for having by his untiring energy and perseverance in the discharge of his duties, as one of the Commissioners to the great Exhibitions of 1851 and 1855, contributed to make the mineral resources of Canada most widely and favorably known, both in England and on the Continent.

The Report was adopted, and remitted to the Council to carry out the recommendations contained therein, so soon as Mr. Logan shall arrive in Canada.

Mr. Pell intimated, in furtherance of the same object, that he would be happy to present to the Institute a frame for the contemplated portrait of its former President, so soon as it shall be completed.

*The following Papers were then read:*

1. By JAMES BROWNE, Esq.

"Experiences in Australia; forming the first part of a series of Papers on the Aborigines of Australia."

2. By PROFESSOR KINGSTON, M. A.:

"Mean Meteorological results of Toronto for 1855."

MONTHLY METEOROLOGICAL REGISTER, AT THE PROVINCIAL MAGNETIC OBSERVATORY, TORONTO, CANADA WEST—FEBRUARY. 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 Direc-tion. | Velocity of Wind. | | | | Rain in Inches. | Snow in Inches. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 6 A.M. | 2 P.M. | 10 P.M. | MEAN. | 6 A.M | 2 P.M | 10PM | ME'N | | 6 A.M | 2 P.M | 10 P.M | M'N | 6 A.M | 2 P.M | 10 P.M | M'N | 6 A.M. | 2 P.M. | 10 P.M. | | 6 A.M | 2 P.M | 10PM | ME'N | | |
| 1 | 29.256 | 29.069 | 29·202 | 29·1710 | ° 20·0 | ° 28.4 | ° 15.8 | ° 21.50 | ° — 2.38 | 0.097 | 0.130 | 0.073 | 0.104 | .87 | .87 | .78 | .84 | Calm | SW b W | W b N | W 16 S | 0.0 | 16.3 | 12.8 | 14.12 | ... | 0.4 |
| 2 | .300 | .325 | ·397 | .3562 | 5·6 | 7.6 | —3.6 | 2.70 | —21.15 | .047 | .049 | .036 | 042 | .78 | .74 | .90 | .77 | W | W b S | W b S | W 2 N | 12.2 | 22.0 | 9.5 | 15.17 | ... | ... |
| 3 | .451 | .430 | — | — | —5.7 | 9.0 | — | — | — | .027 | .040 | — | — | .72 | .57 | — | — | W | W | W b S | W 5 S | 12.4 | 14.0 | 8.0 | 12.59 | ... | ... |
| 4 | .469 | .474 | ·569 | ·5148 | 4·9 | 11.5 | 7.5 | 8.20 | —15.48 | .013 | .037 | .054 | .046 | .75 | .47 | .81 | .69 | W b S | W b S | W S W | W 11 S | 20.0 | 22.2 | 14.0 | 18.44 | ... | ... |
| 5 | .703 | .842 | 30.022 | .8798 | 9.3 | 15.1 | 2.9 | 9.27 | —14.32 | .055 | .062 | .044 | .054 | .78 | .67 | .82 | .76 | W b S | W S W | W b S | W 17 S | 25.8 | 16.6 | 6.3 | 13.08 | ... | ... |
| 6 | 30.086 | .937 | 29·819 | .0295 | —0.4 | 13.6 | 13.3 | 9.85 | —13.67 | .037 | .056 | .070 | .057 | .81 | .66 | .82 | .76 | W | W b S | N E | W 36 S | 5.7 | 7.5 | 2.7 | 7.01 | ... | 1.6 |
| 7 | 29.452 | ·367 | .518 | .4502 | 24.8 | 30.0 | 22.6 | 25.23 | + 1.80 | ·127 | .132 | ·104 | .119 | .93 | .79 | .84 | .85 | S S E | W b S | W b S | W 23 N | 9.8 | 15.0 | 13.0 | 11.90 | ... | 0.3 |
| 8 | .677 | ·636 | .543 | .6103 | 4.7 | 11.1 | 7.7 | 6.73 | —16.63 | ·046 | .059 | ·048 | .047 | .79 | .78 | .72 | .74 | N | Calm | N N W | N 25 W | 9.8 | 0.0 | 6.4 | 5.94 | ... | ... |
| 9 | .545 | ·541 | ·643 | .5840 | 2.2 | 18 0 | 8.6 | 9.80 | —13.47 | ·036 | .066 | ·058 | .054 | .69 | .65 | .83 | .73 | W N W | W b S | W b N | W 2 S | 8.5 | 16.8 | 3.8 | 7.08 | ... | In p |
| 10 | .631 | .530 | — | — | 9.3 | 28.5 | — | — | — | ·035 | .111 | — | — | .50 | .71 | — | — | W | S W | SW b W | W 34 S | 7.0 | 11.7 | 5.0 | 9.53 | ... | ... |
| 11 | .450 | .181 | 28.934 | ·1747 | 28·0 | 33.0 | 26.9 | 28.90 | + 5.63 | ·136 | .169 | ·139 | .145 | .87 | .90 | .94 | .90 | W S W | E | N N W | N 43 W | 3.8 | 3.5 | 15.8 | 11.64 | ... | 5.0 |
| 12 | .049 | .299 | 29.574 | ·3420 | 9.0 | 2.5 | —6.1 | 0.10 | —23.15 | ·054 | .031 | ·019 | .032 | .76 | .57 | .55 | .62 | NW b W | W N W | NW b N | W 25 N | 28.2 | 32.0 | 5.0 | 18.59 | ... | ... |
| 13 | .779 | .830 | ·866 | .8318 | -18·7 | 2.3 | —5.0 | -6.88 | —30.13 | ·018 | .032 | .032 | .027 | .90 | .61 | .86 | .77 | W N W | W S W | W b N | W 2 N | 4.0 | 7·0 | 5.6 | 6.47 | ... | ... |
| 14 | .816 | ·673 | .537 | .6643 | —8.2 | 10.1 | 2.2 | 1.65 | —21.62 | .022 | .038 | ·041 | .035 | .67 | .51 | .80 | .66 | W N W | W S W | W | W 15 S | 5.6 | 8.9 | 7.0 | 10.46 | ... | ... |
| 15 | .373 | .098 | 28.972 | ·1290 | 10.1 | 20.2 | 24.4 | 19.00 | — 4.25 | .063 | .090 | ·113 | .091 | .85 | .80 | .84 | .83 | SW b W | SW b W | SW b W | W 44 S | 14.5 | 16.8 | 7.8 | 13 83 | ... | 0.3 |
| 16 | 28.849 | 28.778 | 29.031 | 28.8972 | 26.2 | 30.6 | 12.2 | 21.17 | — 2.20 | .127 | .156 | ·059 | .099 | .87 | .91 | .73 | .82 | SW b W | S W b S | W N W | W 38 N | 12.0 | 0·2 | 12.5 | 15.37 | ... | 2.0 |
| 17 | 29.188 | 29.279 | — | — | 7.9 | 11.1 | — | — | — | .045 | .048 | — | — | .66 | .62 | — | — | W N W | W N W | N W | W 25 N | 19.2 | 22·2 | 2.8 | 14·37 | ... | 0 1 |
| 18 | .409 | ·593 | .741 | 29·5098 | 0 7 | 6.3 | 3.4 | 3.80 | —19.63 | .036 | .028 | .045 | .038 | .73 | .44 | .80 | .68 | NW b N | N W | W b S | W 40 N | 16.3 | 23·6 | 5.5 | 15·67 | ... | .. |
| 19 | .844 | .765 | .588 | .7207 | 5.7 | 23.1 | 19.4 | 16.32 | — 7.22 | .046 | .077 | ·076 | .069 | .76 | .60 | .70 | .70 | N W | S W b S | SW b W | W 22 S | 25.0 | 10·8 | 13.5 | 13 93 | ... | ... |
| 20 | .431 | ·369 | ·433 | ·4142 | 24.4 | 34.8 | 31.6 | 29.87 | + 6·25 | .115 | .153 | .154 | .134 | .85 | .75 | .87 | .80 | SW b W | W N W | W S W | W 2 N | 16.7 | 17·8 | 8.2 | 12.40 | ... | ... |
| 21 | .423 | ·380 | .395 | .3998 | 19.8 | 32.3 | 26.6 | 25.22 | + 1·48 | .094 | .124 | .123 | .110 | .84 | .68 | .83 | .78 | W | S b W | SW b W | W 7 S | 7.2 | 8·6 | 4.8 | 5 10 | ... | ... |
| 22 | .402 | .383 | .324 | .3687 | 13.7 | 34.5 | 28.0 | 25.33 | + 1·52 | .071 | .150 | .128 | .116 | .81 | .74 | .83 | .81 | W N W | S W b S | N E | S 33 W | 4·6 | 4·2 | 2.0 | 3·21 | ... | ... |
| 23 | .167 | ·122 | .354 | .2217 | 24.8 | 36.3 | 21.9 | 27.08 | + 3·32 | .116 | .151 | .078 | .110 | .85 | .71 | .65 | .73 | NW b W | NW b N | NW b W | N 42 W | 6·1 | 16·6 | 15.4 | 14·23 | ... | ... |
| 24 | .471 | ·447 | — | — | 14.4 | 27.1 | — | — | — | .070 | .098 | — | — | .78 | .66 | — | — | W b N | W b N | N W | W 26 N | 5·2 | 18·5 | 2.6 | 7·80 | ... | ... |
| 25 | .356 | .291 | .439 | .3715 | 14.8 | 27.6 | 16.3 | 19.30 | — 5·03 | .080 | .102 | .073 | .082 | .89 | .67 | .76 | .75 | W S W | S S W | W b N | W 20 N | 0·5 | 6·2 | 5.6 | 6·17 | ... | ... |
| 26 | .548 | .560 | .602 | .5825 | 6.2 | 26.9 | 20.8 | 18.65 | — 5·88 | .052 | .087 | .083 | .077 | .83 | .59 | .72 | .72 | NW b W | S b W | N b E | N 31 W | 3·6 | 5·8 | 10.0 | 6·28 | ... | ... |
| 27 | .614 | ·502 | ·567 | .5635 | 15.8 | 28.7 | 17.2 | 21.05 | — 3·67 | .071 | .123 | .081 | .089 | .76 | .77 | .81 | .75 | N N E | E N E | N N E | N 42 E | 9·2 | 18·2 | 6.0 | 10.81 | ... | ... |
| 28 | .651 | .642 | .672 | .6570 | 14.1 | 20.2 | 25.1 | 22.60 | — 2·30 | .077 | .114 | .111 | .097 | .87 | .70 | .81 | .76 | N | E b S | W N W | N 3 E | 10·6 | 3·0 | 3 2 | 4 97 | ... | ... |
| 29 | ·722 | ·760 | .820 | ·7723 | 20.0 | 31.8 | 26.6 | 25.87 | + 0·85 | .092 | .134 | .129 | .114 | .82 | .75 | .88 | .80 | W | S W b S | N | W 33 N | 2·2 | 6·6 | 4.0 | 5·37 | ... | ... |
| M | 29.4948 | 29.4567 | 29.5027 | 29·4883 | 11.10 | 21.82 | 14.65 | 15.69 | — 7·98 | 0.070 | 0.094 | 0.079 | 0.080 | ·81 | .69 | .80 | ·76 | W 11° N | W 4° S | W 17° N | W 9 N | 10·54 | 12.87 | 7.54 | 10.71 | none | 9.7 |

## REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR FEBRUARY.

Highest Barometer ........................ 30.036 at 6 a. m. on 6th } Monthly range=
Lowest Barometer ......................... 28.778 at 2 p m. on 16th } 1.308 inches.

Highest registered temperature ........... 37°8 at p. m. on 21st } Monthly range=
Lowest registered temperature .........—18°7 at a. m. on 13th } 56°5

Mean maximum Thermometer ........ 24°22 } Mean daily range = 20°65
Mean minimum Thermometer ........ 3°57 }

Greatest daily range ....................... 28°7 from a. m. of 12th to a. m. of 13th.
Least daily range .......................... 9°0 from a. m. of 4th to a. m. of 5th.

Warmest day ........... 20th ... Mean temperature ........ 29°87 } Difference= 36°75.
Coldest day ............. 13th ... Mean temperature ........ -6°88 }

Greatest intensity of Solar Radiation .. ... 58°5 on p. m. of 21st } Monthly range=
Lowest point of Terrestrial Radiation ... -27°8 on a. m. of 13th } 86°3

Aurora observed on five nights, viz., on the 13th, 16th, 20th, 23rd, and 25th; possible to see aurora on 20 nights; impossible to see aurora on 9 nights.

No rain recorded this month.
Snowing on 8 days, depth 9.7 inches—snowing 50.6 hours.
Mean of cloudiness 0.55; most cloudy hour observed, 4 p. m., mean=0.64; least cloudy hour observed, 10 p. m., mean=0.39.

No thunder or lightning recorded this month.

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

| North. | West. | South. | East. |
|---|---|---|---|
| 2129.57 | 5606.28 | 1294.14 | 307.55 |

Mean direction of the wind, W 9° N.
Mean velocity of the wind ............. 10.71 miles per hour.
Maximum velocity ........................ 32.4 miles per hour, from 7 to 8 p. m. on 16th.
Most windy day ........................... 12th...Mean velocity 18.59 miles per hour.
Least windy day ......................... 22nd...Mean velocity 3.21 ditto.
Most windy hour .......... 1 to 2 p. m....Mean velocity 13.42 ditto.
Least windy hour ....... 10 to 11 p. m....Mean velocity 7.81 ditto.
Mean diurnal variation ... 5.61 miles.

Halos observed—Round the Moon at 10 p. m. on 12th; Sun. 2 to 4 p. m. on 19th (perfect); Sun, 2 to 4 p. m. on 22nd (perfect); Moon, 10 p. m. to midnight on 22nd (perfect); Sun, 11 a. m. to 3 p. m. on 29th, (very perfect,) diam. about 42°.

Zodiacal Light very bright on the evenings of the 5th, 22nd, 24th, 26th and 27th.

TEMPERATURE.—The mean temperature of February was 6°95 below the average of the last 17 years, and it is the lowest recorded during that period, excepting those of February 1843, and February 1855. This month shews also the lowest maximum temperature and the lowest minimum but one during the same period. The column of daily means exhibits several remarkable changes.

SNOW.—The fall of snow during the month was 8 inches below the average of 14 years, and the least that has occurred during that period, excepting in Feb. 1851, when, as a compensation, the fall of rain was more than double its average amount.

RAIN.—No rain fell in Feb.; nor has there been any rain since 15th Dec. The only two examples of a total absence of rain in Feb. occurred in Feb. 1841, and Feb. 1846: but in each of these cases there had been an unusual amount of rain in the preceding month.

WIND.—The mean velocity of the wind exceeded the average by 3.34 miles, and is the greatest yet recorded in February by 2.54 miles.

### COMPARATIVE TABLE FOR FEBRUARY.

| 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 | 28.0° | +5.35° | 49.1° | — 8.3° | 57.4° | 8 | 1.475 | 6 | ... | ... | ... |
| 1841 | 22.4 | —0.25 | 43.4 | — 0.3 | 43.7 | 1 | 0.000 | 9 | ... | ... | 0.61 lbs. |
| 1842 | 26.9 | +4.25 | 48.7 | + 2.5 | 46.2 | 8 | 3.625 | 9 | ... | ... | 1.03 " |
| 1843 | 14.5 | —8 15 | 37.5 | —10.2 | 47.7 | 1 | 0.475 | 21 | 14.4 | ... | 1.05 " |
| 1844 | 26.0 | +3.35 | 47.1 | — 0.4 | 47.5 | 4 | 0.430 | 7 | 10.0 | ... | 0.43 " |
| 1845 | 26.0 | +3.35 | 46.6 | — 3.9 | 50.5 | 5 | Imp't. | 9 | 19.0 | ... | 0.99 " |
| 1846 | 20.4 | —2.25 | 41.4 | —16.2 | 57.6 | 0 | 0.000 | 13 | 46.1 | ... | 0.65 " |
| 1847 | 21.5 | —1.15 | 42.2 | — 1.0 | 43.2 | 2 | 0.550 | 13 | 27.3 | ... | 0.69 " |
| 1848 | 26.6 | +3.95 | 46.9 | — 0.6 | 47.5 | 4 | 0.775 | 8 | 10.8 | W 25° N | 5.69 miles. |
| 1849 | 19.5 | —3.15 | 41.1 | — 9.2 | 50.3 | 2 | 0.240 | 13 | 19.2 | N 41° W | 6.58 " |
| 1850 | 26.0 | +3.35 | 49.2 | + 1.3 | 47.9 | 7 | 1.235 | 9 | 23.1 | W 10° N | 7.61 " |
| 1851 | 27.6 | +4.95 | 50.2 | + 1.3 | 48.9 | 7 | 2.600 | 4 | 2.4 | W 26° N | 6.94 " |
| 1852 | 23.4 | +0.75 | 41.2 | — 3.2 | 44.4 | 3 | 0.650 | 11 | 13.0 | W 15° S | 6.42 " |
| 1853 | 24.1 | +1.45 | 43.4 | — 0.6 | 44.0 | 4 | 1.030 | 15 | 12.6 | W 41° N | 7.29 " |
| 1854 | 21.1 | —1.55 | 42.7 | — 5.7 | 48.4 | 5 | 1.460 | 15 | 18 0 | N 7° E | 6.91 " |
| 1855 | 15.4 | —7 25 | 37.3 | —25.0 | 62.3 | 2 | 1.770 | 14 | 21.8 | N 37° W | 8.17 " |
| 1856 | 15.7 | —6.95 | 35.3 | —18.7 | 54.0 | 0 | 0.000 | 8 | 9.7 | W 9° N | 10.71 " |
| Mean | 22.65 | ... | 43.72 | —5.78 | 49.50 | 3.7 | 1.020 | 10.8 | 17.7 | ... | 0.78 lbs. 7.37 miles |

## MONTHLY METEOROLOGICAL REGISTER, AT THE PROVINCIAL MAGNETICAL OBSERVATORY, TORONTO, CANADA WEST—MARCH, 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. | Tension of Vap. | | | | Humidity of Air. | | | | Direction of Wind. | | | Mean Direc-tion. | 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 | 29.826 | 29·660 | 29.328 | 29·5907 | 22·3° | 27.5° | 23.3° | 24.15° | — 1.07° | .110 | .126 | .117 | 113. | .88 | .83 | .91 | .84 | Calm. | E b N | E N E | E 24° N | 6.0 | 15.6 | 22.0 | 15.08 | ... | 4.5 |
| | 28.828 | 29·007 | — | — | 21.5 | 27·9 | — | — | — | .095 | .117 | — | — | .79 | .76 | — | — | N b E | W b N | W b S | W 14 N | 19.2 | 20.0 | 12.8 | 15.78 | ... | 0.3 |
| 3 | 29.471 | ·610 | ·694 | ·6088 | 14.2 | 25·5 | 19·8 | 19.57 | — 6.15 | .071 | .107 | .077 | .081 | .80 | .76 | .70 | .73 | W b S | W b S | SW b W | W 21 S | 10.8 | 16.5 | 6.4 | 11.01 | ... | 3.4 |
| 4 | .410 | .236 | ·563 | .4140 | 23.7 | 27.8 | 23.0 | 24·72 | — 1.28 | .125 | .035 | .110 | .111 | .96 | .55 | .85 | .82 | S E b E | W | W | W 8 S | 14.7 | 41.6 | 22.2 | 20.88 | ... | 0.4 |
| 5 | ·042 | ·480 | .317 | ·4602 | 13·4 | 27.1 | 24.6 | 22.22 | — 3.95 | .076 | .091 | .116 | .090 | .88 | .61 | .86 | .73 | W b S | S W | S W | W 34 S | 10.2 | 16.8 | 14.0 | 13.62 | ... | 0.2 |
| 6 | .218 | ·378 | .629 | ·4253 | 20.0 | 23.0 | 9 4 | 16.40 | —10.10 | .092 | .081 | .047 | .071 | .82 | .64 | .66 | .72 | W N W | N W | W | W 26 N | 16.7 | 23.0 | 7.8 | 15.36 | ... | ... |
| 7 | .620 | ·332 | ·335 | ·4457 | 2.7 | 23.3 | 19.4 | 15·02 | —11.80 | .040 | .089 | .092 | .076 | .76 | .69 | .84 | .79 | Calm. | S S W | W N W | W 20 S | 0.0 | 23.[illegible] | 9 8 | 14·24 | ... | 1.9 |
| 8 | .506 | .690 | .793 | .6937 | 1·3 | 8.3 | -5·0 | 1.03 | —26.20 | .037 | .041 | .026 | .035 | .74 | .60 | .69 | .69 | W N W | W N W | W N W | W 23 N | 8.6 | 19.8 | 5.0 | 14.33 | ... | ... |
| 9 | .812 | .759 | — | — | -13.6 | 6.8 | — | — | — | .025 | .051 | — | — | .96 | .79 | — | — | W N W | SW b W | NW b W | W 31 N | 11.4 | 4.0 | 11.8 | 8.71 | ... | ... |
| 10 | .727 | .639 | .541 | ·6275 | -12·2 | 12·6 | 15.4 | 6.55 | —21.27 | .025 | .052 | .080 | .052 | .89 | .64 | .87 | .78 | W N W | W S W | W S W | W 18 S | 13.3 | 21.4 | 19.8 | 19.15 | ... | ... |
| 11 | .422 | .340 | .350 | ·3617 | 11.7 | 20.1 | 11·1 | 14·40 | —13.83 | .065 | .063 | .048 | .058 | .80 | .56 | .63 | .65 | W b S | W b N | W b S | W 6 N | 19.8 | 27.8 | 5.5 | 18.52 | ... | ... |
| 12 | .373 | ·425 | ·554 | .4627 | 9·5 | 23.7 | 19·4 | 18.23 | —10.27 | .059 | .089 | .069 | .071 | .82 | .68 | .64 | .69 | W | NW b W | W N W | W 21 N | 10.8 | 21.4 | 3.2 | 12.19 | ... | ... |
| 13 | .693 | ·704 | ·758 | ·7237 | 15·8 | 27·6 | 20·8 | 21.90 | — 7.06 | .071 | .087 | .096 | .085 | .76 | .57 | .83 | .71 | N b W | W b N | N N W | N 34 W | 5.8 | 5.3 | 8.5 | 7.53 | ... | ... |
| 14 | .787 | ·742 | .656 | ·7212 | 15.8 | 30.3 | 30.7 | 26.00 | — 3.22 | .067 | .109 | .124 | .102 | .72 | .65 | .72 | .70 | NW b N | S S W | SW b W | W 33 S | 7.0 | 7.3 | 10.8 | 8.61 | ... | 0.2 |
| 15 | .072 | ·728 | ·739 | ·7177 | 24·8 | 32.7 | 28.4 | 28.77 | — 0.95 | .108 | .151 | .111 | .120 | .79 | .81 | .71 | .75 | W b S | W b S | SW b W | W 10 S | 12.2 | 18.2 | 4.4 | 8.88 | ... | ... |
| 16 | .074 | .629 | — | — | 21·9 | 34.0 | — | — | — | .097 | .139 | — | — | .80 | .71 | — | — | Calm. | W b N | W b N | W 8 N | 0.0 | 13.2 | 1.6 | 5.66 | ... | ... |
| 17 | .758 | .781 | ·828 | ·7968 | 22·6 | 38.9 | 29.1 | 30·65 | + 0.20 | .114 | .108 | .117 | .115 | .91 | .45 | .72 | .68 | SW b W | W b S | W | W 4 S | 1.5 | 9.2 | 1.2 | 5.36 | ... | ... |
| 18 | .879 | ·803 | ·658 | ·7687 | 16·2 | 35.5 | 29.6 | 28.55 | — 2.30 | .079 | .131 | .127 | .118 | .82 | .63 | .77 | .74 | N N W | E b S | N E | E 26 N | 0.4 | 2.7 | 4.0 | 3.63 | ... | ... |
| 19 | .496 | ·364 | ·408 | .4150 | 31·2 | 33·4 | 30.5 | 31.60 | + 0.33 | .160 | .169 | .148 | .152 | .92 | .89 | .88 | .86 | E b N | S | W | N 26 E | 8.4 | 6.2 | 0.8 | 4.19 | ... | Inp |
| 20 | .413 | .349 | .386 | ·3820 | 25.5 | 36·8 | 25.5 | 29.82 | — 1.85 | .119 | .148 | .091 | .126 | .85 | .68 | .64 | .75 | N b E | S | NW b N | W 21 S | 5.5 | 2.2 | 2.8 | 2.83 | ... | ... |
| 21 | ·380 | ·414 | — | — | 25·5 | 39.5 | — | — | — | .120 | .171 | — | — | .85 | .71 | — | — | N W | S W b S | N N E | N 19 W | 2.0 | 4.7 | 6.2 | 5.36 | ... | ... |
| 22 | .500 | .522 | ·537 | ·5248 | 28·4 | 38.2 | 29.1 | 31.90 | — 0.58 | .131 | .110 | .136 | .128 | .83 | .48 | .84 | .72 | N b W | S b W | NW b W | W 32 N | 8.2 | 4.0 | 6.2 | 4.42 | ... | ... |
| 23 | .512 | .492 | — | — | 18.7 | 36.0 | — | — | — | .087 | .142 | — | — | .82 | .67 | — | — | NW b W | S b E | S S E | S 15 E | 5.5 | 7.0 | 9.4 | 5.48 | ... | 1.0 |
| 24 | ·187 | .196 | .370 | ·2520 | 33.4 | 35.0 | 35.0 | 34.35 | + 1.18 | .171 | .182 | .172 | .174 | .90 | .90 | .85 | .88 | E b S | N N E | N N W | N 20 W | 4.2 | 7.3 | 13.2 | 10.78 | Inap | 3.6 |
| 25 | ·470 | .542 | ·579 | .5417 | 29.4 | 39.3 | 30·2 | 33.18 | — 0.38 | .140 | .156 | .145 | .146 | .85 | .66 | .86 | .77 | N W | W N W | W b N | W 32 N | 16.6 | 14.5 | 12.5 | 11.79 | ... | ... |
| 26 | .527 | .445 | ·438 | ·4658 | 28.7 | 37.4 | 25.7 | 30.50 | — 3.45 | .137 | .138 | .119 | .132 | .87 | .62 | .84 | .78 | W b N | W N W | W b N | W 19 N | 9.6 | 19.0 | 10.8 | 15.90 | ... | ... |
| 27 | .390 | ·376 | ·402 | .3922 | 23.7 | 28.0 | 21.9 | 23.88 | —10.53 | .105 | 077 | .055 | .066 | .80 | .49 | .70 | .66 | NW b W | N N W | N N W | N 35 W | 17.2 | 20.5 | 27.1 | 21.95 | ... | 0.3 |
| 28 | .446 | .477 | .571 | ·5073 | 15·8 | 21.0 | 24.1 | 20·50 | —14.22 | .078 | .083 | .115 | .091 | .83 | .71 | .86 | .79 | NW b N | NW b N | W N W | W 41 N | 17.0 | 23.2 | 15.1 | 18.53 | ... | 0.2 |
| 29 | .633 | ·608 | ·728 | ·6603 | 15.4 | 30·6 | 19.2 | 21.68 | —13.42 | .061 | .080 | .077 | .072 | .65 | .46 | .71 | .60 | W | W N W | W N W | W 27 N | 9.6 | 21.2 | 11.0 | 15.91 | ... | ... |
| 30 | .746 | .731 | — | — | 13.6 | 28·4 | — | — | — | .066 | .117 | — | — | .78 | .74 | — | — | NW b N | N | NW b N | N 28 W | 12.1 | 11.2 | 7.5 | 12.12 | ... | ... |
| 31 | ·938 | 30·030 | 30.049 | 30·0220 | 11.0 | 28·7 | 22.0 | 20.90 | —15.02 | .049 | .073 | .102 | .075 | .64 | .46 | .54 | .64 | N b W | W N W | W N W | N 35 W | 6.1 | 3.0 | 5.5 | 5.63 | ... | ... |
| M | 29·5622 | 29.5382 | 29.5704 | 29.5592 | 17.77 | 28.40 | 22.49 | 23.06 | — 7.32 | .092 | .105 | .102 | .099 | .82 | .64 | .78 | .74 | W 38 N | W 9 N | W 24 N | W 19 N | 9.17 | 14.56 | 9.64 | 11.39 | Inap | 16.2 |

## REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR MARCH.

Highest Barometer .................. 30.082 at midnight, on 31st } Monthly range=
Lowest Barometer .................. 28.828 at 6 a. m., on 2nd } 1.254 inches.

Highest registered temperature......... +41°4 at p. m., on 25th } Monthly range=
Lowest registered temperature......... —14°0 at a. m., on 9th } 55°4

Mean maximum Thermometer......... 30°47 } Mean daily range = 17°60
Mean minimum Thermometer......... 12°87 }

Greatest daily range ........................ 32°4 from a. m. to p. m. of 10th.
Least daily range.............................. 8°0 from p. m. of 24th to a. m. of 25th.

Warmest day......... 24th ... Mean temperature......... 34°35 } Difference = 33°32.
Coldest day......... 8th ... Mean temperature......... 1°03 }

Greatest intensity of Solar Radiation ... +69°4 on p. m. of 21st } Monthly range=
Lowest point of Terrestrial Radiation ... −22°0 on a. m. of 9th } 91°4

Aurora observed on 7 nights, viz.: 2nd, 3rd, 5th, 6th, 18th, 30th and 31st; possible to see aurora on 20 nights; impossible to see aurora on 11 nights.

Snowing on 12 days, depth 16.2 inches—snowing 75.5 hours. No rain recorded this month at Observatory.

Mean of cloudiness =0.52; most cloudy hour observed, 4 p m, =0.56; least cloudy hour observed, 10 p. m., =0.47.

No Thunder or Lightning recorded this month.

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

| North. | West. | South. | East. |
|---|---|---|---|
| 3031.09 | 5084.00 | 1123.32 | 596.35 |

Mean direction of the wind, W 19° N.

Mean velocity of the wind......... 11.39 miles per hour.

Maximum velocity .................. 41.6 miles per hour, from 1.30 to 2.30 p. m., on 4th

Most windy day.........................27th...Mean velocity 21.95 miles per hour.

Least windy day .....................20th...Mean velocity 2.83 ditto.

Most windy hour ......... 2 to 3 p. m....Mean velocity 14.55 ditto.

Least windy hour......... 5 to 6 a. m....Mean velocity 8.74 ditto.

Mean diurnal variation = 5.81 miles.

Halo round the moon 13th at 10 p. m.; 18th at 7 p. m. to 1 a. m., very perfect; 20th, at midnight.

Halo's round the sun 23rd at 2 p. m.

Zodiacal light very bright on 30th, 8 to 9 p. m.

TEMPERATURE.—The low mean temperatures of February and March, 1856, not compensated as in 1843 by a mild January, but preceded by the coldest January on record, combine to render the three first months of the present year extremely cold. The minimum—13.6 is an example of depression quite unprecedented in March.

BAROMETER.—A remarkable descent is to be noticed from 6 a. m. on the 1st to 6 a.m. on the 2nd.

RAIN.—With the exception of a drizzle too slight for measurement, no rain has fallen since 15th December, (107 days.)

WIND.—The most windy March on record.

### COMPARATIVE TABLE FOR MARCH.

| 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 | 33.3 | +3.4 | 56.9 | 8.7 | 48.2 | 8 | 1.640 | 8 | ... | ... | ... |
| 1841 | 27.7 | −2.2 | 53.5 | − 6.9 | 60.4 | 5 | 1.170 | 7 | ... | ... | 0.51 lbs. |
| 1842 | 35.8 | +5.9 | 68.7 | 14.9 | 53.8 | 4 | 3.150 | 8 | ... | ... | 0.70 " |
| 1843 | 21.3 | −8.6 | 38.6 | − 2.8 | 41.4 | 2 | 0.625 | 18 | 25.7 | ... | 1.18 " |
| 1844 | 31.3 | +1.4 | 50.3 | 9.6 | 40.7 | 8 | 2.470 | 8 | 14.0 | ... | 0.57 " |
| 1845 | 35.4 | +5.5 | 61.7 | 9.9 | 51.8 | 5 | Inap't | 8 | 2.8 | ... | 0.68 " |
| 1846 | 33.1 | +3.2 | 49.3 | 7.6 | 41.7 | 9 | 1.965 | 5 | 2.3 | ... | 0.30 " |
| 1847 | 26.2 | −3.7 | 44.3 | 4.8 | 39.5 | 5 | 0.850 | 6 | 4.2 | ... | 0.71 " |
| 1848 | 28.6 | −1.3 | 58.9 | 0.9 | 58.0 | 5 | 1.220 | 6 | 9.7 | W 13 N | 5.80 miles. |
| 1849 | 33.5 | +3.6 | 53.4 | 15.4 | 38.0 | 7 | 1.525 | 2 | 2.3 | N 8° W | 5.37 " |
| 1850 | 29.8 | −0.1 | 46.0 | 6.0 | 40.0 | 2 | 0.745 | 7 | 11.2 | W 38° N | 7.63 " |
| 1851 | 32.4 | [illegible] | 58.7 | 13.1 | 45.6 | 3 | 0.770 | 9 | 8.8 | N 21° W | 7.63 " |
| 1852 | 27.7 | −2.2 | 44.8 | − 3.2 | 48.0 | 8 | 3.030 | 12 | 19.5 | N 9° W | 5.81 " |
| 1853 | 30.6 | +0.7 | 56.3 | − 0.1 | 56.4 | 6 | 1.080 | 8 | 7.1 | W 25° N | 5.87 " |
| 1854 | 30.7 | +0.8 | 52.8 | 10.4 | 42.4 | 9 | 2.425 | 3 | 2.8 | W 40° N | 8.03 " |
| 1855 | 28.5 | −1.4 | 48.6 | − 2.9 | 51.5 | 5 | 1.485 | 11 | 18.1 | W 16° N | 9.95 " |
| 1856 | 23.1 | −6.8 | 39.3 | −13.6 | 52.9 | 0 | 0.000 | 12 | 16.2 | W 19° N | 11.39 " |
| Mean | 29.91 | ... | 51.89 | 4.22 | 47.66 | 5.3 | 1.512 | 8.1 | 10.3 | ... | 7.50 miles. |

# MONTHLY METEOROLOGICAL REGISTER, ST. MARTIN, ISLE JESUS, CANADA EAST—MARCH, 1855.

(NINE MILES WEST OF MONTREAL.)

## BY CHARLES SMALLWOOD, M. D.

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

| Day. | Barom. corrected and reduced to 32° Fahr. | | | Temp. of the Air. | | | Tension of Vapor. | | | Humidity of Air. | | | Direction of Wind. | | | Mean direction of Wind. | Velocity in miles per hour. | | | Rain in Inches. | Snow in Inches. | WEATHER, &c. A cloudy sky is represented by 10; A cloudless sky by 0. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 6 A.M. | 2 P.M. | 10 P.M. | 6 A.M. | 2 P.M. | 10 P.M. | 6 A.M. | 2 P.M. | 10 P.M. | 6 A.M. | 2 P.M. | 10 P.M. | 6 A.M. | 2 P.M. | 10 P.M. | | 6 A.M. | 2 P.M. | 10 P.M. | | | 6 A.M. | 2 P.M. | 10 P.M. |
| 1 | 30.051 | 29.914 | 29.883 | 12.6 | 34.2 | 3.8 | .088 | .190 | .050 | .87 | .85 | .86 | E N E | E N E | E N E | E 22° N | 2.11 | 0.31 | Calm | ... | ... | Str 10. | Str. 10. | Str. 10. |
| 2 | 29.326 | .065 | .154 | 9.0 | 16.2 | 10.4 | 067 | 098 | 082 | 90 | 87 | 88 | N E by E | N E by E | S W | N 34 E | 17.00 | 23.47 | 5.41 | ... | 3.15 | Snow. | Snow. | Str. 4. [Light. |
| 3 | .494 | .403 | .866 | 8.1 | 21.0 | 3.6 | 065 | 086 | 049 | 89 | 64 | 85 | W | W by S | W N W | W 10 S | 9.88 | 21.70 | 10.81 | ... | ... | Str. 4. | Clear. | Clr., Au.Bo.Zod. |
| 4 | .011 | .496 | .360 | -6.0 | 21.7 | 21.0 | 029 | 125 | 035 | 82 | 38 | 80 | S E by E | S E by S | W S W | W 35 S | 1.05 | 6.04 | 22.20 | ... | 1.34 | Do. 4. | Snow. | Str. 2, ft. Au.Br. |
| 5 | .710 | .647 | .025 | 14.0 | 28.0 | 17.5 | 086 | 129 | 100 | 82 | 74 | 84 | W | S W by S | S S W | W 34 S | 18.56 | 17.61 | 3.96 | ... | .. | Clear. | Cum. Str. 8. | Snow. |
| 6 | .353 | .320 | .514 | 17.0 | 28.4 | 16.8 | 094 | 144 | 098 | 84 | 82 | 88 | S E by S | N W b W | N W b W | S 9 E | 5.42 | 4.15 | 3.82 | ... | 2.00 | Snow. | Cir. Str. 6. | Str. 4, Aur. Bor. |
| 7 | .750 | .701 | .581 | -3.8 | 26.5 | 13.0 | 033 | 119 | 038 | 83 | 76 | 87 | W S W | S W | S S E | S 40 W | 8.65 | 4.51 | 3.30 | ... | Inp | Clear. | Clear. | Slight snow. |
| 8 | .469 | .516 | .742 | 10.7 | 14.8 | -2.9 | 082 | 089 | 036 | 88 | 81 | 84 | W by S | W by N | W N W | W 12 S | 3.08 | 15.67 | 25.67 | ... | ... | Cum. Str. 6. | Cum. Str. 4. | Clear. Aur. Bor. |
| 9 | .843 | .790 | .846 | 10.0 | 10.1 | -4.7 | 023 | 055 | 034 | 77 | 68 | 89 | W S W | W S W | W S W | W 17 S | 13.64 | 14.62 | 12.06 | ... | ... | Clear. | Clear. | Do. [Zod. Light. |
| 10 | .804 | .631 | .610 | 16.3 | 9.0 | 3.0 | 031 | 063 | 048 | 82 | 73 | 84 | S W | S W | S W | W 44 S | 3.40 | 11.50 | 1.20 | ... | ... | Do. | Do. | Str. 4, Lun. Ha. |
| 11 | .530 | .264 | .382 | 12.0 | 18.3 | 2.5 | 030 | 105 | 046 | 83 | 87 | 84 | W S W | W | N W b N | W 30 S | 7.09 | 12.06 | 20.81 | ... | 1.00 | Snow. | Snow. | Cum. 4. |
| 12 | .426 | .405 | .577 | -5.0 | 13.0 | 3.4 | 031 | 068 | 054 | 82 | 67 | 80 | W S W | W by N | W by S | W 8 S | 8.98 | 19.23 | 9.00 | ... | ... | Clear. | Cir. Cm. Str. 4. | Cum. Str. 4. |
| 13 | .766 | .738 | .850 | -1.0 | 27.8 | 21.3 | 043 | 144 | 111 | 90 | 82 | 83 | W by N | W S W | W N W | W 10 S | 4.41 | 0.82 | 6.31 | ... | ... | Do. | Str. 8. | Do. 10. |
| 14 | .908 | .781 | .817 | 19.5 | 38.4 | 22.7 | 101 | 214 | 120 | 87 | 84 | 82 | W | S W by W | S W by W | W 8 S | 0.09 | 5.69 | 8.32 | ... | ... | Cir. Str. 10 | Clear. | Str. 4. |
| 15 | .739 | .714 | .809 | 20.7 | 32.2 | 25.0 | 118 | 191 | 135 | 88 | 90 | 86 | S W | W | W N W | W 25 S | 5.08 | 5.62 | 13.80 | ... | Inp | Slight snow. | Cir. Cm. Str. 8. | Cum. Str. 8. |
| 16 | .783 | .670 | .751 | 23.0 | 38.7 | 26.7 | 112 | 226 | 128 | 77 | 90 | 76 | W S W | W S W | S W by W | W 12 S | 14.00 | 3.80 | 2.87 | ... | ... | Str. 10. | Cum. Str. 1[illegible] | Do. 10. |
| 17 | .725 | .807 | .929 | 19.0 | 30.1 | 26.8 | 097 | 192 | 119 | 77 | 83 | 71 | W | N W b W | N W b W | W 3 N | 1.63 | 9.14 | 5.00 | ... | ... | Cum. Str. 4. | Do. 6. | Cum. 4. |
| 18 | 30.028 | .967 | .977 | 10.0 | 43.6 | 24.7 | 069 | 177 | 117 | 77 | 58 | 76 | W by N | W S W | S by W | W 33 S | 0.22 | 3.01 | 6.80 | ... | ... | Clear. | Clear. | Clear. |
| 19 | .864 | .612 | .573 | 8.5 | 38.1 | 30.3 | 058 | 207 | 160 | 80 | 84 | 86 | E by N | E by N | S E | E 5 S | 2.53 | 2.47 | 0.63 | . | .. | Do. | Do. | Snow. |
| 20 | .542 | .476 | .580 | 28.5 | 44.1 | 29.7 | 119 | 223 | 160 | 80 | 73 | 86 | W | S S W | W S W | S 3 W | 0.25 | 0.74 | 0.22 | ... | 1.40 | Snow. | Snow. | Cir. Str. 4, hazy. |
| 21 | .574 | .644 | .636 | 30.0 | 50.3 | 28.4 | 160 | 283 | 135 | 86 | 75 | 78 | S W by S | S by W | W by S | S 10 W | 0.06 | 0.00 | 0.30 | .. | ... | Fog. | Cir. Str. 6. | Do. 3, Lun. halo. |
| 22 | .714 | .722 | .718 | 17.0 | 51.0 | 26.7 | 096 | 298 | 119 | 84 | 76 | 73 | N W by N | S by W | N W b W | W 33 N | 0.00 | 0.20 | 0.00 | ... | ... | Do. | Cir. 1. | Cum. Str. 4. |
| 23 | .720 | .689 | .715 | 23.0 | 45.2 | 27.1 | 119 | 221 | 137 | 76 | 71 | 82 | E N E | W by N | S E | S 40 E | 4.02 | 1.62 | Calm | ... | ... | Cir. Cm. Str. 8. | Cir. 2. | Clr. Z.Lt. ft.A.B |
| 24 | .614 | .604 | .561 | 21.7 | 48.1 | 30.0 | 092 | 242 | 160 | 70 | 69 | 86 | N N E | N N E | N E b E | N 34 E | 1.63 | 3.15 | 8.00 | ... | ... | Clear. | Cir. Str. 6. | Do, Zod. Light. |
| 25 | .614 | .634 | .504 | 25.7 | 53.0 | 23.7 | 123 | 230 | 091 | 76 | 57 | 69 | N N E | S W | N W b W | N 35 E | 15.32 | 1.61 | 2.08 | ... | . | Do. | Cum. Str. 6. | Do. Zod. Light. |
| 26 | .424 | .325 | .314 | 17.6 | 39.0 | 29.1 | 088 | 214 | 152 | 72 | 84 | 85 | W N W | W N W | N W b W | W 3 N | 3.27 | 17.54 | 14.60 | ... | .. | Do. | Do. 6. | Do. Zod. Light. |
| 27 | .357 | .352 | .403 | 19.0 | 24.6 | 16.4 | 080 | 112 | 084 | 70 | 71 | 73 | N W b W | W | N W | W 15 N | 22.40 | 13.00 | 14.05 | ... | .. | Cir. Str. 4 | Do. 10. | Do. |
| 28 | .398 | .336 | .410 | 7.0 | 13.1 | 11.7 | 054 | 083 | 060 | 79 | 82 | 78 | W N W | W N W | W N W | W 21 N | 12.67 | 20.05 | 20.71 | ... | 1.15 | Cir. Cm. St. 10. | Snow. | Snow. |
| 29 | .516 | .546 | .671 | 10.6 | 23.0 | 20.0 | 092 | 112 | 101 | 88 | 77 | 78 | W by S | W by N | N W | W 17 N | 24.06 | 4.14 | 12.12 | ... | 1.43 | Snow. | Cir. Str. 8. | Cir. Str. 10. |
| 30 | .751 | .787 | .916 | 12.7 | 23.0 | 11.3 | 077 | 112 | 070 | 78 | 77 | 73 | W by N | W by N | W N W | W 17 N | 20.40 | 8.82 | 13.83 | ... | Inp | Cir. Str. 10. | Do. 10. | Do. |
| 31 | 30.026 | 30.056 | 30.130 | 10.4 | 39.0 | 19.4 | 082 | 169 | 114 | 88 | 71 | 87 | W N W | S W | S W | W 23 S | 7.62 | 0.61 | 3.40 | .. | | Cir. Cm. Str. 4. | Clear. | Clear. Zod. Light. |

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

(NINE MILES WEST OF MONTREAL.)

BY CHARLES SMALLWOOD, M. D.

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

| Day. | Barom. corrected and reduced to 32° Fahr. 6 A.M. | 2 P.M. | 10 P.M. | Temp. of the Air. 6 A.M. | 2 P.M. | 10 P.M. | Tension of Vapor. 6 A.M. | 2 P.M. | 10 P.M. | Humidity of Air. 6 A.M. | 2 P.M. | 10 P.M. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 29.626 | 29.430 | 29.267 | —4.5 | 4.7 | 9.1 | .036 | .056 | .057 | .89 | 96 | .91 |
| 2 | .860 | .312 | 409 | 5.5 | 8.9 | —1.0 | 051 | 059 | 038 | 80 | 79 | 83 |
| 3 | .393 | .311 | .415 | —4.5 | 4.0 | .0 | 033 | 033 | 039 | 87 | 84 | 87 |
| 4 | .436 | .512 | .566 | 2.6 | 8.1 | 2.0 | 047 | 065 | 040 | 86 | 82 | 85 |
| 5 | .750 | .781 | .987 | —1.1 | 9.9 | 5.1 | 038 | 061 | 053 | 84 | 79 | 85 |
| 6 | 30.216 | 30.168 | 30.126 | 10.2 | 18.[illegible] | 13.5 | 072 | 094 | 081 | 91 | 65 | 93 |
| 7 | 29.796 | 29.531 | 29.517 | 14.[illegible] | 27.0 | 17.7 | 080 | 140 | 09[illegible] | 90 | 83 | 91 |
| 8 | .744 | .785 | .796 | 9.0 | 14.[illegible] | —2.5 | 067 | 078 | 032 | 90 | 81 | 71 |
| 9 | .746 | .615 | 781 | 0.1 | 19.[illegible] | 3.0 | 041 | 059 | 048 | 82 | 76 | 80 |
| 10 | .815 | 759 | .741 | 5.0 | 28.5 | 18.0 | 058 | 136 | 101 | 90 | 81 | 90 |
| 11 | .565 | .365 | .240 | 29.2 | 38.8 | 30.4 | 159 | 214 | 177 | 94 | 86 | 95 |
| 12 | 28.781 | .016 | .414 | 31.9 | 11.6 | —6.5 | 191 | 077 | 029 | 90 | 83 | 81 |
| 13 | 29.835 | .802 | .875 | —21.1 | 3.[illegible] | —9.5 | 015 | 032 | 024 | 79 | 70 | 80 |
| 14 | .924 | 810 | .742 | —11.8 | 8.5 | 1.3 | 021 | 066 | 043 | 82 | 80 | 86 |
| 15 | .541 | .487 | .202 | 6.0 | 25.5 | 13.1 | 058 | 127 | 074 | 90 | 84 | 85 |
| 16 | .100 | .064 | .033 | 20.4 | 25.2 | 18.6 | 103 | 118 | 101 | 87 | 79 | 89 |
| 17 | 031 | .160 | 150 | 17.0 | 15.4 | 9.0 | 089 | 098 | 060 | 89 | 90 | 86 |
| 18 | .270 | .303 | .501 | 2.0 | 6.4 | 7.4 | 033 | 059 | 655 | 81 | 79 | 80 |
| 19 | .714 | .703 | .725 | 7.2 | 17.1 | 10.2 | 057 | 087 | 065 | 82 | 80 | 84 |
| 20 | .521 | .409 | .449 | 18.1 | 30.7 | 25.1 | 088 | 152 | 135 | 79 | 81 | 86 |
| 21 | .423 | .323 | .447 | 23.4 | 34.0 | 29.1 | 118 | 165 | 161 | 89 | 72 | 89 |
| 22 | .551 | .572 | .570 | 15.6 | 38.4 | 19.6 | 095 | 210 | 110 | 87 | 85 | 88 |
| 23 | 416 | .270 | .330 | 18.0 | 28.3 | 21.0 | 086 | 144 | 118 | 84 | 83 | 87 |
| 24 | .481 | .465 | .524 | 10.2 | 19.7 | 15.2 | 074 | 089 | 081 | 82 | 68 | 77 |
| 25 | .446 | .432 | .435 | 10.0 | 30.8 | 20.7 | 076 | 168 | 111 | 84 | 81 | 83 |
| 26 | 570 | .595 | .746 | 15.2 | 29.2 | 20.9 | 099 | 152 | 099 | 90 | 85 | 86 |
| 27 | 850 | .752 | .748 | 3.8 | 32.7 | 16.2 | 050 | 161 | 098 | 83 | 78 | 88 |
| 28 | .874 | .816 | .856 | —3.5 | 32.3 | 11.0 | 033 | 107 | 072 | 83 | 80 | 81 |
| 29 | .865 | .874 | .912 | 0.0 | 31.7 | 10.4 | 048 | 160 | 092 | 90 | 80 | 83 |

| Day. | Direction of Wind. 6 A.M. | 2 P.M. | 10 P.M. | Mean direction of Wind. | Velocity in miles per hour. 6 A.M. | 2 P.M. | 10 P.M. | 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. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | N E by E | N E by E | N E by E | E 22° N | 2.60 | 8.40 | 7.15 | .. | 2.20 | Cir. Cm. St. 4. | Snow. | Clear. |
| 2 | W | W by S | W by S | W 1 S | 4.15 | 11.57 | 9.01 | .. | ... | Clear. | Cum. Str. 4 | Do. Zod. Light. |
| 3 | W by S | W by S | W | W 11 S | 13.60 | 16.15 | 20.87 | .. | 1.20 | Do. | Do. 6. | Snow. |
| 4 | W by S | W by S | W by S | W 11 S | 8.40 | 11.45 | 12.80 | | Inp | Cir. Str. 10. | Do. 4. | Cir. Str. 4. |
| 5 | W by N | W | W by S | W 2 N | 6.00 | 16.10 | 7.80 | | Inp | Do. 8. | Do. 8. | Clear Zod. Lt. |
| 6 | W S W | S W by W | S W b W | W 21 S | 1.47 | 2.27 | 0.45 | | .. | Cir. Cm. St. 6. | Cir. Cm. St 10 | Cir. Str. 10. |
| 7 | E N E | S E by S | S S W | E 16 S | 0.01 | 0.01 | Calm | . | 2.45 | Snow. | Snow. | Do. 10. |
| 8 | W | S W by W | S E by E | W 13 S | 10.27 | 3.13 | 4.40 | .. | ... | Str. 2. | Clear. | Clear. |
| 9 | N E by N | S W | W by S | S 25 W | 0.30 | 0.33 | 3.06 | .. | .. | Cum. Str. 4. | Do. | Do. Aur. Bor. |
| 10 | S | S by E | S by W | S 24 W | 0.66 | 0.07 | 2.66 | ... | .. | Do 6. | Cum. Str. 6. | Cum. Str. 10. |
| 11 | S W by W | S W by W | E by N | S 30 E | 5.80 | 6.66 | 0.21 | . | 1.45 | Do 10. | Snow. | Do. 10. |
| 12 | S | W by N | W N W | W 10 N | 4.22 | 22.61 | 29.27 | ... | 0.55 | Snow. | Cum. Str. 6 | Do. 10. |
| 13 | W S W | W S W | W S W | W 23 S | 16.87 | 9.05 | 9.12 | | . | Clear. | Clear. | Clear. |
| 14 | W S W | S W by W | S S E | W 21 S | 3.88 | 4.63 | 6.30 | | .. | Do. | Do. | Cir. Cm. Str 4. |
| 15 | S | S S E | S S E | S 3 W | 3.18 | 6.21 | 0.31 | ... | ... | Cum. Str. 10 | Cir. Cm. St. 6. | Do. 10. |
| 16 | E by E | S by E | E N E | E 3 N | 1.61 | 0.81 | 3.92 | .. | 1.20 | Snow. | Cum. Str. 10. | Cum. Str. 10. |
| 17 | S W by W | W S W | W N W | W 18 S | 10.18 | 20.10 | 18.74 | ... | 2.60 | Snow. | Snow. | Str. 10. |
| 18 | W | W | W N W | W 14 N | 22.11 | 21.40 | 24.48 | .. | ... | Cum. Str. 10. | Cum. Str. 10. | Cum. Str. 10. |
| 19 | W N W | W S W | S W b W | W 6 N | 20.72 | 24.01 | 20.25 | .. | .. | Do. 4. | Clear. | Clear. |
| 20 | W S W | W by S | W S W | W 25 S | 10.21 | 6.40 | 4.21 | ... | ... | Str. 10. | Cum. Str. 6. | Str. 10. |
| 21 | W N W | W | W N W | W 2 N | 7.4 | 16.18 | 12.30 | ... | .. | Cir. Str. 6. | Do. 10. | Clear. [d. 41° |
| 22 | W S W | W S W | W N W | W 3 S | 4.[illegible] | 7.05 | 2.12 | ... | ... | Clear. | Clear. | C.C.Str.4 L.H. |
| 23 | E N E | E N E | W N W | N 5 E | 0.17 | 3.71 | 0.56 | . | ... | Cum. Str. 10. | Cir. Cm. St. 8. | C. Str. 10 Z. L. |
| 24 | W | W | W N W | W 15 N | 0.25 | 8.53 | 11.55 | ... | .. | Cir. Str. 6. | Cum. Str. 10. | Str. 8. Au. Bor. |
| 25 | S W | W S W | W N W | W 10 S | 0.16 | 7.44 | 9.22 | ... | ... | Str. 10. | Do. 4. | Do. 10. |
| 26 | W by N | W by N | N W | W 27 N | 11.66 | 10.35 | 13.43 | ... | ... | Clear. | Clear. | Cir. Z. L. A. B. |
| 27 | S S W | S by W | N E | S 43 W | 6.95 | 0.93 | 0.92 | ... | ... | Do. | Do. | Do. Z L E 79.32 |
| 28 | S W | S | W by S | W 36 S | 1.17 | 0.01 | 0.01 | ... | ... | Do. | Do. | Do. |
| 29 | W S W | W S W | W S W | W 30 S | 0.16 | Calm | 0.30 | ... | ... | Str. 10. | Cum. Str. 10. | Do. Zod. Lt. |

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

| | | |
|---|---|---|
| Barometer | Highest, the 6th day | 30.216 |
| | Lowest, the 12th day | 28.781 |
| | Monthly Mean | 29.561 |
| | Monthly Range | 1.435 |
| Thermometer | Highest, the 22nd day | 36°.6 |
| | Lowest, the 13th day | −21°.4 |
| | Monthly Mean | 13°.40 |
| | Monthly Range | 58°.00 |
| Greatest Intensity of the Sun's Rays | | 87°.5 |
| Lowest Point of Terrestrial Radiation | | −22°.6 |
| Mean of Humidity | | .845 |

No rain fell during the month.

Snow fell on 9 days, amounting to 11.66 inches; it was snowing 16 hours 20 minutes.

The most prevalent Wind was W by S—1147.70 miles.

The least prevalent Wind was E—1.00 miles.

The most windy day was the 18th; mean miles per hour, 22.66.

The least windy day was the 7th; mean miles per hour, 0.06.

Most windy hour, from 9 till 10, a. m., on the 12th—41.10 miles.

Aurora Borealis visible on 3 nights—might have been seen on 13 nights—impossible on 13 nights.

Zodiacal Light unusually bright and well defined.

Winds resolved into the four cardinal points, N 71.90,—S 280.00,—W 4834.80,—E 277.20—total miles, 5463,90.

Ozone—was in moderate quantity.

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

Electrometer almost constantly affected.

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

| | | |
|---|---|---|
| Barometer | Highest, the 31st day | 30.130 |
| | Lowest, the 2nd day | 29.065 |
| | Monthly Mean | 29.647 |
| | Monthly Range | 1.065 |
| Thermometer | Highest, the 24th day | 54°.2 |
| | Lowest, the 10th day | −17°.1 |
| | Monthly Mean | 25°.7 |
| | Monthly Range | 71°.3 |
| Greatest Intensity of the Sun's Rays | | 119°.4 |
| Lowest Point of Terrestrial Radiation | | −18°.2 |
| Mean of Humidity | | .804 |

Snow fell on 10 days, amounting to 11.47 inches; it was snowing 77 hours 55 minutes.

No rain during the month,—it is now a period of 100 days since rain fell.

The most prevalent Wind was W—1119.20 miles.

The least prevalent Wind was W by S—1.00 miles.

The most windy day was the 28th; mean miles per hour, 17.82.

The least windy day was the 22nd mean miles per hour, 0.06.

Most windy hour, from 8 till 9. a. m., 2nd day—39.50 miles;—total miles traversed by the wind, 5866.40—resolved with the Four Cardinal Points, gives N 674.80 miles, S 917.30 miles, W 3706.60 miles, E 567.70 miles.

There were 177 hours of calm during the month.

Aurora Borealis visible on 5 nights—might have been seen on 14 nights—impossible on 12 nights.

Zodiacal Light visible.

Lunar Halo seen on 2 nights.

Ozone—was in rather large quantity.

The electrical state of the atmosphere has been marked by high tension, the Electrometer has been almost constantly affected.

Crows first seen here on the 19th day.

# MONTHLY METEOROLOGICAL REGISTER, QUEBEC, CANADA EAST, FEBRUARY, 1856.

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

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

| Date. | Barometer corrected and reduced to 32 degrees, Fahr. 6 A.M. | 2 P.M. | 10 P.M. | MEAN. | Temp. of Air. 6 A.M. | 2 P.M. | 10 P.M. | M'N. | Tens. of Vapour. 6 A.M. | 2 P.M. | 10 P.M. | M'N | Humid'y of Air. 6 A.M. | 2 P.M. | 10 P.M. | M'N | Direc'n of Wind. 6 A.M. | 2 P.M. | 10 P.M. | Vel'ty of Wind. 6 A.M. | 2 P.M. | 10 P.M. | Rain in Inches. | Snow in Inches. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | ° | ° | ° | ° | | | | | | | | | | | | | | | | |
| 1 | 29.626 | 29.457 | 29.230 | 29.438 | 5.3 | 8.9 | 12.0 | 8.7 | .038 | .054 | .078 | .057 | 1.00 | 0.77 | 0.97 | 0.91 | Calm. | E | E N E | 0.0 | 6.2 | 10.9 | ... | 4.0 |
| 2 | .000 | .042 | .108 | .082 | 11.6 | 10.7 | 1.4 | 7.0 | 066 | 048 | .041 | 052 | 83 | 63 | 80 | 75 | E N E | E N E | W N W | 3.8 | 14.7 | 9.3 | ... | 0 5 |
| 3 | .008 | 28.979 | .083 | .023 | - 3.1 | 1.6 | - 7.6 | - 1.0 | 035 | 051 | 045 | 014 | 81 | 1.00 | 1.00 | 94 | W N W | W | W | 17.2 | 22.7 | 21.3 | ... | ... |
| 4 | .183 | 29.235 | .380 | .249 | - 3.4 | 1.6 | 0.4 | - 0.5 | 024 | 036 | 037 | 030 | 58 | 59 | 75 | 64 | W N W | W N W | W N W | 23.0 | 20.3 | 12.9 | ... | ... |
| 5 | .419 | .516 | .766 | .537 | 0.1 | 8.9 | 9.8 | 6.3 | 015 | 045 | 039 | 043 | 93 | 64 | 59 | 72 | W N W | W N W | W N W | 18.9 | 11.3 | 10.9 | ... | ... |
| 6 | 30.020 | 30.006 | 30.012 | 30.013 | 5.5 | 15.2 | 13.5 | 11.4 | 042 | 050 | 038 | 058 | 68 | 55 | 77 | 67 | W N W | W N W | Calm. | 10.0 | 6.2 | 0.0 | ... | ... |
| 7 | 29.877 | 29.522 | 29.362 | 29.587 | 11.8 | 17.2 | 18.8 | 15.9 | 066 | 099 | 098 | 088 | 82 | 1.00 | 91 | 91 | E S E | E | Calm. | 3.8 | 10.9 | 0.0 | ... | ... |
| 8 | .469 | .597 | .620 | .562 | 19.1 | 12.8 | 4.3 | 12.1 | 092 | 061 | 044 | 067 | 85 | 77 | 76 | 79 | W S W | N | Calm. | 8.8 | 6.2 | 0.0 | ... | 3.0 |
| 9 | .594 | .487 | .561 | .547 | 5.7 | 11.2 | 6.8 | 7.7 | 043 | 060 | 037 | 047 | 69 | 77 | 58 | 68 | E | W N W | W N W | 15.6 | 14.7 | 14.7 | ... | 0.5 |
| 10 | .720 | .662 | .579 | .654 | - 0.4 | 11.7 | 14.2 | 8.5 | 035 | 057 | 072 | 055 | 74 | 71 | 82 | 76 | Calm. | Calm. | Calm. | 0.0 | 0.0 | 0.0 | ... | 1.0 |
| 11 | .480 | .380 | .158 | .342 | 19.2 | 28.1 | 28.9 | 25.4 | 108 | 154 | 160 | 141 | 1.00 | 1.00 | 1.00 | 1.00 | Calm. | Calm. | W N W | 0.0 | 0.0 | 3.8 | ... | 2.6 |
| 12 | 28.744 | 28.579 | 28.999 | 28.774 | 30.6 | 19.1 | - 4.6 | 15.0 | 171 | 070 | 025 | 089 | 1.00 | 65 | 64 | 76 | Calm | W S W | W N W | 0.0 | 14.3 | 19.4 | ... | 6 0 |
| 13 | 29.305 | 29 513 | 29.621 | 29.510 | -17.4 | 9.7 | - 8.8 | -11.8 | 011 | 018 | 018 | 016 | 58 | 58 | 54 | 57 | W N W | W N W | W N W | 22.1 | 20.6 | 15.6 | ... | 1.4 |
| 14 | .677 | .611 | .629 | .639 | -15.8 | 0.9 | - 2.0 | - 5.8 | 015 | 030 | 039 | 028 | 62 | 60 | 87 | 70 | W N W | W N W | W N W | 13.4 | 10.9 | 5.2 | ... | ... |
| 15 | .540 | .328 | .245 | .371 | - 2.8 | 11.2 | 11.9 | 6.8 | 013 | 051 | 054 | 049 | 1.00 | 65 | 67 | 77 | Calm | Calm. | Calm. | 0.0 | 0.0 | 0.0 | ... | ... |
| 16 | .104 | .014 | 28.997 | .038 | 14.8 | 22.2 | 20.7 | 19.2 | 063 | 102 | 104 | 090 | 70 | 83 | 89 | 81 | E N E | E N E | Calm. | 35.9 | 24.0 | 0.0 | ... | 2.0 |
| 17 | 28.915 | 28.808 | .718 | 28.814 | 15.6 | 23 6 | 19.6 | 19.6 | 003 | 114 | 080 | 076 | 1.00 | 87 | 72 | 86 | E N E | E N E | W S W | 5.8 | 21.6 | 19.0 | ... | ... |
| 18 | .775 | .880 | 29.068 | .908 | 10.1 | 9.4 | 6.3 | 8.6 | 045 | 045 | 063 | 051 | 61 | 63 | 1.00 | 75 | W | W | W | 23.6 | 19.4 | 52.0 | ... | 3.5 |
| 19 | 29.319 | 29 402 | .455 | 29.392 | 5.5 | 17.6 | 14.2 | 12.4 | 043 | 054 | 051 | 049 | 69 | 53 | 58 | 60 | W | W | W | 35.0 | 39.4 | 29.0 | ... | 1.0 |
| 20 | .359 | .217 | .131 | .236 | 9.6 | 23.4 | 24.3 | 19.1 | 057 | 091 | 106 | 085 | 79 | 70 | 80 | 76 | W | W | W | 10.0 | 7.2 | 6.2 | ... | ... |
| 21 | .142 | .147 | .211 | .167 | 18.9 | 25.2 | 21.2 | 21.8 | 062 | 103 | 092 | 086 | 58 | 79 | 78 | 72 | W N W | W N W | W N W | 17.6 | 14.7 | 11.5 | ... | ... |
| 22 | .257 | .363 | .362 | .327 | 18.7 | 24.5 | 16.9 | 20.0 | 078 | 095 | 098 | 090 | 75 | 66 | 72 | 71 | W N W | W N W | Calm. | 3.8 | 14.7 | 0.0 | ... | ... |
| 23 | .323 | .193 | .170 | .272 | 28.9 | 23.7 | 14.7 | 22.4 | 074 | 033 | 112 | 092 | 75 | 56 | 86 | 72 | Calm | Calm. | W N W | 0.0 | 0.0 | 3.8 | ... | ... |
| 24 | .141 | .195 | .233 | .190 | 16.4 | 21.0 | 15.8 | 17.7 | 080 | 06[illegible] | 052 | 065 | 82 | 51 | 55 | 64 | W S W | W N W | W N W | 14.7 | 10.9 | 12.9 | ... | 0.5 |
| 25 | .227 | .170 | .177 | .191 | 9.3 | 20.3 | 20.8 | 16.8 | 050 | 076 | 059 | 061 | 70 | 66 | 57 | 64 | W N W | W N W | W | 11.5 | 17.6 | 8.8 | .. | ... |
| 26 | .304 | .307 | .452 | .354 | 11.8 | 25.1 | 14.5 | 17.1 | 056 | 076 | 082 | 065 | 70 | 55 | 69 | 65 | W N W | W N W | W N W | 19.0 | 16.0 | 11.3 | ... | ... |
| 27 | .619 | .523 | .575 | .569 | 11.1 | 26.9 | 17.0 | 18.3 | 018 | 045 | 035 | 012 | 62 | 29 | 35 | 42 | W N W | W N W | W N W | 11.3 | 12.9 | 3.8 | ... | ... |
| 28 | .640 | .603 | .646 | .630 | 6.8 | 21.1 | 22.4 | 16.8 | 034 | 06[illegible] | 017 | 018 | 53 | 53 | 57 | 54 | W S W | S W | Calm. | 4.0 | 3.8 | 0.0 | ... | ... |
| 29 | .701 | .711 | .759 | .724 | 6 0 | 25.2 | 12.2 | 14.5 | 015 | 052 | 013 | 017 | 71 | 39 | 53 | 54 | W S W | W S W | W S W | 3.8 | 9.3 | 5.2 | ... | ... |
| M | 29.3081 | 29.3258 | 29.3536 | 29.3559 | 8.26 | 15.87 | 11.91 | 11.99 | 0573 | 0671 | 0643 | 0820 | .762 | .670 | .734 | .722 | | | | 11.2 | 12.7 | 10.1 | ... | 26.0 |

REMARKS.

12th—Halo round moon 35° in diameter.

18th—Solar halo 45° in diameter. Between 10 and 11, p.m., velocity of gusts of wind 70 miles per hour.

Auroral light observed on the 2nd. 8th. 9th, 13th, 24th, 25th, 26th, 27th, 28th, 29th.

Auroral arch and streamers on the 14th.

# MONTHLY METEOROLOGICAL REGISTER, QUEBEC, CANADA EAST, MARCH, 1855.

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

*Latitude*, 46 *deg.* 49.2 *min. North*; *Longitude*, 71 *deg.* 16 *min. West.* *Elevation above the level of the Sea*, 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. | | | 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. | 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 | 29.920 | 29.575 | 29. 03 | 29.367 | 4.5 | 17.5 | 8.8 | 10.3 | .035 | .048 | .048 | .041 | 0.60 | 0.48 | 0.69 | 0.59 | W N W | W S W | Calm. | 10.9 | 17.2 | 0.0 | ... | ... |
| 2 | .561 | .149 | 28.997 | .236 | 13.2 | 12.4 | 10.0 | 11.9 | 056 | 082 | 073 | 070 | 66 | 1.00 | 1.00 | 89 | E | E | E | 41.0 | 50.3 | 35.9 | ... | 8.0 |
| 3 | .142 | .379 | 29.645 | .389 | 5.9 | 13.2 | 12.5 | 10.8 | 043 | 050 | 050 | 048 | 69 | 60 | 61 | 63 | Calm. | W | W | 0.0 | 17.2 | 10.9 | ... | ... |
| 4 | .870 | .602 | .183 | .552 | 2.7 | 18.1 | 18.6 | 13.1 | 040 | 056 | 105 | 067 | 74 | 54 | 1.00 | 76 | Calm. | W | E N E | 0.0 | 3.8 | 13.4 | ... | 4.0 |
| 5 | .382 | .475 | .507 | .451 | 10.5 | 21.5 | 15.7 | 15.9 | 058 | 085 | 087 | 076 | 77 | 55 | 93 | 75 | W S W | W N W | S E | 10.0 | 5.2 | 3.8 | ... | 1.5 |
| 6 | .368 | .186 | .345 | .300 | 12.2 | 21.0 | 18.2 | 17.1 | 066 | 090 | 087 | 081 | 81 | 77 | 84 | 81 | Calm. | E S E | Calm | 0.0 | 5.2 | 0.0 | ... | 3.4 |
| 7 | .405 | .641 | .516 | .517 | 5.2 | 15.1 | 9.4 | 9.9 | 036 | 042 | 045 | 041 | 59 | 46 | 63 | 56 | W | W | W | 8.8 | 6.2 | 5.2 | ... | ... |
| 8 | .370 | .286 | .422 | .359 | 8.9 | 21.1 | - 1.6 | 9.5 | 057 | 035 | 031 | 038 | 81 | 73 | 69 | 74 | Calm. | W | W | 0.0 | 7.2 | 12.9 | .. | 1.0 |
| 9 | .496 | .529 | .598 | .538 | - 9.5 | 2.2 | - 2.8 | - 3.4 | 018 | 030 | 027 | 025 | 58 | 58 | 63 | 60 | W N W | W N W | W N W | 20.3 | 23.0 | 22.6 | ... | ... |
| 10 | .536 | .447 | .439 | .474 | -10.8 | 3.5 | - 1.1 | - 2.8 | 017 | 026 | 026 | 023 | 57 | 46 | 58 | 54 | W | W | Calm. | 3.8 | 8.8 | 0.0 | ... | ... |
| 11 | .328 | .079 | .007 | .138 | - 3.7 | 15.2 | 2.1 | 4.5 | 031 | 055 | 032 | 039 | 76 | 60 | 61 | 66 | Calm. | W | W | 0.0 | 5.2 | 15.6 | ... | ... |
| 12 | .088 | .142 | .366 | .199 | - 6.7 | 7.8 | 0.6 | 0.6 | 026 | 041 | 034 | 034 | 72 | 61 | 68 | 67 | W N W | W S W | W S W | 17.2 | 18.3 | 10.9 | .. | ... |
| 13 | .385 | .580 | .665 | .543 | 3.9 | 19.3 | 16.2 | 13.1 | 033 | 062 | 063 | 053 | 58 | 57 | 65 | 60 | W S W | S W | Calm. | 16.5 | 20.3 | 0.0 | .. | ... |
| 14 | .730 | .685 | .621 | .679 | 10.9 | 29.5 | 22.5 | 21.0 | 055 | 111 | 115 | 091 | 72 | 67 | 92 | 77 | W | W | Calm. | 8.8 | 7.2 | 0.0 | ... | .5 |
| 15 | .593 | .515 | .569 | .559 | 16.9 | 30.3 | 21.7 | 23.0 | 070 | 113 | 071 | 085 | 71 | 66 | 59 | 65 | W | S W | S W | 5.2 | 5.2 | 6.2 | ... | .6 |
| 16 | .611 | .507 | .529 | .519 | 16.2 | 30.9 | 23.7 | 23.6 | 065 | 100 | 096 | 087 | 67 | 58 | 74 | 66 | N N W | W S W | W S W | 9.3 | 6.2 | 5.2 | ... | .2 |
| 17 | .625 | .638 | .740 | .668 | 22.3 | 30.4 | 23.0 | 25.2 | 080 | 078 | 094 | 081 | 65 | 46 | 66 | 59 | W S W | W S W | W S W | 5.2 | 5.2 | 5.2 | ... | ... |
| 18 | .849 | .757 | .818 | .808 | 10.4 | 30.4 | 23.2 | 21.3 | 043 | 063 | 072 | 059 | 57 | 37 | 56 | 51 | W S W | W S W | W S W | 8.8 | 3.6 | 2.1 | ... | ... |
| 19 | .784 | .498 | .443 | .575 | 11.8 | 37.9 | 29.4 | 26.4 | 057 | 074 | 103 | 078 | 71 | 33 | 62 | 55 | W S W | Calm. | Calm | 4.0 | 0.0 | 0.0 | ... | ... |
| 20 | .419 | .394 | .423 | .412 | 29.2 | 38.0 | 31.3 | 32.5 | 111 | 134 | 153 | 133 | 69 | 59 | 87 | 72 | Calm. | Calm. | Calm | 0.0 | 0.0 | 0.0 | .. | ... |
| 21 | .452 | .466 | .531 | .483 | 26.1 | 34.2 | 30.5 | 30.4 | 145 | 165 | 132 | 147 | 1.00 | 84 | 73 | 87 | Calm. | Calm. | Calm | 0.0 | 0.0 | 0.0 | ... | ... |
| 22 | .614 | .608 | .623 | .615 | 25.2 | 32.8 | 30.0 | 29.3 | 107 | 144 | 167 | 135 | 73 | 77 | 1.00 | 83 | E N E | E N E | E N E | 2.0 | 20.3 | 21.6 | ... | ... |
| 23 | .631 | .574 | .587 | .597 | 29.1 | 32.1 | 28.8 | 30.0 | 149 | 145 | 188 | 141 | 92 | 80 | 86 | 86 | E N E | E N E | E N E | 23.2 | 23.9 | 22.1 | ... | ... |
| 24 | .591 | .500 | .492 | .528 | 22.5 | 32.5 | 29.0 | 28.0 | 090 | 138 | 138 | 122 | 72 | 75 | 86 | 78 | E | E N E | Calm. | 5.2 | 6.2 | 0.0 | ... | ... |
| 25 | .488 | .365 | .330 | .304 | 21.0 | 35.2 | 24.7 | 27.0 | 091 | 193 | 112 | 114 | 70 | 72 | 83 | 75 | Calm. | Calm. | Calm. | 0.0 | 0.0 | 0.0 | ... | ... |
| 26 | .207 | .080 | .087 | .125 | 23.0 | 31.8 | 25.0 | 26.6 | 055 | 072 | 077 | 068 | 44 | 40 | 58 | 47 | W N W | W N W | W N W | 19.3 | 10.9 | 13.4 | ... | In p |
| 27 | .031 | .150 | .172 | .134 | 18.9 | 23.5 | 17.7 | 20.0 | 073 | 073 | 069 | 072 | 68 | 57 | 68 | 64 | W | W N W | W N W | 12.4 | 10.0 | 6.2 | ... | In p |
| 28 | .081 | 28.987 | .064 | .044 | 14.7 | 15.2 | 13.3 | 14.4 | 075 | 091 | 084 | 083 | 83 | 98 | 99 | 93 | W N W | W N W | W N W | 10.0 | 11.3 | 14.3 | ... | 3.6 |
| 29 | .206 | 29.271 | .427 | .301 | 10.0 | 22.3 | 18.1 | 16.8 | 044 | 066 | 069 | 060 | 60 | 54 | 67 | 60 | W N W | W N W | W N W | 14.7 | 15.6 | 23.0 | ... | ... |
| 30 | .523 | .519 | .665 | .579 | 14.5 | 20.6 | 17.4 | 17.5 | 054 | 068 | 083 | 068 | 61 | 59 | 83 | 68 | W N W | W N W | W N W | 12.9 | 16.0 | 13.4 | ... | ... |
| 31 | .882 | .879 | .982 | .914 | 16.2 | 30.1 | 20.3 | 22.2 | 073 | 071 | 074 | 073 | 82 | 42 | 65 | 63 | E N E | Calm. | N W | 3.8 | 0.0 | 3.9 | ... | ... |
| M | .4935 | .4417 | .4729 | .4691 | 12.11 | 23.41 | 17.29 | 17.60 | .0627 | .0851 | .0891 | .0786 | .698 | .612 | .749 | .698 | | | | 8.5 | 10.6 | 8.6 | ... | 22.8 |

**REMARKS.**

9th—Aurora appeared suddenly at 10, p. m.; streamers but no arch.

10th—Corona round moon.

19th—At 10, p. m., halo 40° in diameter round the moon.

20th—Circle round sun at 3, p. m., and a lunar corona at 10, p. m.

21st—Heavy fog from 6 to 9, a. m.

23rd—Aurora was observed through a break in the clouds.

Displays of aurora observed on the 1st, 9th, 17th. 23rd and 31st.

Auroral light on the 3d, 4th, 5th, 7th. 8th. 10th, 11th, 21st, 24th. 25th. 27th and 28th.

## REMARKS ON THE QUEBEC METEOROLOGICAL REGISTER FOR FEBRUARY.

| | |
|---|---|
| Maximum Barometer, 6 a.m. on the 6th | 30.020 |
| Minimum Barometer, 2 p.m. on the 12th | 28.579 |
| Monthly Range | 1.441 |
| Monthly Mean | 29.3561 |
| Maximum Thermometer on the 12th | 31°9 |
| Minimum Thermometer on the 13th | —18.0 |
| Monthly Range | 49.9 |
| Mean Maximum Thermometer | 17.80 |
| Mean Minimum Thermometer | 3.04 |
| Mean daily Range | 14.25 |
| Mean monthly Temperature | 11.90 |
| Greatest daily Range of Thermometer, on 12th | 49°3 |
| Least daily Range of Thermometer, on 18th | 5°5 |
| Warmest Day, 11th. Mean Temperature | 25.4 |
| Coldest Day, 13th. Mean Temperature | —11.8 |
| Climatic Difference | 37.2 |

Possible to see Aurora on 13 nights.
Aurora visible on 11 nights.
No Rain fell.
Total quantity of Snow, 26.0 inches.
Snow fell on 12 days.

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## REMARKS ON THE QUEBEC METEOROLOGICAL REGISTER FOR MARCH.

| | |
|---|---|
| Maximum Barometer, 10 p.m. on the 31st | 29.982 |
| Minimum Barometer, 2 p.m. on 23th | 28.987 |
| Monthly Range | .995 |
| Monthly Mean | 29.4694 |
| Maximum Thermometer, on the 19th | 39°0 |
| Minimum Thermometer, on the 10th | —11.0 |
| Monthly Range | 50.0 |
| Mean Maximum Thermometer | 24.28 |
| Mean Minimum Thermometer | —9.11 |
| Mean daily Range | 15 17 |
| Mean monthly Temperature | 17.60 |
| Greatest daily Range of Thermometer, 8th | 31.1 |
| Least daily Range of Thermometer, 2nd | 7.3 |
| Warmest day, 20th | 32.8 |
| Coldest day, 9th | —3.4 |
| Climatic difference | 36.2 |

Possible to see Aurora on 19 nights.
Aurora observed on 17 nights.
No Rain fell.
Total quantity of Snow, 22.8 inches.
Snow fell on 11 days.

## MONTREAL NATURAL HISTORY SOCIETY.

*Ordinary Monthly Meeting—March*, 1856.

L. A. H. Latour, Esq., First Vice-President, in the chair.

The following donations were laid on the table, and ordered to be acknowledged with thanks. viz.—From the Minister *des Colonies Françaises*, through Mr. A. Perry; one pair of sandales du Sénégal, one cartouchiere du Sénégal, and four birds—From W. H. Boulton, Esq., through Mr. Perry, one minie rifle bullet, and a piece of shell gathered on the heights of Sebastopol—From Mr. Perry, a few French coins—From E. Crisp, M. D., (the author) a copy of his work on "Structure and Use of the Spleen"—From L. A. H. Latour, Esq., a copper coin of Ferdinand III. king of Spain, with eleven other copper coins, and five Reports published by order of the Legislature—From Col. Stone, of Plattsburgh, through Mr. Rennie, some bullets taken from old houses on each side of the River Saranac, and an account of the celebration of the Battle of Plattsburg—From Mr. D. Browne, a specimen of soap-stone. The thanks of the Society were unanimously voted to Mr. A. Perry, for his exertions to advance the interests of the Natural History Society while in Paris. Mr. Perry acknowledged the compliment that had been paid him, regretting that he he had been able to do so little for a Society which deserved so well at the hands of the public. It was want of time, however, that prevented him, not want of will. He made many applications for specimens, and, as might be expected, got many refusals. He hoped at the next World's Fair, the Society would make arrangements to have itself specially represented there. He had several other specimens on their way to Montreal for the Society, and hoped they would reach safely. Mr. Perry having also stated to the Society that M. Milner, the Director of the Jardin des Plantes, in Paris, was anxious to put himself into communication with the Society, to obtain possession of specimens of living animals peculiar to this country, it was ordered that the Corresponding Secretary write to M. Milner, offering in the name of the Society to do all in its power to forward his views, and assist him in carrying them out. Dr. Barnston was also requested to open a correspondence with Sir William Hooker, of Kew Gardens, respecting the plants and roots he wishes to procure. Messrs. Dutton and Perry were named a Committee to prepare a paper on the subject of fish-breeding in our rivers, and bring it before the Society at its next ordinary meeting. The meeting then proceeded to ballot, when T. M. Taylor, Esq., James Taylor, Esq., and F. F. Mullins, Esq., were unanimously elected ordinary members.

A. N. Rennie, *Secretary*.

## ERRATA.

*Page* 35—The sentence in the third line of note to description of *Necrophila affinis* should read thus:—*N. Canadensis* is evidently the ♀ (Venus) of *Americana*.

*Page* 38—♂ (Mars, sig. male) should be at the beginning of the description of *O. Bicornis;* and the second paragraph thus:—♀ same color as ♂.