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THE PRESIDENT'S ADDRESS.

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Read before the Canadian Institute, January 13th, 1861.

Gentlemen of the Canadian Institute,

It was with a high appreciation of the honor conferred on me that I acknowledged on a former occasion the distinction of being elected by you to fill this Chair, which had already been successively occupied by men whose names reflect a dignity on any one who may succeed to them; and it is with feelings not less appreciative of the kindness with which you have marked your sense of my hearty zeal in all that pertains to the progress of the Canadian Institute, that I have again to thank you for this renewed testimony of your favor in placing me a second time in the high position of your President.

It is usual on such anniversaries as this to review the more important events which have recently transpired in the world of science; and especially to note what progress has been made within our own Province. During the past year, however, the interest and the energies of Canada have been largely absorbed in proceedings, which, while they had for their special object the inaugural completion of that gigantic triumph of engineering skill which now spans the St. Lawrence, and challenges comparison with the greatest mechanical achievements of ancient or modern times; were chiefly pregnant for all of us with moral and social influences of a high order, though deriving their value from elements apart from those with which Science has chiefly to deal. Now that the glare and excitement attendant on the visit to our colony of the Heir apparent to the British Throne have passed away, and we can look calmly back on that event which gave birth to such enthusiastic demonstrations in every corner of this wide Province, I feel assured that many realize the elevating influences which are begotten by the awakening of pure and lofty sentiments of patriotism and loyalty; and reflect with unalloyed pleasure on the feelings of generous and affectionate interest with which they looked on that son of our loved and gracious Queen on whom rest the future hopes of this great empire. Amid all the cordial expressions of loyalty which greeted our Prince in his progress through this Province, none, I feel assured, were more heartfelt and sincere than those in which the members of this Institute gave utterance to their earnest prayer: that, endowed with all noblest graces and divine blessings, trained in sound learning, and gifted with a liberal love of Science and the Arts, he might be eminently fitted for the high trust of which he is the heir.

Happily it is still our boast that, while, under the genial sway of our beloved Queen, science and letters are accomplishing triumphs which will render the Victorian era illustrious in future ages, we participate in all the glories of that empire—the mother of future nations,—which is now girdling the world with a glorious confederacy of provinces, alike united in freedom, in intellectual progress, and in loyal devotion to their sovereign head; so also, as members of an Institute specially devoted to investigations and researches into the hidden truths of nature, we claim an interest in all the triumphs which mark the progress of Science, wheresoever achieved. In attempting a *résumé* of progress since our last anniversary, I may accordingly be expected to refer to the alleged addition to our solar system of the new planet Vulcan, as one of the most popular among recently announced discoveries. The names of Le Verrier and Adams are indissolubly associated with that beautiful demonstration which, reasoning from the known forces Newton had revealed, determined the existence of the unseen planet Neptune, and with a prescience based on true scientific faith, dictated the precise point in the heavens where, amid the infinite multitudes of stars which the telescope reveals, the astronomer should find the unknown wanderer, that, afar on the verge of our solar system, obeyed the same laws which hold our earth within its annual path, and control the fulfilment for us of the divine promise that "while the earth remaineth, seed time and harvest, cold and heat, summer and winter, and day and night shall not cease."

The perturbations of Uranus had long warned the astronomer of some unknown element present within the remote confines of the system; and more recently the distinguished French discoverer of Neptune had given expression to the belief that certain disturbances in the movements of the planet Mercury must be attributed, in all probability, to a similar cause: when the scientific world was startled by the announcement that, at the opposite extreme of our solar system, within the burning zone which intervenes between Mercury and the sun, the intra-mercurial planet Vulcan had been seen, revolving around the common solar centre within a period of nineteen days and seventeen hours, at a distance from the sun not exceeding eight degrees, and with a mass only one-seventeenth of that of Mercury. The glimmering twilight of Neptune, wandering in its remote orbit, the outer sentinel of our system, long withheld it even from the gaze of the astronomer; and we await the confirmation of this announcement of another planet, still longer hidden in the burning splendor of its orbit by excess of light. But if it should prove true, it will not diminish our interest in the result, that the discovery is due to the self-taught labors of M. Lescarbault, an humble amateur astronomer, working with rude instruments of his own construction.

But from this I pass to other researches in Astronomical Science in which we may claim some personal interest. The year which has closed was specially marked to the Astronomer by a total eclipse of the sun, on the 18th of July, the line of central shadow of which extended from a point near Vancouver's Island eastward to the Labrador Coast, and after traversing the Atlantic, passed across Spain and Northern Africa, terminating finally at the southern extremity of the Red Sea. On this continent, accordingly, an Astronomical expedition was organized by the accomplished superintendent of the U. S. Coast Survey, for the purpose of observing the eclipse at Cape Chudleigh, on the Coast of Labrador, and included in its staff, as a representative of Canadian Science, one of our own members, Lieut. E. D. Ashe, R.N., the director of the Quebec Observatory.

Exposed to unusually tempestuous weather, and precluded from some of the most important observations by the intervention of a thin veil of cloud between them and the sun just previous to its total immersion, the expedition to the Coast of Labrador has not contributed any novel truths to science. The intervening cloud, though but a fleecy veil, of utmost insignificance at any other moment, was sufficiently dense to almost entirely preclude the observation of the corona usually seen surrounding the moon during the period of total eclipse. It was the good fortune of Lieutenant Ashe alone, of all the observers, to catch a single point of brightness and fix its position in the corona; and thus to supply one precise observation for comparison with those simultaneously made in other parts of the globe. But it is of interest to us to know that our New World of the West bore its part, and our own young Province had its representative among those devotees of science who were engaged at widely separate stations: at Hereña, near Miranda de Ebro, and at Tarazona, in Spain, as well as at other favourable points along the line traversed by the great shadow; in watching the phases of this beautiful and rare phenomenon. Among the most striking results hitherto communicated to the scientific world, are the observations made under the direction of Le Verrier, at Tarazona; though in one respect an interesting correspondence is noticeable between the phenomena noted by the members of the French Astronomical expedition, and those which attracted the attention of the observers on our own Labrador Coast. At the period of total obscuration alike at Cape Chudleigh, and at Tarazona, the general illumination of the atmosphere proved much greater than the relations of former observers had led either party to anticipate. But the more important phenomena recorded by Le Verrier, are: first, the observation of three lofty peaks, 30° below the horizontal diameter on the eastern edge of the solar disc,—of the reality of the toothed form of which the French Astronomer entertains no doubt,—with their upper sides tinged with rosy and violet light, while the lower sides were brilliant white; and secondly, but of more importance, that as the moment of reappearance of the sun approached, and while watching for its first rays, the previously white margin of the disc appeared tinged with a delicate fillet of unappreciable thickness, of a purplish red, which enlarged by degrees until it formed around the black disc of the moon, over a breadth of about 30°, a red border perfectly defined in thickness, crescent shaped, and with an irregular outline above. The visible part of the emergent sun over its whole breadth and up to the height of seven or eight seconds, was covered by a bed of rosy clouds, which appeared to gain in thickness as they emerged from behind the disc of the moon. Without enlarging on other phenomena noted by the French astronomer, it may suffice here to note that Le Verrier has been led by those to the entire re-construction of the theory hitherto maintained relative to the physical constitution of the sun; and, discarding the idea of a central dark globe, with successive opaque and luminous cloudy or gaseous envelopes, he now inclines to the belief that the sun is a body, luminous simply because of its high temperature, and covered by an unbroken layer of roseate matter, the existence of which he conceives his observations have demonstrated. Other observers, including those who watched the eclipse at Hereña, still adhere to the opinion that the corona and the luminous clouds are alike ascribable to simple optical appearances; and we must not only be content to wait the full publication of the results of the various independent observations, but in all probability reserve for the disclosures of future eclipses, the determination of some of those interesting questions relative to the physical constitution of that central sun which rules the undisputed sovereign of our system, dictates laws to the remotest planet, curbs the blazing comet in his far-wandering aphelion, and measures life, and time, and changing seasons, to all the worlds revolving in its train.

But from this department of the history of scientific progress during the past year, in which Canada has been honorably represented, though on a scale greatly inferior to what a just ambition would lead us to desire, I turn to glance at another sphere of labor. Among recent actions connected with the practical applications of science, most nearly related to our own immediate sympathies, none is, perhaps, calculated to awaken a deeper interest than the expedition of Sir Leopold McClintock to survey the projected North Atlantic route for a new telegraphic cable between Great Britain and America. It recalls to us the memory of high hopes wrecked in the very hour of triumph. After repeated disappointments, and when every mind was prepared for failure, we all remember when, on the fifth of August, 1858, the news flashed along all telegraphic lines on the American continent that the *Niagara* and *Gorgon* steamers had reached Trinity Bay with their portion of the Atlantic cable intact; and on the same memorable fifth of August the *Agamemnon* communicated by its means the equally successful completion of her moiety of the work. The magnitude of the triumph of Science seemed to impress with a solemn awe the humblest actors in this great event. The hardy seamen who bore the cable to land, knelt together and united their voices in prayerful recognition of a divine and overruling Providence to whose aid they ascribed it that their labor had not been in vain; and the English board—abandoning the cold formalities of a joint-stock company,—despatched to the American directory the telegram, memorable in its form as in its news:—EUROPE AND AMERICA ARE UNITED BY TELEGRAPH; GLORY TO GOD IN THE HIGHEST, ON EARTH PEACE, GOOD WILL TO MEN.

The great pulse of the empire throbbed in sympathy with that of the proud young western nation kindred with itself, and the common ancestral blood seemed to kindle anew into generous aspirations, with the consciousness that time and space had been annihilated, and the broad Atlantic no longer severed them and us from the vital heart of Britain's world-wide empire. Science had her triumph. The costly experiment proved beyond all doubt the possibility of laying electric wires along the depths of the ocean's bed, and of transmitting the electric current through their vast length of cable. But, that accomplished, all waited impatiently—and as it proved, in vain,—for the practical working of the wondrous telegraphic line. It had uncoiled its voluminous folds, and stretched its mighty length across the submarine valleys of the ocean, like some fabled leviathan, only to mock us as with an enchanted sleep. The wealth of thousands was embarked in the vessels freighted with its folds; the hopes of millions were awakened by the calm unheralded announcement of its triumph; and the most unimaginative reflected with a glow of pleasurable wonder on the noiseless freight of human thought speeding on the wings of the lightning through the dark abysses of the ocean. But there is, perhaps, something even more calculated to awaken our just admiration in the fact that, undaunted by so costly a failure, the indomitable enterprise of England has resumed the task, and will never rest till her Canadian sons, and her American kin, are united with her by this grand electric chain. In the expedition which sailed in the *Bulldog* and the *Fox* for the purpose of resuming this great work, Canada also had her representative in Dr. John Rae, a distinguished associate of our own body, who had already been the pioneer of Sir Leopold McClintock in the nobler task which he accomplished in the previous voyage of the *Fox* to Arctic Seas. But, exposed to the same tempestuous weather which impeded the astronomical expedition to the Coast of Labrador, the voyage of the *Bulldog* and *Fox* was accomplished under circumstances calculated to warn us that such triumphs are not to be won without toil and disappointment. Continuous bad weather retarded the survey, though it could not thwart the persevering energy of those entrusted with its execution; and they effected a series of soundings sufficient to demonstrate the practicability of an Atlantic cable carried from the north of Scotland to the Faroe Islands, thence to the east shore of Iceland, and from its western coast along a sea-bed over which the annual icebergs of the Arctic Ocean sweep southward their mighty hulks, like mountains torn from their foundations, to waste and perish as strange intruders in a southern clime.

But while we are thus encouraged to anticipate once more, with eager longing, the time when the ocean-buried coil shall emerge on our own British American coasts, and its wondrous freight of thought shall sweep across half a world, swift and noiseless as the stellar rays through the blue depths of space; we have meanwhile other results of interest and value to note, as products of this great enterprise. Dr. Wallich, the naturalist of the expedition, has recently published a valuable series of observations, having for their chief object to determine the depths to which animal life extends in the sea. The result of these is to establish beyond question that life exists in the vast depths of the ocean, under circumstances which have heretofore been deemed incompatible with any condition of vitality. The soundings in the bed of the Atlantic had previously made us familiar with the fact that the oozy deposits along its great basins are to a considerable extent made up of the minute calcareous shells of Foraminifera. But these have been obtained during the recent expedition, at depths of from fifty to nearly two thousand fathoms, with the cell-contents entire, and otherwise presenting satisfact , evidence of having been in a vital state when disturbed in their ocean habitats by the sounding line and lead. Nearly midway between Cape Farewell and Rockall, the deep-sea line brought up, along with numerous specimens of the Globigerinæ, several living star-fishes belonging to the genus Ophiocoma, recovered from a depth of upwards of twelve hundred fathoms. The facts are highly suggestive and replete with interest for us. That in the dark caverns of mid-ocean, the solid rock was in process of formation out of the minute calcareous shells of some of the most simply organised families of the animal kingdom, was a fact already established, in full accordance with all the phenomena of geological history already revealed to us. The main subject disclosed in those wonderful lithological chronicles of the preadamite world which palæontology reveals, is the history of the beds of former seas. But in addition to this we now learn of organic life abundantly present under conditions hitherto deemed incompatible with any forms of vitality; and of contemporaneous zones of life immensely extending its assigned range. Science has long since revealed to us the fact that we ourselves live—and require such a condition as an element essential to life,—in the depths of a great atmospheric ocean, which subjects us to a pressure of fourteen pounds on the square inch, or to a mean weight of 21,240 pounds. But from those latest disclosures of submarine life it is proved that in deep zones of the ocean, upwards of two miles from its surface, where the feeblest refraction of sunlight can scarcely be supposed to shed a glimmering ray, and the pressure must amount to more than a ton and a half on the square inch, not only the minute Foraminifera, but highly organized species of radiata, revel in the enjoyment of life, and sport their strange forms and brilliant colours, in ocean's dark unfathomed caves. To the lamented Edward Forbes we owe some adequate appreciation of the comprehensive truths which the intelligent use of the dredge places within reach of the naturalist, and we may now regard those results of deep ocean soundings, carried on under such peculiar disadvantages, as a mere glimpse and fortaste of the disclosures which await us relative to a new submarine fauna. There strange and beautiful forms reveal glimpses to us of the infinite variety of characters in which God is still writing the revelations of his creative power to shame the petty cavils of the sceptic, and invite our study of new zones of life at depths to which light itself can scarcely penetrate, but from which science thus recovers vital truths, calculated to illuminate many obscurities in that great geological past, built up out of the wrecks of still older life and organization. Whilst so many are watching with eager, though bated hope, the prospect of practical results to the political and commercial world from this new Atlantic Telegraph expedition, less tantalizing and evanescent than those which were celebrated with such joyous pæans, when the "bridal clasp" and the magnetic "wedding ring" were believed to have plighted perpetual troth between Britain and her western scions: it is something to know that Science has gained new and important truths, interesting and replete with promise, alike for the Old World and the New.

Thus it is that in pursuing one line of inquiry we are almost imperceptibly led into another and seemingly totally independent one. Thus it is that the connexion of the physical sciences is ever revealing itself in new phases; and with every extension of our knowledge we are the more taught to recognize in them an intimately related sister-band. Geology and Natural History, Astronomy, Electricity, and Magnetism, are all found to have their points of contact, and mutually minister to each others completeness, while each presents its special claims on our sympathy and interest. In the observation of magnetic phenomena, and the patient accumulation of data calculated to determine the solar magnetic influence on the earth, the laws of periodicity connected with terrestrial magnetic force, and the search for those hidden truths which comprehend the mysterious power by which the electrician already triumphs over time and space, Toronto, with its efficient staff of workers at the Provincial Observatory, already takes a prominent place. The novel truths to which Le Verrier's observations seem to point relative to the physical constitution of the sun involve new views, which if once established must modify the whole theory of solar magnetic influence, and lead to further investigations of the apparent relations between the changes observed on the cloudy envelope of the solar photosphere, and the periodical changes of variation in the elements of the earth's magnetic force. Theory and observation go hand in hand in demonstrating the physical characteristics of the sun, and the influences which control the genial despotism with which that luminary reigns supreme, the monarch of our system. The accelerated motion of Enke's comet at each return has sufficed to suggest the abandonment of the idea that planetary and cometary motions are performed in vacuo, and leads to the belief that space is everywhere pervaded by an ether, too rare to effect a perceptible change on the motions of the planets, but sufficient by its resistance to subject such attenuated substances as the comets more completely to the attractive force of gravity, and urge them onward, with an ever diminishing orbit and increasing velocity, until they fall into the sun. These strange wanderers of the heavens that sweep at times their streaming train across the sky, "with fear of change perplexing nations," are thus shown, in their attenuated fragility, like some frail moth irresistibly attracted towards the solar lamp; and fluttering ever nearer and nearer around the light until it is consumed. Yet it is not less true of that grand theatre of action where suns and planets move in stately order, than of this little world of ours:

> "That not a worm is cloven in vain;
> That not a moth with vain desire
> Is shrivell'd in a fruitless fire."

Already it has been suggested by Professor William Thompson, of Glasgow, that such may be the means by which the solar fires are replenished, and the central luminary of our system is maintained in undiminished brightness, while raying forth light and heat to all its planetary train. Such a phenomenon is believed to have been recently independently observed by two distinguished English astronomers, Mr. Carrington and Mr. Hodgson, who chanced by a happy coincidence to be simultaneously engaged at their different observatories in watching a group of solar spots. Two intensely luminous bodies were seen suddenly to burst into view, and to move within a period of a few minutes through a space on the solar disc of about 35,000 miles, during which they attained their maximum brightness and then faded away, without affecting the forms of the group of solar spots which lay directly in their path. Lord Wrottesly, while drawing the attention of the British Association, at its recent Oxford meeting, to this interesting contribution of his own favorite science, failed not to note the remarkable coincidence that the simultaneous observations at Kew show on the same day, at the very hour and minute of this unexpected and curious phenomenon, the occurrence of a marked magnetic disturbance. Nor will it, I feel assured, fail to interest you when I state that on applying to my colleague Professor Kingston, he informs me that the register of the Provincial Magnetic Observatory records a corresponding magnetic disturbance at Toronto within a few seconds of the same time.

Thus are we stimulated anew to watch with intelligent sympathy and interest the patient and little-heeded labors of our own Canadian magnetic observers, as day by day they silently note the minutest variations in the phenomena connected with this mysterious force, and strive to wrest from nature the hidden secrets of this uncomprehended power. Yet that is not an altogether uncomprehended power, in the operations of which we already recognize a law of the Universe, alike relating itself to the economic appliances of science in the telegraphic lines of daily commercial intercourse, and bearing its part in the grand triumphs of intellect by which we reach forth to grasp at truths written for us in the central sun, in the revolving planets, and amid the wondrous galaxy of stars that stretch away in mysterious magnificence into the infinite depths of space, until imagination and reason tremble alike in the vain effort to conceive of a finitude for that visible Universe, by which the heavens declare the glory of God, and nightly utter knowledge of Him who alone is truly infinite.

But the subsidiary labours already referred to in connection with the Atlantic Telegraphic expedition bring us into relation with another branch of scientific labour in which Canada maintains a no less efficient staff of workers. The novel and interesting truths of Natural History revealed by the deep-sea soundings conducted under the guidance of Sir Leopold McClintock and Dr. Wallich, not only greatly enlarge the sphere of organic life, and open up an ample field for fresh explorations of the naturalist in those deep zones of the ocean which have hitherto been assumed to present conditions incompatible with organic life: but they are calculated to throw fresh light on the palæontology of the long emerged terra firma; and, with their accumulated calcareous shells of the minute Foraminifera, amounting, in some of the specimens of soil brought up from the profound depths of the ocean bed, to 95 per cent. of the whole mass; and their highly organized and brilliantly tinged living radiata and mollusca: to illustrate the processes by which vast strata which now invite the study of the geologist, were slowly accumulated in the abysses of the primeval ocean.

The distinguished geologist who so honorably presides over the labours of our provincial corps of observers, and whose former occupance of this chair reflects an honor on the humblest of his successors, is peculiarly devoid of that ambition which, among scientific workers on both sides of the Atlantic, is seen to tempt some from the patient fidelity to their legitimate pursuits, in the search for showy but often worthless disclosures that win the temporary meed of vulgar applause. He rather exhibits to us in a preeminent degree the example of a modest and patient searcher after those hidden truths of nature, the full worth of which will only be fully appreciated when other generations have entered into his labours; and it is then seen how largely such earnest and faithful verification of the thousand isolated facts of his young science have contributed to supply the missing links of that great chain by which we are reaching back from the living present into that infinite past through which creative power has manifested itself in ever varying forms and conditions in the succession of life. Nevertheless all the recognition of Sir William Logan's indefatigable labours is not left for posthumous appreciation. Owing to some special advantages which the geological formations of Canada supply, the researches of our provincial staff have largely aided in throwing a new and clearer light on those Azoic rocks which by their essentially inorganic character appear to point clearly to a terrestrial era prior to the first creation of life; and thus to offer a scientifice confirmation to that initial stage of creation in which the earth was without form, and void. Sir Roderick Murchison in his recent reclassification of the more ancient rocks of Scotland,* when referring to those on the North West Scottish coast, remarks: "The phenomenon relating to these Cambrian sandstones, which may well strike the geologist, is that these very ancient rocks, on which unquestionably the Lower Silurian rocks repose, should be simply sandstones and grits which have undergone much less change than the sandstone which lies upon them,—the latter having been metamorphosed into quartz-rock. However difficult it may be to account for this fact, it is at all events most instructive as regards the origin nd succession of life in the crust of the earth, and sustains my view of a beginning. For here the older of the two rocks in Scotland has offered no trace of fossils, whilst the more crystallized structure above exhibits unmistakeable signs of former living things." Having accordingly set forth in detail the evidence and reasoning on which he bases his new views on the order of the ancient stratified rocks of Scotland, and their associated eruptive rocks, Sir Roderick Murchison thus proceeds: "The beginning of the geological alphabet, as applied in the maps of the Geological Survey to the Cambrian rocks of England, Wales, and Ireland, must therefore be preceded in Scotland by the first letter of some alphabet earlier than the Roman, showing a still lower deep in the north-west of Scotland—as in North America,—than exists in England, Wales, or Ireland. If this most ancient gneiss required a British name, it might indeed, with propriety, be termed the *Lewisian System*, seeing that the large island of Lewis is essentially composed

* Proceedings of the Geological Society, Vol. XVI., page 240.

of it; but the term *Laurentian* having been already applied to rocks of this age in North America by our distinguished associate, Sir Wm. Logan, I adhere to that name, the more so as it is derived from a very extensive region of a great British Colony."

Thus geology is pointing with accumulating proofs to the beginnings of terrestrial life; while we are reminded by familiar evidence around us in many of the Canadian rocks, that at the commencement of those fossil records in the Laurentian strata, trilobites, and other crustacea abound; and we are now assured, by the most recent disclosures of science, that the bed of the present ocean is the arena of many inferior forms of organic life. Here therefore the accumulating evidence seems to force upon us the adoption, or rather the firmer retention, of opinions altogether at variance with those novel views on the nature and origin of species, to which I had occasion to refer when last addressing you from this Chair. But the questions in relation to the origin of species, which were then beginning to attract the attention of men of science, have during the past year excited a more general interest than any other purely scientific inquiry.

When the views of DeMaillet, Oken, and Lamarck were reproduced in a popular form, it was not altogether without reason that the argument was affirmed to place science in conflict with religion. It seemed like an attempt, if not to dispense entirely with a supreme creative power and divine first cause, at least to reduce to the smallest conceivable minimum the controlling government of an ever-present, overruling providence; and to demonstrate a universe which having been constructed like some ingenious piece of mechanism, wound up, and set agoing, was thenceforth capable of working out its results without further oversight, until the term of its mechanical forces was exhausted, and the finger, stopping of itself on the great dial, declared that time shall be no more. The theories of spontaneous generation and the modification of organized beings by external physical agents, or by the direct operation of their own voluntary acts, have indeed found advocates among those honestly in search of guiding lights towards the hidden laws and truths of nature; but they have maintained but a feeble hold on the earnest students of science, and have for the most part been diluted into popular forms of scepticism in which all recognition of a providential government of the universe has been ignored. But the novel and highly suggestive views on the origin of species by means of natural selection, are presented to us under very different auspices. We cannot treat them with too sincere respect even while rejecting them. They are no rash and hastily formed fancies of a shallow theorist, but the earnest convictions of an eminent English naturalist of great and varied experience, set forth as deductions based on a continuous series of observations and experiments, extending over upwards of twenty years; and heralded by the favourable testimony of some of the most cautious and discriminating among his scientific contemporaries. Nevertheless, the time which has been already allowed for the critical investigation of such evidence as is advanced to sustain his comprehensive hypothesis, has only tended to discredit his transmutation theory, and add assurance to the convictions of the scientific believer in the idea of creation as the only satisfactory solution of the succession of life. Science has achieved wondrous triumphs, but life is a thing it can neither create nor account for, by mere physics. Nor can we assume even that the whole law of life can be embraced within the process of induction, as carried out by an observer so limited as man is, in relation to the sequence of time, and to the cosmical changes by which so much of the record is erased. Darwin, indeed, builds largely on hypotheses constructed to supply the gaps in the geological record; but whilst welcoming every new truth which enlarges our conception of the cosmic unity, all nature still says as plainly to us as to the Idumean patriarch: "Canst thou by searching find out God? canst thou find out the Almighty to perfection?"

Assuredly it is in no spirit of sceptical presumption that Darwin has set forth his views; and I heartily accord with the claim advanced by Professor Huxley, that the arguments of an experienced and profound naturalist on pure questions of science, must be met on scientific grounds alone. But when science claims not only to disclose the nature of all living and extinct organizations, but to determine their primary origin, it is difficult even on purely scientific grounds, to avoid reasserting the truth which all nature audibly affirms, that creation owes its existence to a Creator. And at every appearance of new organic forms in the geological strata of the earth, science sacrifices no jot or tittle of its true dignity, when owning a higher law, it admits that He who, in the beginning, created the heavens and the earth, has in like manner put forth the same creative power at every successive origination of species.

The geologist in reasoning on the succession of life, has hitherto appealed to palæontological evidence by which he traces every specific form through provinces of space uniform in their relations to the order of geological strata, and therefore determinate as to the relative period of time within which they sprung into being, ran their appointed course, and were superseded by new orders of life. Yet it is not to be doubted that the record is very imperfect, and so leaves room for piecing it out with theory, hypotheses, and a comprehensive generalization. Nor need we affirm that the Lamarckian idea of an abnormal organic power of self-development; or that which assigns to external influences a modifying power on the characters of species: is wholly unsupported by observation. Neither these, nor the opinions set forth by Darwin in favour of the derivation of well determined forms of one period from others more or less diverse in earlier formations, are altogether unsustained by evidence; though they can carry us but a short way in accounting for, or determining the plan of creation. They may induce us to reject the claims of many specific variations in organic form to be ranked as distinct primary spec s; but they leave the grand questions of the origin of species a the source of organic life, precisely where they were. We are st ree to look upon the successive orders of life as the manifestations o an intelligent creative power: the intellectual conceptions of the supreme Intelligence by whom the universe subsists, wrought out, like all else in His visible creation, by material means.

But leaving this aspect of the question, I rather turn to the consideration of the bearing of the bold naturalist's views on the origin of man himself. Drawing his ingenious theories to a close he exclaims: "The whole history of the world, as at present known, although of a length quite incomprehensible by us, will hereafter be recognised as a mere fragment of time, compared with the ages that have elapsed since the first creature, the progenitor of innumerable extinct and living descendants, was created. In the distant future I see open fields for far more important researches. Psychology will be based on a new foundation, *that of the necessary acquirement of each mental power and capacity by gradation.* Light will be thrown on the origin of man and his history. Authors of the highest eminence seem to be fully satisfied with the view that each species has been independently created. To my mind it accords better with what we know of the laws impressed on matter by the Creator, that the production and extinction of the past and present inhabitants of the world should have been due to secondary causes, like those determining the birth and death of the individual. When I view all beings not as special creations, but as the lineal descendants of some few beings which lived long before the first bed of the Silurian system was deposited, they seem to me to become ennobled." But apart from what I cannot avoid characterizing as the monstrous notion that any new system of psychology can account for the origin of the intellect and living soul of man by development: the question is not whether man in reality acquires a scientific patent of nobility by tracing his ancestry back, through the Gorilla or the Chimpanse, to some vital monad that had its being ages before the first bed of the Silurian system was deposited; but whether science affords the slightest countenance to such a pedigree. If the origin of species be really traceable to natural selection and the preservation of favoured races in the struggle for life, then it should be demonstrable that man is pre-eminently favoured in physical organization, for he has every where triumphed over all other animals. But that triumph has been the result of no such physical preeminence, but of that intellectual power bestowed on him when—as we believe on an authority to which the progress of science adds ever fresh confirmation,—God breathed into him the breath of life, and man became a living soul.

In defining the contrasting gifts of instinct and reason which distinguish the lower animals from man, it was remarked by one whose death has robbed life to me of one of its greatest charms,—one, let me add, who found his earnest faith in things divine confirmed by every step he advanced in scientific knowledge:—"Our working instincts are very few; our faith in them is still more feeble; and our physical wants far greater than those of any other creature. Had the assembled lower animals been invited to pronounce upon what medical men call the 'viability,' or managers of insurance offices 'the chances of life' of the first human infant, their verdict would have been swift, perhaps compassionate, but certainly inexorable. The poor little featherless biped, pitied by the downy gosling, and despised by the plumed eaglet, would have been consigned to the early grave, which so plainly in appearance awaited him; and no mighty Nimrod, with endless lion-slaying hunter-sons, would have been seen to dawn in long perspective above the horizon, and claim the fragile infant as their stalwart father. Yet the heritage of nakedness, which no animal envies us, is not more the memorial of the innocence that once was ours, than it is the omen of the labours which it compels us to undergo. With the intellect of angels, and the bodies of earth-worms, we have the power to conquer and the need to do it."*

Viewing man thus exercising dominion over the inferior creation by no preeminence of physical power, but solely by intellectual supremacy, we can no more conceive of the development of the brute into man,—dowered with reason, capable of intelligent faith, the heir of immortality,—than we can conceive of the conversion of inorganic matter into the very lowest forms of organic life, without the intervention of creative Omnipotence.

Nevertheless truth is ever the gainer by the collision of opinions, and the most important results may be anticipated in reference to the Science of Ethnology, from the revision of the whole question as to the origin and nature of species, consequent on the discussion to which the theories of Darwin have given rise. The increasing proneness towards the unlimited multiplication of species has unquestionably tended to the cumbrance instead of the elucidation of every department of zoology; and the minute subdivisions which naturalists have latterly favoured, have given an undue force not only to such general arguments as those of Darwin in relation to organic life, but to the theories of modern ethnologists by which the genus *homo* has been divided into an ever growing multiplicity of species. If we take the typical man of each of Blumenbach's comparatively simple divisions; we cannot evade the conclusion that very clearly defined elements of diversity furnish grounds for the classification into Caucasian, Ethiopian, Mongolian, Malayan, and American. But the simplicity of this system has secured for it no permanent adoption. Pickering, the able ethnologist of the United States exploring expedition, after examining, as he believes, every variety of the human race, rejects the idea that the American Red Man is distinct from the Asiatic Mongolian, and yet redivides the human family into eleven essentially distinct races, or species. "There is" he adds, "no middle ground between the admission of eleven distinct species in the human family, and the reduction to one." But other ethnologists, while pursuing the same course, have manifested even less favour for any middle ground. Borey de St. Vincent divides mankind into fifteen species; Broc greatly enlarges this by numerous sub-genera; and Gliddon and Nott,

* What is Technology?—An Inaugural Lecture. By George Wilson, M.D., F.R.S.E. Regius Professor of Technology, Edinburgh University.

following out the suggestion of Agassiz as to the correspondence of different species of men with the natural geographical areas of the animal kingdom, divide the globe into eight zoological realms, throughout which their human fauna are distributed under forty-three different heads; and it is by no means apparent that this is an exhaustive division into species of the genus *homo*.

Looking to the tendency of such views to an ever-widening multiplicity of species, or races of men, and to the consequent diminution in a corresponding ratio, of the elements of difference between them, it is impossible, I conceive, to overlook the force of some of Darwin's arguments in their bearing on this momentous question. Take, for example his favourite illustration, the domestic pigeon; we look in vain for the slightest trace of the transmutation of a bird of another genus into any one of the varied and widely-scattered breeds of the wild or domestic pigeon, whatever force we may recognise in the arguments by which he traces all alike back to the Columba livia. Pigeons, he shows, have been domesticated for thousands of years. Lepsius indicates the record of them on the monuments of Egypt in the fifth dynasty, some three thousand years before Christ; Birch traces them in an Egyptian bill of fare of a still earlier date; Pliny refers to their extravagant cost among the luxurious Romans; Akber Khan maintained them by thousands; and the monarchs of Iran and Turan deemed them fitting gifts for the lordly Sultan. The same wild breed of pigeons has been found capable of domestication in northern Europe, and in India, and is seen to agree in habits and in numerous points of structure with all the domestic breeds; yet, says Darwin, "although an English carrier or short-faced tumbler differs immensely in certain characters from the rock-pigeon, by comparing the several sub-breeds of these breeds, more especially those brought from distant countries, we can make an almost perfect series between the extremes of structure." Finally he adds: "It is also a most favourable circumstance for the production of distinct breeds, that male and female pigeons can be easily mated for life." But we have only to remember that those, and all the other elements referred to, are to a far higher extent characteristic of man. Domestication and a social settled life, the permanent mating in pairs, the migration in communities, the external influences of an artificial civilization and highly diverse climatic influences for thousands of years, have all pertained to his normal condition, and may all therefore be made to yield still stronger proofs that the man of Europe, of Egypt, and of India, are alike descended of one primal stock.

In relation to the psychological aspect of the question, and the possible acquirement of each mental power and capacity by gradation, one argument has forcibly impressed my own mind, whatever value it may appear to possess to others. In recently carrying out some minute investigations into the characteristics of the languages of this continent, I have been struck with the confirmation which those of the Red Indian nations supply to the well known philological truth, that while vocabularies are simple in the early stages of intellectual development, and acquire their complex character with the progress of the nation: grammar on the contrary appears more full, complete, and harmoniously consistent, the further back it is traced. Selecting one of the native languages of our western forests, we find among the rude children of nature, destitute of all science, and ignorant even of letters, no rudimentary combination of half-developed utterances, the transitional stage between brute cries and human speech; but a language having systematised grammatical forms as rich, regular, and consistent, as that in which Plato wrote, and Homer sung. Such perfection of organization in languages, devoid of all abstract terms, of the whole vocabulary of mental science, and of generic symbols of that classification which accompanies the recognition alike of the laws of external nature and of thought, is utterly irreconcileable with those ideas of development once more offered for our acceptance on such high authority, and of a grand futurity, wherein "all corporeal and mental endowments will tend to progress towards perfection," by the natural selection of favoured races in the struggle for life.

In thus attempting, however inadequately, to review the recent progress of knowledge, with a special relation to our own Province, I have aimed at recalling to your notice alike those labours in the cause of science, during the past year, in which we possess some personal interest, and those novel and suggestive theories which have most recently given a new impulse to thought. We claim, as associates of this Institute to rank as lovers of science, united for the investigation of the laws of nature, and the discovery of new truths in every department of human knowledge. We desire also to rank as workers, and to associate with us all the workers in the same noble cause. It would indeed be a grave reflection on this Province, dowered with the inestimable blessings of a fertile soil, a hardy yet genial climate, and above all, with free institutions which are the envy of less favoured lands: if, amid all its eager pursuit of material wealth, it could point to no phalanx of labourers aiming at the increase of the wealth of mind; to none who covet being sharers in that glorious advancement of knowledge by which God, who has revealed himself to us in his word, is making ever new revelations of himself in his works; and having made known to us Him who is the wisdom and the power of God, through whom we have the assurance of life and immortality in the gospel of his grace; is anew, in the great volume of nature, adding fresh evidence of man's immortality, by revelations of the inexhaustible wonders of that creation, which, I doubt not, is to employ the purified and enlarged faculties of man in its study through all the ages of that future life to which it is his atribute to aspire. May we, while seeking here the pure and elevating enjoyments which spring from the discovery of nature's truths, find knowledge of the humblest works of God an incitement to the adoration and love of Him, whom to know is life eternal.

ON THE THEORY OF TYPES IN CHEMISTRY.

BY T. STERRY HUNT, M.A., F.R.S.

In the *Annalen der Chemie und Pharmacie* for March, 1860, (cxiii., 293) Mr. Kolbe has given a paper on the natural relations between mineral and organic compounds, considered as a scientific basis for a new classification of the latter. He objects to the four types admitted by Gerhardt, namely, hydrogen, hydrochloric acid, water, and ammonia, that they sustain to organic compounds only artificial and external relations, while he conceives that between these and certain other bodies there are natural relations having reference to the origin of the organic species. Starting from the fact that all the bodies of the carbon series found in the vegetable kingdom are derived from carbonic acid with the concurrence of water, he proceeds to show how all the compounds of carbon, hydrogen and oxygen may be derived from the type of an oxide of carbon, which s either C_2O_4, C_2O_2, or the hypothetical C_2O.

When in the former we replace one atom of oxygen by one of hydrogen we have C_2O_3H, or anhydrous formic acid; the replacement of a second equivalent would yield $C_2O_2H_2$, or the unknown formic aldelyde; a third, $C_2O{\cdot}H_3$, the oxide of methyle; and a fourth, C_2H_4, or formene. By substituting methyle for one or more atoms of hydrogen in the previous formula, we obtain those of the corresponding bodies of the vinic series, and it will be readily seen that by introducing the higher alcoholic radicals we may derive from C_2O_4 the formulas of all the alcoholic series. A grave objection to this view is however found in the fact that while this compound may be made the type of the aldehydes, acetones, and hydrocarbons, it becomes necessary to assume the hypothetical C_2O_2, HO, as the type of the acids and alcohols. Oxide of carbon, C_2O_2, is according to Kolbe, to be received as the type of hydrocarbons like olefiant gas, (C_2HMe,) while C_2O, in which ethyle replaces oxygen, is C_6H_5 or lipyle, the supposed triatomic base of glycerine.

The monobasic organic acids are thus derived from one atom of C_2O_4, while the bibasic acids, like the succinic, are by Kolbe, deduced from a double molecule C_4O_8, and tribasic acids, like the citric, from a triple molecule C_6O_{12}. He moreover compares sulphuric acid to carbonic acid, and derives from it by substitution the various sulphuric organic compounds. Ammonia, arseniuretted and phosphuretted hydrogen, are regarded as so many types; and by an extension of his view of the replacement of oxygen by electro-positive groups, the ethylids ZnEt, $PbEt_2$, and $BiEt_3$, are, by Kolbe, assimilated to the oxides of ZnO, PbO_2, and BiO_3.

Ad. Wurtz, in the *Repertoire de Chimie Pure* for October, 1860, has given an analysis of Kolbe's memoir, (to which, not having the original before me, I am indebted for the preceding sketch) and follows it by a judicious criticism. While Kolbe adopts as types a number of mineral species, including the oxides of carbon, of sulphur and the metals, Wurtz would maintain but three, hydrogen, (H_2) water, (H_2O_2) and ammonia, (NH_3); and these three types, as he endeavoured to show in 1855, represent different degrees of condensation of matter. The molecule of hydrogen, H_2 (M_2), corresponding to four volumes, combines with two volumes of oxygen (O_2) to form four volumes of water, and may thus be regarded as condensed to one-half in its union with oxygen, and derived from a double molecule, M_2M_2. In like manner four volumes of ammonia contain two volumes of nitrogen and six of hydrogen, which, being reduced to one-third, correspond to a triple molecule, M_3M_3, so that these three types and their multiples are reducible to that of hydrogen more or less condensed.—(WURTZ, *Annales de Chimie et de Physique.* (3) xliv. 304).

As regards the rejection of water as a type of organic compounds, and the substitution of carbonic acid, founded upon the consideration that these in nature are derived from C_2O_4, Wurtz has well remarked that water, as the source of hydrogen, is equally essential to their formation, and indeed that the carbonic anhydrid C_2O_4, like all other anhydrous acids, may be regarded as a simple derivative of the water type. Having then adopted the notion of referring a great variety of bodies to a mineral species of simple constitution, water is to be preferred to carbonic anhydrid, first, because we can compare with it many mineral compounds which can with difficulty be compared with carbonic acid; and secondly, because the two atoms of water being replaceable singly, the mode of derivation of a great number of compounds (acids, alcohols, ethers, etc.,) is much more simple and natural than from carbonic acid. As Wurtz happily remarks, Kolbe has so fully adopted the theory of types that he wishes to multiply them, and even admits condensed types, which are, however, molecules of carbonic acid and not of water; "he combats the types of Gerhardt and at the same time counterfeits them."

Thus far we are in accordance with Mr. Wurtz, who has shown himself one of the ablest and most intelligent expounders of this doctrine of molecular types, as above defined, now almost universally adopted by chemists. He writes,—" to my mind this idea of referring to water, taken as a type, a very great number of compounds, is one of the most beautiful conceptions of modern chemistry."—(*Repertoire de Chimie Pure*, 1860, p. 359); and again, he declares the idea of regarding both water and ammonia as representatives of the hydrogen type, more or less condensed, to be so simple and so general in its application that it is worthy " to form the basis of a system of chemistry.—(*Ibid.* p. 356.)

We have in this theory two important conceptions: the first is that of hydrogen and water regarded as types to which both mineral and organic compounds may be referred; and the second is the notion of condensed and derived types, according to which we not only assume two or three molecules of hydrogen or water as typical forms, but even look on water as the derivative of hydrogen, which is itself the primal type.

As to the history of these ideas, Wurtz remarks that the proposition enunciated by Kolbe that all organic bodies are derived by substitution from mineral compounds is not new, but known in the science for about ten years. "Williamson was the first who said that alcohol, ether, and acetic acid were comparable to water—organic waters. Hoffman and myself had already compared the compound ammonias to ammonia itself." * * * "To Gerhardt belongs the merit of generalizing these ideas, of developing them, and supporting them with his beautiful discovery of anhydrous monobasic acids. Although he did not introduce into the science the idea of types, which belongs to M. Dumas, he gave it a new form which is expressed and essentially reproduced by the proposition of Kolbe. Gerhardt reduced all organic bodies to four types—hydrogen, hydrochloric acid, water and ammonia.—(*Ibid*, p. 355.)

The historical inaccuracies of the above quotation are the more surprising since in March, 1854, I published in the *American Journal of Science*, (xvii. 194) a concise account of the progress of these views. This paper was re-published in the *Chemical Gazette*, (1854, p. 181,) and copies of it were by myself placed in the hands of most of the distinguished chemists of England, France and Germany. In this paper I have shown that the germ of the idea of mineral types is to be found in an essay of Auguste Laurent, (*Sur les Combinaisons Azotées*, *Ann. de Chimie et Physique*, Nov., 1860,) where he showed that alcohol may be looked upon as water (H_2O_2) in which ethyle replaces one atom of hydrogen, and hydric ether as the result of a complete substitution of the hydrogen by a second atom of ethyle. Hence he observed that while ether is neutral, alcohol is monobasic and the type of the monobasic vinic acids, as water is the type of bibasic acids. In extending and developing this idea of Laurent's, I insisted in March, 1848, and again in January, 1850, upon the relation between the alcohols and water as one of homology, water being the first term in the series, and H_2 being in like manner the homologue of acetene and formene, while the bases of Wurtz were said to "sustain to their corresponding alcohols the same relation that ammonia does to water." (*Am. Jour. Sci.* v. 265; ix. 65; xiii. 206.)

In a notice of his essay, published in September, 1848, (*Ibid*, vi., 173) I endeavored to show that Laurent's view might be farther extended, so as to include in the type of water "*all those saline combinations (acids) which contain oxygen*;" and in a paper read before the American Association for the Advancement of Science at Philadelphia, in Sept., 1848, I farther suggested that as many neutral oxygenized compounds which do not possess a saline character are derivatives of acids which are referable to the type H_2O_2, "*we may regard all oxygenized bodies as belonging to this type*," which I farther showed in the same essay, is but a derivative of the primal type H_2, to which I referred all hydro-carbons and their chlorinized derivatives, as also the volatile alkaloids, which were regarded "as amidized species" of the hydro-carbons, in which the residue amidogen, NH_2, replaced an atom of H or Cl., or what is equivalent, the residue NH was substituted for O_2 in the corresponding alcohols. (Ibid viii., 92.)

In the paper published in Sept., 1848, I showed that while water is bibasic, the acids which like hypochlorous and nitric acids were derived from it by a simple substitution of Cl and NO_4 for H, were necessarily monobasic, and I then pointed out the possible existence of the nitric anhydrid $(NO_4)_2O_2$, which was soon after discovered by Deville. Gerhardt at this time denied the existence of anhydrids of the monobasic acids, while he regarded anhydrids as characteristic of polybasic acids, and indeed was only led to adopt my views by the discovery of the very anhydrids whose formation I had foreseen.*

In explaining the origin of bibasic acids I described them as produced by the replacement, in a second equivalent of water, of an atom of hydrogen by a monobasic saline group; thus sulphuric acid would be $(S_2HO_6H)O_2$. Tribasic acids in like manner are to be regarded as derived from a third equivalent of water in which a bibasic residue replaces an atom of hydrogen. The idea of polymeric types was further illustrated in the same paper, where three hydrogen types were proposed, (HH) (H_2H_2) and (H_3H_3) corresponding to the chlorids MCl, MCl_3 and MCl_5. It was also

* The anhydrids of the monobasic acids correspond to two equivalents of the acid, minus one of water, as, $2\,(C_2\,H_4\,O_4)-H_2\,O_2=C_4\,H_6\,O_6$, while one equivalent of a bibasic acid (itself derived from $2\,(H_2\,O_2)$ loses one of water, and becomes an anhydrid as $C_2\,H_2\,O_6-H_2\,O_2=C_2\,O_4$. So that both classes of anhydrids are to be referred to the type of one molecule of water $H_2\,O_2$.

illustrated by sulphur in its ordinary state, which I showed is to be regarded as a triple molecule S_3, (or S_6 = 4 volumes) and referred sulphurous acid SO_2 to this type, to which also probably belongs selenic oxide. (At the same time I suggested that the odorant form of oxygen or ozone was possibly O_3.) Wurtz in his memoir, published in 1855, adopts my view, and makes sulphur vapour at 400° C the type of the triple molecule. I farther suggested (*American Journal of Science,* v. 408, vi. 172,) that gaseous nitrogen is NN, an anhydrid amid or nitryl, corresponding to nitrite of ammonia, (NO_3, NH_4O) — H_4O_4 = NN. This view a late writer attributes to Gerhardt, who adopted it from me, (*Ann. de Chimie et Phys,* lx. 381.) May not nitrogen gas, as I have elsewhere suggested, regenerate under certain conditions, ammonia and a nitrite, and thus explain not only the frequent formation of ammonia in presence of air and reducing agents, but certain cases of nitrification ?*

I endeavoured still further to show that hydrogen is to be looked upon as the fundamental type from which the water type is derived by the replacement of an atom of H by the residue HO_2, (*American Journal,* viii. 93.) In the same way I regarded ammonia as water in which the residue NH replaced O_2.

I have always protested against the view which regards the so-called rational formulas as expressing in any way the real structure of the bodies which are thus represented. These formulas are invented to explain a certain class of reactions, and we may construct from other points of view, other rational formulas which are equally admissable. As I have elsewhere said "the various hypotheses of copulates and radicals are based upon the notion of dualism, which has no other foundation than the observed order of generation, and can have no place in a theory of science." All chemical changes are reducible to union (identification,) and division (differentiation). When in these changes only one species is concerned, we designate the process as metamorphosis, which is either by condensation or by

* The formation of a nitrite in the experiments of Cloez appears to be independent of the presence of ammonia, and to require only the elements of air and water (*Comptes Rendus.*) Some experiments now in progress lead me to conclude that the appearance of a nitrite in the various processes for ozone, is due to the power of nascent oxygen to destroy by oxydation the ammonia generated by the action of water on nitrogen, the nitrous nitryl; so that the odor and many of the reactions assigned to ozone or nascent oxygen are really due to the nitrous acid which is set free when the former encounters nitrogen and moisture. On the other hand, nascent hydrogen, which readily reduces nitrates and nitrites to ammonia, by destroying the regenerated nitrite of the nitryl, produces ammonia in many cases from atmospheric nitrogen.

expansion, (homogeneous differentiation.) In metagenesis, on the contrary, unlike species may unite, and by a subsequent heterogeneous differentiation give rise to new species, constituting what is called double decomposition, the results of which, differently interpreted, have given origin to the hypothesis of radicals and the notion of substitution by residues, to express the relations between the parent bodies and their progeny. The chemical history of bodies is then a record of their changes; it is in fact their genealogy, and in making use of typical formulas to indicate the derivation of chemical species, we should endeavour to show the ordinary modes of their generation. (See *On the Theory of Chemical Changes*, *Am. Jour. Sci.* xv. 226, *L. E. & D. Phil. Mag.* (4) v. 526, and *Chem. Centralblatt*, 1853, p. 849. Also *Thoughts on Solution*, *Am. Jour. Sci.* xix. 100, and *Chemical Gazette*, 1855, p. 92.

Keeping this principle in mind let us now examine the theory of the formation of acids. As we have just seen I taught in 1848 that the monobasic, bibasic and tribasic acids are derived respectively from one, two and three molecules of water, H_2O_2. Mr. Wurtz, seven years later, (in 1855) put forth a similar view. He supposes a monatomic radical PO'_4 a diatomic radical $P''O_3$, and a triatomic radical PO'''_2, replacing respectively one, two and three atoms of hydrogen in H_2O_2, H_4O_4, and H_6O_6, thus $(PO'_4H)\,O_2(PO''_3H_2)O_4$ and $(PO'''_2H_3)O_6$. These radicals evidently correspond to PO_5 which has lost one, two and three atoms of oxygen in reacting upon the hydrogen of the water type, and these acids may be accordingly represented as formed by the substitution of the residue PO_5—O for H, etc.

To this manner of representing the generation of polybasic acids we object that it encumbers the science with numerous hypothetical radicals, and that it moreover fails to show the actual successive generation of the series of acids in question. When phosphoric anhydrid, $P_2O_{10}=(PO_4)_2O_2$, is placed in contact with water it combines with one equivalent, H_2O_2. The union is followed by homogeneous differentiation, and two equivalents of metaphosphoric result, $(PO_4)_2O_2+H_2O_2 = 2\,(PO_4H)O_2$. Two equivalents of this acid with one of water at ordinary temperatures are slowly transformed into two of pyrophosphoric acid, by a reaction precisely similar to the last. $2\ (PHO_6) = (PHO_5)_2O_2 + H_2O_2 = 2\,(PHO_5H)O_2$, and two equivalents of pyrophosphoric acid when heated with a third equivalent of water yield, in like manner, two of tribasic phosphoric acid; $2\,(PH_2O_7) = (PH_2O_6)_2O_2 + H_2O_2 = 2\,(PH_2O_6H)O_2 = 2\,PH_3O_8$.

Gerhardt long since maintained that we cannot distinguish between polybasic salts and what are called sub-salts, which are as truly neutral salts of a particular type. Thus the bibasic and tribasic phosphates are to be looked upon as subsalts, which sustain the same relation to the monobasic phosphates that the basic nitrates bear to the neutral nitrates. He succeeded in preparing two crystalline subnitrates of lead and copper, having the formulas NO_5,M_2O_2,HO (tribasic), and NO_5,M_4O_4,H_3O_3 (quadri or heptabasic), both of which retain their water of composition at 392° F. The compounds of sulphuric acid are: 1st. The true monobasic sulphate S_2O_6MO, corresponding to the Nordhausen acid and the anhydrous bisulphates; 2nd. The ordinary neutral sulphates, S_2O_6, M_2O_2; 3rd. The so-called disulphates, S_2O_6, M_4O_4, corresponding to the glacial acid density 1·780; 4th. The type, S_2O_6, M_6O_6, represented by turpeth mineral; and, 5th. The so-called quadribasic sulphates, $S_2O_6M_8O_8$. The copper salt of this type, according to Gerhardt, retains, moreover, 6HO at 392° F.—(*Gerhardt on Salts, Jour. de Pharmacie*, 1848, vol. xii.; *Am. Jour. Sci.* vi. 337.)

Without counting the still more basic sulphates of zinc and copper, described by Kane and Schindler, we have the following salts, which in accordance with Wurtz's notation, correspond to the annexed radicals:

1.	Monobasic	$S_2HO_7 = S_2O_5$	monatomic.
2.	Bibasic	$S_2H_2O_8 = S_2O_4$	diatomic.
3.	Quadribasic...........	$S_2H_4O_{10} = S_2O_2$	tetratomic.
4.	Sexbasic	$S_2H_6O_{12} = S_2$	hexatomic.
5.	Octobasic..............	$S_2H_8O_{14} = S_2 - O_2$	octatomic.

It is easy to apply a similar *reductio ad absurdum* to the radical theory in the case of the oxychlorids and other basic salts, and to show that the radicals of the dualists are often merely algebraic expressions.—(See further my remarks in the *Am. Jour. Science*, vii. 402—404.)*

* Those who are familiar with chemical literature, will remember an amusing *jeu d'esprit* of Laurent's, in which he invited the attention of the advocates of the radical theory to a newly invented electro-negative radical *Eurhizene.—Comptes Rendus des Travaux de Chimie* for 1850, pp. 251 and 376.) We observe a late writer in the *Chemical News* (vol. i. p. 326) proposing, as a new electro-negative radical, under the name of hydrine, the peroxyd of hydrogen HO_2, the eurhizene of Laurent!

The above, which we conceive to be a simple statement of the process as it takes place in nature, dispenses alike with hypothetical radicals and residues, both of which are, however, convenient for the purposes of notation. In the selection of a typical form, to which a great number of species may be referred, hydrogen or water merits the preference from its simplicity, and from the important part which it plays in the generation of species. Water and carbonic anhydrid are both so directly concerned in the generation of the bodies in the carbon series, that either may be assumed as the type, but we prefer to regard C_2O_4, like the other anhydrids, as only a derivative of the type of water, and eventually of the hydrogen type.

These views were first put forward by myself in 1848, when I expressed the opinion that they were destined to form "the basis of a true natural system of chemical classification;" and it was only after having opposed them for four years to those of Gerhardt, that this chemist, in June 1852, renounced his views, and without any acknowledgment, adopted my own.—(*Ann. de Chim. et Phys.* (3) xxxvii. 285.) Already in 1851, Williamson, in a paper read before the British Association, had developed the ideas on the water type to which Wurtz refers above, and to him the English editor of *Gmelin's Handbook* ascribes the theory. The notion of condensed types, and of H_2 as the primal type, was not, so far as I am aware, brought forward by either of these, and remained unnoticed until resuscitated by Wurtz in 1855, seven years after I had first announced it, and one year of my reclamation, published in the *American Journal of Science*, in March, 1854.

My claims have not, however, been overlooked by Dr. Wolcott Gibbs. In an essay on the polyacid bases, he remarks that in a previous paper, he had attributed the theory of water types to Gerhardt and Williamson, and adds, "in this I find I have not done justice to Mr. T. Sterry Hunt, to whom is exclusively due the credit of having first applied the theory to the so-called oxygen acids and to the anhydrids, and in whose earlier papers may be found the germs of most of the ideas on classification usually attributed to Gerhardt and his disciples."—(*Proc. Am. Assoc.* Baltimore, May, 1858, p. 197.) It will be seen, from what precedes, that I not only applied the theory, as Dr. Gibbs remarks, but except so far as Laurent's suggestion goes, invented it and published it in all its details some years before it was accepted by a single chemist.

In conclusion, I have only to ask that future historians will do justice to the memory of Auguste Laurent, and will ascribe to whom it is due the credit of having given to the science a theory which has exercised such an important influence in modern chemical speculation and research, remembering that my own publications on the subject, which cover the whole ground, were some years earlier than those of Williamson, Gerhardt Wurtz, or Kolbe.

MONTREAL, *January*, 1861.

NOTICES OF BIRDS OBSERVED NEAR HAMILTON, C. W.

BY THOMAS MC'ILWRAITH, ESQ.

Continued from page 18.

The small family of *Marsh blackbirds* is next in order, two species of which are well-known on account of their gaudy colours. One is the Red-winged Blackbird so common in our marshes during summer, and the other is the *Baltimore Oriole*, whose pensile nest we sometimes see suspended from the drooping twigs of our willow shade trees. The former of these enjoys the unenviable reputation of being a notorious corn thief, and though several writers have endeavoured to clear his character from this imputation, yet if brought to the Bar on such a charge, we might expect to hear very strong condemnatory evidence given against him by the farmer, and unless he could succeed in getting upon the jury a majority of his friends, the *Crow Blackbirds*, who had themselves tasted the corn, the chances are that the case would go against him. Admitting, however, that he does occasionally take what was intended for others, he amply compensates for it by the destruction of innumerable grubs and caterpillars, whose ravages among the corn would have far exceeded his own. A more remarkable species than either of these is the *Cow Bunting*, which, like the British Cuckoo, builds no nest, but dropping its egg into that of another bird, leaves the care of its offspring to those not related to it, even by family ties. With us, the Cow-birds are summer residents only, usually making their appearance about the beginning of April, and retiring to the south about the end of October, It is possible that a few individuals may spend the winter with us, in sheltered situations; as when visiting a farm house near Dundas, early in March (1857,) I was surprised to see half a dozen of these birds nestling close together on a beam just above the cattle in the cow-house. On enquiry, I found they had been there all winter, coming out for a few hours about midday, and gleaning seeds from among the fodder of the cattle. They were all males, and seemed in excellent condition.

It was long a subject of remark among those who were fond of observing the habits of birds, that the nest of the Cow Bunting was seldom, if ever, found, and suspicions were entertained that some irregularity existed in their mode of perpetuating their race, but Wilson was the first to establish the fact, that they not only shirk the duties of incubation, but that the whole tribe live in a state of the most unrestrained polygamy. Their conduct, in this respect, forms a striking contrast to that of all our other summer birds: these, as soon as they arrive from their winter quarters, lay aside the instinct which has kept them in flocks during their migratory course, and scattering about in pairs, each pair makes choice of a particular tree or bush, which is to be their home for the season. To this spot they are devotedly attached, and near it the male may be constantly seen, either cheering his mate with a song, or fighting bitter battles of disputed boundary with his troublesome neighbours. Even the Woodpeckers, which, some writers say, have the smallest share of enjoyment of all the feathered tribes, may at this season be seen chattering and chasing each other round the favorite decayed tree, whose hollow recess is to be the cradle for their young. During all this excitement, the Cowbirds remain in a state of callous indifference, and in small flocks, keep roaming about the clearings like bands of vagrants, with no song save a few spluttering notes, holding no intercourse with other birds, and with no attachment to any locality, save that where food is most abundant.

As the season of incubation advances, the female Cow-bird leaves the flock, and having made choice of a nest to suit her purpose, deposits therein one egg, and leaves it, not only without hesitation, but, judging from her manner, with evident satisfaction. The nest so selected is usually that of a Fly-catcher or Warbler, in which the owner has just made a similar deposit. Wilson, who spent much time in investigating this matter, tells us, that the egg of the Cow-bird is hatched in less time than the others, and that the female being obliged to leave the nest to provide for the wants of the youngster, the unhatched eggs are exposed to the weather, and do not come to maturity, but, in a few days, disappear altogether, leaving the intruder in undisputed possession of the nest. It has ever been a puzzle to naturalists to account for this singular habit, and as it may be interesting to hear what has been said on the subject, I will here make one or two short extracts.

Wilson, after devoting more space to the description of this than any other bird he met with, says, "what reason nature may have for this extraordinary deviation from the general practice, is, I confess, altogether beyond my comprehension. Many conjectures, indeed, may be formed as to the probable cause, but all of them, which have occurred to me, are unsatisfactory and inconsistent. Future and more numerous observations may throw some light on the matter, till then, we can only rest satisfied with the fact." Mr. Selby, the eminent English naturalist, suggests, regarding this habit in the Cuckoo, that the old birds retire to the south before the young are able to accompany them, and *therefore* they have to be confided to the care of others. The writer of an article on this subject, in the *British Cyclopedia of Natural History*, says regarding Mr. Selby's theory, "this is perhaps about as good an explanation of the Cuckoo's peculiarities as has yet been offered, but it fails, like all the others, in being quite inapplicable to the North American Cow Bunting. The true cause, whatever that may be, of this extraordinary deviation, must, we are persuaded, be the same in both, nor can we at present accept of any explanation as satisfactory, which will not alike apply to either."

I have been particular in making these extracts, because it occurs to me that an important consideration connected with the subject has been overlooked, it is one which applies alike to the Cuckoo and the Cowbird, and will, I think, if carefully followed up, go far to explain the seemingly unnatural conduct of both species. We recognize in it, as in accordance with the all wise laws which regulate animated nature, that over each class there is imposed a salutary check, to prevent excess in production; this is specially observable among the feathered tribes, some of which have their eggs carried away by the ship-load from the breeding places; others, such as the grouse and waterfowl, are greatly reduced in number by sportsmen, or those who make a business of sending them to market, while the finches and blackbirds contribute largely to the support of the birds of prey, and in the southern part of the continent, are, during the winter, taken in numbers with the net, and sold for the table. None of these causes, however, in any way affect the class which embraces the Fly-catchers and Warblers, as from their small size and the nature of their food, they are not sought after for these purposes. The check which applies to this class must therefore be of a different description from those referred to, and finding no way in which their numbers are reduced to any extent, *except* by the sacrifice made of their own young while rearing that of the Cowbird, leads me to conclude, that the habit has been given for the special purpose of keeping within proper bounds, a class of birds which might otherwise have exceeded their due proportion in the economy of nature. If we suppose the habit to be the result of any physical defect in the Cowbird, we might naturally expect, that it would confide the care of its young to a bird nearly allied to its own species, but in nine cases out of ten, the foster parents belong to a group which are different both in size, habit, and the nature of their food; it is evident therefore that the *result* of the peculiarity is intended by nature to bear specially on the class to which the foster parents belong, and any one who has noticed the flocks of cowbirds which pass along on their migratory course in spring and fall, and estimated that for each bird in these flocks, from three to five of a different class have been prevented from coming to maturity, must admit that it is no small influence which the Cowbird exercises, in maintaining the balance of power which so admirably prevails among the feathered tribes.

If we could imagine such a thing in nature, whose movements are all so well ordered as that the Cow Buntings should at any time get in excess of the other class referred to, it would be curious to estimate the results; the Flycatchers would then be fully occupied in rearing foster children, and not being permitted to perpetuate their own species, must soon die out, when the Cowbirds, finding themselves without a substitute in the rearing of their young, would either be driven by necessity to make the attempt themselves, or they too would soon be added to the list of extinct species.

Passing the *Jays* and the *Crows*, (both of which are well deserving of notice did our limits permit,) we come to a species, which, in our vicinity, is the sole representative of his family.* This is the *American*

* Since writing the above, I have found a second species near the city, which appears to be the *Lanius Excubitoroides* of Baird.

Shrike, or *Butcher Bird*, so called from his habit of impaling his prey on thorns. With us this species appears about the end of September, and a few adults remain over the winter. The male frequently makes choice of a particular district as his hunting ground during his stay, 'and I am inclined to think returns to it, year after year. His aspect bespeaks both strength and courage, the short neck, broad head, and notched beak giving him much the appearance of a bird of prey. His favourite food consists of grasshoppers and other insects, but in winter when these cannot be procured, he does not hesitate to hunt down the smaller finches, killing them with a blow of his powerful beak. In October last, when passing through an open field west of the race course, I noticed one of these birds, whose motions led me to suspect he was engaged in the occupation which has gained him his name; he was too shy to allow a close inspection of his operations, but on examining the thorn bush I found two of his victims still in life on thespikes. I did not observe anything which could lead to an explanation of this singular habit, except that he seemed to take great delight in the pastime, skipping about between the ground and the bush, and warbling a few rather musical notes in evident token of satisfaction.

To those who have occasion to be in the woods in winter, there is no bird so familiar as the *White Breasted Nuthatch*; it is one of the few which remain with us all the year round, and is remarkable for its restless inquisitive habits; as a climber it has no equal, and may often be seen running downward on the smooth bark of a perpendicular tree, a feat which no other Canadian bird ever attempts. An examination of its feet shows a remarkable adaptation for this peculiar habit. It is furnished with a long and strongly hooked hind claw which enables it to hang firmly in that position. It is said to roost head downward, and I have often seen it when shot, hanging in this position after death. The Red-breasted Nuthatch is another species of the same genus; it resembles the other, but is more migratory in its habits,less in size, and slightly different in colour.

The family of *Woodpeckers* is well represented in our woods, seven different species being observed. Of these the most common are the two spotted varieties, which resemble each other in colour, but differ considerably in size; they are partially migratory, only a few remaining during the winter. In the fall, when passing along to the south, they are frequently seen on the shade trees of the city, jerking themselves round to the offside of the branch when observed, or again startling the inmates of our frame dwellings, by rattling loudly on the decaying boards.

A very beautiful species of this family is the *Red Headed Woodpecker*, which has been remarked by those who are observant of our native birds, to be less common in this district than formerly. This can only be accounted for by the removal of the heavy decaying timber which forms the nursery of its favourite insect food, and as the country gets more under cultivation, we may look forward to the time when it will only pay us a passing visit on its way to and from the woody regions to the north of us.

The least common species of this class which I have observed is the *Arctic three-toed Woodpecker*. Wilson does not appear to have met with it all, and Audubon mentions the northern part of the State of New York, as the southern limit of its migration; it resembles the spotted woodpeckers in size and manners, but differs from them in colour, and in wanting the hind toe. Why one class of these birds should have *four toes*, and another, similar to it in habits should have only *three*, we are at a loss to determine. I may remark, however, that the three-toed species belongs exclusively to the north, being seldom found among deciduous trees, and I have no doubt that a careful examination of the feet of this bird, and their mode of application to the bark of the pine, would give a satisfactory explanation of the seeming defect.

Passing the *Pigeons* and the *Grouse*, which are equally interesting to the sportsman and the naturalist, we come to the *Waders* and *Swimmers*. Here my remarks will be general, as the haunts of these birds being beyond the reach of morning excursions I cannot say much from personal observation.

Of the first division of this group, which includes the Plovers, Sand-pipers, Curlews, &c., little can be said, except that they visit the sandy shores of Burlington Beach in considerable numbers every spring and fall, when on their migratory course to and from their summer residence in the north. In spring these visits are usually made during the month of May, occasionally the flocks remain for a day or two, but more frequently they move off after a rest of only a few hours, and are succeeded by others bound on the same journey. By the first of June they have all disappeared except the little Spotted Sandpiper, which stays with us during the summer, rearing its young on the shores of the bay.

Of the *Heron* family we have four species: viz, the Great Blue Heron, the Black-crowned Night Heron, and the greater and lesser Bitterns. Much information has yet to be gained regarding the birds of this class. Being all more or less night feeders, the study of their habits is attended with peculiar difficulty. On the breast of the great blue heron, covered by the long plumage of the neck is a tuft of soft tumid feathers, which, when exposed in the dark emit a pale phosphorescent light. The use of this does not yet appear to be fully understood, though the fishermen aver that when the heron retires at night to his feeding ground, he wades knee deep in the water, and shewing this light attracts the fish within his reach, much in the same way as the Indian does when fixing the torch of pitch-pine on the bow of his canoe.

Of the flocks of the larger water-fowl which periodically pass along on their migratory course, only a very few now visit us; occasionally, in thick or stormy weather a few stragglers alight on the bay to rest and recruit themselves, though they generally forfeit their lives by so doing. Last fall three specimens of the American Swan were thus procured, and a single individual of what has hitherto been considered the young of the Snow Goose was also obtained; doubts still exist as to the identity of the latter bird, some writers maintaining that it is a separate and distinct species, while others declare it to be the young of the snow goose in immature plumage. There are good arguments on both sides, but conclusive information on the subject can only be obtained from their breeding grounds in the far north.

Of Ducks I have noticed in the market and elsewhere, twenty different species, the gayest of which is the *Wood-duck*, so called from its habit of building its nest in the hollow of a decayed tree. A few pairs of this species annually raise their broods near the shores of the Dundas marsh; the *Teal* and the *Mallard* have also been observed leading out their young from the ready inlets of the Bay, but there are exceptional cases, as the great body pass farther to the north, paying us a short visit going and returning.*

* It has been remarked by fishermen and others, who have had occasion to be on the waters of the Bay during the summer months, that there are usually about a dozen ducks which keep together in a small flock, and do not seem to take any share in the duties of the breeding season. The flock is composed of both sexes, and frequently of different species. Various conjectures have been formed as to the cause of this singular conduct, but the

Nearly allied to the Ducks is the small family of *Mergansers*, which contains only three species* peculiar to the American continent, all of which are, at certain seasons of the year found round the shores of the bay. The birds of this class subsist chiefly by fishing, and have the bill compressed and deeply serrated, to enable them to hold their slippery prey. They are also furnished with a crest, the use of which has been a matter of conjecture among naturalists, one of whom suggests that the elongated feathers of the head being acted on by the water, serve to give precision to the blow when striking the fish, much in the same way as a feather acts on the shaft of an arrow. The most beautiful of this class is the hooded merganser, whose fine erectile crest extends from the bill right over to the hind head. With us this species is never abundant, but a few pairs are seen every spring as soon as the ice begins to shove from the sides of the bay. Their stay at this season is short, as they soon pass on to the north to breed; in the fall they again pay us a visit accompanied by their young, and follow their avocation round the bay till they are frozen out, when they move off to the south to spend the winter.

Two species of Tern visit the bay in spring, and during winter three species of Gull have been observed at the beach; of the latter class the most conspicuous is the Great Black-backed Gull, which arrives from the north at the approach of winter, and leaves again on the first appearance of spring. The word *Gull,* as applied to the human species is often used to denote dullness or stupidity, but such a meaning could not be suggested by the character of the birds to which it belongs, as there is not, among all our water-fowl, a more vigilant species than that which we have just referred to; it never comes within gun-shot, and the only specimen ever procured at the beach, met his death by following the example of an eagle in tasting a poisoned carcase, a few minutes after which, both were stretched dead upon the ice.

Lowest on the list as being least perfect in their organization, are the Grebes, a class of birds which frequent the borders of our smaller lakes and ponds, finding their sustenance chiefly in the shallow waters, which abound with water-plants. Three different species of this genus

probability is, that they are birds, which, from being wounded, or otherwise in ill health, have been unable to perform the journey northwards, and prefer spending the summer in retirement, joining their comrades on their return in the fall.

* The Smew, or White Nun, is mentioned in some works as an American bird, but its occurrence is very rare and considered accidental.

are found in the bay, all of which are known to the gunners by the somewhat suggestive name of "Helldiver." An examination of these birds shows the most wonderful adaptation to their peculiar mode of life. Their food being obtained entirely under water, and their nest being only a few inches above its level, they have little occasion to be on land. When surprised in that situation, they seem most helpless, their legs being placed so far aft, they are unable to keep the body in anything like a horizontal position, and so make poor progress in walking, but the moment they reach the water, they disappear under the surface, and are not again seen while the cause of alarm remains. The plumage of this species is of the most compact and silky texture, and is never penetrated by water while the bird is in life. The legs are placed far behind the centre of gravity, to give it greater power in swimming, and are much compressed so as to offer the least possible resistance to water, while the toes, in place of being connected with a web as in the duck, are each furnished with a separate membrane, which enables the bird to pass with ease and celerity through the tangled masses of water-plants, among which its favorite food is found. In some parts of the European continent the skin of the Grebe is much prized as trimming for ladies' dresses; and in olden time, when the fowling piece was a less perfect instrument than at present, considerable difficulty was found in supplying the demand, as the Grebe being a most expert diver, disappeared at the first flash of the gun, and was under water ere the shot could reach it. Since the invention of the percussion cap, however, they are more readily killed, and were any of our Hamilton ladies desirous of having a dozen or two of Grebes skins for trimmings, I have no doubt the birds would be forthcoming. At present there being no demand for the *skins*, and the *flesh* being unsuitable for the table, they are not much disturbed.

Of the three species alluded to, one is a winter visitor, the other two remain during summer and rear their young in the Dundas marsh and the reedy inlets of the bay. They are well protected with feathers, yet seem very sensitive to the cold, moving off to the south at the first touch of frost, returning again about the latter end of April.

I have thus alluded to only a few of our more remarkable birds. The total number of species observed in the near vicinity of the city, from May, 1856, to the present time, amounts to 206, each of which has a separate and distinct history of its own, though in many cases it is very imperfectly known to us. If sportsmen and others who have opportunity of observing the birds in their native haunts could be induced to make notes of their observations, and communicate them to public bodies having the means of making them known, much new information would no doubt be gained, and we could with tolerable certainty ascertain the geographical distribution of many species, a point at present undetermined.

There are few places in Canada so well situated for making such observations as Hamilton, for besides being in the near vicinity of a large lake and extensive marshes, which are the favorite resort of the waterfowl, it is situated between two lakes, on a narrow neck of land, which is most probably the route chosen by a large proportion of our short-winged summer birds when migrating to and from their great nursery in the north. It would also add much to the interest taken in this branch of natural history if museums were formed, accessible to the public, and containing well-preserved specimens ot all the birds found in their particular districts. Good books of reference should also be in the libraries, so that those whose tastes tend in that way, might have the means of gett: _ correct information on their favorite subjects, without incurring very great expense.

With such facilities at command, we might fairly expect, that many of our young men would be induced to devote a portion of their spare time to these healthful and elevating studies, as a pleasing relaxation from the more confining duties of the counting-house and the store; and by cultivating and extending the love of what is true and beautiful in nature, keep alive the better feelings of the heart which the cares of the world are too often allowed to overgrow.

ON THE DEVONIAN FOSSILS OF CANADA WEST.

BY E. BILLINGS, F.G.S.

(*Continued from* Vol. V. *page* 282.—No. XXVII. *May*, 1860.)

As the nomenclature of the important and widely-distributed genus *Athyris* is somewhat confused, it seems advisable to give, in this place, a short account of the leading points of its history. Professor McCoy was the first to separate the species, of which this genus is composed, from *Terebratula, Atrypa, Spirifera,* and other genera to which they had been previously referred. His original description was published in the "Synopsis of the Carboniferous Fossils of Ireland," in 1844. From this work we shall make the following extracts :—

"The family *Delthyridæ* appears to be divided into the five following genera: 1. *Spirifera,* Sow., composed of those longitudinally-ribbed species, in which the hinge-line is equal to, or exceeds the width of the shell, the cardinal area with parallel sides, the cardinal teeth of the ventral valve (now called the dorsal valve) large, spirally rolled, and having a triangular foramen beneath the beak of the dorsal (ventral) valve. 2. *Martinia,* McCoy, or the smooth Spirifers, in which the hinge-line is less than the width of the shell, and the cardinal area triangular. 3. *Athyris,* McCoy, in which there is no vestige of either foramen, cardinal area, or hinge-line. This remarkable genus is frequently confounded with those shells usually named *Terebratula,* in the older rocks, but is distinguished by the large, spiral appendages, which are wanting in the other group. 4. *Brachythyris,* McCoy, in which we find the longitudinally-ribbed surface of *Spirifera,* united with the short hinge-line of *Martinia.* 5. *Orthis,* Dal., in which there are no spiral appendages, the hinge-line and striæ frequently spinose (as in *Leptæna*), and the cardinal area common to both valves, and its sides inclined towards each other at its angles; dorsal valve smallest."—Work cited, page 128.

On page 146 of the same work, he thus concisely describes the genus :—

"*Gen. Ch.*—Nearly orbicular, small; no cardinal area or hinge-line; spiral appendages very large, filling the greater part of the shell.

"This very interesting group possesses all the external characters of the *Terebratulidæ,* united to the internal structure of the Spirifers, to which latter family it truly belongs. Professor Phillips is the only author who has recognized the group: he forms of it his last division of the genus *Spirifera,* but gives no characters to distinguish it from *Terebratula;* the internal structure is, however, a sure guide."

The above descriptions include all the more comprehensive and important characters, or those which connect the species together into one group by general affinities pervading the whole. In this respect nothing more has been done for this genus since 1844, although several minor and highly interesting points of the internal arrangements, such as the complicated structure of the spires and the form of the muscular impressions, have been ascertained by other authors; (especially by Messrs. Davidson, Bouchard, and Suess.)

McCoy was under the impression that all of the species were destitute of an aperture in the ventral valve, but it now turns out that many of them have a small circular perforation in the beak. Some are therefore disposed to reject the name *Athyris* (which means "without a door;" or, "deltidium," as Mr. Woodward construes it) altogether as inappropriate; and accordingly D'Orbigny, in 1847, re-described the genus under the name of *Spirigera*. His description is in substance the same as that of McCoy, but more in detail, and, with the additional character, that the ventral valve is truncated at the beak by a circular orifice.* This would exclude more than half the species that he placed in his genus; as all those which belong to the group typified by *A. tumida, A. Ceres, A. passer*, &c., have the beak entire. With respect to this part of the shell, therefore, D'Orbigny's definition is quite as defective as McCoy's.

In 1851, Professor Suess, of Vienna, proposed the name of *Merista* for some of these shells, but did not define his genus nor give the names of any species to be included in it.†

In 1852, McCoy, in the 2nd Fasciculus of the "British Palæozoic Fossils," page 196, re-defined *Athyris* as follows:—

"*Gen. Ch.*—Nearly orbicular or ovate, both valves convex; no cardinal area, foramen, or hinge-line; spiral appendages to beak of entering valve very large, nearly filling the shell; a strong mesial septum in the rostral part of entering valve; dental lamellæ moderate; tissue of shell apparently fibrous.

"One specimen [of *A. tumida*] shews the pallial and ovarian impressions to be thick, numerous, and dichotomising frequently from beak to margin."

Afterwards, in 1854, Suess objected to the term *Athyris* being applied to such species as *A. tumida*, on the ground that it was originally used to include *Spirigera concentrica, S. lamellosa*, and other similarly organized forms.‡ He therefore proposed to suppress *Athyris* altogether, substituting *Spirigera* for those with the beak perforate, and his own genus *Merista* for the others with entire beak, or mesial septum in the dorsal valve and a shoe-lifter process in the ventral. It is quite certain now, however, that some of those with a non-perforate beak have no shoe-lifter process, and cannot be included in *Merista*.

In Davidson's "Introduction, on the Classification of the Brachiopoda," *Spirigera* is retained for those with the beak perforate, and no

* *Paléontologie Française*, vol. iv. page 357.

† *Jahrbuch der K. K. Geologischen Reichanstalt, Vienna*, ii. pt. 4, pp. 150, 160. 1851.

‡ This is taken from a note by Mr. Davidson, on page 4 of the Appendix to his British Oolitic and Liasic Brachiopoda.

mesial septum in the dorsal valve, (type *S. concentrica,*) and *Athyris* for those of which *A. tumida* is the typical form. This is the most just arrangement of the difficulty that has yet been proposed, and has been adopted by F. Rœmer in the last edition of Bronn's "Lethæa Geognostica."

Mr. Woodward in the "Manual of the Mollusca," adopts *Athyris* in the wide sense as intended by McCoy, but admits *Merista* as a sub-genus for those with a shoe-lifter process.

In the New York Reports, the species of this genus, until within the last four or five years, have been placed in the genus *Atrypa.*

In the tenth annual report of the Regents of the University of the State of New York, published in 1857, Professor Hall describes six species from the Upper Silurian rocks, under the genus *Merista,* and one from the Hamilton group, under *Spirigera.* This latter, which he calls *Spirigera spiriferoides,* is considered by many authors to be identical with *S. concentrica.*

In the Geology of Iowa, dated 1858, he describes three species from the carboniferous rocks of the Western States, under *Athyris.* These appear to be perfectly congeneric with *S. concentrica,* or, *S. spiriferoides* as he calls it.

In the twelfth Annual Report of the Regents, dated 15th March, 1859, published October, 1859, he proposes a new generic name (*Camarium,*) for those with a shoe-lifter process. This genus is identical with *Merista.*

In the thirteenth Annual Report of the Regents, published January 1861, Professor Hall abandons his genus *Camarium,* finding it to be identical with *Merista,* and then for those shells which have *Athyris tumida* for the type he proposes a new name, *Meristella.*

Some of the European authors, such as Pictet and Sandberger, retain *Spirigera,* and in his recent highly instructive papers in the "Geologist," Mr. Davidson places all the species under *Athyris,* but says that sub-genera may be admitted provided they be founded on good and sufficient distinctive characters.

It is not necessary to extend this list of references to the opinions of palæontologists. Sufficient appears in the above to shew that the nomenclature of this genus is in a state of confusion. I think the best way of getting out of the difficulty, is to fall back upon the arrangement proposed by Mr. Davidson in his Introduction.

1. McCoy's several definitions should be construed literally or

according to his intended meaning, and confined to such species as have the beak imperforate, and usually a mesial septum in the dorsal valve. For these the name *Athyris* is perfectly proper and involve no contradiction whatever. The type of this group would be *Athyris tumida,* as given by Davidson in his Introduction.

2. D'Orbigny's definition also literally, and it would include all the species with perforated beaks which have *Spirigera concentrica* for the type. The mesial septum in the dorsal valve in this genus is either rudimentary or entirely absent.

3. the genus *Athyris* being limited as above, two sub-genera might be subtracted from it, that is to say, *Merista*—Suess, and *Nucleospira*—Hall.

According to Professor Hall's recent proposals, *Spirigera* must be suppressed, and *Athyris* made to take its place. This would leave the first of the above groups without a name, and thus his genus *Meristella* would be accommodated.

The following figures represent some of the internal characters of the above mentioned genera :

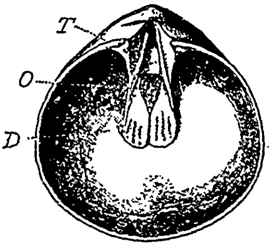

Fig. 48.

Fig. 49.

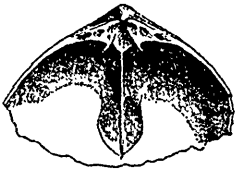

Fig. 50.

Fig. 48.—*Athyris tumida.*—Dalman.—Interior of ventral valve. *D.*—divaricator impressions *O.*—occlusor impressions. *T.*—teeth.
Fig. 49.—Interior of ventral valve of *Athyris Clara*—Billings.
Fig. 50.—*Athyris Clara,* interior of dorsal valve.

In the interior of the ventral valve of *A. tumida,* Fig. 48, the two elongate oval scars which indicate the place of the attachment of the divaricator muscles or those whose function it was to open the valves, are situated side by side about the centre of the shell. Above, or partly between, is the small heart-shaped scar of the occlusor, the muscle that served to close the valves. Beneath the beak is seen the wide triangular foramen which, in consequence of the close incurvation of the beak is always completely closed. This foramen is a different thing from the small circular aperture which occurs in the point of the beak of *Spirigera.* On each side is a short stout tooth, beneath which a strong nearly vertical septum extends a short way towards the front. These two septa are the dental-plates. Fig. 49 shews the form of the muscular impressions in *A. Clara.* At first sight they appear to be widely different from those of *A. tumida,* but this is owing to the greater thickness of the shell in the upper half of the ventral valve of this species. Since this species was described in this Journal, in May last, I have ascertained that the same variations in the form of the muscular impressions occur in the genus *Spirifera.* In the thick-shelled species it is deeply excavated, and is represented on the cast of the interior by an abrupt prominence, longitudinally or diagonally striated.

In the thin-shelled species it is superficial, and presents a different appearance. There are other variations in the form of the scars in the ventral valve not represented in the above figures. Sometimes they extend nearly to the front of the shell, as is the case in an undescribed species from Anticosti, and in a Corniferous species of which I have some fragments.

In the dorsal valve, fig. 50, there is a horizontal plate (the hinge-plate) just beneath the beak, with a triangular depression in the middle, from which a thin vertical septum extends about one-half the length of the shell. On each side of the central depression the hinge-plate of the specimen figured shows two short, slender, spine-like projections, these are simply the bases of the spiral arms, which were here attached to the anterior edge of the plate. At the extremities of the hinge-plate are two small pits,—the sockets for the reception of the teeth of the opposite valve. The occlusor muscular impressions are four in number, and elongate oval, the anterior pair about the middle of the shell, and the posterior pair between the anterior and the beak.

Fig. 48 is copied from Mr. Davidson's paper in the "Geologist," Vol. I., Plate 12. Figs. 49 and 50 are from specimens in the collection of the Geological Survey.

In the sub-genus *Merista* the dental plates are connected by a peculiar arched plate, resembling a shoe-lifter, hence its name,—the shoe-lifter process or septum. (See fig. 53). In the species on which Prof. Hall founded his genus, *Camarium,* and also in some of the European forms, it extends from the beak downwards half the length of the valve, and the dental plates are partly supported by it. I think this process is an abnormal form of the pseudo-deltidium, that occurs in some of the Spirifers.

In all of the genera, *Spirifera, Cyrtia, Spiriferina, Suessia, Cyrtina, Athyris, Spirigera, Merista, Nucleospira,* and *Uncites,* the spiral appendages have the apices of the cones which they form directed outwards, towards the sides of the shell, as represented in the following figure, 51.

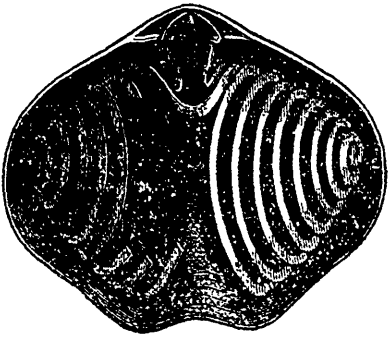

Fig. 51.

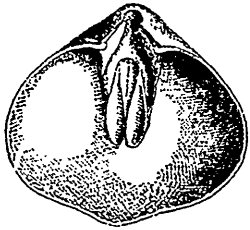

Fig. 52.

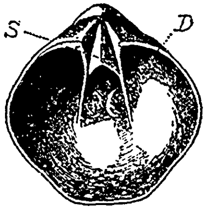

Fig. 53.

Fig. 51. Interior of *Athyris* (Spirigera) *ambigua*, showing the disposition of the spiral appendages. Copied from Davidson.—(*Geologist*, Vol, III. Plate 1.

Fig. 52. Interior of ventral valve of *Spirigera concentrica* shewing the muscular impressions and the circular aperture in the beak.

Fig. 53. Interior of ventral valve of *Merista Herculea* (Barrande), a Bohemian species, S.—the shoe-lifter process. D.—the divaricator muscular impressions.

It will be seen on examining fig. 51 closely, that the first coils of the spiral appendages are connected on the dorsal side by a transverse bar, from which an upright process springs, sloping upwards slightly towards the beak, and giving off two half coils,—one on each side. It is yet to be ascertained in how many species this complicated structure prevails. We may expect to find by continued search in our Canadian rocks, specimens which will enable us to make out the structure of these peculiar organs in such species as we have. As yet, I have only seen five or six specimens of *A. Clara* and *A. Maia* in which the spires could be seen, but none are sufficiently perfect to exhibit the details.

In Mr. Davidson's earlier writings, the muscle called the "DIVARICATOR" in this article, is styled the "RETRACTOR," while the "OCCLUSOR" is designated the "ADDUCTOR." But in his recent papers in the *Geologist* he uses both. It appears that the new names, "Divaricator" and "Retractor," were devised by Mr. Hancock.

I shall hereafter, from time to time, as materials are collected, publish in this Journal such other particulars of the structure of these interesting genera as may seem to be of importance.

Of this genus, *Spirigera*, we have, as yet, clearly recognized only one species in Canada, but it is, in the opinion of some good palæontologists, identical with the famous *S. concentrica*, the type of the group. Three species, described in May last in this Journal, which have the beak perforated, may possibly belong to *Spirigera*, and would have been so referred, but at that time I had not made up my mind what course to take with regard to the sub-divisions of *Athyris*. The three species in question are not yet generically determined, and I have therefore marked them doubtful thus: *Athyris* (?) *scitula*, *Athyris* (?) *rostrata* and *Athyris (?) Chlöe*.

SPIRIGERA CONCENTRICA.—(Bronn, *Sp.*)

TEREBRATULA CONCENTRICA.—Bronn, 1829. ATRYPA + SPIRIGERA + ATHYRIS CONCENTRICA,—of the generality of authors. SPIRIGERA SPIRIFEROIDES, Hall.—*Tenth Annual Report of the Regents of the University of the State of New York*, p. 153. 1857.

Fig. 54.

Fig. 55.

Fig. 54. *Spirigera concentrica*.—Dorsal view. Fig. 55. The same.—Ventral view.

Fig. 56.

Fig. 57.

Fig. 56.—Side view. Fig. 57.—Dorsal view of a specimen with a truncated front margin.

Description.—Transversely sub-oval; greatest width about the middle or a little above; the front margin sometimes extended into a short, broadly-rounded linguiform projection, and sometimes nearly straight, or even a little concave for about one-third the width. Both valves moderately convex; the ventral valve usually with a shallow mesial sinus, or depression, which becomes obsolete before reaching the beak; dorsal valve with a broad slightly elevated mesial fold. Beak and umbo of ventral valve of moderate size, the former incurved, and perforated at the point by a circular aperture. The umbo of the dorsal valve is small and neatly rounded, the beak buried beneath that of the opposite valve. Surface marked by sharp concentric ridges, which are sometimes so greatly developed as to cover the whole shell with thin overlapping scale-like plates.

Length from nine to fifteen lines; width a little greater than the length.

This well known fossil has a very wide geographical distribution, being found in the Devonian rocks of Russia, Germany, France, Spain, England, and America.

It varies a good deal in form, according to the sediment in which it is found. Where the shell is thin, the middle of the front margin is straight or concave, as in Fig. 57; but the thick-shelled individuals have the front margin more or less pointed. Some think our species different from the European form; but others, such as De Verneuil, Roemer, Lyell, Sharpe, and others, who have compared specimens from both sides of the Atlantic, have pronounced them to be identical.

Locality and formation.—Occurs in the Corniferous Limestone in the Township of Cayuga, and in the Hamilton Shales at various places in the Township of Bosanquet.

Collectors.—A. Murray, T. Richardson, J. De Cew.

Genus RETZIA.—(King.)

RETZIA.—King. *Monograph of the Permian Fossils of England*, p. 137. 1850.

RETZIA.—Woodward. *Manual of the Mollusca*, p. 224.

Generic characters.—The species of this genus are in general smaller than those of *Athyris* or *Spirigera.* The form is ovate or sub-globular; the ventral valve the largest, with an elevated beak, which is perforated at the tip by a small circular aperture; a small flat area beneath the beak. In some species there is a shallow mesial fold and sinus, or more usually two or three of the ribs in the middle smaller than the others. The surface is covered with radiating ribs, as in Rhynconella. The internal characters are not yet well known, but it is certain that the spiral appendages have their apices turned outwards, as in *Spirigera.* The shell structure is punctate.

Retzia differs from *Spirigera* in being strongly ribbed, smaller, the beak of the central valve erect, or nearly so, and in having a small flat area beneath the rostral aperture.

Rhynchospira,—Hall, does not appear to me to differ from *Retzia.* The genus is said to range from the Silurian up to the Permian.

Dedicated (by King) to the celebrated naturalist *Retzius.*

RETZIA EUGENIA.—*N. Sp.*

Fig. 58.

Fig. 58.—*Retzia Eugenia.* *a, b, c,* dorsal, side, and ventral views of a specimen; *d,* a smaller specimen—dorsal view.

Description.—Shell small, sub-globular, with from ten to twelve strong angular ribs on each valve. Ventral valve convex, most prominent on the upper half, a slight mesial depression the width of three or four of the ribs in the lower half; beak elevated, incurved, but not in contact with the umbo of the dorsal valve, perforated at the point; a flat, solid deltidium or area beneath the aperture. Dorsal valve rather strongly and uniformly convex, most prominent along the middle, where slight indications of a mesial fold are evident; umbo small, rounded; beak buried beneath the lower edge of the deltidium or area of the ventral valve.

Length of the largest specimen seen, six lines; width about the same, or slightly less than the length; elevation of the beak of the ventral valve above the umbo of the dorsal valve, half a line.

We have one small specimen three lines in length, which appears to belong to this species. In form it is rather more elongate-oval, and not so convex as the larger specimens.

Closely allied to *Retzia globosa* (*Trematospira globosa*), Hall, but in that species when there are any indications of mesial fold or depression, it consists of one, two, or three ribs, which are smaller than the others, and do not reach the beak. It may be that specimens will be found connecting the two species, but at present I think it best to keep them separate.

Locality and Formation.—Lot No. 5, Con. 4, Township of Walpole.

Collector.—The only specimens I have seen were collected by J. De Cew.

(To be continued.)

NOTE ON A NEW GENUS OF PALÆOZOIC BRACHIOPODA.

BY E. BILLINGS, F.G.S.

Genus CHARIONELLA.—*N. G.*

Since the foregoing article on Devonian Fossils was written, I have ascertained the generic characters of the so-called *Atrypa* or *Athyris scitula.* It has internal spires with their apices directed outwards, as in *Athyris* and *Spirigera,* but the dorsal hinge-plate has its anterior margin and a large portion along the middle anchylosed to the bottom of the valve. In another congeneric species, the middle portion of the same plate is obsolete, there remaining only two small, thin, nearly vertical septa, (socket plates) one on each side of the cavity of the umbo. The perforation in the beak of the ventral valve is bounded on the lower side by a deltidium of either one or two pieces or by a portion of the shell. The mesial septum in the dorsal valve is either rudimentary or entirely absent.

The several species of this group, at present known to me, resemble *Athyris,* but are not so convex, and are, besides, more elongate ovate, or approaching to *Terebratula* in general form. I shall give further details and some figures in the next number of this Journal.

The genus is only proposed as a sub-group to be retained in case *Athyris* is divided.

A POPULAR EXPOSITION OF THE MINERALS AND GEOLOGY OF CANADA.

BY E. J. CHAPMAN,

PROFESSOR OF MINERALOGY AND GEOLOGY IN UNIVERSITY COLLEGE, TORONTO.

(Continued from Vol. V., page 531.)

The present article concludes the Second Part of this subject, completing our Synopsis of Canadian Minerals.

D. *Aspect Non-metallic (stony, glassy, etc.) Hardness insufficient to scratch glass*.*

D. 1. Soluble (sapid) minerals.

To this group belong: Rock Salt, Sulphate of Iron or Green Vitriol, Sulphate of Copper or Blue Vitriol, Sulphate of Zinc, Alum, &c., none of which have yet been discovered, at least as solid minerals, in Canada. Rock Salt occurs elsewhere in lamellar masses and in cubes, either colourless or coloured brown, red, &c. It has a strongly saline taste, and is deliquescent. Green Vitriol occurs chiefly on decomposing iron-pyrites, in white or greenish crusts and acicular crystals. Blue Vitriol, as a bluish efflorescence or in crystalline groups on decomposing copper ores; and also in solution in mine waters, from which the copper may be precipitated on pieces of iron plate. Both yield a strong, metallic taste. An efflorescence of Epsom Salt, a substance easily recognized by its peculiar taste, has been noticed in certain serpentines from Marmora, C. W.

D. 2. Taking fire when held in thin splinters in the flame of a candle.

The minerals belonging to this group admit of a natural subdivision into two sections, according to the following arrangement:—§ 1. *Burning with blue flame and odour of Sulphur or of Garlic:*—Native Sulphur, (aspect, resinous; yellow, sp. gr. about 2·0); Orpiment, (golden or lemon-yellow, paler in the streak, sp. gr. 3·4–3·5); Realgar, (red, with orange-yellow streak); Cinnabar or sulphide of Mercury, (red, with red streak; sp. gr., in pure specimens, 8·0–8·2). Orpiment and Realgar are compounds of sulphur and arsenic, and yield, when burning, an alliaceous or garlic-like odour. § 2. *Burning with yellowish flame and bituminous or resinous odour:*—Amber, and also the various kinds of Bituminous Coal, including Jet, with Brown Coal or Lignite, and Bitumen or Asphaltum, may be placed in this section. Of these minerals, two only have been met with in Canada: (1.) A kind of indurated bitumen, occurring in small, black, and more or less friable masses, in crevices in the Trenton Limestone and other fossiliferous rocks, sometimes filling, indeed, the interior of fossil shells, and much resembling coal

* See the heads of this arrangement or classification at page 170 of Vol. V.

in its general aspect; and, (2.) A dark variety of Petroleum, becoming viscous and even solid on continued exposure to the atmosphere. This latter substance, which occurs abundantly in springs and wells traversing the Devonian beds of Inniskillen, Mosa, &c., of the western peninsula of Canada, and which has also been discovered in Gaspé, will be noticed fully in its geological relations, under PART V., of the present Essay. The bituminous and more or less inflammable shales of these Devonian beds, and those belonging to the Utica Slate subdivision of the Lower Silurian series, will come under review, also, in the same place.

D. 3. *Not exhibiting the reactions of D. 1 or D. 2. Streak coloured.*

Earthy Manganese Ore:—Black or Brown; in earthy masses, which usually soil the hands. Streak, chiefly dark-brown, sometimes black. Infusible, yielding water in the bulb-tube. When fused with carbonate of soda, it forms a "turquoise enamel," blue whilst hot, and green when cold. Composition very variable, but essentially: hydrated sesquioxyd of manganese. Earthy or Bog Manganese Ore, sometimes called "Wad," occurs in the Eastern Townships of Bolton and Stanstead; in Aubert-Gallion, Tring, and Ste. Marie, in Beauce County; and at Ste. Anne, in Canada East.

Scaly Iron Ore (A variety of *Red Iron Ore*):—In glistening, red masses, of a scaly or laminar structure; streak, red. Soils the hands, more or less. Becomes magnetic before the blow-pipe. This variety of Red Iron Ore occurs in small quantities at many of the localities in which the latter mineral is found. See A. 4, (vol. V. p. 173.) Some specimens have recently been sent to us from the back of Peterboro', Canada West.

Red Ochre (An earthy variety of *Red Iron Ore*):—Chiefly in amorphous masses of a dull red colour, with earthy aspect, red streak, and low degree of hardness; but sometimes occurring as a red powder. It leaves a red trace on paper. Blackens and becomes magnetic before the blow-pipe, or when held (in the form of a thin splinter) in the flame of a candle or ignited match. Red Ochre occurs at Point-du-Lac (St. Maurice County), St. Nicholas, Ste. Anne, and other localities in Eastern Canada, accompanying Bog Iron Ore and Yellow Ochre. With the latter, it is largely employed as a wash or paint for wood-work, and also in the preparation of various pigments.

Bog Iron Ore (A variety of *Brown Iron Ore*):—Chiefly in amorphous masses with sub-metallic aspect. Colour dark brown; streak, yellowish-brown. Gives off water in the bulb-tube, and becomes magnetic after ignition. For more complete description, see A. 4, (Vol. V. p. 175.)

Yellow Ochre (An earthy variety of *Brown Iron Ore*) :—In amorphous and earthy masses of a dull yellow colour and streak. Leaves a yellow trace on paper; gives off water in the bulb-tube, and becomes magnetic after ignition. Localities and uses, the same as those of Red Ochre, described above. Of the two ochres, however, the present is by far the more abundant, and is the principal basis of the pigments manufactured at Point-du-Lac, in St. Maurice County. Quite recently it has been found, in some abundance, in the County of Middlesex, C. W.

Humboltine, (Oxalate of Iron):—In yellowish crusts or thin layers in the bituminous shales (Devonian) of Kettle Point, Lake Huron, and the township of Inniskillen, Canada West. Streka, pale yellow or greyish. Turns black and red before the blow-pipe, and becomes magnetic. Yields about 16 per cent. of water in the bulb-tube.

Uran-Ochre, (Hydrated Oxide of Uranium):—In small earthy masses of a yellow colour, accompanying actynolite in the magnetic iron-ore of Madoc, C. W. Blackens before the blow-pipe, but does not fuse.

Vivianite or *Phosphate of Iron*:—In blue pulverulent masses, associated with bog iron ore in Vaudreuil County, on the St. Lawrence and Ottawa, C. E. Composition: phosphoric acid, protoxide of iron, and about 28 per cent. of water.

Malachite or *Green Carbonate of Copper*:—Chiefly in green masses of a fibrous or lamellar structure, sometimes with botryoidal surface and banded shades of colour. Otherwise, in earthy coatings on copper ores, &c. Streak, pale green. H. 3·5—4·0 (or less); sp. gr. 3·7—4·0. Yields water in the bulb-tube, and becomes reduced *per se* to metallic copper before the blow-pipe, tinging the flame green. Composition: carbonic acid, 20; oxide of copper, 72; water 8—the latter, however, usually somewhat higher. Malachite occurs in small quantities, with native silver, &c., in quartz and calc-spar at Prince's Mine, Spar Island, Lake Superior. Also occasionally, as an incrustation, amongst the copper ores of Lake Huron and those of the Eastern Townships. The blue carbonate, in an earthy state, is sometimes mixed with it.

The following minerals may also be referred to, in connexion with this group:—*Red Copper Ore* (sub-oxide of copper.) Red, with red streak; often in octahedrons and rhombic dodecahedrons, converted on the surface into green melachite; fusible and reducible *per se*, colouring the flame green.—*Black Oxide of Copper.* Chiefly in black, earthy, or amorphous masses, (or cubical crystals) from the south shore of Lake Superior. Blowpipe characters like those of red copper ore.—*Red Zinc Ore.* In granular or lamellar masses of a red colour, with orange-yellow streak. Lustre inclining to semi-metallic. H. 4·0–4·5. Quite infusible. Hitherto found only in New Jersey. Normal composition: Oxygen 19·75, zinc 80·25; but sesquioxide of manganese, to the amount of 3 or 4 per cent., is present, also, in most specimens.

D 4. Streak, white. Anhydrous. Not yielding water in the bulb-tube.

The Canadian minerals of this group may be conveniently arranged in several sections, as follows: § 1. YIELDING TO THE NAIL: *Mica* of different kinds; certain varieties of *Talc; Asbestus.*—§ 2. EFFERVESCING STRONGLY IN COLD HYDROCHLORIC ACID: *Calcite* or *Calc Spar.*—§ 3. EFFERVESCING FEEBLY IN COLD, BUT SENSIBLY IN HOT ACID: *Dolomite, Magnesite.*—§ 4. FUSIBLE: *Fluor Spar* (phosphoresces); *Heavy Spar* (colours flame pale green); *Celestine* (colours flame red)—INFUSIBLE: Light-coloured varieties of *Zinc Blende.*

§ 1. YIELDING TO THE NAIL.

Mica.—The term "mica" includes properly, a series of distinct though closely allied silicates, presenting equally a metallic-pearly lustre and a strongly-marked foliaceous or fissile structure, the thin, component laminæ of which are flexible and elastic. These distinct species being, however, in many instances, of very difficult separation—frequently requiring indeed, for that purpose, the aid of accurate chemical analysis, and minute optical and crystallographic investigation—they may be grouped together in an Essay like the present, more especially with regard to their geological bearings, and treated practically as one species. Thus considered, mica occurs in foliated and scaly masses, and occasionally in six-sided and rhombic prisms, of a white, brown, black, grey, green, red, or yellow colour, with pseudo-metallic or pearly aspect. The prisms are often tabular, as in figure 46. H. 1·0 on the faces or broad surfaces of the laminæ, and sometimes as high as 5·0 on the edges. Cleavage very strongly marked in one direction, so that by means of the finger-nail, or the point of a knife, leaves of extreme tenuity may be obtained. These are flexible and elastic. Sp. gr. 2·7—3·1. Some varieties are fusible; others become opaque before the blowpipe, but

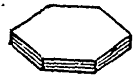

Fig. 46.

do not fuse. Common mica is essentially composed of silica, alumina, and potash; but other micas contain magnesia, oxides of iron, lithia, &c. Mica is a component of granite, of ordinary gneiss, mica slate, and other eruptive and metamorphic rocks, besides being of frequent occurrence in trachytes, lavas, &c. In Canada it occurs in more or less distinct specimens throughout the area occupied by our Laurentian rocks, and also in the metamorphic district of the Eastern Townships, both in the stratified-crystalline and in the trappean or trachytic rocks there present. In the crystalline limestone (Laurentian Series) of the township of Grenville, Argenteuil county, C.E., plates are obtained of sufficient size to be employed for stove-fronts, lanterns, &c. We possess some crystals of a yellowish-green colour, over half-an-inch in length, and perfectly translucent in a transverse direction or parallel with the cleavage-plane. They are imbedded in crystalline limestone and are said to have come from the Upper Ottawa. A lithia-containing mica, known as *Lepidolite*, in granular-scaly masses of a pink or reddish-grey colour, and pearly lustre, occurs in Maine, and elsewhere in the United States, but has not been found, as yet, in Canada. It fuses very easily and with continued bubbling, tinging the flame red.

Talc (certain varieties.)—In white or greenish foliated masses, somewhat unctuous to the touch, and yielding readily to the nail. Most varieties give off water when heated, and hence this mineral is described more fully under division *D* 5 below.

Asbestus.—In soft, fibrous, and more or less flexible masses, of a green, white, or other colour. Easily fusible. See under *Hornblende* and *Augite*, *C* 3, above. (Vol. V., p. 527.)

§ 2. Effervescing strongly in Cold Acids.

Calcite or Calc Spar.—Of all colours—white, grey, yellow, black, &c., with white streak. Occurs in lamellar, fibrous, and granular masses, in stalactites, &c., and in crystals of the hexagonal system, some of which are shewn in the accompanying figures. Cleavage strongly marked in three directions, producing a rhombohedron of 105° 5′ and 74° 55′,—fig. 47 *a*. H. 3·0; sp. gr. 2·5—2·75. Infusible, but glows strongly before the blowpipe, and becomes caustic. Soluble with effervescence in acids. Composition: carbonic acid 44, lime 56; but a small portion of the carbonate of lime is generally replaced by carbonate of iron or magnesia. This substance, in the form of rock

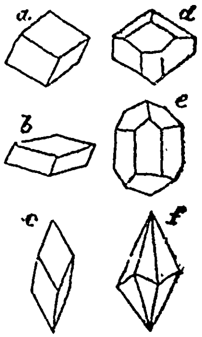

Fig. 47.

masses, (limestone, marble, &c.,) is perhaps the most abundantly distributed of all minerals, quartz only excepted. In Canada, in the crystalline limestones of the Laurentian Series, and in the vast calcareous deposits of the Huronian, Silurian, and Devonian formations, it occupies extended areas, although much concealed by the overlying clays and gravels of the Drift. Rhombohedrons, scalenohedrons, and other crystals are frequently met with in cracks and hollows in these limestone and other rocks.* Stalactitic masses are also found under similar conditions; and nodular concretions occur in the amygdaloidal traps of Lake Huron and Lake Superior. Fine crystallizations, also, amongst the copper deposits of these lakes. White and variously coloured marbles of much beauty are obtained from our Laurentian rocks and from the more modern metamorphic series, south of the St. Lawrence; but these, with the other economic limestones of Canada, will come under review in PART V. of this Essay. It should be observed, however, that many of our so-called limestones are dolomites or dolomitic limestones, containing magnesia. See under *Dolomite* below.

NOTE.—Carbonate of lime is a dimorphous substance, occurring under two distinct series of crystal-forms: the crystallographic difference being accompanied, moreover, by a difference of hardness and other physical characters. It thus forms two distinct minerals: *Calc spar* and *Arragonite*. Whilst the former, or normal condition of carbonate of lime, is exceedingly abundant, the latter is comparatively rare. Arragonite crystallises in rhombic prisms and other trimetric combinations (the compounds of which often present a pseudo-hexagonal aspect), and also in fibrous, coralloidal and botryoidal masses. Small splinters, when heated, become immediately opaque, and crumble or decrepitate gently into powder, a peculiarity by which this mineral may be distinguished from calc spar. Fibrous arragonite appears to occur sparingly amongst the Lake Superior traps and occasionally in thin coatings on the sides of cracks in some of our limestone rocks, but nowhere in very distinct specimens.

* Whilst writing this description, for example, we have received some large crystals (combinations of a rhombohedron and two scalenohedrons) from a cavity in the Trenton limestone (Lower Silurian Series) of Huntingdon township, in the county of Hastings, C.W. The cavity contained an immense number of these crystals.

§ 3. EFFERVESCING IN HEATED HYDROCHLORIC ACID, BUT NOT AT ALL, OR ONLY FEEBLY, IN COLD ACIDS.

Dolomite.—White, grey, brown, &c., in lamellar and granular masses, and in rhombohedrons, closely resembling calc spar. H. 3·5–4·0; sp. gr. 2·8–2·95. Infusible, but becoming caustic after ignition. Effervesces feebly in cold, but vigorously in heated acids. Composition: carbonic acid, lime, and magnesia; or, carbonate of lime 54·35, carbonate of magnesia 45·65; a certain portion of the lime and magnesia being, however, generally replaced by protoxide of iron or manganese. Dolomite occurs (in small groups of rhombohedrons) amongst the copper ores of Lake Huron, and also in fissures and cavities in many of our limestone rocks, as at Niagara Falls and elsewhere. Many of our so-called limestones indeed, consist, in themselves, of dolomite, pure, or nearly so. Those of Galt, Guelph, &c., in Canada West, may be cited as examples. Others are dolomitic limestones, or mixtures of limestone and dolomite. Very few are wholly destitute of magnesia. Crystalline dolomite and dolomitic limestone, again, exactly resembling the ordinary crystalline limestones, occur in beds amongst the gneissoid rocks of the Laurentian Series, as at Lake Mazinaw, &c. These rocks come properly under discussion in PART V.

Magnesite.—White, grey, &c., in granular-crystalline masses and in rhombohedrons, much like those of calc spar and dolomite.* H. 3·5–4·5; sp. gr. 2·8–3·0. Infusible, but becoming caustic after strong ignition. Composition: carbonic acid 52·5, magnesia 47.5; but most specimens contain a small amount of carbonate of iron, lime, &c. Magnesia does not efferversce in cold hydrochloric or nitric acid, and dissolves but slowly in these acids under the aid of heat. In Canada, this mineral occurs in beds amongst the altered Silurian strata of Bolton and Sutton townships, in Canada East. (See analyses by T. Sterry Hunt in the Geological Report for 1856.)

§ 4. FUSIBLE.

Fluor Spar.—Chiefly in cubes, either simple, or modified on the edges and angles (Fig. 48, *a* to *c*). These cubical crystals break readily at the corners, owing to their strongly-pronounced octahedral

* In calc spar, the cleavage rhombohedron measures 105° 5' over a polar edge; in dolomite, 106° 15'; and in magnesite 107° 29'. In carbonate of iron (a mineral also belonging, with carbonate of manganese, carbonate of zinc, &c., to the natural group of Rhombohedral Carbonates), the same angle equals 107°.

cleavage, and the regular octahedron (Fig 48 *d*) may thus be obtained from them. Specimens occur of all colours, but chiefly, dark violet-blue, lilac, yellow, green, white, and grey: the edges of the crystals being often of a deeper or lighter shade, or even of a different colour, from the central parts. Streak, white. H. 4·0; sp. gr. 3·1–3·2. Fusible before the blowpipe into a white enamel, but most specimens decrepitate on the first application of the flame. (See PART I., Vol. V., pp. 17–18). When crushed to a coarse powder and gently heated, a greenish or other coloured phosphorescence is usually exhibited. Composition: fluorine 48·7, calcium (the metallic base of lime) 51·3. Fluor spar occurs in some of the crystalline limestones of our Laurentian rocks; and here and there in the metalliferous veins of the Huronian formation; also, in small cavities in the limestones of the Silurian series. The best known localities comprise Fluor Island in Prince's Bay, on the north shore of Lake Superior, where fine green crystals occur; Iron Island on Lake Nipissing, where blue crystals were discovered by Mr. Murray*; the township of Ross in Renfrew County, on the Ottawa; the Niagara limestone about the Falls, &c. In Europe fluor spar occurs, more especially, in association with lead, tin, and silver ores, in metallic veins.

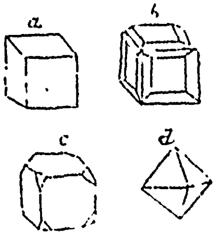

Fig. 48.

Heavy Spar or *Sulphate of Baryta.*—White, grey, yellow, reddish, etc., with white or uncoloured streak. In lamellar, laminar, and fibrous masses; and also in trimetric crystals, of which a common example is given in figure 49. H. 3·0–3·5; sp. gr. 4·3–4·7. Decrepitates (in general) before the blowpipe, (see PART I., Vol. V., p. 17–18), and fuses into a white enamel, tinging the point of the flame pale green. This latter character is well-marked, and serves to distinguish, very readily, small pieces of heavy spar from other minerals of a similar aspect. With carbonate of soda in the yellow flame, it forms an alkaline sulphide, which imparts, when moistened, a dark stain to

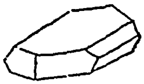
Fig. 49.

* See *Canadian Journal*, Vol. III, New Series, p. 325. Also Geological Report for 1854. The crystals occur in crevices and fissures of a cavernous limestone associated with specular iron ore.

silver.* Composition: sulphuric acid 34·33, baryta 65.67. This mineral occurs abundantly in many parts of Canada. In the Laurentian series of metamorphic strata, it forms considerable veins, usually accompanying galena: as in the townships of Lansdowne, Leeds Co., C. W.; Bathurst, Lanark Co.; McNab, Renfrew Co.; Dummer, Peterboro' Co.; and elsewhere. Red crystals were discovered by Mr. Murray on Iron Island, Lake Nipissing. It occurs likewise, in connection with the trap dykes of Lake Superior and the north shore of Lake Huron, as at Spar Island, &c., besides being found in some of the copper-ore veins of the Bruce mines. Heavy spar has also been met with in the serpentines and other rocks of the eastern metamorphic region, south of the St. Lawrence; and occasionally in cavities in the Niagara limestones of the west. It is employed somewhat largely in the manufacture of paints, and is too often used in this connection as a fraudulent substitute for white lead. Heavy spar is also the principal source of the baryta salts of the laboratory.

Celestine or *Sulphate of Strontia*:—White, grey, pale-blue, &c. In lamellar and fibrous masses, and in Trimetric crystals, often closely resembling those of Heavy Spar. A common combination is shewn in Figure 50. H. 3·0-3·5; sp. gr. 3·9–4·0. Before the blow-pipe, it (generally) decrepitates, fuses, and imparts a red coloration to the point of the flame. (See also the note under *Heavy Spar*.) Composition: sulphuric acid 43·6, strontia 54·4. Celestine occurs with small crystals of dolomite, gypsum, fluorspar, blende, and other minerals, in cavities of the Niagara limestone, as in the district around the Falls, and in the vicinity of Owen Sound, &c. Drummond's Island, Lake Huron, is likewise a noted locality of this mineral. It occurs also, occasionally, in crystalline limestone, as in the neighbourhood of Kingston. Celestine is the chief source of strontia salts, used in pyrotechny to

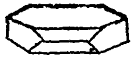

Fig. 50.

* To detect sulphur, in any form in mineral bodies, fuse a small quantity of the substance under examination, with carb. soda and a very little borax, on charcoal, in a good reducing flame. Detach the fused mass, moisten it, and place it on a piece of bright silver, or on lead test-paper. (A coin or glazed visiting-card may be substituted for the purpose.) If sulphur be present, a yellowish, brown, or black stain will result. See *Canadian Journal*, New Series, Vol. III., p. 217-18. Both sulphate of baryta and sulphate of strontia dissolve readily in carbonate of soda before the blowpipe, resembling, in this respect, alkaline sulphates. Sulphate of lime (with all lime salts) on the other hand, requires the addition of a little borax to promote solubility.

impart a red colour to rockets and signal lights, and for laboratory purposes.

§ 5. INFUSIBLE.

Zinc Blende (Sulphide of Zinc):—This mineral has been already described under sub-division *B* 8, (Vol. V. p. 182,) but it is mentioned again in this place, as some of the light-coloured varieties present a vitreo-resinous or other non-metallic lustre. These are chiefly light brown or yellow, with colourless or very pale-brown streak. H. 3·5–4 0. Infusible. Sometimes phosphorescent when rubbed or scratched. Small bright-yellow crystals and crystalline masses occur sparingly in cavities and fissures of the Niagara limestone in the vicinity of the Falls. For other localities, &c., see *B* 3, above.

D 5. *Streak, white. Yielding water in the bulb-tube.*

The minerals of this sub-division (many of which, however, are merely altered varieties of other species) may be conveniently grouped in three sections, as follows: § 1. YIELDING TRACES ONLY, OR A VERY SMALL AMOUNT OF WATER: *Mica*, (some few varieties): *Talc*, (including *Steatite*); *Renselaerite; Diallage.* § 2. YIELDING A CONSIDERABLE AMOUNT OF WATER; SLOWLY DISSOLVED BY BORAX BEFORE THE BLOWPIPE: *Serpentine; Chlorite; Loganite; Pholerite.* § 3. YIELDING A LARGE AMOUNT OF WATER: READILY DISSOLVED BY BORAX BEFORE THE BLOWPIPE, THE BEAD, WHEN SATURATED, BECOMING OPAQUE: *Gypsum.*

Mica:—In foliated masses, &c., with pearly pseudo-metallic lustre. Normally, anhydrous,—but specimens occasionally yield a little water when heated in the bulb-tube. See sub-division *D* 4 (§ 1) above.

Talc; (including *Steatite*):—Greenish-white, green, greyish, &c. In foliated, and also in compact masses, which feel more or less greasy, and which yield to the nail; sp. gr. 2·55–2·8. Very sectile. Flexible in thin foliæ, but not elastic. Infusible. Composition: silica 62, magnesia 33, water 5. Talc occurs in the form of talcose slate, in foliated masses, and more especially in the form of steatite or compact talc, principally amongst the metamorphic rocks of the more modern series, south of the St. Lawrence. Under the latter condition, or that of steatite, it forms extensive beds in the townships of Potton, Sutton, Bolton, Stanstead, Leeds, Ireland, Broughton, &c., throughout this region. It occurs also, though far less abundantly, amongst the older metamorphic rocks of the Laurentian series, as in the townships of Marmora, Elzevir, &c., in Canada

West. It is used as a fire-brick or refractory stone, and also as a coarse paint or wash.

Renselaerite (a variety of *Steatite*; or *Altered Augite*) :—Greenish-white, brownish, &c.; in granular and compact masses much resembling steatite, and in pseudo morphous crystals after augite. H. 2·5–4·0; sp. gr. about 2·7–2·8. Very sectile. Lustre, somewhat waxy. Infusible, yielding about 4 or 5 per cent. of water in the bulb-tube. Composition: silica, magnesia, and water. Renselaerite cannot be regarded as a distinct mineral species. The crystals are evidently augite pseudomorphs, and the substance agrees essentially in composition with steatite. It occurs in beds associated with the crystalline limestones of the Laurentian rocks, as in the township of Grenville, Argenteuil County, C. E. Also in the townships of Ramsey, Rawdon and Lansdown. In Grenville, it contains (in fissures) a soft, yellowish-white, and earthy variety of serpentine (= *aphrodite*.)

Diallage :—This substance is generally regarded as a variety of Augite. (See *C* 3, above. Vol. V. p. 527.) Normally, it is anhydrous; but it is frequently more or less altered, and contains 3 or 4 per cent. of water. It forms lamellar or foliated masses, chiefly of a green or greenish-grey colour. H., sometimes, 5·0, but usually rather less; sp. gr. 3·0 to 3·1. Fusible into a greyish slag, though not easily. Canadian specimens give off a little water in the bulb-tube, and become in general red or reddish-brown. A variety from the township of Oxford, analysed by Mr. Sterry Hunt, contained: silica 47·20, magnesia 24·53, protoxide of iron 8·91, alumina 3·40, lime 11·36, water 5·80; with traces of the oxides of nickel and chromium. Occurs chiefly in the altered strata of the Eastern Townships, as in Oxford, Ham, and elsewhere, associated with serpentine, chromic iron ore, &c.

§ 2. Yielding a considerable quantity of Water in the bulb-tube. Slowly soluble in borax before the blowpipe.

Serpentine, (including *Retinalite*, *Picrolite*, *Chrysotile*, *&c.*) :—This substance occurs chiefly in amorphous or rock masses of a green, red, brown, bluish-grey, yellowish, or other colour, frequently veined or mottled. Also, occasionally, in small granular and fibrous masses, the latter sometimes producing a *serpentine-asbestus*. Lustre, usually somewhat waxy. H, in general, about 3·0; sometimes 4·0–5·0. Very sectile, sp. gr. 2·2–2·6. Some of the fibrous varieties fuse on the edges, the others are infusible. All yield water (and harden) in the bulb-tube. Composition, essentially: silica, magnesia, and about 12 to 15 per cent. of water. Serpentine occurs in association with the crystalline limestones of the Laurentian rocks, as in the township of Grenville, Argenteuil county, C.E., where it occurs in disseminated grains; Calumet Island on the Ottawa; the township of Burgess, Lanark County, C.W.; Marmora and adjacent townships, with magnetic iron ore; and in other places where these rocks prevail. It is met with, however, far more extensively amongst the altered Silurian strata of the Eastern Townships, both alone, and forming, in some localities, especially in the townships of Oxford and Broughton, serpentine marbles of great beauty. Fine varieties of green serpentine occur about Brompton lake, in the former of these townships. A tough, fibrous variety occurs in Bolton township, Brome County. In Bolton and Ham also, serpentine rock, carrying thin beds of chromic iron ore, is met with; and in the county of Beauce, this rock contains a bed of mixed magnetic and titaniferous ore, fifty feet in thickness. To these localities must be added Mount Albert in Gaspé, where, as described by Mr. Richardson of the Geological Survey of Canada, an inexhaustible supply of green, brown, and variously striped and mottled serpentine, capable of economic employment, occurs in association with chromic iron. In its rock relations, serpentine will be discussed more fully in a succeeding part of this Essay.

Chlorite.—This mineral occurs chiefly in foliated, scaly, and granular masses of a dark green colour; or in greenish-grey slaty beds, forming the so-called *potstone,* a name also sometimes applied to varieties of steatite. H. 2·0—2·5; sectile; sp. gr. 2·6—2·8. Fusible (or fusible on the edges only, in some varieties,) and yielding water in the bulb-tube. Composition, essentially: silica 32·5, alumina 18·5, magnesia 36, water 13: hence, the chloritic potstones differ from the workable steatites in containing alumina as an essential constituent. In union with quartz, forming chlorite slate, this mineral is of common occurrence amongst metamorphic strata. In Canada, it occurs chiefly in the altered rocks of the Eastern townships, associated with magnetic and specular iron ores, sphene, &c., and with beds of dolomite. In this region, as in the townships of Potton, Bolton, &c., it is met with also in thick beds of a slaty or more or less compact structure, forming an aluminous potstone of good workable quality. Chloritic schists, probably of Huronian age, occur likewise, according to Sir William Logan, in great force in the valley of Lake Temiscaming, within the northern geological-basin of Canada. (See Part V. of this Essay.)

Loganite.—This substance named by Mr. Sterry Hunt, in honour of the Director of the Geological Survey of Canada, is a very doubtful species. It occurs in sub-resinous brownish masses, and in apparently pseudomorphous crystals (after Hornblende? Dana,) in the crystalline limestone of Calumet Island on the Ottawa. H, 3·0; sp. gr. about 2·6. Composition, according to the analysis of T. Sterry Hunt: Silica 32·49, alumina 13·18, sesqui-oxide of iron 2·14, magnesia 35·77, lime 0·95, water (and carbonic acid) 16·92. Dana places it under Pyrosclerite, a mineral closely related to Chlorite, if, indeed, truly separable from that species.

Pholerite.—The substance thus named, is usually looked upon as a product of alteration, arising from the decomposition of one of the feldspar species, (see *C.* 8, above: Vol. v. p. 528–9,) or, more directly, from the alteration of clay-slate. Under this view, it is a kind of *Kaolin*, with which substance it agrees in general composition. It presents, however, peculiar physical characters, much resembling those of talc, a mineral with which it is often confounded. Pholerite occurs in soft, unctuous, and scaly masses of a pearly aspect, and of a white or pale greenish or yellowish colour. Sp. gr. 2·3—2·6. Before the blowpipe, it exfoliates and curls up, but remains infusible. It consists essentially, of silica, alumina, and water: the latter varying from 13 to 15 per cent. Nacreous scales of this mineral occur, in fissures, in sandstone strata of Silurian age, near the Chaudière Falls in Canada East; and many of the altered slates of the adjoining metamorphic region appear to owe their talcose aspect to its presence, or to that of closely related non-magnesian silicates of more or less indefinite composition.

§ 3. Yielding a large amount of water. Readily dissolved by borax before the blowpipe: the bead, when saturated, becoming opaque.*

Gypsum.—(Hydrous Sulphate of lime.)—This important mineral occurs chiefly in lamellar, fibrous, and granular masses, of a white, grey, yellowish, or other colour, and also in crystals of the Monoclinic System, a common example of which is shown in the margin: fig. 50. Lustre often pearly. H=1·5—2·0, (and thus, all specimens of gypsum may be scratched by the nail,) Sp. gr. 2.25—2·35. Sectile; and, in thin lamellæ, somewhat flexible. Yields a large quantity of water in the bulb-tube; becomes opaque in the flame of a candle; and exfoliates and fuses before the blowpipe, into a white enamel. Composition: sulphuric acid 46·51, lime 32·56, water 20·93. The

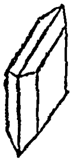

Fig. 50.

* The same result is produced with a moderate amount of the assay substance, when the bead is exposed to the action of an intermittent flame: a process technically termed "flaming."

transparent cleavable varieties are often called "selenite," and the fibrous and fine granular varieties are known by lapidaries as "satin spar," and "alabaster,"—names, however, sometimes applied to varieties of calc spar. Gypsum, when deprived of its water by a low heat, forms the well known *plaster of Paris.* In Western Canada, this most useful mineral occurs abundantly in the Gypsiferous or Onondaga Salt Group of the Upper Silurian Series (see Part V. of this Essay): as in the townships of Dumfries, Brantford, Oneida, Seneca, and Cayuga, more especially, along the valley of the Grand River. The gypsum does not occur in beds, properly so-called, but in vast irregular masses, supposed by Mr. Sterry Hunt, (*Comptes Rendus*, 1855, and *Esquisse géologique du Canada,*) to arise from the action, on the surrounding limestone strata, of springs containing free sulphuric acid. In these localities the gypsum is more or less mixed with carbonate of lime. Fibrous and other varieties occur also in the vicinity of Owen Sound, and throughout the tract of country, generally, between the eastern extremity of Lake Erie and the mouth of the Saugeen. Likewise, here and there, in small cavities and fissures in the Niagara limestone and older rocks.

APPENDIX.

A Classified List of the Canadian Minerals described above.

In this list, which is intended to serve as a kind of Index to the minerals described in the present Part of our Essay, each substance will be found arranged under the chemical sub-division to which it belongs. The letters and numerals within brackets, refer to the groups and sub-groups of the Arrangement adopted above.

1. *Simple Substances.*

Native Gold, (*B.* 1.) Native Platinum and Osmium-Iridium, (*B.* 1.) Native Silver, (*B.* 1.) Native Copper, (*B.* 1.) Graphite, (*B.* 2.)

2. *Arsenides* and *Sulphides,* (Combinations of arsenic, or sulphur, with metallic bases.)

Arsenical Nickel, (*A.* 2.) Sulphide of Silver, (*B.* 1.) Galena or Sulphide of lead, (*B.* 3.) Sulphide of Copper, (*B.* 3.) Purple Copper Pyrites, (*B.* 3.) Copper Pyrites, (*B.* 3.) Zinc Blende,

(B. 3, and D. 4.) Molybdenite, (B. 2.) Magnetic Pyrites, (B. 3.) Iron Pyrites, (A. 1.) Arsenical Pyrites, (A. 3.)

3. *Oxides of Iron, Manganese, &c.*

Specular or Red Iron Ore, (A 4, and D 3.) Ilmenite (A 4.) Brown Iron Ore (A 4, and D 3.) Magnetic Iron Ore (A 4, and C 1.) Iserine (A 4.) Chromic Iron Ore (A 4, and C 1.) Earthy Manganese Ore (D 3.) Uran Ochre (D 3.)

4. *Alumina* and *Aluminates.*

Corundum (C 1.) Spinel (C 1.)

5. *Silica* and *Silicates**.

Quartz (C 1.) Zircon (C 1.) Andalusite (C 1.) Cyanite (C 1.) Staurolite (C 1.) Garnet (C 3.) Idocrase (C 3.) Epidote (C 3.) Mica (D 4.) Tourmaline (C 3.) Chondrodite (C 2.) Olivine (C 2.) Hornblende, Actynolite, Tremolite (C 3.) Augite, Diopside, Asbestus (C 3, and D 4.) Hypersthene, Bronzite (C 3.) Diallage (C 3, and D 5.) Wollastonite or Tabular Spar (C 3.) Talc (D 5.) [Rensselaerite (D 5.)] Serpentine (D 5.) Chlorite (D 5.) [Loganite (D 5.)] Orthoclase or Potash Feldspar (C 3.) [Pholerite, Kaolin (D 5.)] Albite (C 3.) Labradorite (C 3.) Scapolite or Wernerite (C 3.) Prehnite (C 4.) Datolite (C 4.) Thomsonite (C 4.) Analcime (C 4.) Apophyllite (C 4.)

6. *Titanic acid and Titaniates.*

Rutile (C 1.) Sphene (C 3): usually regarded as a silico-titaniate of lime, but its true atomic constitution is still uncertain.

7. *Carbonates.*

Calcite or Calc Spar (D 4.) Dolomite (D 4.) Magnesite (D 4.) Arragonite (D 4.) Malachite and Blue Carbonate of Copper (D 3.)

8. *Sulphates.*

Barytine or Heavy Spar (D 4.) Celestine or Sulphate of Strontia (D 4.) Gypsum (D 5.) Epsom Salt (D 1.)

* Keeping in view the popular and explanatory character of this Essay, it may not be inappropriate to observe that the term "Silicate" signifies a combination of silica or silicic acid with one or more oxidized bases, such as lime, magnesia, oxide of iron, alumina, &c. In like manner (to cite a few more examples of this nomenclature,) a "carbonate" is a combination of carbonic acid,—a "phosphate," of phosphoric acid,—a "sulphate," of sulphuric acid—with one or several of these oxides. Thus, *Gypsum*, consisting of sulphuric acid, lime, and water, is a hydrous sulphate of lime. The term "sulphide," or "sulphuret on the other hand, denotes a compound of sulphur with some simple substance, as lead, copper, iron, &c., or with several of these.

9. *Phosphates.*

Apatite or Phosphate of Lime (*C* 2.) Vivianite (*D* 3.)

10. *Fluorides.*

Fluor Spar (*D* 4.)

11 *Salts of Organic Origin.*

Humboldtine (*D* 3.)

12 *Bituminous substances.*

Asphaltum and Indurated Bitumen (*D* 2.)

CONCLUDING NOTE TO PART II.

The minerals of Canadian occurrence—including both the very rare and the doubtful species, such as native Platinum, occasionally found in small grains with the Native Gold of the Rivière du Loup; and the altered substances, Renselaerite Pholerite, &c.,—amount in number to about seventy. Many of these are of more or less local occurrence, but others, on the contrary, are comparatively common. These latter are collected together, and arranged in accordance with their more obvious characters, in the Table annexed to this Note. The less experienced reader, consequently, may avoid some trouble in the determination of an unknown mineral, by consulting this Table in the first instance. If the specimen under examination do not agree with the species here cited, the regular Table given at page 170 of Vol. V., can then be referred to. In case of agreement also, recourse may be had to the latter as a confirmatory test.

CANADIAN MINERALS OF MORE COMMON OCCURRENCE.

* *Aspect Metallic or Sub-Metallic.*

** *Hard enough to scratch glass.*

Brass-yellow :—*Iron Pyrites* (*A* 1.)

Steel-grey; powder, reddish :—*Specular Iron Ore* (*A* 4.)

Iron-black; powder, black; magnetic :—*Magnetic Iron Ore* (*A* 4.)

*** *Too soft to scratch glass:*

Bronze-yellow; slightly magnetic :—*Magnetic Pyrites* (*B* 3.)

Brass-yellow; streak, greenish-black :—*Copper Pyrites* (*B* 3.)

Reddish, with blue tarnish; streak, greyish-black :—*Purple Copper Pyrites* (*B* 3.)

Lead-grey; breaking into rectangular fragments :—*Galena* (*B* 3.)

Lead-grey; in soft scales; marking :—*Molybdenite* (*B* 2.)

Black; in soft scales; marking :—*Graphite* (*B* 2.)

Lustre, metallic-pearly; brown, silvery-white, etc.; in scales or foliated masses with white streak :—*Mica* (*D* 4.)

† *Aspect, vitreous, stony, or earthy.*

†† *Hard enough to scratch glass.*

Colourless, amethystine, red, &c.; No lamellar structure. Infusible:—*Quartz* (*C* 1.)

White, red, green, &c.; Lamellar structure. Fusible on the edges:—*Feldspar* (Orthoclase *C* 3.)

Dark-red; in 12-sided crystals, &c. Fusible:—*Garnet* (*C* 3.)

Black; fibrous, or in triangular crystals. Fusible:—*Schorl* (*C* 3.)

Black or green, (sometimes colourless in crystalline limestone.) Fusible:—*Hornblende* and *Augite* (*C* 3.)

††† *Too soft to scratch glass.*

White, grey, &c. Effervescing strongly in acids:—*Calc Spar* (*D* 4.)

White, grey, brownish, &c. Effervescing feebly in acids:—*Dolomite* (*D* 4.)

White, bluish, &c. Fusible. Often accompanying Galena:—*Heavy Spar* (*D* 4.)

White, greenish, mottled, &c. Very soft. Infusible. Yielding water in bulb-tube:—*Steatite* (*D* 5.) Also *Serpentine* (*D* 5.)

White, &c. Very soft. Fusible. Yielding water in bulb-tube:—*Gypsum* (*D* 5.)

Brown. Streak, yellowish-brown. Magnetic after exposure to heat:—*Bog Iron Ore* (*D* 3.) Also *Yellow Ochre* (*D* 3.)

Red. Streak, red. Magnetic after ignition:—*Red Ochre* and *Scaly Iron Ore* (*D* 3.)

SPECIMEN OF A FLORA OF CANADA, WITH PRELIMINARY REMARKS.

BY WILLIAM HINCKS, F.L.S., F.R.S.E.

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Flora is the name appropriated since Linnæus's time to a descriptive catalogue of the vegetable productions of any particular country, prepared in such a manner as to assist a student in acquiring a knowledge of the plants he may meet with. Where a country is separated from others by strongly marked natural boundaries, its flora often presents characteristic features of much interest in respect to the general distribution of plants. I need not say that this is not the case with Canada—the North American continent exhibiting in its flora many common characteristics modified by latitude and local circumstances. It has been found a convenience by the students of Canadian Botany that the floras of the neighbouring United States, where there has earlier been a demand for such works, contain nearly all our plants, and consequently offer us much of the assistance that we need; but at the same time besides the not unnatural feeling of a desire as a nation to provide for our own scientific wants, the large number of plants found in the middle United States, which our more northern climate refuses to support, increases the catalogue to an extent which very materially adds to the difficulties of the student, and if no more were attempted than to exclude from the list, plants which we can have no expectation of finding within our borders, the utility of a Canadian Flora to those amongst us who desire to be acquainted with our native plants would not be small. My attention having been directed to the subject with this view, I have carefully considered in what respect I should be disposed to deviate from the methods which I find adopted by others, and I propose now very concisely to explain and defend my views, which I shall also illustrate by a sufficient specimen.

I would speak first of the system which it seems expedient to follow. I presume it would be needless to argue in favour of some modification of the natural method, and this being admitted, it will be found that, excepting in a few cases where sub-divisions are deem . necessary by some and rejected by others, there is general agreement as to the *orders* of plants. The differences, excepting where they have to do with the limits of genera and species, relate to the larger combinations, and to the most proper series, subjects manifestly of very inferior importance, and of such a nature that any one who has an ordinary acquaintance with the principles of the Science, could employ with facility any of the methods which have been recently proposed. The method of De Candolle, from its real merits and the deservedly high reputation of its author, as well as from its having been employed in his celebrated work, (*Prodromus Systematis Naturalis regni Vegetabilis,*) the greatest attempt in modern times at a general description of the species of plants, has obtained more currency than any other, and for that reason is apt to meet with favour. It seems to me, however, that the trifling inconvenience of making a change to those who are habituated to a particular arrangement, should by no means prevent our aiming at improvement, and having come to the conclusion that on the whole the method of Lindley, (our greatest English authority in respect to Botanical classification,) is to be preferred; and especially that his attempt to characterize *alliances* or more extended groups, as well as Orders, is a great assistance to an intelligent student; I have made use of this method, undertaking on my own part to construct a series of tables, of a kind which I have long found advantageous, to facilitate its application. In the names of the Orders I have uniformly followed Lindley, discarding such names, however familiar or expressive, as Cruciferæ, Leguminosæ, Umbelliferæ, Compositæ, and adopting the names ending in *aceæ* formed from some well-known characteristic genus. I confess to some unwillingness to give up the above mentioned names, but the advantages of a uniform system are in my estimation too great to be neglected, and require the sacrifice of mere habit and prejudice.

In giving the characters, I have been very particular about the language employed, discarding all such terms, however sanctioned by good recent authorities, as imply notions of structure which are now known to be erroneous. For example: the term *monopetalous* is avoided as implying that the Corolla to which it is attributed really consists of a single petal, whilst it is now universally understood to arise from the coherence by their edges of several petals which are really distinct organs. De Candolle's term *Gamopetalous* not seeming to be approved, I have used *Synpetalous*, and instead of *Poly-petalous*, *dialypetalous*, which very clearly and simply convey the right idea.

On a similar principle I object strongly to the term *pistil*, which I think should now only be used in its Linnæan sense and in connection with the Linnæan Artificial System. The inner part of the flower which becomes the fruit, (the Gynœcium,) is now well understood to consist of a certain number, one or more, leafy organs modified in their development, so as to be germ-producing, and furnished with a stigma—each of these is a carpel (carpellum.) The differences of structure consist in the number of carpels—one, some part of a complete circle, or the whole of it, or several circles—distinctly arranged or indefinitely crowded, with the carpels distinct or coherent, and if the latter, uniting together in several modes and degrees—with, or without the adherence upon them of the torus only, or of the calyx as well as the torus, with several modifications as to substance, membranous, coriaceous, woody, fleshy, or pulpy—and consequent differences in the mode of freeing the ripe seeds. These are the differences which claim attention, and they cannot be expressed without a correct phraseology with which the use of the old term pistii is entirely inconsistent—nor do I believe that the use of terms correctly expressing our meaning can create difficulty to any one having even a slight acquaintance with vegetable organography.

It appears to me that accuracy in these matters is of real importance and that we cannot expect right notions to be formed in the minds of learners, whilst we cling to a terminology founded upon mistakes, now generally abandoned.

In order to make the study of our native plants a source of as much information as possible, I have in all important cases said something of the extent, properties and distribution of the order; I have given the number of known species in the genus from the best accessible authority, and I have stated respecting each species in what other parts of the world it is known to be found. As far as I could satisfy myself upon the subject I have distinguished between our genuine natives and introduced plants, and I have added notices of a few cultivated species, distinguishing them by a different type. I have formed my list of native plants from my own observations during six years, aided by several published catalogues, by the kind communications of several friends, and by such published authorities as I could consult, but I have thought it best to place in my list species known to be found in the Northern United States, and which might probably be expected in Canada, though I do not know of their having been found here.

The omission of any station or authority will sufficiently distinguish these doubtful natives to which I have also attached a note of interrogation.

I now lay before the Canadian Institute a specimen sufficient to illustrate my plan, including as many of the tables as are required to show their nature and use, and one small section of the work in its complete state. I have spoken of adopting the system of Lindley referring to my preference of it for practical use to that of De Candolle, but I must not seem to make that distinguished Botanist responsible for some changes which have seemed to me desirable, and which I can only submit to the candid judgment of those who study the subject.

(*To be continued.*)

REVIEWS.

Contributions to the Natural History of the United States of America. By Louis Agassiz. Second Monograph, in five parts:—I. Acalebps in general; II. Ctenophoræ; III. Discophoræ; IV. Hydroidæ; V. Homologies of the Radiata: With forty-six plates. Vol. III. Boston: Little, Brown and Co. London: Trübner, and Co. 1860.

Every lover of nature will watch with interest the progress of this great work and feel grateful to its illustrious author for opening his stores of curious and valuable information, which it has required genius, enthusiasm, indomitable industry, and long experience to bring together, apply and make available as he has done. The second monograph, of which the first volume is now before us, relates to the Acalephæ, sea-nettles or jelly-fish, a class of the Radiata branch, or sub-kingdom of the Animal Kingdom, to which it appears that the author has devoted much attention, and which, consisting chiefly of marine animals difficult to preserve and rarely seen in museums, is less known to persons of general information and even to many intelligent naturalists, than almost any other that could be named. Information respecting it founded on an intimate acquaintance with all that has been done by others, joined with most important original observations, applied in a truly philosophic spirit, must be proportionably acceptable.

After an historical introduction referring to all that has been done on the subject from the earliest time to the present day, our author proceeds to the determination of the natural limits of the class, and thence of the sub-kingdom or branch of the Animal Kingdom to which it belongs, examining the question whether the so-called Cœlenterata are really separable from the Echinodermata as a distinct branch. He decides this question on evidence satisfactory to us, setting aside the sub-kingdom Cœlenterata and establishing three classes of Radiata: Echinodermata, Acalephæ, and Polypifera, but proposing some changes in the limits of the two last-mentioned classes which deserve attention and have much probability in their favour.

It is a highly interesting and curious discovery of recent times that whilst certain Acalephæ in their early stages of development, assume the Polype form, the lowest division, as they were believed to be, of Polypes called Hydroids, most of them are found to produce from what are called their ovarian vesicles, what seem to be true medusæ whether free or fixed. This remarkable observation caused some embarassment to speculative naturalists in determining the true gradation of animal forms. Since if Polypiferæ be the lower class it is credible enough that the early stages of development of Acalephæ, the next class in order, should bear a resemblance to Polypes, and *vice-versa*, but that two neighbouring classes should each in the young state assume the form of the other is antecedently improbable and is difficult to reconcile with our ideas of the order of nature. Our author proposes a novel view which completely relieves us from this difficulty, but which yet is not recommended to us for that purpose, but is supported by facts and by arguments of great weight, claiming careful consideration, and which we must say come near to convincing our minds. He maintains that Hydroid Polypes are imperfectly developed, or at least merely nutrient forms of the lower Acalephæ. He shows that the anomalous forms of Acalephæ are truly, in accordance with some of the most probable recent speculations, compound animals; that the floating colony contains Polype or nutrient forms along with medusan, which are reproductive forms, and he considers the Hydroid polypes as sedentary colonies of analogous character, either producing free medusæ, which are the perfect and properly reproductive form of the animal, or having as a part of the colony fixed medusæ forms, which fulfil the same function. Hence he transfers the Hydroid polypes altogether to the class Acalephæ, where with the other inferior and often compound animals of that class they make the lowest order *Hydroidæ*. Two other orders are recognized: the *Discophoræ*, or typical medusæ, and the *Ctenophoræ*, which are to be regarded as highest in the class.

It is a recognised principle that the presence of the polype form does not necessarily imply connection with the class Polypifera, as besides embryonic conditions of Acalephæ we have the Polyzoa of much higher organization, and the Vorticellidæ belonging to a lower type, both simulating the Polypes. Mr. Dana had already marked the great importance of the structural difference between the Hydroid and Actinoid Polypes. It remained for Agassiz, by determining the real characteristics of Polypifera, and the true interpretation of the medusa forms produced by the Hydroids, to settle, we may at least say with the highest probability, the proper limits of the classes, giving the Hydroids their place among Acalephæ.

The second chapter on Morphology and nomenclature among the Radiates contributes not a little to clearness of ideas, the correct perception of homologies, and the removal of popular errors in respect to this branch of the Animal Kingdom. The body taken as a whole of any Radiate animal, our author denominates a Spherosome. Its homological segments are Spheromeres; the peculiar mouth of these creatures is the Actinostome. A community of Hydroids is an *Hydrarium*: a bunch of medusa buds arising from a Hydra is a *Medusarium*, a community of heterogeneous communities is a *Hydro-medusarium*. The useful application of these names we shall illustrate by a quotation. (Chap. ii. p. 81.)

"The use of such names for these different communities and their combinations, will greatly simplify our descriptions and add much precision to our characteristics of the different families and genera of the Hydroids. For instance, the *Tubularioids* as a family may be described as *Hydro-Medusaria*, arising from single *Hydræ* which by budding and by stolons become Hydraria; each adult Hydra producing in time several pendant *Medusaria*. The different genera of the family may then be characterized by the peculiarities of their Hydræ, and of their Medusæ. The *Campanularians* as a family may be described as *Hydraria* with two kinds of *Hydræ*; some being sterile and more numerous, whilst others are fertile and produce Medusæ from their proboscis. The different genera may easily be distinguished by the peculiarities of the two kinds of Hydræ, as well as by their Medusæ. Similar differences exist among the Siphonophoræ. The *Velellidæ* are simply *Hydraria* arising from a single *Hydra*, which grows larger and larger until it produces other *Hydræ* of a different form, and from these single Medusæ buds spring forth and finally free themselves. The *Physalidæ*, on the contrary, are *Hydro-Medusaria*, arising, like the Velellidæ, from a single *Hydra*, which also grows larger and larger, and even acquires an enormous size, forming in the end the large swimming-bag, from which single additional Hydræ at first arise, and afterward a larger and larger number, forming several distinct *Hydraria*, suspended from the original enlarged Hydra. These Hydraria themselves consist of heterogeneous Hydræ, though of Hydræ only. Others produce *Medusaria* and thus become *Hydro-Medusaria*; so that a Physalia community is really made up of many heterogenous communities attached to a gigantic Hydra. The *Diphyidæ* are also *Hydro-Medusaria*, but of a very different kind from those of the Physalidæ. Here the community begins from a Medusoid individual, from which arises another Medusa, thus forming Medusa twins. This twin community produces a string of Medusoid Hydroids, from each of which arises another kind of Medusæ, in clos connection with their Hydroids, thus forming secondary twin communities, each of which consists of a Medusoid Hydra, and a genuine Medusa. In the *Physophoridæ*, the combinations are still different. The community constitutes also a *Hydro-Medusarium*; but it arises from a single *Hydra*, from the upper part of which bud sterile *Medusæ*, while other *Hydræ* arise from its lower part, between which, finally, a number of *Medusaria* make their appearances."

Those who only know the compound Acalephæ animals, which comparatively few naturalists can study in the living state, from the descriptions given in the ordinary books may be surprised at the above statements, which nevertheless they will soon find to shed a beautiful light over the whole of a very obscure subject.

The fifth section of this chapter on "Individuality and specific differences among Acalephs," furnishes our author with an occasion for remarks on Darwin's "Origin of Species," in which he earnestly and powerfully opposes the views of that writer, which now occupy so large a share of the attention of the lovers of Natural Science. In a former number of this Journal we copied from Silliman's journal the extract on this subject from the then unpublished volume now before us, and we only add a short passage which strongly expresses the convictions of one who eminently unites Philosophy with varied and novel practical observation in his researches. After referring to the polymorphism of the lower Acalephæ, he goes on to say:—

"But, notwithstanding this polymorphism among the individuals of one and the same community generically connected together, each successive generation reproduces the same kinds of heterogeneous individuals, and nothing but individuals, linked together in the same way. Surely, we have here a greater diversity of individuals, born one from the other, than is exhibited by the most diversified breeds of our domesticated animals; and yet all these heterogeneous individuals remain true to their species, in one case as in the other, and do not afford the slightest evidence of a transmutation of species. Would the supporters of the fanciful theories lately propounded, only extend their studies a little beyond the range of domesticated animals, would they investigate the alternate generations of the Acalephs, the extraordinary modes of development of the Helminths, the reproduction of the Salpæ, &c. &c., they would soon learn that there are in the world far more astonishing phenomena, strictly circumscribed between the natural limits of unvarying species, than the slight differences produced by the intervention of men, among domesticated animals; and perhaps, cease to be so confident as they seem to be, that these differences are trustworthy indications of the variability of species. For my own part, I must emphatically declare that I do not know a single fact tending to shew that species do vary in any way, while it is true that the individuals of one and the same species are more or less polymorphous. The circumstance that naturalists may find it difficult to trace the natural limits of any one particular species, or the mistakes that they may make in their attempts to distinguish them, has [have] nothing whatsoever to do with the question of their origin."

We must not pretend to follow the learned author too closely through the contents of so large a volume. He establishes the claim of the class Acalephæ to the Ctenophoræ, which some distinguished naturalists have been disposed to connect with the Tunicated Molluscs, whilst at the lower extremity of the class he not only takes in the Hydroid Polypes but the Millepora and several other forms. He concludes the portion of his work forming the general introduction by an account of the various attempts at the classifica- of these animals, which is very valuable to the student, who could not without great difficulty have collected for himself the scattered materials. The remainder of the present volume is devoted to the first order of Acalephæ, Ctenophoræ. Their structural features must not be allowed to detain us farther than by a single short quotation to mark the character which gives them their name: (p. 164.)

"One of the most apparent peculiarities of the Ctenophoræ, consists of eight rows of locomotive flappers, extending along the eight vertical and peripheric chymiferous tubes, with which they are closely connected. As far as I can ascertain, all Ctenophoræ have eight such rows, though some of them are represented with only four and others with twelve. But their close connection with the ambulacral tubes, and the constancy of the number of these tubes in all the Ctenophoræ which I ever had the opportunity of examining, lead me to take it for granted that the typical number of the vertical rows of locomotive flappers must be eight. I am inclined to ascribe the conflicting statements upon this point to the marked inequality observed among these rows in different families. The fact is, that while they are all eight, of equal length and equal prominence in certain representatives of this order, in others there are four larger, longer and more prominent ones, and four shorter and smaller ones, differing more or less in their course. I hold, therefore, that the smaller rows may have been overlooked in those genera which are described as having only four rows of locomotive flappers; and that in those which are represented as having twelve rows, the vibratile cilia of the epithelial cells lining the digestive cavity, may have been mistaken for additional rows of locomotive flappers. Gegenbaur gives the same explanation of the singular figure of the Alcinoe papillosa of Delle Chiajè. The close connection which exists between the rows of locomotive flappers and the chymiferous tubes is so similar to the general organization of the ambulacral system of the Echinoderms, that I do not hesitate to consider these structures as homologous."

Passing by all that relates to the sub-orders and families of Ctenophoræ, and proceeding to the North American species, we must indulge ourselves in a descriptive quotation well fitted to excite the curiosity and admiration of every reader:

"There can be scarcely anything more beautiful to behold than such a living transparent sphere sailing through the water, coursing one way or another, now slowly revolving upon itself, then assuming a straight course, or retrograding, advancing, or moving sideways, in all directions with equal precision and rapidity; then stopping to pause, and remaining for a time almost immoveable, a slight waving of some of its vibrating organs easily counterbalancing the difference of its specific gravity and that of the water in which it lives. So Pleurobrachia may appear at times, and so does it also appear when moving in a state of contraction. But generally, when active, it hangs out a pair of most remarkable appendages, the structure and length, and contractility of which are equally surprising, and exceed in wonderful adaptation, all I have ever known among animal structures. Two apparently simple, irregular, and unequal threads hang out from opposite sides of the sphere. Presently these appendages may elongate, and equal in length the diameter of the sphere, or surpass it, and increase to two, three, five, ten, and twenty times the diameter of the body, and more and more; so much so that it would seem as if these threads had the power of endless extension and development. But as they lengthen they appear more complicated, from one of their sides other delicate threads shoot out like fringes, forming a row of beards like those of the most elegant ostrich feathers, and each of these threads itself elongates till it equals in length the diameter of the whole body, and bends in the most graceful curves. These two long streamers, stretching out in straight or undulating lines, sometimes parallel, then diverging or variously curving, follow the motions of the main sphere, being carried on with it in all its movements, which are no doubt influenced by them to a considerable extent. Upon considering this wonderful being, one is at a loss which most to admire, the elegance and complication of that structure, or the delicacy of the colours and hues, which, with the freshness of the morning dew upon the rose, shine from its whole surface. Like a planet round its sun, or, more exactly, like the comet with its magic tail, our little animal moves in its element as those larger bodies revolve in space, but unlike them, and to our admiration, it moves freely in all directions; and nothing can be more attractive than to watch such a little living comet as it darts with its tail in undetermined ways, and revolves upon itself, unfolding and bending its appendages with equal ease and elegance, at times allowing them to float for their whole length, at times shortening them in quick contractions and causing them to disappear suddenly, then dropping them as it were from its surface so that they seem to fall entirely away, till, lengthened to the utmost, they again follow in the direction of the body to which they are attached, and with which the connection that regulates their movements seems as mysterious as the changes are extraordinary and unexpected. For hours and hours I have sat before them and watched their movements, and have never been tired of admiring their graceful undulations. And though I have found contractile fibres in these thin threads, showing that these movements are of a muscular nature, it is still a unique fact in the organization of animal bodies, that parts may be elongated and contracted to such extraordinary and extensive limits by means of muscular action."

We must bring this notice to a conclusion. We cannot speak too highly of the merit and interest of the work, or of the beauty, effectiveness and usefulness in conveying information of the numerous plates which accompany it. The work has met with liberal patronage, and neither author nor publisher has spared any pains to deserve it both by the originality and value of the matter, and by the sumptuous manner in which it is brought before the public. W. H.

Narrative of the Canadian Red River Exploring Expedition of 1857, *and of the Assiniboine and Saskatchewan Exploring Expedition of* 1858. By Henry Youle Hind, M.A., F.R.G.S., Professor of Chemistry and Geology in the University of Trinity College, Toronto. 2 vols., 8vo. London: Longman & Co. 1860.

In the year 1858 there was issued from the press of the Provincial Government, a Canadian *Blue Book,* "printed by order of the Legislative Assembly," and embodying the "report on the exploration of the country between Lake Superior and the Red River Settlement." In 1859 a second *Blue Book*, printed by the same authority, reported the result of another exploratory expedition, to survey the valleys of the Assiniboine and Saskatchewan rivers. Both reports were illustrated with maps, sections, and wood-cuts of geological and other objects of interest; and attracted fully as much attention as the most interesting of blue books usually do. A review in our own pages, directed the attention of our readers to some of the most attractive of their varied contents; and the Canadian press generally published notices and extracts from them. But it is an old saying that Parliament can print blue books, but it is beyond its power to make people read them; and we doubt if the "Red River" and "Assiniboine" Blue Books furnished any very notable exception to this popular dictum. Extracts and digests in the periodical press sufficed to gratify popular enquiry; a few copies were bound and placed on the shelves of both public and private libraries, both here and at home, and the remainder, it is to be feared, experienced the usual fate of Blue Books, however valuable. But the enterprising leader of those expeditions wisely conceived that the subject treated of in his two reports merited a wider and more enduring interest; and the two handsome and copiously illustrated volumes, now issued from the London press, suffice to show what good editing and liberal publishing zeal can effect. A soldier returned from a rough campaign, tattered, travel-stained, and way-worn, does not differ more marvellously from the hero set forth by the most fashionable of army tailors for a review or presentation at Court, than does the Blue Book of our Canadian Parliamentary press from these gay volumes, with their chromo-xylographs, wood-cuts, maps, and sections. The very wood-cuts which had already figured in the first issue are scarcely recognisable in their new and greatly improved aspect, under the combined effects of good paper and London printing.

From the attention which those expeditions have already excited in the Province, and the extent of our former notice of them, it is scarcely necessary that we should now do more than call attention to this revised edition of the reports. They have been augmented by information derived from various sources; new maps and plans greatly add to their practical value, and the whole work is reproduced in a highly creditable permanent form. To the topographer it supplies much valuable material; the ethnologist will find in it many references full of interest to him; while to the future historian of the extending provinces and colonies of British North America it will be indispensable as a book of reference. In this latter department, the history of British America, like that of our great Indian Empire, is intimately interwoven with that of one of the great trading companies of the remarkable people whom the first Napoleon sneeringly designated a nation of shopkeepers. That they do now constitute a nation dependent for their enduring greatness on their world-wide trading relations and commercial enterprise is indisputable; and among the powerful trading corporations by which their territorial influence and wealth have been extended, an important place must be given to that company, which, deriving its name from the great Arctic Bay that bears the name of the bold explorer Henry Hudson, has extended its forts and trading-posts from the Gulf of the St. Lawrence to Vancouver's Island and the shores of the Pacific and Arctic Oceans. Professor Hind gives this condensed sketch of the great Fur Company's history:

"The Hudson's Bay Company was incorporated in the year 1670, under a royal charter of Charles the Second, which granted them certain territories in North America, together with exclusive privileges of trade and other rights and advantages. During the first twenty years of their existence the profits of the Company were so great that, notwithstanding considerable losses sustained by the capture of some of their establishments by the French, amounting in value to £118,014, they were enabled to make a payment to the proprietors in 1684 of fifty per cent., another payment in 1688 of fifty per cent., and a farther payment in 1689 of twenty-five per cent.

In 1690 the stock was trebled without any call being made, besides affording a payment to the proprietors of twenty-five per cent. on the increased or newly created stock; from 1692 to 1697 the Company incurred loss and damage to the amount of £97,500 sterling from the French. In 1720 their circumstances were so far improved that they again trebled their capital stock, with only a call of ten per cent. from the proprietors, on which they paid dividends averaging nine per cent. for many years, showing profits on the originally subscribed capital stock actually paid up of between 60 and 70 per cent. per annum from the year 1690 to 1800, or during a period of 110 years.

Up to this time the Hudson's Bay Company enjoyed a monopoly of the fur trade, and reaped a rich harvest of wealth and influence.

In 1783 the North-West Company was formed, having its head-quarters at Montreal. The North-West Company soon rose to the position of a formidable rival to the Hudson's Bay Company, and the territory the two companies traded in became the scene of animosities, feuds, and bloodshed, involving the destruction of property, the demoralization of the Indians, and the ruin of the fur trade. Owing to this opposition, the interest of the Hudson's Bay Company suffered to such an extent, that between 1800 and 1821, a period of twenty-two years, their dividends were, for the first eight years, reduced to four per cent., during the next six years they could pay no dividend at all, and for the remaining eight years they could pay only four per cent.

In the year 1821 a union between the North-West and Hudson's Bay Companies took place, under the title of the last named. The proprietary were called upon to pay £100 per cent. upon their capital, which, with the stock in trade of both parties in the country, formed a capital stock of £400,000, on which four per cent. dividend was paid in the years 1821 to 1824, and from that time half yearly dividends of five per cent. to 1828, from 1828 to 1832 a dividend of five per cent. with a bonus of ten per cent. was paid, and from 1832 to 1837 a dividend of five per cent., with an average bonus of six per cent. The distribution of profits to the shareholders for the years 1847 to 1856, both inclusive, was as follows:—

1847—1849, ten per cent. per annum; 1850, twenty per cent. per annum, of which ten per cent. was added to stock; 1851, ten per cent.; 1852, fifteen per cent., of which five per cent. was added to stock; 1853, £18 4s. 6d., of which £8 4s. 6d. was added to stock; 1854 to 1856, ten per cent. per annum dividend. Of 268 proprietors in July 1856, 196 have purchased their stock at from 220 to 240 per cent.

The affairs of the Hudson's Bay Company are managed by a Governor-in-chief, sixteen chief factors, twenty-nine chief traders, five surgeons, eighty-seven clerks, sixty-seven post masters, twelve hundred permanent servants, and five hundred voyageurs, besides temporary employés of different ranks, chiefly consisting of voyageurs and servants. The total number of persons in the employ of the Hudson's Bay Company is about 3000.

Sir George Simpson has been Governor of the Hudson's Bay Company for forty years. He exercises a general supervision over the Company's affairs, presides at their councils in the country, and has the principal direction of the whole interior management in North America.* The Governor is assisted by a council for each of the two departments into which the territory is divided.

The seat of council for the Northern department is at Norway House, on Lake Winnipeg; for the southern department at Michipicoten, Lake Superior, or Moose Factory, on James's Bay.

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* Before the volumes reached Canada death had deprived the Company of their long-tried and efficient Governor.

The council consists of the chief officers of the Company, the chief factors being ex-officio members of council. Their deliberations are conducted in private. The sixteen chief factors are in charge of different districts in the territory, and a certain number of them assemble every year at Norway House, for the northern department, generally about the middle of June, to meet the Governor and transact business. Seven chief factors, with the Governor, form a quorum, but if a sufficient number of the higher rank of officers are not present, a quorum is established by the admission of chief traders.

The Hudson's Bay Company's operations extend not only over that part of North America called Rupert's Land and the Indian territory, but also over part of Canada, Newfoundland, Oregon, Russian America, and the Sandwich Isles. The following table exhibits the number of departments and district posts into which this immense territory is divided for the prosecution of the fur trade:—

Country.	Departments.	Districts.	No. of Posts.
Part of Indian territory and part of Rupert's Land.	Northern.	Athabaska	4
		McKenzie River	11
		English River.	5
		Saskatchewan	9
		Cumberland	3
		Swan River	6
		Red River	6
		Lac la Pluie	7
		Norway House	2
		York	5
Part of Rupert's Land, and Canada.	Southern.	Albany	4
		Kmogumisse	2
		Lake Superior	9
		Lake Huron	5
		Sault St. Marie	1
		Moose	4
		East Main	3
		Rupert's River	8
		Temiscamingue	6
Newfoundland and part of Rupert's Land.	Montreal.	Fort Coulonge	3
		Lac des Sables	2
		Lacluire	1
		St. Maurice	3
		King's Posts	6
		Mingan	3
		Esquimaux Bay	4
Part of Indian territory, Washington territory, U.S. and Oregon, U.S.	Oregon.	Columbia	8
		Colville	5
		Snake Country	3
Vancouver's Island, part of Indian territory and Russian America.	Western.	Vancouver's Island	3
		North-West Coast	1
		Thompson's River	1
		New Caledonia	8
3 Independent Countries.	5 Depmts.	33 Districts.	152 Posts.

From the foregoing table it appears that the operations of the Hudson's Bay Company extend over territories whose inhabitants owe allegiance to three different and independent governments, British, Russian, and the United States. These immense territories, exceeding 4,500,000 square miles in area, are divided; for the exclusive purposes of the fur trade, into four departments and thirty-three districts, in which are included one hundred and fifty-two posts, commanding the services of three thousand agents, traders, voyageurs, and servants, besides giving occasional or constant employment to about one hundred thousand savage Indian hunters. Armed vessels, both sailing and steam, are employed on the North-West Coast to carry on the fur trade with the warlike natives of that distant region. More than twenty years ago the trade of the North-West Coast gave employment to about one thousand men, occupying twenty-one permanent establishments, or engaged in navigating five armed sailing vessels, and one armed steamer, varying from one hundred to three hundred tons in burden. History does not furnish another example of an association of private individuals exerting a powerful influence over so large an extent of the earth's surface, and administering their affairs with such consummate skill and unwavering devotion to the original objects of their incorporation."

This is a remarkable chapter in British Colonial History. The capital, property, and investments, of the company were set down by one of their own officials in 1856 at the immense sum of one million two hundred and sixty-five thousand and sixty-seven pounds sterling; and its influence over the destinies alike of natives and settlers throughout the vast area extending from the Atlantic to the Pacific shores, is all-predominant and unchecked.

The history of the Selkirk colony of Red River curiously illustrates the relations alike of Indians and European settlers to the all-powerful trading company.

"The Indian wars undertaken by the United States Government during the last half century, have cost infinitely more than the most liberal annuities or comprehensive efforts for the amelioration of the condition of the aborigines would have done; and in relation to the northern prairie tribes, war is always to be expected at a day's notice.

"The encroachments of western settlers upon Indian lands are constant and increasing in the United States, and there is no reason to suppose that these encroachments will diminish for many years to come. Already the Red River south of the boundary line, as well as its south-western tributaries, are invaded from the valley of the Mississippi, and as the territory of Dakotah has not yet been ceded to the United States Government, the prospect of a war with the Sioux, whose hunting grounds embrace it, becomes daily more imminent. Lieutenant Warren, who has conducted several United States' exploring expeditions in Dakotah and Nebraska territories, remarks:—"The advance of the settlements is universally acknowledged to be a necessity of our national development, and is justifiable in displacing the native races on that ground alone. But the Government, instead of being so constituted as to prepare the way for settlement by wise and just treaties of purchase from the present owners, and proper protection and support for the indigent race so dispossessed, is sometimes behind its obligations in these respects; and in some instances Congress refuses or delays to ratify the treaties made by the duly authorized agents of the government. The result is, that the settler and pioneer are precipitated into the Indian's country, without the Indian having received the first consideration promised him; and he often, in a manner that enlists the sympathies of all mankind, takes up the tomahawk in defence of his right and perishes in the attempt." The same officer states that there are so many inevitable causes at work to produce a war with the Dakotahs (Sioux) before many years, that he regards the greatest fruit of his explorations to be the knowledge of the proper routes by which to invade their country and conquer them, but at the same time he thinks that many of the causes of war with them might be removed by timely action in relation to the treaties made with them.

"The country of the Dakotahs borders on British territory, some of the tribes are the confirmed enemies of the half-breeds and Ojibways of Red River; peace has often been made, but as often broken again upon trivial and even accidental grounds.

"The frontier tribes can muster at least two thousand warriors by uniting with several of their more southern allies. Being the most warlike and numerous Indians in the United States territories, and their hunting grounds interlocking with those of the Crees in British America, they will probably yet play an important and active part in the future of the colony and the new adjoining territory of Chippewa.

"Thickwood Crees, Swampy Crees, Plain Crees, and Ojibways are the Indian nations who now occupy that part of Rupert's Land where settlements would first be made. These nations are friendly to one another and hostile to the Sioux. They are, in fact, the hunters of the Hudson's Bay Company, and consequently friendly with that body, who have never sought to extend the settlements of the white race in Rupert's Land; but of late years since the questions relating to title to lands, annuities, and compensation have been raised, they are becoming dissatisfied, suspicious, and untrustworthy.

"The Right Honourable Edward Ellice, M.P., in reply to a question put by Mr. Christie during his examination before the Select Committee on the Hudson's Bay, respecting the extinction of the Indian title in Rupert's Land, stated that "the English Government never extinguished the Indian title in Canada when they took possession; the Americans, while they have been extending their possessions, have extinguished the Indian title, but in Canada there has never been any treaty with the Indians to extinguish the title; the Crown, retaining certain reserves for the Indians, has always insisted upon the right to occupy the lands, and to grant the lands."

"Great and apparently reasonable doubts exist respecting the Indian title to that part of the valley of Red River and Assinniboine now occupied by the settlements. The royal charter for incorporating the Hudson's Bay Company, granted by Charles II., A.D. 1670, transferred to the Company the trade, lands, mines, minerals, fisheries, &c., of Rupert's Land. The territory to be reckoned one of his Majesty's plantations or colonies in America, and the Governor and Company to be the Lords Proprietors of the same for ever.

"On the 12th June, 1811, the Hudson's Bay Company made a grant of lands to Lord Selkirk included within the following boundaries:—"All that tract of land or territory bounded by an imaginary line running as follows, that is to say, beginning on the western shores of the Lake Winnipeg at a point in 52° 30′ north latitude, and thence running due west to the Lake Winnepego-sis, then in a southerly direction through the said lake so as to strike its western shore in latitude 52°, then due west to the place where the 52° intersects the western branch of Red River, the Assiniboine River, then due south from that point of intersection to the height of land, which separates the waters running into Hudson's Bay from those of the Missouri and Mississippi, then in an easterly direction along the said height of land to the source of the Winnipeg River (meaning by such last named river the principal branch of the waters which unite in Lake Seiganagah,) thence along the main stream of these waters, and the middle of the several lakes through which they flow, to the mouth of the Winnipeg River, and thence in a northerly direction through the middle of Lake Winnipeg to the place of beginning."

Ross, in his "Red River Settlement, its Rise, Progress, and Present State," introduces a treaty made between Lord Selkirk and certain Indian chiefs, Crees and Saulteaux (or Ojibways,) on the 18th July, 1817, in which the chiefs agree to give unto the king, for the use of the Earl of Selkirk, a considerable tract of land on the Assinniboine and Red Rivers for the quit-rent of 100 lbs. of tobacco, to be paid annually to the chiefs and warriors of the Cree and Saulteaux tribes then occupying the country.

"In 1857 Peguis, an immigrant from Pigeon River, Lake Superior, at Red River, sent a letter to the Aborigines' Protection Society, London, complaining of the non-fulfilment of this treaty. The following extract from the letter sent by Peguis is published in the Blue Book:—

"Many winters ago, in 1812, the lands along the Red River, in the Assinniboine country on which I and the tribe of Indians of whom I am chief then lived, were taken possession of, without permission of myself or my tribe, by a body of white settlers. For the sake of peace, I, as the representative of my tribe, allowed them to remain on our lands on their promising that we should be well paid for them by a great chief, who was to follow them. This great chief, whom we call the silver chief (the Earl of Selkirk), arrived in the spring after the war between the North-West and Hudson's Bay Companies (1817). He told us he wanted land for some of his countrymen, who were very poor in their own country; and I consented, on the condition that he paid well for my tribe's land, he could have from the confluence of the Assinniboine to near Maple Sugar Point on the Red River (a distance of twenty to twenty-four miles), following the course of the river, and as far back on each side of the river as a horse can be seen under (easily distinguished). The Silver Chief told us he had little with which to pay us for our lands when he made this arrangement, in consequence of the troubles of the North-West Company. He, however, asked us what we most required for the present, and we told him we would be content till the following year, when he promised again to return, to take only ammunition and tobacco. The Silver Chief never returned, and either his son or the Hudson's Bay Company have ever since paid us annually for our lands only the small quantity of ammunition and tobacco which in the first instance we took as a preliminary to a final bargain about our lands."

In March, 1859, Peguis dictated another letter on the subject of the title of his tribe to a portion of the lands on Red River. This singular communication, as published in the "Aboriginies' Friend and Colonial Intelligencer," is as follows:

"I Peguis, + (his mark), Salteaux Chief of the Indian Settlement at Red River, wish to make my statement to the Great House across the great waters.

"I and my people have our minds much disturbed by the Hudson's Bay Company, because the said Company have never arranged with me for our lands. We never sold our lands to the said Company, nor to the Earl of Selkirk; and yet the said Company mark out and sell our lands without our permission. Is this right? I and my people do not take their property from them, without giving them great value for it, as furs and other things, and is it right that the said Company should take our landed property from us without our permission, and without our receiving payment for the same? I have asked the said Company for payment, through their agents, and I asked Mr. Mactavish for the same thing, last spring, but I got nothing for my lands.

"If I were nearer the Great House, I would speak much and loud. I and my people are disturbed, and will the Great House approve of another Fur Company being chartered from Canada? Will there be another Company for the North, and another for the South? Will the Great House sanction more hostilities as before, when there were two Fur Companies trading in our country? And will another Company take in land for five miles on each side of the great road to be made between this place and Canada, without consulting me and my brother chiefs? I speak loud: listen! We have had enough of all Fur Companies. Please send us out rather mechanics and implements to help our families in forming settlements, and to secure as reserves," &c.

The subject thus referred to is still unsettled. An annual payment of £8 sterling has been made by the Hudson's Bay Company, regularly since 1812, to certain Indians and their descendants, in fulfilment of the treaty with Lord Selkirk; but the Indians now deny that the Cree Chief, who alone had the right of disposal, ever parted with the land either to the Earl of Selkirk or to the Fur Company; and future difficulties with Assinniboines, Plain Crees, and Objibway Indians, will have to be dealt with in some satisfactory way before an undisputed title can be acquired to the coveted lands in this territory.

These extracts and notices may suffice to illustrate the interest which attaches to the volumes in question. Many other subjects of equal value are discussed. The routes of travel, future lines of road, character and resources of the country, statistics of population, and the industry, trading, and missionary enterprise, of the various districts explored, are all treated of in detail. Indian customs, superstitions, and general characteristics, as well as the history of the curious mixed population growing up within the Company's territories, supply materials for another series of chapters; while a third is devoted to the geological and palæontological characteristics of the country explored. Numerous illustrations add to the minuteness and value of those details; and combine to form a work which ought to find a place in every public library in Canada. D. W.

The Manufacture of Vinegar; its theory and practice. By Charles M. Wetherill, LL.D., M.D., &c. &c. Philadelphia: Lindsay and Blackiston.

Vinegar is a substance which is used so extensively both in domestic life and in many of the useful arts, that its cheap and certain manufacture has of late years become a subject of considerable importance. For persons requiring any large amount of vinegar in their domestic economy, and especially if living at any great distance from towns, the knowledge of a sure process of manufacture is very desirable, not only on account of a possibility of a failure in the supply, but also on the score of economy. Vinegar even for domestic purposes is used in large quantities, especially in the preparation of those hideously indigestible pickled cucumbers which form so frequent an addition to the dinner table on this continent, and being a bulky article, containing but little of the acidifying principle in comparison with the water, the cost of transport becomes considerable, and the marketable price far beyond that for which it can be manufactured in every private farm house. A few pounds of starch obtained from damaged wheat, from Indian corn, from potatoes (even diseased ones,) or a like quantity of sugar obtained from the maple or the sorghum, or even a gallon of unrefined maple or sorghum molasses, will, with proper management, yield an amount of excellent vinegar, which in most country places could only be purchased by the expenditure of many dollars.

The above mentioned work is well calculated to afford all necessary information on the subject, not only to the manufacturer in the larger towns, but also to the Paterfamilias of our rural districts. Many treatises have been written on the subject, among which none is more complete than the elaborate one of Otto, to which our author with most commendable frankness, owns his material indebtedness. Although much of the work before us is therefore merely a translation from Otto, the community is not the less indebted to Dr. Wetherill for the production of a very readable and carefully compiled work on this subject, especially as it contains in addition the results of much personal experience.

The work is divided into two sections, the first treating of the chemical history of those substances which are used in the production of vinegar, of the theory of its formation, and of its chemical history generally; the second of the purely practical part of its manufacture. Perhaps our author's work might have been as useful if confined to the second portion, but any one who desires to enter upon the manufacture of vinegar whether for domestic or manufacturing purposes, will not find himself any the worse for an attentive perusal of the preceding pages. He will be much less likely to fall into error, and will be better enabled to remedy any defect which may occur in the process of manufacture.

The very complete second part of the present work, in which all necessary practical details are fully described, is not of such a character as to admit of much remark, but a few observations may be made on the first part, in which our author first treats of the history of vinegar or acetic acid, of chemical principles generally, of sugar, cellulose, starch, gum, dextrine, &c., with their various modifications, of alcohol and fermentation, malting, brewing, hydrometers, &c., and lastly of acetic acid, its strength, properties, and the theory of its preparation.

In the historical portion, our author, with a laudable anxiety to enhance the value of the substance of which he is treating, endeavours to prove its great antiquity, and in support of this proposition, affirms that it must have been known to Noah, as he "drank of wine" to intoxication, and wine is converted into vinegar by keeping. The reasoning is ingenious but the deduction somewhat illogical, inasmuch as if Noah used his wine so freely as to induce intoxication, the probabilities are that he never kept it sufficiently long to form vinegar. That it was known at the time of Solomon appears from the following passage from the Proverbs, "As he that taketh away a garment in cold weather, and as vinegar upon nitre, so is he that singeth songs to a heavy heart," where nitre probably signifies carbonate of soda or potassa. Cleopatra is said to have swallowed the value of a million sesterces in pearls dissolved in vinegar. Geber in the eighth century first described the method of concentrating vinegar by distillation. Wood vinegar, which was long considered to be a distinct substance and known under the name of pyroligneous acid, was described as early as 1648 by Glauber, as resulting from the distillation of vegetable substances. Dr. Wetherill states that "this and alcohol are the only sources of acetic acid if we except the brilliant researches of Berthelot." It may be remarked that the formation of acetic acid from the products resulting from the action of chlorine on sulphide of carbon, was known long before Berthelot commenced his researches.

The first step towards improvement in the manufacture of vinegar dates from the year 1822, when Döbereiner discovered the possibility of converting alcohol into acetic acid by means of air and spongy platinum; from this has arisen the so-called quick process of manufacture which bids fair to supersede the older methods of fabrication. Our author states that on this continent this process is still held to be a secret and often sold for exorbitant prices, a statement which from our own experience we can perfectly confirm for Canada.

The only advantage which the old process, consisting in a slow acetification or conversion into vinegar of beer or wine, possesses over the new, is derived from the fact that by the old process certain ethereal and aromatic substances are generated which do not appear when vinegar is made from alcohol, especially if pure, and to which the pleasant flavours of beer and wine vinegar seem to be due. This objection may, however, be obviated by the addition of a trace of these essences artificially prepared to the vinegar generated by the quick process. Dr. Wetherill enters into the subject of these fruit flavours rather largely, and fully confirms the opinion expressed by the writer in a former number of this journal, as to the harmlessness of the compounds thus used. Indeed our author submitted the matter, as regards one of the essences, to a very striking proof, a true experimentum crucis, for he states that in order to test the innocuousness of the so-called essence of Jargonelle pear, he consumed a whole pound of pear drops, without "experiencing any injurious effect." Any injury done, must we conceive have been to the confectioner, for it seems highly improbable that the Dr. would ever eat any more pear drops for the rest of his life.

Chapter I.—Treats of chemical principles generally, and contains a description of those elements which as entering into the composition of vinegar or its producers, are of interest to the manufacturer.

Chapter II.—Treats of cellulose and lignine or woody fibre, starch and its conversion into sugar, dextrine, gums, diastase and the sugars. It is stated under the head of Milk Sugar, that the "Tartars ferment the milk of their mares to form the alcoholic drink kouhmiss, which when distilled yields the spirit called arrack." We were always of opinion that arrack was obtained from the fermentation of rice, and that the spirit procured from Kouhmiss was called Asa.

Our author objects to the term grape sugar, as grapes do not contain the modification thus designated, and substitutes raisin sugar, a change for which there does not seem to be any valid reason, inasmuch as it is only old raisins and not these that are new and fresh, which contain true grape sugar. The name glucose is also objected to, inasmuch as grape sugar is not so sweet as that from the cane. an objection which seems of little value, as after all glucose is sweet, and the name is not intended to show that it is the sweetest of all sugars. The term dulcose has been proposed with some reason, instead of glucose, on account of the termination *osus* being essentially Latin.

We can scarcely imagine that our author has himself tried the test for cane sugar mentioned at page 78, viz.,—boiling with dilute sulphuric acid, if he had, he would certainly not have recommended it.

Chapter III.—Contains a very full account of alcohol, its chemical nature, its presence in wines and all fermented liquors, the methods of determining its strength, and the calculations necessary for preparing a mixture which shall contain a definite quantity, together with a full description of the different processes of malting, fermenting and brewing generally, by which any one may prepare for himself an alcoholic liquid from the substances described in the preceding pages, and adapted for the manufacture of vinegar.

Chapter IV.—Contains a chemical history of acetic acid, and copious extracts from Otto's work on the different methods of determining the strength, and hence the marketable value of any sample of vinegar.

The second part contains the information most valuable to the manufacturer, consisting of very plain and full descriptions of the old and new processes, both as applicable to domestic purposes, and to the preparation of vinegar on the large scale. Although there is certainly a large portion of the above work which might have been omitted without greatly detracting from its usefulness, yet on the whole it may be safely recommended as a very complete and trustworthy manual on this particular branch of manufacture.

H. O.

Contributions to Palæontology, 1858 *and* 1859, *with additions in* 1860. By James Hall, Geologist and Palæontologist. (Thirteenth Annual Report of the Regents of the State Cabinet, &c., of Albany.) 1861.

It has been said that to stand still in science is really to retrograde. If this be true of science in general, it is more especially true of palæontology. Within the last ten years, to carry our retrospective view no farther, the entire domain of this science has been subjected to many and material changes; and, as these are still going on, our most elaborate works become rapidly obsolete, or fail, at least, to keep up with the progress of the time. In this light, the valuable contributions of Professor Hall to American Palæontology, as published in the Reports of the Regents of the University and State Cabinet of Albany, are always welcome. The present series embraces a wide field: Graptolites, Brachiopods, Cephalopods, Trilobites, and other types, come under review; and new forms and points of structure are educed in each. Amongst the graptolites, a species of Barrande's genus *Rastrites,* hitherto unrecognised on this continent, is figured and described from the Hudson River shales of the environs of Albany. Some curious illustrations are also given of the old species *G. gracilis,* a form which will probably be found to include several of the more recently established species. Notwithstanding the comparatively perfect structures obtained from the Quebec rocks, our knowledge of the true nature of the graptolite still remains obscure, and much uncertainty prevails respecting the characters on which species may be legitimately founded. In the linear forms, so far as present observation goes, the form and comparative distances of the serratures or cells, appear to be the only trustworthy characters (and that only in part) available for this purpose. If the mode of branching, or that of the general aggregation of the stipes be employed, it is evident that many identical forms will be described under different specific names. In the work before us, Professor Hall proposes two new genera: *Reteograptus* and *Thamnograptus*. The former is characterised by the reticulated structure of the entire stipe (as in the *G. tentaculatus* of Point Levy, described by the author in the Geological Report of the Canadian Survey for 1857) and thus resembling to some extent the genus *Retiolites* or *Gladiolites* of Barrande, but the serratures do not reach the central cells. In the new genus *Thamnograptus*, on the other hand, the stipe appears to be entirely destitute of cells or serratures of any kind.

Amongst the Brachiopods, several new genera, in addition to those described more or less recently by the author, are also proposed; but the data on which these are founded, appear to be somewhat unsatisfactory. As regards fossil forms, which so greatly outnumber living species in this class of mollusca, the classification-characters, indeed, are beset in their application, and throughout the entire group, with almost insurmountable difficulties. The earlier genera were established, to a great extent, on external characters of more or less easy employment; but it soon became evident that many species were thus placed in forced or artificial collocation: as, although alike externally, their inner structure was frequently found to be entirely distinct. Thus, the forms of the genus *Athyris* became separated from *Terebratula* (or mostly so,) by their internal calcareous spires, and placed properly amongst the *Spiriferidæ*, although a straight hinge-line was originally thought to be one of the essential characters of these latter. In *Terebratella*, again, the supposed arched hinge-line of the *Terebratulæ* was shewn to be an uncertain or artificial character. But many internal points of brachiopodous structure, besides being of difficult, and frequently of impossible observation, may be also to some extent of little value as natural classification-elements. It seems clear, at least, that subdivisions based on minute and subordinate internal characters, may be pushed too far. All palæontologists must agree that it is at present next to impossible to refer certain fossils of this class to their proper genera, and the difficulty will not only be much increased by minute generic distinctions founded on characters that cannot be observed in the great majority of examples, but each separate species bids fair to become eventually the type of a distinct genus.

The new genera proposed by Professor Hall are named respectively, *Skenidium*, *Ambocœlia*, *Vitulina*, *Meristella*, and *Leiorhynchus*; with *Rhynchotrema* as a doubtful genus, founded on the old *Rhynconella in-*

crebescens, certain examples of which have been found to exhibit a well-marked area. The genus *Skenidium*, founded on *orthis insignis*, is characterized by the prolongation of the cardinal process into a median septum which extends to the base or front margin of the shell, and occasionally bifurcates at this lower extremity. In the typical species, the area is large and triangular, but this character, although cited by the author in the generic description, is probably more or less inconstant. It would, at least, be manifestly unsafe to refer to this genus (allowing it to be really distinct) all the orthis-like forms with large area, high ventral valve, and radiating striæ, where other characters could not be observed; and yet, in nine cases out of ten, these external characters are alone open to us. The genus *Ambocœlia*, of which the long-known *orthis umbonata* of Conrad is the type, possesses a large and curved beak in the highly convex ventral valve, and a four-parted muscular impression near the centre of the dorsal valve. The proposed genus *Vitulina* somewhat resembles the author's *Tropidoleptus*, but the dental processes are not crenulate, nor distinctly separated from the area, as in the latter. One species only is cited: *V. pustulosa* from the Hamilton Group of Genesee County, New York. The genus *Meristella* is separated from *Merista* (with which the author's *Camarium* is now seen to be identical) by the absence of the peculiar arched, or "shoe-lifter," process, belonging to the ventral valve of that genus. From *Athyris*, on the other hand, it is distinguished chiefly by the presence of a well-marked median septum, absent, or rudimentary, in the former, and by a slightly different muscular impression; but these characters are surely insufficient to warrant the separation, even if they should prove to be constant. Finally, *Leiorhynchus* is made to include the meristella or athyris-like forms with plications on the central portion (or, occasionally, on the entire surface) of the shell. Internal spires have not yet been recognised, so that the family to which this type should be referred, cannot be strictly determined; and great difficulty must be experienced, if the genus be adopted, in distinguishing many of its species from those of *athyris* or *rhynconella*.

In the Devonian rocks of Western Canada, the genus *Lingula* appears to be of exceedingly rare occurrence, but, from strata of this age in New York, Professor Hall has described several species of comparatively large size, together with a large species of *Discina*, and several species of *Crania*. Some forms referred to the genus *Tere-*

bratula, are also described. These have a punctate shell-structure, but the internal characters have not been made out.

A considerable portion of the work before us, is devoted to descriptions of new goniatites and related forms, from the Hamilton Shales and other Devonian strata of New York. We may attempt an analysis of these, in another number of the *Journal,* but the large space occupied by other articles in the present number, compels us to pass them by with this brief allusion. Well-executed figures are given of most of the species.

Towards the close of Professor Hall's Report, we have some additional remarks on the trilobites of the "Quebec shales" of Georgia, Vermont. These forms, it will be remembered, have given rise to much recent discussion, both on this continent and in Europe, and have made known to us the undoubted presence of an American "primordial zone." These trilobites have hitherto been referred to the genus *Olenus* (or, by Professor Hall, to *Olenus* and *Peltura*), but the author now considers them entitled to the rank of new and distinct genera, upon which he bestows the names of *Barrandia* and *Bathynotus.* The species formerly referred by him to *Peltura* he places under *Bathynotus,* and the two other species under *Barrandia.* This latter genus is undoubtedly a legitimate one, holding an intermediate place between *Paradoxides* and *Olenus.* It differs from Paradoxides, more especially, by the anterior contraction of the glabella; and from Olenus by its contracted pygidium, this latter being apparently composed of a single article, without the slightest trace of side lobes. In *Barrandia,* moreover, the *third* pleuræ are produced beyond the others. It appears to us, therefore, that this genus must hold good, so long as *Paradoxides* and *Olenus* are kept distinct;* but the two species placed under it, seem, on the other hand, to be identical. Considering the crushed state of the form referred to *B. Vermontana,* no certain conclusions can be drawn from the glabella, and the rounded anterior lobe of the glabella of *B. Thompsoni* might undoubtedly be so distorted by pressure as to produce the appearance exhibited by the other example. The produced horns of the head-shield are certainly much shorter in one form than in the other, but that is a character of no specific value, as exemplified by *Asaphus Canadensis* and other species of trilobites. The proposed genus *Bathynotus* may likewise prove to be well founded, but the im-

* The name *Barrandia* has already been applied, however, to a doubtful genus, by McCoy.

perfect condition of the solitary example on which it is based, scarcely warrants us to accept it, at present, otherwise than provisionally.

In bringing to a close, this rapid notice of Professor Hall's valuable contributions to palæontological science, as contained in the Report before us, we may congratulate our readers, who may be interested in this subject, on the near completion of the author's third volume of the Palæontology of New York. In this volume we are promised, in addition to much important matter regarding various fossil groups, some new and interesting details on the structure of *Eurypterus* and other crustaceans of a similar type. These details, it is stated, are of a far more complete character than those hitherto educed from European examples.

E. J. C.

Supplementary Chapter to Acadian Geology. By J. W. Dawson, LL.D., F. R. S., Principal of McGill College, Montreal. Edinburgh: Oliver and Boyd. Montreal: B. Dawson and Son. 1860.

The *Acadian Geology* of Dr. Dawson, a very elaborate treatise on the geological structure and characteristics of New Brunswick and Nova Scotia, published in 1855, was brought before the notice of our readers in an early Number of the Journal.* In the present "Supplementary Chapter" to this work, the author embodies the various discoveries and deductions, relating to the geology of these districts, which have accrued, since that time, from his own researches and those of other laborers in the same field. In this manner, the modern and Post-Pliocene deposits of Nova Scotia are briefly discussed and compared with those of Canada and Europe; and a succinct but very able review is given of the Coal Measures, with their vegetable, reptilian, and other remains. The illustrations presented in connection with the author's views on the structure of the *Sigillariæ* and other Carboniferous plants, are particularly interesting. All the new facts gleaned from recent examinations of the Silurian and Devonian strata of these provinces, are also brought together in a separate chapter, presenting as complete a view of the subject as the present state of our knowledge will admit. Dr. Dawson's valuable *Supplement*, therefore, regarded even as a separate work, will be found of the greatest service to all engaged in the study of American Geology.

E. J. C.

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* Vol 1. New Series, p. 39—48.

Coins, Medals, and Seals, Ancient and Modern; Illustrated and described. With a sketch of the history of coins and Coinage, instructions for young collectors, tables of comparative rarity, price lists of English and American coins, medals, and tokens, &c., &c. Edited by W. C. Prime, author of "*Boat Life in Egypt and Nubia,*" &c. New York: Harper and Brothers. 1861.

The author of this neatly executed and tastefully illustrated work begins his preface with the remark: "This volume is published without any pretence to novelty." There is, however, a very notable novelty in the issue of such a work with its preface dating from New York, and its copyright secured "in the Clerk's Office of the District Court" of that state, according to Act of Congress. As a popular hand-book for the young numismatist, it is a highly creditable and significant production. It undertakes too much within the compass of its two hundred and eighty pages to be of great practical value for the minute requirements of the experienced coin collector; but as an introduction to numismatic studies, and a help to the young beginner in the stocking and valuing of his cabinet, it is well suited for its purpose; while to the numismatist who feels any interest in the coins and medals of the New World, it offers some curious information, such as will be highly appreciated in some quarters. If it were our purpose to trace either the facts or the illustrations to their original sources, it would not be difficult to show the process of compilation by which the work has been got up; but we rather turn to the only department in which the numismatist has any reason to look for authoritative information on the subject treated of, viz., the mints and coinage of the New World.

Chapter VI. is devoted to the American Colonial and United States coinage, in which characteristically enough, the history begins with the primitive wampum, and the native systems of barter. From this may be learned what are the rare and prized treasures of the American numismatist; the Gomers Island piece of Bermuda, of which only three specimens are known; the Pine Tree coinage; and the Scrub Oak shilling of Massachusetts, a source of quarrel between the Colonists and the Crown, till a witty New Englander told Charles II. that the device was none other than the Royal Oak that saved his majesty's life.

A good story is told of John Hull, the Mint-master of Boston, by whom the Pine Tree money was coined. He received for his labour and expenses, one shilling out of every twenty he coined; and by this toll in silver, he became at last one of the richest men in the colony. When his daughter was married to Samuel Sewall he accordingly settled her dowry by placing her on her wedding day in one scale, and filling the other with shillings till he outweighed her. The editor enters into an estimation of the probable weight of an average bride, and so estimates the worth of the fair lady by this curious standard. Along with pleasant illustrations of like kind, the book embodies much minute information, especially about the United States coinage of the early years which followed the Revolution, such as can not fail to be welcome to the collector; and along with this are minute tables of rare medals and coins, with the prices given for them at recent sales. The volume is well calculated to awaken a taste for numismatics in the young collector who may not hitherto have had his attention turned in that direction.

D. W.

CANADIAN INSTITUTE.

ANNUAL REPORT OF THE COUNCIL FOR THE YEAR 1860.

(Read before the Institute, Saturday, Dec. 15th, 1860.)

The Council of the Canadian Institute have the honor to present the following Report of the proceedings of the Society for the past year:—

Since the last Annual Report thirty-six new members have been elected. while a loss, from various causes, of forty-one members has been sustained, showing a decrease of five members during the year. The subjoined list shows the present state of the membership:—

Members at commencement of Session 1859-60		467
New Members elected, Session 1859-60		36
By the Council, during the recess		1
Total		503
Deduct—Deaths	8	
Withdrawn	25	
Left the Province	8	
		41
Total on 30th November, 1860		462

Composed of—	Honorary Members	5
	Life Members	35
	Corresponding Members	6
	Members	406
	Junior Members	10
	Total	462

The Council are glad to be able to report the continued efficiency of the library. During the year they have added thirty-nine volumes by purchase, and one hundred and two volumes have been received as donations from various sources. A list of the books added will be found appended to this Report. The number of volumes taken out by members during the year has been considerably larger than in any former year, showing a growing appreciation of the advantages offered by this important branch of the Institute.

COMMUNICATIONS.

The following list of Papers, read at the ordinary meetings held during the Session, will be found to contain many communications of value, and some of general interest :—

3RD DECEMBER, 1859.

Rev. J. McCaul, LL.D., " On Ancient Shields."

Professor E. J. Chapman, " On Canadian Minerals."

10TH DECEMBER.

John Rae, M.D., " On the Search for Sir John Franklin."

17TH DECEMBER.

Professor E. J. Chapman, " On the Geology of Belleville and surrounding District."

7TH JANUARY, 1860.

Professor H. Y. Hind, M.A., " On the Distribution of Clay Iron Stone in the Carbonaceous Rocks of Rupert's Land, or the North-Western Territory and its value as a source of Iron in that country."

14TH JANUARY.

F. Assikinack, Esq., " On some Peculiarities of the Odahwah Language."

Rev. Prof. W. Hincks, F.L.S. " Specimens of a Canadian Flora."

21ST JANUARY.

Hon. G. W. Allan, M.L.C. " On the Topography of the Roman Forum." Illustrated by a series of Photographic views.

Professor D. Wilson, LL.D., (the President.) " Observations on the Skull of a Circassian Lady, brought from Kertch in the Crimea."

28TH JANUARY.

Professor H. Y. Hind, M.A. " Remarks on Indian Art, illustrated by a collection of Indian relics, obtained during the Assinniboine and Saskatchewan Expedition."

Professor J. Bovell, M.D., "Observations on the Skull of an Indian infant, found with many others in a pit near Weston."

4TH FEBRUARY.

Professor J. Bovell, M.D., "Notes of a Visit to Barbadoes in 1859."

11TH FEBRUARY.

Rev. Professor W. Hincks, F.L.S., "On some Particulars in the Structure of the Brassicaceæ and Primulaceæ."

Professor G. T. Kingston, M.A., "On the Meteorological Phenomena of 1859."

18TH FEBRUARY.

Sandford Fleming, Esq., C.E., "On a new Construction of Railway Joints."

Professor Henry Y. Hind, M.A., "On the Manufacture of Shale Oil from the Utica Slate of Collingwood."

C. Fuller, Esq., "On the processes and results of Chromo-Lithography, illustrated by Drawings and Specimens of the process in all its stages."

25TH FEBRUARY.

Rev. W. S. Darling, "Remarks on the Manuscripts of the Middle Ages."

Rev. Professor G. P. Young, M.A., "On the Relation which can be proved to subsist between the area of a Plane Triangle and the sum of the Angles, on the Hypothesis that Euclid's 11th Axiom in any case fails."

Hon. G. W. Allan, M.L.C., "Notes on some of the Different Races composing the Population of the Valley of the Nile." Illustrated by coloured drawings procured by the Author when in Egypt.

3RD MARCH.

T. C. Wallbridge, Esq., "On some Ancient Mounds on the shores of the Bay of Quinté."

W. G. Tomkins, Esq., C.E., "On the Thickness of the Earth's Crust."

P. Freeland, Esq., "Notes on some Specimens of Diatomaceæ collected in the St. Lawrence, illustrated by Microscopical Specimens."

10TH MARCH.

Rev. Professor W. Hincks, F.L.S., "On the true Aims, Foundations, and Claims to attention of Political Economy."

D. Martin, "On some Geometric Problems, relating to Curves having double contact."

J. H. Dumble, Esq., C.E., "On the Expansion and Contraction of Ice."

17TH MARCH.

Professor E. J. Chapman, "On the Geological structure of the Blue Mountains near Collingwood." (2) "On some rules for calculating the thickness of inclined strata, and (3) On a new species of *Agelacrinites* from Peterboro', C.W."

Professor G. P. Young, M.A., "Proof of the impossibility of representing the common transcendental functions of a variable as finite Algebraical functions."

Professor D. Wilson, LL.D. (President), "On the origin of Alphabets in their reference to the question of the age of Man."

24TH MARCH.

Professor J. B. Cherriman, M.A., "Remarks on Newton's investigations of the velocity of sound."

Professor H. Croft, D.C.L., "On a reputed Blue Sand from India."

31ST MARCH.

G. R. R. Cockburn, M.A., "On Rent."

Professor J. B. Cherriman, M.A., "On a Problem in Substitutions."

Sandford Fleming, Esq., C.E., "On the development of lines of internal Communication, with a view to the future progress of Canada."

14TH APRIL.

Professor H. Y. Hind, M.A., "On the occurrence of Grasshoppers (so called) in the North-West."

Rev. Professor Hatch, M.A., Trinity College, "On the moral relations of the Greek Oracles."

The Council take this opportunity of urging upon Members the necessity of individual exertion and active co-operation with them, to render this portion of the Society's operations more efficient and successful,—many communications of value and interest, they are convinced, might be secured with a little attention on the part of Members.

It is unnecessary here to repeat what has been alluded to in former Reports of your Council, regarding the honourable position occupied by the *Journal* in Europe and the United States, as well as in this Province. The volume just completed, the Council feel persuaded, will further assist in maintaining its standing. The following is the Report of the Editing Committee:—

REPORT OF THE EDITING COMMITTEE.

In fulfilment of the usual observance, the Editing Committee of the *Canadian Journal* have herewith the honour to present their Annual Report to the Council of the Institute.

In the volume of the *Journal* just completed, the fifth of the New Series, the Committee have sought, to the best of their ability, to maintain and extend the Canadian character of this publication, as developed, under the auspices of Dr. Wilson and former committees, in the preceding volumes of the series. Thus, each number of the *Journal* issued during the present year, will be found to contain at least two, and in most instances, three or four, original communications on subjects exclusively Canadian; whilst in the department of Reviews, various works, emanating from the Provincial Press, have also been brought under notice. These articles, together with the contributions on other subjects, contained in the volume, will bear, it is thought, a not unfavourable comparison with the published communications of former years. The Committee, however, cannot refrain from an expression of regret, that so little has been done by the members at large towards the literary support of the *Journal*. In the volume just completed, for example, the first department, or that of Original Communications, has obtained but thirteen contributors; the department of Reviews, no more than three; and that of Literary and Scientific Notes, a scarcely greater number. Much labour has thus necessarily fallen upon some two or three of the editorial staff. The Committee, therefore, would earnestly urge upon the Members in general, a request for more active co-operation, in enabling them to maintain unimpaired the favourable character and position now acquired by the *Journal* both in home and foreign circles.

No additional Societies have been placed on the exchange list since the date of the last Report; but the Committee have continued to receive, from time to time, valuable publications from those with which the Institute is already in correspondence. The titles of these corresponding Societies and Institutions,—amounting to fifty-four in number,—are given for the information of members, in the annexed classified view:—

Canada.

Literary Society, Quebec.
Natural History Society, Montreal.
Hamilton Association, C. W.

The United States.

Smithsonian Institution, Washington.
American Geographical and Statistical Society, New York.
Lyceum of Natural History, New York.
American Antiquarian Society, Boston.
Natural History Society, Boston.
Harvard University, Cambridge, Massachusetts.
Observatory, Cambridge, Mass.
Essex Institute, Salem, Mass.
Historical Society, Pennsylvania.
Academy of Sciences, Philadelphia.
Franklin Institute, Philadelphia.
Academy of Sciences, New Orleans.
Historical Society, Chicago, Illinois.
University Library, Michigan.
Academy of Sciences, St. Louis.

England.

Royal Society, London.
Royal Geographical Society, London.
Royal Geological Society, "
Royal Astronomical Society, "
Royal Society of Arts, "
Royal College of Surgeons, "
Society of Antiquaries, "
Linnæan Society, "
Chemical Society, "
Royal Society of Literature, London.
Institute of British Architects, "
Institute of Civil Engineers, "
Ethnological Society of London.
Archæological Institute, London.
British Archæological Institute, London.
Microscopical Society of London.
Athenæum Club, London.
Philosophical Society of Cambridge.
Society of Antiquaries of Newcastle-on-Tyne.

Scotland.

Royal Society of Edinburgh.
Royal Society of Arts, Edinburgh
Royal Physical Society, "
Royal Society of Antiquaries, Scotland.

Ireland.

Royal Irish Academy.
Royal Dublin Society.
Trinity College, Dublin.
Natural History Society of Dublin.
Geographical Society of Dublin.

British India.

Geological Survey of India, Calcutta.

France.

Imperial Library of France.
Geological Society of France.
Society of Antiquaries of France.

Denmark.

Royal Library of Copenhagen.
Society of Antiquaries of the North Copenhagen.

Sweden and Norway.

Royal Library of Stockholm.
University of Christiania.

Finally, the Committee beg to observe, that, the actual expense of publication, including engravings, has amounted, during the past year, to £275 16s.; a sum not in excess of the average annual expenditure in this department.

EDWARD J. CHAPMAN, *General Editor.*

The Report of our Treasurer, submitted herewith, shows the finances to be in a satisfactory state :—

STATEMENT OF THE CANADIAN INSTITUTE GENERAL ACCOUNT FOR 1860.

Debtor.	£	s.	d.
Cash—Balance from last year	602	4	5
" Received from Members	246	12	4
" " for Journals	62	7	10
" " for Interest on Loans	97	0	0
" Parliamentary Grant, 1860—*due*	250	0	0
" Due by Members	328	6	3
" Due for Sale of Journals—Old Series	22	1	3
" " " " New Series	51	6	3
	£1659	18	4
Creditor.			
Cash paid on account of Journal, 1859	35	4	2½
" " " " 1860	156	6	0
" " " Library and Museum	85	6	11
" " " Sundries	336	10	3
" Due on account of Journal	149	10	1
" " of Sundries	30	9	10
" " of Library	13	17	7
Estimated balance in favour of Institute	852	13	6
	£1659	18	4

STATEMENT OF THE BUILDING FUND.

Cash—Balance and Investments last year	1845	6	9
" Received for Interest on Loans	97	0	0
Subscription list	534	15	0
	£2477	1	9

THE TREASURER IN ACCOUNT WITH THE CANADIAN INSTITUTE.

Debtor.	£	s.	d.
Cash balance last year	602	4	5
Securities	1425	0	0
Interest received on Securities	97	0	0
Cash received from Members	246	12	4
" on account of Journal sold	62	7	10
	£2433	4	7
Credit.			
Cash paid for Journal, 1859	35	4	2½
" " 1860	156	6	0
" for Library and Museum	85	6	11
" on account of sundries	336	10	3
Securities	1425	0	0
Balance	394	17	2½
	£2433	4	7

D. CRAWFORD,
Treasurer.

TORONTO, 5th December, 1860.

Compared vouchers with cash-book, investment securities exhibited, and balance in hands of Treasurer, £394 17s. 3d.

(*Signed*) SAM. B. HARMAN, SAM. SPREULL, } *Auditors.*

On the occasion of the recent visit of the Prince of Wales to Toronto, the Council availed themselves of the opportunity, to present to His Royal Highness, a loyal address, which has already appeared in the Journal; but in order that a more permanent record of the matter may appear on the proceedings of the Society, the Council subjoin a copy of the address, and of the reply graciously made thereto.

To His Royal Highness, Albert Edward, Prince of Wales, K.G., &c. &c. &c.

MAY IT PLEASE YOUR ROYAL HIGHNESS,—The President, Council, and Members of the Canadian Institute, incorporated by Royal Charter for the promotion of Science and Literature in this province, humbly approach your Royal Highness with loyal and affectionate greetings; and tender to you, with unfeigned respect, their welcome on this auspicious occasion.

While the energies of this province are chiefly directed to the development of its vast agricultural capabilities, and to the fostering of trade and commerce, as the essential sources of its material prosperity, the Canadian Institute specially devotes itself to investigations and researches such as lead to the discovery of abstract truths in Science, but which ultimately tend to the intellectual and social progress of man. While, therefore, uniting with their fellow subjects in this province of the Empire, in welcoming your Royal Highness with grateful and hearty loyalty, as the representative of their beloved Queen, and the heir apparent to the British Throne, they beg leave respectfully to tender their loyal congratulations unitedly as an Institute devoted to objects and pursuits specially fostered by Her Majesty's countenance, and to the furtherance of which the illustrious Prince Consort has extended his highest favour and influence.

Enjoying as they do all the priceless blessings derived from institutions by right of which Her Gracious Majesty rules over a free and united people; and sharing in the glories, and sympathising in all the interests of the empire, of which this province forms no unimportant member: they hail with loyal satisfaction the presence of your Royal Highness, on whom rest the future hopes of this Great Empire. Their earnest prayer is, that, endowed with all noblest graces and divine blessings, trained in sound learning, and gifted with a liberal love of Science and the Arts, you may be eminently fitted for the high trust of which you are the heir. May he who is the Kings of Kings, long spare to you, as to them, her who, while commanding honour from your filial heart, lives not less fondly in the affections of a willing people. On her sceptre, the virtues of their loved and gracious Queen have conferred a might more potent than ever ruler achieved by conquest. Under its genial sway, science and letters have accomplished triumphs which will render the Victorian era illustrious in all future ages; and while other nations are struggling to attain such privileges as her subjects freely enjoy, the British Empire—the sceptre of which they trust will hereafter be no less illustrious in your hands than in those of their beloved Queen,—has girdled the world with a glorious confederacy of provinces, alike united in freedom, in intellectual progress, and in loyal devotion to their Sovereign head.

In their united capacity, as an Institution incorporated by Royal Charter, and specially recognised by the Provincial Parliament as representatives of the interests of Science and Letters, the President, Council, and Members of the Canadian Institute renew their assurances of devoted loyalty to Her Gracious Majesty, and of cordial welcome to your Royal Highness.

D. WILSON, LL.D., *President.*

Toronto, September 8th, 1860.

SIR,—I have the honour to convey the thanks of His Royal Highness the Prince of Wales, for the address presented to him by the President, Council, and Members of the Canadian Institute.

I have the honour to be,

Sir,

Your obedient servant,

NEWCASTLE.

DANIEL WILSON, Esq., LL.D.,
&c., &c., &c.,
President.

In the last Annual Report allusion was made to the expediency of changing the name of the Institute, a subject first brought under the notice of members during the session of 1858-9. The Council have not during the session further moved in the matter; they however think the question one of great importance to the Society, and trust it will not be lost sight of, as they fear the causes which appeared to render such a change desirable have not been removed.

Though the progress of the Society during the past year has not been so great as in some former years, or as its previous history might seem to warrant, it has, nevertheless, been on the whole satisfactory. It must not be forgotten that the Province is only beginning to recover from a state of unprecedented depression, which materially affected societies like the Canadian Institute. The Council cherish the hope that returning prosperity may have the effect of producing new activity and vigour among members, and that the session now opening may prove to be far in advance of any previous one in everything that pertains to its true and best interests.

D. WILSON,
President.

APPENDIX.

BOOKS PURCHASED.

	VOLS.
Encyclopædia Britannica. 8th edition. Vols. 19 and 20	2
Geological Survey of Canada, Sir W. Logan, F.R.S., Director.—Figures and descriptions of organic remains: Decade 1, " 3, " 4	8
Maclear's Almanac for 1860	1
My Diary in India in the year 1858-59. By W. Howard Russell, LL.D., special correspondent of the *Times*. In two vols. 1 and 2	2
The Voyage of the *Fox* in the Arctic Seas. McClintock, (a narrative of the fate of Sir John Franklin, &c.	1
The Origin of Species by means of Natural Selection, &c., &c. By Charles Darwin, M.A., &c.	1
The Complete Writings of Thomas Say. On the Entomology of North America, &c. Edited by John L. LeConte, M.D. Vols. 1 and 2	2
——— Conchology	1
Hayes' Arctic Boat Voyages	1
Geology and Mineralogy considered with reference to Natural Theology. By the late Very Rev. William Buckland, D.D., &c., Dean of Westminster. Vols. 1 and 2. Bridgewater Treatise	2
History of the Conquest of Peru. By William H. Prescott. In two vols. Vols. 1 and 2	2
The Institutions of the Mind inductively investigated. By Rev. James McCosh, LL.D	1
Micrographic Dictionary. Griffith and Henfrey	1
Outlines of Astronomy. Sir John Herschell	1
British Diatomaceæ. Smith. Vols. 1 and 2	2

	VOLS.
Journal of the Royal Geographical Society. Vols. 27 and 28	2
The Permanent Way and Coal Burning Locomotive Boilers of European Railways	1
Voyage of the *Barracouta* to Japan, Kamtschatka, Siberia, China, etc. By J. M. Tronson, R. N., 1859	1
Story of New Zealand. Thomson. Vols. 1 and 2	2
Stephen's Central America. Vols. 1 and 2	2
——— Yucatan. Vols. 1 and 2	2
Collection of Rare and Original Documents and Relations concerning the Discovery and Conquest of America. No. 1. By E. G. Squire, M A., F.S.A.	1
The recent Foraminifera of Great Britain. By W. Crawford Williamson, F.R.S., Prof. of Natural History, Owen's College, Manchester, 1858	1
Kitchi-Gami Wanderings round Lake Superior. By J. G. Kohl. Chapman and Hall	1
History of Canada from the time of its Discovery till the Union year (1840-1.) Translated from "L'Histoire du Canada" of F. X. Garneau, Esq., and accompanied with illustrative notes, &c. By Andrew Bell. 3 vols.	3
Total	39

DONATIONS OF BOOKS, &c.

From T. C. WALLBRIDGE, ESQ.

The Poetical Works of James Hoskins, A.B., M.B., Trinity College, Dublin. Edited by H. T. Baldwin, A.M., of Osgoode Hall, U. C., Barrister at Law. 1

From REV. DR. RYERSON, SUPERINTENDENT OF EDUCATION, *Upper Canada.*

Annual Report Normal, Model, Grammar, and Common Schools U. C., for 1858, with appendix 2

From the PUBLISHER.

Archaia. By J. W. Dawson, LL.D., F.G.S., &c. 1

Report on the Exploration of the Country between Lake Superior and the Red River Settlement, and between the latter place and the Assiniboine and Saskatchewan. By S. J. Dawson, Esq., C.E. 1

North West Territory.—Report on the Assiniboine and Saskatchewan Exploring Expedition. By Henry Youle Hind, M.A. 1

From the AMERICAN GEOGRAPHICAL AND STATISTICAL SOCIETY, *New York.*

Bulletin. Vol. I. (3 Nos.) 1

——— Vol. II 1

Journal. Vol. I, (10 parts) 1

Johnson's Railroad to the Pacific. 8vo. 1

Criminal Statistics of New York, 1854. 8vo 1

Hewitt on Iron 1

	VOLS.
De la Roquette on Keilhau..................................	1
Report of Council for 1857	1
First Annual Report of the Cooper Union, for the advancement of Science and Art. 1st January, 1860..................................	2

From the AUTHOR.

Course of Practical Chemistry as adopted at University College, Toronto. By Prof. H. Croft, D.C.L.F.C.S., Prof. of Chemistry, University College	1

From the HON. J. M. BRODHEAD, *Washington.*

Explorations for a Railroad Route from the Mississippi River, to the Pacific. Vols. 10. 11..................................	2
Patent Office Reports, 1859 :—Agriculture..................................	1
Compulsory Enlistment of American Citizens..................................	1
Messages and Documents, 1859-60 :—Abridged in one Volume............	1
Commerce and Navigation, 1859..................................	1
Report of the Finances, 1858-59..................................	1

From MAJOR LACHLAN, *Cincinnati.*

Meteorologische Waarnamingen in Nederland en Zijne Bezittingen, en af wijkeugen van Temperatuur en Baromterstand op vele plaatsen in Europa Uitgiven door het Roninklijk Nederlandsch Meteorologische Instituut, 1856 & 1857.—*Quarto*..................................	2
The 4th Meteorological Report of Professor James P. Espy, (Quarto) to the United States Government, 27th July, 1854..........................	1
Cotton is King, and Pro-Slavery arguments, comprising the writings of Hammond, Harper, Christy, Stringfellow, Hodge, Bledsoe and Cartwright.—Published and sold exclusively by subscription, 1860.................	1

From the HON. G. W. ALLAN, M.L.C., *Toronto.*

A monogram of the Trochilidæ. Parts, 17 & 18..........................	2

Presented Anonymously.

Hume's History of England in 5 Vols., full Bound in Calf, Illustrated year 1793..................................	5
Picture frame—For Lithograph of St. Helena. Presented by Colonel J. H. Lefroy, Royal Artillery..................................	1

From the HISTORICAL SOCIETY *of Pennsylvania.*

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From the SMITHSONIAN INSTITUTION, *Washington, U. S.*

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The General Grievances and oppression of the Isles of Orkney and Shetland. By Mr. James Mackenzie, writer, Edinburgh, 1836 1

Sacontala eller den Uheldidge ring et Indiansk Drama af Cálidás oversat af original Sprogene Sanscrit og Pracrit i Engelsk og heraf i Dansk med en Indledning til den Danske oversættelse Kiöbenhavn, 1793........... 1

From the CLERK OF THE HOUSE OF ASSEMBLY.

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Annual Report of Normal, Model, Grammar, and Model Schools, U. C..... 1

From LEONARD SCOTT & CO., *New York.*

Edinburgh, Westminster, North British, and London Quarterly Reviews; and Blackwood's Magazine for 1860 ....

From B. QUARITCH, *London.*

Catalogue Raisonné of Rare Valuable and Curious Books................ 1

From JAMES HODGES, ESQ., *Victoria Bridge per* B. DAWSON.

Construction of the Great Victoria Bridge in Canada, by James Hodges, Engineer to Messrs. Peto, Brassey and Betts, Contractors. 2 vols. 1 Construction. 1 Plates 2

From the ROYAL SOCIETY, *London, per* SMITHSONIAN INSTITUTE, *Washington, U. S.*

Observations made at the Magnetical and Meteorological Observatory at St. Helena, with discussions of the observations at St. Helena, the Cape of Good Hope, the Falkland Islands, Carlton Fort in North America and Pekin, &c. Vol. II. London, 1860.................... 1
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The Oceanic Hydrozoa, &c., by Thomas Henry Huxley, F.R.S., F.L.S. &c. .. 1

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From the HISTORICAL SOCIETY *of Chicago.*

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Minutes of the General Association of Illinois.......................... 1
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Silliman's American Journal, 1860	1
Canadian Naturalist and Geologist, 1860	1
Proceedings of the Boston Natural History Society, 1860	1
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Proceedings of the Academy of Natural Sciences of Philadelphia. Pages 1—48 and 81—412	1
Transactions of the Royal Scottish Society of Arts. Vol. V., Part III.	1

	VOLS.
Journal of the American Geological and Statistical Society. Vol. II., No 1. July, 1860	1
Journal of the Board of Agriculture, Upper Canada, 1860	1

ANNALES DES MINES, &c., *France.*

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"	2nd "	"	1
"	3rd "	"	1
XVI	4th "	"	1
"	5th "	"	1
"	6th "	"	1
XVII	1st "	"	1

Essex Institute, Historical Recollections of. Vol. II., No. 1. February, 1860. No. 2—April—No. 3 June—No. 4 August—No. 5 October	5
The Weal-Reaf, a Record of the Essex Institute Fair, Nos	7
Transactions of the Academy of Sciences, St. Louis. Vol, 1—No. 4	1

DONATIONS TO THE MUSEUM.

From JOHN FLEMING, ESQ.

A collection of Trilobites and other Geological Specimens from Collingwood, Canada West.

BOOKS BOUND FROM PERIODICALS RECEIVED.

Journal of the Franklin Institute, 1859	2
Journal of Education, Lower Canada, 1857 and 1858	1
Illustrated London News, 1859	2
Hunt's Merchants' Magazine, 1858. July to December	1
" do " 1857	2
Silliman's American Journal, July—Nov., 1858	1
Canadian Merchants' Magazine. Vol. 4, January—June, 1859	1
Journal of the Society of Arts, Nov., 1858—Nov , 1859	1
The Artizan, 1859	2
The Art Journal, 1859	1
Quarterly Journal Geological Society. Vols. 10, 11, 12, 13 and 14	5
Quarterly Journal of Microscopical Science. Vols. 1, 2, 3, 4 and 7	5
The London, Edinburgh and Dublin Philosophical Magazine. Vols. 11, 12, 13, 14, 15 and 16	6
The Edinburgh New Philosophical Magazine. Vols. 2, 3, 4, 5, 7, 8, 9, 10	8
The Chemical Gazette. Vols. 5, 6, 7, 8 and 9	5
The Canadian Naturalist and Geologist. Vols. 2, 3 and 4	3
The Civil Engineer and Architects' Journal, 1859	1
Journal of the Chemical Society. Vols. 7, 8, 9, 10, 11 and 12	6
The Mining Journal, 1859	1
The Athenæum, 1859	2

CANADIAN INSTITUTE.

SESSION—1860-61.

THIRD ORDINARY MEETING—*12th January*, 1861.

Professor DANIEL WILSON, LL.D., President, in the Chair.

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

For the Library.

1. From the Hon. Sir J. B. Robinson, Bart.
   Natural History of the United States of America, by Louis Agassiz. Vol. 3.
2. From France.
   Annales des Mines, &c., Tome XVII. 2nd Livraison de 1860.

II. *The following Gentlemen were elected Members:*

Col. EARDLY WILMOT, Royal Artillery, Montreal.
S. G. WOOD, Esq., Toronto.

III. *The following Papers were read:*

1. By the President:
   "The Annual Address."
2. By W. Arnold, Esq.:
   "On an Inconvertible Paper Currency for (nada."

FOURTH ORDINARY MEETING—' \ *January*, 1861.

Professor W. HINCKS, F.L.S., 1st Vice-President, in the Chair.

I. *The following Gentlemen were elected Members:*

JOHN BOYD, Esq., Toronto.
JAMES DYKES CAMPBELL, Esq., Toronto.
L. B. HALL, Esq., M.D., Toronto.
S. T. ABBOTT EVANS, Esq., P.L.S., Bristol, C.E.

II. *The following Papers were read:*

1. By P. Freeland, Esq.:
   "On the movements of the Diatomaceæ, with illustrations of living specimens under the microscope."
2. By A. E. Williamson, Esq.:
   "On some fresh water Mollusca collected in the neighbourhood of Toronto."

FIFTH ORDINARY MEETING—*26th January*, 1861.

Professor DANIEL WILSON, LL.D., President, in the Chair.

I. *The following Papers were read:*

1. By J. F. Smith, Junr., Esq.:
   "On a new species of Triarthrus."
2. By the Rev. Prof. W. Hincks, F.L.S.:
   "On some 'litions to the Flora of Toronto, observed during the past year."

MEAN METEOROLOGICAL RESULTS AT TORONTO FOR THE YEAR 1860.

BY PROFESSOR KINGSTON, M.A., DIRECTOR OF THE OBSERVATORY, TORONTO.

Read before the Canadian Institute 16th February, 1861.

Temperature.—The mean temperature of the year 1860 was 44.°32, a number exceeding by 0.°20 the average of 21 years. This small excess was due to the mildness generally of the Spring and Autumn, since the means of both the Summer and Winter months were mostly below the average. The average of the differences, without regard to signs of the monthly means from their respective normals, was 1.°98 for the year 1860, and 2.°42 for the period 1853–60. As far as this can be taken as a test, 1860, in respect to temperature, may be regarded as approximately a normal year.

The range of the year, the mean of the monthly ranges, and the mean of the daily ranges, were respectively 96.°5, 45°93, and 14.°24; which, compared with 108.°11, 48.°08, and 16.°41, the corresponding numbers for the period 1853–60, indicate a general moderation in the fluctuations of temperature.

The warmest day was July 19, with a mean of 75°0, and the coldest, December 14, when the mean was 1.°08. The extremes of temperature for the year (88.°0 and —8.°5) occurred on July 19 and February 1. The former was 2.°4 below, and the latter 3.°2 above, the averages of the yearly maxima and minima.

There were 32 days in which the mean of the day differed from the normal by 12° and upwards. Of these none occurred in the summer months, but were distributed through the rest of the year in a tolerably regular progression, their frequency increasing with a decreasing temperature, and reaching a maximum in February. In grouping together the four years terminating with 1860, a well-marked double progression becomes apparent with a second or inferior maximum in June. If regard be had, not to the *number* of abnormal daily means but to the *amount* of abnormal variation of each observation, without reference to any arbitary limit, it will be found that the aggregate of these variations in the several months derived from a series of six years conform to a double progression, similar to that above described, the principal maximum of mean abnormal variation 10.°1 occurring in February; the two minima, 5.°1 and 4.°5, in May and August; and the second maximum, 5.°7, in June, the mean for the whole year being 6.°7.

Barometer.—It will be seen from the table that the mean height of the barometer for the year differed from the average by —.0276 inches, an unusually large difference as compared with other years. The mean of the monthly differences from their respective averages, and without regard to sign, was small, being only ·0449 inches against ·0509 inches, the corresponding number for the period 1855–60.

The extremes of pressure were within narrow limits as regards their amount, and were separated by an interval of only 138 hours, the maximum, 30·267 inches, having occurred on December 14 at 5 P.M., and the minimum, 28·838 inches, on December 20 at 11 A.M.

The days of excessive abnormal variation, in which the mean pressure of the day differed by ·200 inches, and upwards, from the normal, were 115, a number somewhat larger than usual. The law of their distribution among the months is not so well marked as in the case of temperature, but their greater frequency in the winter than in the summer months is sufficiently obvious, being 19 and 5 in December and August of 1860, and on the aggregate of four years, 50 in December and 17 in August. If further the aggregate amounts of the abnormal variations of all the observations in each month be compared, a law will be found to prevail in the distribution resembling very closely in its general character that just stated.

Humidity.—The mean humidity of the year was 77, which is rather in excess of that of the preceding year. Its distribution among the several months was more than usually equable.

Clouds.—The extent of sky clouded, in accordance with the experience of former years, amounted to $\frac{2}{3}$ of the hemisphere on the average of the year. July and August were the clearest months, and December the most cloudy.

Wind.—The resultant direction of the wind was N. 60 W., (almost identical with that of 1859) and the resultant velocity 3·32 miles. The mean velocity was 8·55 miles, which shows a still further increase on the velocity of the preceding year. The day of greatest wind was March 21, when the velocity averaged 28·83 miles; and the calmest day was February 4, when the mean velocity was only 0·85 miles per hour. The greatest velocity recorded for a whole hour was 40·6 miles, from 8 P.M. to 9 P.M. on February 9.

The most windy hours on the average of the year were from 1 P.M. to 2 P.M., and from 2 P.M. to 3 P.M., with a mean velocity in each case of 11·17 miles; and the calmest hour from 1 A.M. to 2 A.M., when the mean velocity was 6·91 miles.

Rain and Snow.—The depth of rain was 23·434 inches, or nearly 10 inches less than in 1859, a deficiency having occurred in every month but February, July and August. The amount of snow (45·6 inches) was also below the average to the extent of 15·3 inches, and the rain and melted snow combined fell short of the average by 8·589 inches. While the quantity of rain and snow was deficient the number of days on which rain fell was about 8 per cent., the number of days of snow 2 per cent., and the number of rain or snow about 5 per cent., greater than the average of the six years given in the annexed table.

July was the most rainy month in respect to the amount of rain, and May in respect to its frequency. Even when snow is taken into account and reckoned as rain, July still maintains its predominance in the amount of precipitation, but the maximum of frequency is then transferred to December.

~~The heaviest fall of rain was 1·265 inches on December 19,~~ and the heaviest fall of snow 9 inches on February 18.

Thunderstorms.—Of the 31 thunderstorms recorded the earliest took place on February 22, and the latest on October 15. The storm of August 24 was one of great violence.

Auroras.—Of the 58 auroras given in the table the most brilliant occurred on March 26, 27, and September 6 and 15.

The following is the General Meteorological Abstract for the year 1860, deduced from the observations taken at the Provincial Observatory:—

GENERAL METEOROLOGICAL

Provincial Magnetical Observatory,

LATITUDE, 43° 39′.4 North. LONGITUDE, 5 h. 17 m. 33 s. West. ELEVATION ABOVE

	Jan.	Feb.	March.	April.	May.	June.
	°	°	°	°	°	°
Mean Temperature	23.38	22.83	34.48	39.55	55.53	63.16
Difference from average (21 years)	− 0.32	0.00	+ 4.19	− 1.38	+ 3.95	+ 1.80
Thermic Anomaly (Lat. 43° 40′ N.)	− 9.42	−11.87	− 5.62	−10.65	− 2.57	− 1.44
Highest Temperature	46.4	50.2	67.0	61.8	74.5	81.6
Lowest Temperature	− 6.8	− 8.5	12.8	19.5	32.5	49.2
Monthly and Annual Ranges	53.2	58.7	54.2	42.3	42.0	32.4
Mean Maximum Temperature	29.83	29.43	41.89	47.04	63.97	72.58
Mean Minimum Temperature	17.58	15.32	27.35	32.19	47.79	55.33
Mean Daily Range	12.25	14.11	14.54	14.84	16.18	17.24
Greatest Daily Range	30. 5	26.5	30.1	25.6	24.6	28.9
Mean Height of Barometer	29.6420	29.6324	29.5111	29.5775	29.5659	29.4978
Difference from average (13 years)	+.0131	+.0199	−.1203	−.0296	−.0176	−.0840
Highest Barometer	30.142	30.136	29.934	30.265	29.886	29.859
Lowest Barometer	29.155	28.920	29.044	28.896	29.088	28.909
Monthly and Annual Ranges	0.987	1.216	0.890	1.369	0.798	0.950
Mean Humidity of the Air	.81	.81	.71	.74	.76	.71
Mean Elasticity of Aqueous Vapour	.110	.112	.148	.185	.338	.414
Mean of Cloudiness	0.71	0.67	0.49	0.59	0.57	0.58
Resultant Direction of the Wind	N 89 W	N 61 W	N 64 W	N 37 W	N 26 E	N 44 W
Resultant Velocity of the Wind	6.09	3.28	7.61	4.10	2.66	3.13
Mean Velocity (Miles per hour)	9.37	8.73	12.41	10.30	7.17	7.61
Difference from average (13 years)	+1.62	+0.85	+3.97	+2.51	+0.75	+2.40
Total Amount of Rain (in inches)	0.740	1.330	0.882	1.282	1.815	2.136
Difference from average (20 and 21 years)	−0.703	+0.273	−0.637	−1.153	−1.419	−1.012
Number of Days Rain	6	7	5	11	16	14
Total Amount of Snow (in inches)	8.7	18.8	2.4	0.3	0.0	...
Difference from average (18 years)	− 4.54	+1.42	−6.47	−1.96	−0.08	...
Number of Days Snow	16	13	11	5	0	...
Number of Fair Days	11	11	17	15	15	16
Number of Auroras observed	5	2	12	7	7	2
Possible to see Aurora (No. of Nights)	16	11	19	18	19	17
Number of Thunderstorms	0	1	0	1	8	5

* In this table the averages with which the yearly means of temperature, the velocity of pared, all include 1860. In former tables the back years given for comparison were each

REGISTER FOR THE YEAR 1860.

Toronto, Canada West.

LAKE ONTARIO, 108 feet. APPROXIMATE ELEVATION ABOVE THE SEA, 342 feet.

July.	Aug.	Sept.	Oct.	Nov.	Dec.	Year 1860.	Year 1859.	Year 1858.	Year 1857.	Year 1856.	Year 1855.
° 63.92 — 2.99 — 4.78	° 64.46 — 1.59 — 4.04	° 55.34 — 2.51 — 6.10	° 47.25 + 1.88 — 6.55	° 37.05 + 1.28 — 5.25	° 24.00 — 1.88 —12.00	° 44.32 + 0.20 — 6.68	° 44.19 + 0.07 — 6.81	° 44.74 + 0.62 — 6.26	° 42.73 — 1.39 — 8.27	° 42.16 — 1.96 — 8.84	43.°96 —0.16* —7.02
88.0 43.8 44.2	87.0 46.8 40.2	75.8 28.7 47.1	68.0 28.4 39.6	64.5 13.2 51.3	39.0 — 7.0 46.0	88.0 — 8.5 96.5	88.0 —26.5 114.5	90.2 — 7.3 97.5	88.2 —20.1 108.3	96.6 —18.7 115.3	92.8 —25.4 118.2
72.00 55.85 17.15 30.7	73.73 56.27 17.46 24.4	63.12 47.20 15.83 23.2	53.65 41.58 12.06 23.2	43.23 33.53 9.70 26.0	28.70 19.25 9.54 23.5	14.24 30.7	13.66 39.8	13.84 31.2	16.38 37.0	18.20 44.2	18.19 39.4
29 5640 —.0333	29.5825 — 0536	29.6733 +.0192	29.6711 +.0313	29.5226 —.0962	29.6666 +.0203	29.5923 —.0276	29.6209 +.0010	29.6267 +.0068	29.6054 —.0145	29.5999 —.0200	29.6249 +.0050
29.839 29.157 0.682	29 903 29.211 0.692	30.170 29.233 0.937	29.982 29.019 0.963	29.959 28.844 1.115	30.267 28.838 1.429	30.267 28.838 1.429	30.392 28.286 2.106	30.408 28.849 1.559	30.361 28.452 1.909	30.480 28.459 2.021	30.552 28.459 2.093
.72	.76	.74	.81	.80	.84	.77	.74	.73	.79	.75	.77
.427	.463	.342	.272	.195	.115	.260	.249	.259	.254	.244	.263
0.43	0.43	0.48	0.70	0.70	0.83	0.60	0.61	0.60	0.60	0.57	.60
N 60 W 2.15 7.29 +2.36	N 70 W 1.83 5.80 +0.56	N 71 W 2.63 5.79 +0.35	N 9 W 2.00 6.93 +1.08	S 89 W 4.95 11.02 +3.52	N 62 W 4.66 10.14 +1.04	N 60 W 3.32 8.55 +1.83	N 61 W 2.24 8.17 +1.45	N 41 W 1.59 7.64 +0.92	N 74 W 2.54 7.99 +1.27	N 71 w 3.03 8.31 +1.59	N 62 w 2.51 8.14 +1.42*
4.336 +0.806 13	3.405 +0.455 14	1.959 —2.032 14	1.618 —0.892 15	2.569 —0.513 12	1.362 —0.232 3	23.434 —7.059 130	33.274 +2.781 127	28.051 —2.442 131	33.205 +2.712 134	21.505 —8.988 99	31.650 +1.157* 103
... ...	... ...	... ...	Inapp. —0.88 1	1.9 —1.19 8	13.5 —1.60 21	45.6 —15.30 75	64.9 + 4.00 87	45.4 —15.50 67	73.8 +12.90 79	65.5 + 4.60 69	99.0 +33.10* 64
18	17	16	15	15	8	174	169	178	171	198	198
6 19	8 19	6 22	0 10	1 12	2 8	58 190	53 199	59 198	26 189	35 212	46 204
4	9	2	0	0	0	31	30	19	28	25	38

the wind, and the yearly amount of rain and snow, for each of the years 1855—1860 are com-
referred to the average including itself, but no subsequent year.

MONTHLY METEOROLOGICAL REGISTER, AT THE PROVINCIAL MAGNETICAL OBSERVATORY, TORONTO, CANADA WEST,—DECEMBER, 1860.

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

Day.	Barom. at temp. of 32°.				Temp. of the Air.				Excess of mean above Average	Tens. of Vapour.				Humidity of Air.				Direction of Wind.			Result't. Direction.	Velocity of Wind.					Rain in inches.	Snow in inches.
	6 A.M.	2 P.M.	10 P.M.	Mean.	6 A.M.	2 P.M.	10 P.M.	ME'N		6 A.M.	2 P.M.	10 P.M.	M'N	6 A.M.	2 P.M.	10 P.M.	M'N	6 A.M.	2 P.M.	10 P.M.		6 A.M.	2 P.M.	10 P.M.	Result'.	ME'N		
1	29.108	29.221	29.291	29.2417	22.6	23.7	24.1	23.28	— 7.50	.096	.105	.100	.101	.79	.82	.77	.81	NW b N	N W	NW b W	N 53 W	13.0	21.0	22.0	20.47	20.73	...	0.1
2	.322	.376	—	—	24.1	29.5	—	—	—	.107	.141	—	—	.82	.87	—	—	W N W	W N W	W N W	N 75 W	19.0	21.5	9.0	14.65	14.79	...	Inp.
3	.545	.576	.593	.5747	29.5	32.7	31.3	31.22	+ 1.05	.150	.165	.166	.155	.92	.88	.95	.88	W	W	W	N 78 W	6.2	11.0	6.5	5.24	6.76	...	Inp.
4	.542	.483	.446	.4878	28.0	29.8	28.0	28.38	— 1.40	.131	.140	.131	.135	.86	.84	.86	.87	N b E	N b E	N N W	N 6 W	9.5	10.0	3.8	7.69	7.89	...	0.1
5	.410	.387	.410	.4017	23.0	21.8	23.0	23.70	— 5.55	.106	.128	.113	.115	.86	.94	.92	.90	N	N W	W N W	N 53 W	8.8	5.7	0.5	5.86	6.35	...	Inp
6	.348	.261	.310	3075	25.9	28.8	24.1	26.25	— 2.82	.120	.144	.120	.129	.86	.89	.93	.90	W b S	S W b S	W S W	S 44 W	4.0	18.2	1.0	6.01	6.36	...	1.0
7	.385	.575	.702	.5738	29.1	35.6	27.7	30.32	+ 1.65	.148	.142	.142	.139	.92	.68	.94	.83	W S W	W b N	N N W	N 31 W	5.0	10.2	4.5	4.96	8.53	...	...
8	.756	.852	.020	.8517	25.2	25.3	24.1	24.92	— 3.55	.115	.120	.107	.117	.85	.86	.82	.87	NE b N	N b E	NW b N	N 1 W	11.8	2.7	2.5	3.60	5.83	...	...
9	.890	.856	—	—	29.8	35.2	—	—	—	.147	.163	—	—	.88	.81	—	—	W S W	W	Calm.	S 68 W	9.0	8.2	0.0	2.95	5.56	...	1.5
10	.363	.070	.297	.2387	31.6	33.4	29.5	31.20	+ 3.35	.170	.187	.144	.165	.96	.98	.87	.94	E b S	N b E	NW b N	N 20 W	11.0	6.0	14.0	6.93	9.57	...	4.5
11	.427	.605	.480	.5007	23.3	19.7	21.2	20.75	— 6.90	.093	.064	.099	.084	.73	.61	.87	.74	NW b N	W b N	W S W	S 82 W	17.0	12.5	11.7	11.37	14.18	...	Inp
12	.155	.166	.168	.1737	27.3	26.2	24.8	25.20	— 2.15	.139	.090	.112	.108	.94	.62	.84	.79	W S W	W S W	SW b W	S 69 W	18.2	17.2	20.8	18.75	19.04	...	0.2
13	.335	.524	.812	.5805	17.6	15.4	4.2	11.25	—15.90	.088	.059	.047	.063	.92	.66	.89	.84	W b S	W N W	W N W	N 63 W	18.8	26.0	3.0	11.73	12.75	...	0.1
14	30.000	30.233	30.216	30.1893	—6.6	8.2	1.3	1.08	—25.88	.029	.040	.043	.037	.89	.63	.91	.79	N b W	N N W	N b W	N 8 W	4.0	3.0	6.5	5.30	5.63	...	0.2
15	30.114	29.968	29.902	29.9892	0.7	19.6	12.5	13.20	—13.57	.052	.065	.067	.061	.88	.62	.88	.78	N N W	E S E	E N E	N 56 E	7.8	9.0	6.5	1.45	6.18	...	...
16	29.725	.827	—	—	23.7	31.6	—	—	—	.118	.156	—	—	.93	.87	—	—	W S W	S W b W	W S W	S 60 W	14.5	14.5	1.5	8.47	8.52	...	...
17	.984	30.015	30.087	30.0488	25.5	25.0	22.3	23.98	— 2.38	.125	.109	.092	.105	.91	.81	.77	.81	W S W	N b E	N E b N	N 28 E	6.5	1.0	7.0	6.89	7.89	...	Inp.
18	30.130	30.091	29.905	30.0290	24.8	25.0	27.0	24.92	— 1.25	.112	.109	.136	.119	.84	.81	.93	.87	E b N	E N E	E N E	N 75 E	14.0	19.5	21.5	17.45	17.70	...	0.5
19	29.687	29.414	.234	29.4345	33.4	36.0	36.7	35.45	+ 9.38	.171	.196	.213	.196	.89	.93	.98	.95	E	E	E	S 84 E	14.5	12.0	7.0	8.78	8.95	1.265	...
20	28.895	28.990	.157	28.9973	37.8	38.5	34.9	37.05	+11.17	.217	.174	.145	.178	.96	.74	.71	.80	E	W	W	S 89 W	7.4	19.0	14.8	11.05	13.23	0.047	...
21	29.343	29.287	.099	29.2355	29.1	30.2	27.7	28.27	+ 2.48	.141	.128	.142	.138	.87	.76	.94	.87	W b N	NW b W	N N E	N 9 W	8.2	2.2	14.7	8.34	10.17	...	5.0
22	.215	.461	.698	.4902	24.1	24.2	17.2	21.15	— 4.53	.114	.099	.075	.094	.87	.76	.78	.82	N W	W b S	W	N 86 W	17.0	18.2	5.0	10.02	10.48	...	Inp.
23	.780	.816	—	—	10.7	21.9	—	—	—	.059	.097	—	—	.82	.82	—	—	W	W b N	W b N	N 82 W	2.8	3.5	4.5	5.58	5.59	...	...
24	.950	.990	.932	.9605	17.6	24.4	13.6	18.30	— 7.18	.083	.106	.067	.084	.85	.81	.83	.84	W b N	W b N	N N W	N 61 W	5.6	9.0	6.0	6.49	7.12	...	...
25	.844	.791	—	—	20.1	23.7	—	—	—	.099	.112	—	—	.91	.87	—	—	N	N N W	N N W	N 16 W	9.5	9.0	9.0	9.53	9.74	...	Inp.
26	.972	30.051	30.116	30.0577	20.8	27.3	25 9	23.88	— 1.42	.097	.111	.128	.110	.86	.74	.91	.85	N N W	N W	NW b N	N 42 W	3.0	18.0	12.0	10.23	10.27	...	Inp.
27	30.172	30.163	30.215	30.1888	24.1	28.8	25.1	25.80	+ 0.52	.114	.137	.116	.121	.87	.86	.86	.86	N W	N W	N b W	N 37 W	8.4	13.5	5.0	7.80	8.28	...	...
28	30.225	30.183	30.110	30.1697	18.3	25.2	19.7	21.70	— 3.45	.080	.115	.096	.101	.81	.85	.91	.86	N b E	E	N E	N 66 E	5.0	9.4	9.8	9.15	10.64	...	...
29	29.986	29.864	29.820	29.8707	28.0	32.0	32.7	31.03	+ 5.87	.131	.143	.173	.150	.86	.79	.92	.86	E	E S E	S b W	S 20 E	15.0	11.7	15.0	9.21	13.64	0.050	0.2
30	.870	.899	—	—	24 4	19.0	—	—	—	.096	.067	—	—	.73	.64	—	—	S W	W S W	W b S	S 73 W	13.1	10.0	10.5	10.79	11.01	...	Inp.
31	30.099	30.076	30.010	30.0617	16.1	20.5	16.9	17.82	— 7.37	.081	.070	.077	.076	.90	.64	.83	.79	W S W	S W b S	W S W	S 66 W	10.5	8.0	7.2	10.91	11.05	...	0.1
M	29.6530	29.6578	29.6774	29.6666	23.31	26.44	23.02	24.00	— 3.09	.116	.118	.114	.115	.88	.78	.87	.84	....	....	....	....	10.28	11.64	8.54	.....	10.14	1.362	13.5

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR DECEMBER, 1860.

Highest Barometer . . . . 30.267 at 5 p. m. on 14th. } Monthly range=
Lowest Barometer . . . . 28.838 at 11 a. m. on 20th, } 1.429 inches.

Self-registering Ther. { Maximum temperature . . . . 39°0 on p.m. of 20th } Monthly range=
{ Minimum temperature . . . . —7°0 on a.m. of 14th } 46°0

{ Mean maximum temperature . . 28°79 } Mean daily range = 9°54.
{ Mean minimum temperature . . 19°25 }
{ Greatest daily range . . . . 23°5 from a. m. to p. m. of 16th.
{ Least daily range . . . . 2.8 from a. m. to p. m. of 10th.

Warmest day . . 20th ... Mean Temperature . . .=37°05 } Difference=35°97.
Coldest day . . . 14th ... Mean Temperature . . .= 1°08 }

Maximum { Solar . . . . 53°0 on p. m. of 7th } Monthly range=
Radiation { Terrestrial . . . . . . —17.0 on a. m. of 14th } 70°0.

Aurora observed on 2 nights, viz.: on the 10th and 15th; possible to see Aurora on 8 nights; impossible on 23 nights.

Snowing on 21 days: depth, 13.5 inches; duration of fall, 68.4 hours.
Raining on 3 days; depth, 1.362 inches; duration of fall, 24.0 hours.
Mean of cloudiness=0.83; most cloudy hour observed, 8 a. m., mean=0.89: least cloudy hour observed, 10 p. m.; mean=0.75.

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

North.	South.	East.	West.
2703.93	1065.97	1355.05	4411.21

Resultant direction, N 62° W; Resultant Velocity, 4.66 miles per hour.
Mean velocity 10.14 miles per hour.
Maximum velocity . . . 29.5 miles, from 7 to 8 a.m. on the 22nd.
Most windy day . . 1st —Mean velocity, 20.73 miles per hour. } Difference 15.17
Least windy day . . 9th —Mean velocity, 5.56 do } miles.
Most windy hour, 1 to 2 p. m.—Mean velocity, 11.94 miles per hour. } Difference
Least windy hour, 9 to 10 p m....—Mean velocity, 8.52 do. } 3.42 miles.

1st. Stormy day. Very high wind.—10th. Heavy snow storm from 4 to 7 p. m.—15th. Brilliantly colored aurora; very perfect arch and streamers 7 p. m. to midnight.—10th. Greatest day's rain during the year.—20th. Dense wetting fog from 6 to 11 a. m.—21st. Heavy snow storm from 2.30 p. m. to 1 a. m. of 22nd.—24th. Lunar halo from 5 p. m. to midnight.—26th. Solar halo at 9 a. m.—30th. Faint solar halo at 2.30 p. m.

Rapid Barometric movements.

Ascent { From 12th, at 6 a. m.=29.155
{ To 14th, at 5 p. m. =30.267

Range in 59 hours=1.112

Descent { From 18th, at 8 a. m. =30.130
{ To 20th, at 11 a. m. =28.838

Range in 51 hours=1.292

The Resultant Direction and Velocity of the Wind, for the month of December, from 1848 to 1860 inclusive, were respectively N. 69° W., and 2.93 miles.

The meteorological elements for December, 1860, differed from their respective averages as follows:—Temperature —1°38; Rain —0.232 inches; Snow —1.60 inches; Wind +1.94 miles per hour, and clouds +0,07.
The month was therefore comparatively cold, dry, windy, and very cloudy.

COMPARATIVE TABLE FOR DECEMBER.

YEAR.	TEMPERATURE.					RAIN.		SNOW.		WIND.		
	Mean.	Difference from Average.	Maximum observed.	Minimum observed.	Range.	No. of days.	Inches.	No. of days.	Inches.	Resultant Direction.	Resultant Velocity.	Mean Velocity
	°	°	°	°	°					°		
1840	24.3	— 1.6	41.0	— 4.4	45.4	3	inap,	18	...	...	...	...
1841	23.7	+ 2.8	45.5	+ 2.4	43.1	7	6.600	5	...	...	...	1.33 lbs.
1842	24.7	— 1.2	40.3	+ 3.8	36.5	3	0.880	17	...	...	...	0.61 "
1843	30.0	+ 4 1	41.1	+ 2.7	38.4	6	1.040	8	8.1	...	...	0.53 "
1844	28.2	+ 2.3	48.9	— 0.8	49.7	6	imp.	6	4.2	...	...	0.40 "
1845	21.1	— 4.8	37.6	— 2.7	40.3	2	inap.	12	4.7	...	...	0.70 "
1846	27.5	+ 1.6	49.2	+ 3.7	45.5	5	1.215	9	6.0	...	...	0.57 "
1847	30.1	+ 4.2	50.0	+ 6.6	43.4	7	1 185	8	6.8	...	...	0.35 "
1848	29.1	+ 3.2	49.1	+ 0.6	48.5	7	2.750	7	16.5	S 83 W	1.12	5.44ms.
1849	26.5	+ 0.6	41.3	— 5.2	46.5	5	0.840	12	9.6	N 82 W	2.56	6.23 "
1850	21.7	— 4.2	48.3	— 9.7	58.0	2	0.190	18	29.5	N 44 W	2.93	7.40 "
1851	21.5	— 4.4	43.8	—10.5	54.3	6	1.075	15	10.7	N 82 W	4.00	7.37 "
1852	31.9	+ 6 0	51.0	+13.9	37.1	7	3.995	10	20.1	S 69 W	1.03	6.54 "
1853	25.3	— 0.6	42.2	— 5.2	47.4	4	0.625	13	22.3	N 35 W	2.39	4.98 "
1854	21.9	— 4.0	41.8	— 5.9	47.7	6	0.590	12	17.2	N 41 W	4.30	8.56 "
1855	26.8	+ 0.9	45.9	— 2.1	48.0	6	1.845	10	29.5	S 88 W	5.29	11.38 "
1856	22.9	— 3.0	41.2	— 9.1	50.3	6	1.790	20	16.3	S 87 W	[illegible]	11.56 "
1857	31.9	+ 6.0	45.6	+ 5.7	39.9	7	3.205	14	9.0	N 89 W	[illegible]	6.84 "
1858	27.4	+ 1.5	43.6	+ 5.0	38.6	11	1.657	18	10.4	N 18 W	1.66	9.36 "
1859	17.9	— 8.0	54.8	— 3.3	58.1	3	1.035	23	37.4	N 53 W	4 29	10.77 "
1860	24.0	— 1.9	38.5	— 7.0	45.5	3	1.362	21	13.5	N 62 W	4.66	10.14 "
Mean	25.88	...	44.80	—1.02	45.82	5.3	1.594	13.1	15.10	...	...	8.20

MONTHLY METEOROLOGICAL REGISTER, AT THE PROVINCIAL MAGNETICAL OBSERVATORY TORONTO, CANADA WEST—JANUARY, 1861.

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

Day.	Barom. at temp. of 32°.				Temp. of the Air.				Excess of mean above Average	Tens. of Vapour.				Humidity of Air.				Direction of Wind.			Resultant Direction.	Velocity of Wind.					Rain in Inches.	Snow in Inches.
	6 A.M.	2 P.M.	10 P.M.	MEAN.	6 A.M	2 P.M	10 PM	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 PM	Resul't.	ME'N		
1	29.768	29.807	29.763	29.7815	25.5°	29.8°	27.7°	27.60°	+ 2.38°	.104	.096	.128	.109	.75	.58	.84	.72	S W	SW b W	W S W	S 62° W	24.0	8.0	6.5	8.80	8.88	...	...
2	.716	.710	.680	.7080	26.2	32.0	28.0	28.75	+ 3.55	.124	.158	.139	.140	.87	.87	.90	.88	S W b W	SW b W	N	N 29 W	3.5	6.5	8.0	2.45	7.03	...	...
3	.678	.610	.617	.6350	16.9	17.6	11.1	15.12	—10.03	.084	.076	.063	.075	.90	.79	.87	.86	N	N N W	N N W	N 17 W	7.8	9.5	6.2	8.15	8.33	...	Inp.
4	.663	.715	.709	.7027	11.4	18.8	21.0	17.17	— 7.97	.068	.081	.105	.081	.94	.79	.89	.84	N W b N	W N W	SW b W	S 71 W	5.5	7.0	12.5	9.91	11.13	...	Inp.
5	.846	.825	.871	.8543	14.0	19.4	23.0	19.08	— 6.05	.074	.080	.106	.089	.91	.77	.86	.85	S W b W	SW b W	W S W	S 66 W	15.2	13.0	11.4	9.68	9.96	...	Inp.
6	.880	.711	—	—	21.9	28.4	—	—	—	.105	.134	—	—	.89	.86	—	—	W b S	S E b S	N E	S 81 E	1.5	7.0	5.0	3.74	5.35	...	1.0
7	.346	.301	.565	.4170	20.1	23.0	17.2	23.00	— 2.13	.148	.120	.087	.118	.92	.97	.91	.94	E b N	N E b N	N N W	N 21 E	9.5	8.5	3.5	5.66	7.63	0.050	3.0
8	.675	.719	.733	.7165	19.0	23.7	21.9	21.42	— 3.72	.098	.112	.105	.103	.95	.87	.89	.90	N N W	N W b N	N W b N	N 12 W	2.0	3.5	1.5	3.03	3.20	...	0.5
9	.604	.405	.285	.4185	19.7	24.4	22.6	22.43	— 2.70	.096	.110	.111	.107	.91	.84	.90	.89	N N E	N E	N W b N	N 12 E	7.5	5.5	3.6	3.89	6.21	...	0.1
10	.203	.377	.713	.4553	22.3	15.8	0.6	11.63	—13.42	.116	.065	.040	.071	.96	.74	.88	.87	W S W	N W b N	W	N 47 W	6.5	26.0	5.5	12.42	13.83	...	Inp.
11	.731	.568	.500	.6010	—4.4	1.5	3.9	0.12	—24.93	.033	.046	.051	.043	.90	.97	.97	.94	N N E	N E b N	N N E	N 18 E	6.0	16.2	13.8	11.87	12.71	...	4.0
12	.657	.934	30.059	.8045	—1.9	—3.4	—6.6	—4.15	—29.23	.039	.030	.026	.032	.97	.83	.80	.89	N	N N W	N N W	N 16 W	13.0	7.5	7.6	7.16	7.25	...	...
13	30.125	30.079	—	—	—1.2	14.0	—	—	—	.039	.074	—	—	.94	.90	—	—	N b W	S b E	N E b N	N 64 E	7.2	5.0	6.5	1.93	4.78	...	Inp.
14	29.830	29.632	29.669	.7180	12.2	27.3	26.2	22.67	— 2.43	.069	.126	.139	.113	.89	.84	.98	.90	N N E	E N E	N N E	N 38 E	9.0	7.5	7.8	5.86	6.55	...	Inp.
15	.646	.567	.478	.5512	26.2	28.4	27.7	27.38	+ 2.28	.139	.134	.142	.140	.98	.86	.94	.94	N N E	E N E	E N E	N 63 E	7.2	14.2	13.0	13.75	13.86	0.140	Inp.
16	.132	.022	.203	.1162	29.8	33.8	34.2	32.53	+ 7.53	.162	.190	.196	.181	.98	.98	.99	.98	E N E	N b W	S b W	S 10 E	22.0	7.8	13.2	1.25	11.19	0.475	Inp.
17	.506	.710	.842	.7027	29.5	26.2	24.8	26.60	+ 1.58	.150	.124	.120	.128	.92	.87	.90	.88	W b N	W b N	N W	N 49 W	11.0	9.8	4.0	6.29	7.53	...	Inp.
18	.744	.364	.204	.4153	28.0	28.0	28.4	28.02	+ 3.05	.139	.146	.148	.145	.90	.95	.95	.94	E b N	N E b N	N N W	N 39 E	11.0	14.5	0.5	4.41	12.37	...	3.0
19	.282	.352	.416	.3595	32.0	31.6	27.3	29.88	+ 5.00	.166	.156	.118	.147	.91	.87	.79	.87	S S W	S b W	S S W	S 16 W	16.6	14.5	17.5	16.31	16.42	...	0.1
20	.491	.631	—	—	21.9	22.6	—	—	—	.113	.107	—	—	.96	.87	—	—	W b N	W S W	W b N	N 85 W	14.5	8.5	12.0	7.55	7.62	...	0.1
21	.813	.941	30.075	.9563	7.1	20.8	10.7	12.45	—12.33	.053	.083	.059	.066	.88	.75	.82	.85	W	SW b W	W	S 73 W	3.5	13.8	2.0	5.21	5.44	...	...
22	30.199	30.279	30.316	30.2722	—0.1	15.4	7.8	7.47	—17.30	.037	.077	.056	.055	.85	.87	.91	.86	W	W	W	N 70 W	2.0	0.5	5.4	2.60	2.73	...	...
2.	30.324	30.223	30.041	30.1757	10.0	24.6	27.7	21.52	— 3.15	.059	.094	.135	.100	.87	.71	.89	.83	—	—	E b S	—	7.6	16.0	17.5	—	14.40	..	1.0
24	29.725	29.422	29.452	29.5305	28.0	32.4	32.4	30.38	+ 5.82	.146	.184	.169	.161	.95	.100	.91	.95	E b S	E b S	SW b W	S 5 W	18.2	10.5	19.5	5.06	15.37	0.020	6.0
25	.610	.651	.807	.6985	15.1	22.3	12.2	15.03	— 9.55	.074	.079	.059	.067	.86	.66	.78	.75	SW b W	W S W	W S W	S 65 W	14.8	15.5	1.5	9.81	9.88	...	...
26	.873	.806	.735	.7957	1.7	20.1	11.1	11.25	—13.23	.038	.091	.060	.065	.80	.65	.83	.85	W	W b S	N W	N 77 W	6.5	0.5	3.0	2.95	3.25	...	...
27	.661	.506	—	—	14.3	29.1	—	—	—	.071	.126	—	—	.85	.78	—	—	N N W	S b E	SW b W	S 32 W	1.0	10.5	8.0	6.77	7.66	...	0.2
28	.553	.610	.563	.5837	22.6	28.0	25.1	25.37	+ 1.07	.103	.109	.123	.112	.85	.71	.91	.82	W S W	SW b W	S b W	S 33 W	7.8	13.5	4.8	9.07	10.45	...	1.2
29	.309	.195	.262	.2602	29.5	34.5	21.9	28.45	+ 4.25	.158	.181	.106	.146	.97	.90	.90	.91	S b E	S W	W b S	S 75 W	6.6	11.8	14.0	13.97	15.21	...	0.4
30	.439	.594	.754	.6143	15.0	24.8	19.7	19.35	— 4.75	.082	.120	.090	.093	.95	.90	.84	.87	W b S	W b S	W S W	S 71 W	21.5	17.2	9.5	13.24	14.10	...	Inp.
31	.731	.648	.587	.6527	15.0	16.5	16.1	15.75	— 8.23	.075	.076	.081	.078	.87	.83	.90	.88	SW b W	W S W	W S W	S 60 W	15.5	12.0	6.6	7.80	7.83	...	...
M	29.6320	29.6298	29.6631	29.6517	17.78	22.86	19.43	19.86	— 4.94	.098	.109	.102	.102	.90	.84	.89	.88	......	......	......	......	9.85	10.38	8.11	......	9.30	0.685	20.6

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR JANUARY, 1861.

Highest Barometer .... 30.330 at 7 p. m., on 22nd } Monthly range=
Lowest Barometer .... 29.006 at 1 p.m., on 16th } 1.324 inches.

Self-registering Thermom.
Maximum Temperature .... 37°0 on p. m. of 18th } Monthly range=
Minimum Temperature ....—11°2 on p. m. of 12th } 48°2
Mean maximum Temperature .... 25°14 } Mean daily range=
Mean minimum Temperature .... 13°93 } 11°21
Greatest daily range .... 25°2 from a. m. to p. m. of 13th.
Least daily range................. 2°0 from a. m. to p. m. of 3rd.

Warmest day......... 16th... Mean temperature......... 32.53 } Difference = 36°68.
Coldest day......... .. 12th... Mean temperature.........—4°15 }

Maximum { Solar................................ 54°0 on p. m. of 29th } Monthly range=
Radiation. { Terrestrial.........................—18°5 on p. m. of 12th } 72°5.

Aurora observed on 0 nights,
Possible to see Aurora on 9 nights; impossible on 22 nights.
Snowing on 23 days; depth 20.6 inches; duration of fall 93.6 hours.
Raining on 4 days,—depth 0.685 inches; duration of fall 14.5 hours.
Mean of cloudiness = 0.76. Above average .05.
Most cloudy hour observed, 8 a. m., mean = 0.85; least cloudy hour observed, 10 p. m., mean, = 0.66.

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

North.	South.	East.	West.
2051.34	1913.15	1168.42	3271.01

Resultant direction N. 86° W.; Resultant velocity 2.92 miles per hour.
Mean velocity......................... 9.30 miles per hour.
Maximum velocity .... 26.8 miles, from 10 to 11 a. m. on 10th.
Most windy day .... 10th......Mean velocity 16.42 miles per hour. } Difference=
Least windy day . ... 22nd......Mean velocity 2.73 ditto. } 13.69 miles.
Most windy hour ...11 a.m. to noon...........Mean velocity 10.87 ditto. } Difference =
Least windy hour... 7 to 8 p. m. ....Mean velocity 7.96 ditto. } 2.91 miles.

1st. Lunar Halo at 6 a. m.—11th and 12th. Very cold and stormy days.—16th. Dense fog 4 to 6 p. m.—20th. Very distinct lunar halo at 6 p. m.—23rd. Well defined solar halo at 2 p. m.—23rd. Very perfect lunar halo from 5.30 to 11 p. m.—24th. Dense fog 2 to 4 p. m.—26th. Faint lunar halo at 11 p. m.—31st. Solar halo from 3 p. m.

Great Barometric ranges. { 13th, 6 a. m. = 30.125 / 16th, 1 p. m. = 29.006 } Descent in 79 hours = 1.119.

Ditto. { 18th, midn't. = 29.190 / 22nd, 7 p. m. = 30.330 } Ascent in 91 hours = 1.140.

The Resultant Direction and Velocity of the Wind for the month of January, from 1848 to 1861 inclusive, were respectively N. 77 W. and 2.98 miles.

The Direction Shaft of the Anemometer was out of order on the 23rd, the Resultant Direction and Velocity of the Wind for that day are consequently imperfect.

COMPARATIVE TABLE FOR JANUARY.

Year.	Temperature.					Rain.		Snow.		Wind.		
	M'n.	Diff. from Aver.	Max. ob'd.	Min. ob'd.	Range.	No. of days.	Inch's.	No. of days.	Inch's.	Resultant Direction.	Resultant V'y.	Mean Force or Velocity.
	°	°	°	°	°							
1840	17.0	—6.5	40.6	—13.8	54.4	4	1.395	11	...	...	...	....
1841	25.6	+2.1	41.7	— 4.1	45.8	2	2.150	14	...	...	...	0 36 lbs.
1842	27.9	+4.4	45.8	1.3	44 5	5	2.170	9	...	...	...	0.78
1843	28.7	+5.2	54.4	1.5	52.9	6	4.295	12	14.2	...	...	0.69
1844	20.2	—3.3	44.6	— 7.7	52.3	7	3.005	11	24.9	...	...	0.70
1845	26.5	+3.0	43.0	— 3.4	46 4	5	Imp.	9	22.7	...	...	0.70
1846	26.7	+3.2	41.2	0.3	40.9	5	2.335	10	6.0	...	...	0.55
1847	23.3	—0.2	42.6	— 2.2	44.8	7	2.135	5	7.5	...	...	1.09 mls.
1848	28.7	+5.2	51.5	—12.0	63.5	7	2.245	8	7.1	N 82° W	2.03	5.82
1849	18.5	—5.0	40 1	—15.2	55.3	4	1.175	10	9.2	N 63° W	3.06	6.71
1850	29.7	+6.2	46.3	10.6	35.7	5	1.250	8	5.2	N 37° W	0.69	5.80
1851	25.5	+2.0	43.2	—12.8	56.0	4	1.275	10	7.8	S 77° W	3.26	7.69
1852	18.4	—5.1	37.3	— 7.0	44.3	0	0.000	19	30.9	N 68° W	3.14	7.67
1853	23.0	—0.5	40.9	— 6.6	47.5	1	0.290	6	7.5	N 27° W	2.52	6.34
1854	23.6	+0.1	45.2	— 4.3	49.5	7	1.270	11	7.5	N 77° W	2.44	6.91
1855	25.9	+2.4	48.2	— 4.7	52.9	5	0.525	13	23.3	N 73° W	1.91	7.26
1856	16.0	—7.5	33.1	—12.1	45.2	0	0.000	14	15.6	N 75° W	5.24	10.69
1857	12 8	-10.7	34.6	—20.1	54.7	3	Imp.	16	21.8	N 70° W	4.96	10.31
1858	30.0	+6.5	45.8	7.5	38.3	6	1.152	11	4.0	N 71° W	2.33	7.40
1859	26.4	+2.9	41 5	—26.5	68.0	6	1.449	19	16.4	S 81° W	3.17	8.76
1860	23 4	—0.1	45.4	— 5.1	50.5	6	0 740	16	8.7	N 89° W	6 09	9.37
1861	19.9	—3.7	34.5	— 7.0	41.5	4	0.685	23	20.6	N 86° W	2.92	9.30
M	23.55	...	42.80	—6.52	49.31	4.5	1.407	12.0	13.63	....	...	7.86 Ml.
Diff. from av'g	-3.67	...	-8.30	—0.48	-7.81	-0.5	-0.722	+ 11.0	+ 6.97	....	...	+ 1.44

MONTHLY METEOROLOGICAL REGISTER, ST. MARTIN, ISLE JESUS, CANADA EAST—DECEMBER, 1860.

(NINE MILES WEST OF MONTREAL.)

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

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

Day.	Barom. corrected and reduced to 32° 6 A.M.	2 P.M.	10 P.M.	Temp. of the Air. 6 A.M.	2 P.M.	10 P.M.	Tension of Vapour. 6 A.M.	2 P.M.	10 P.M.	Humidity of Air. 6 A.M.	2 P.M.	10 P.M.	Direction of Wind. 6 A.M.	2 P.M.	10 P.M.	Horizon'l Movem't in 24 hrs. In miles.	Mean of Ozone. (tenths)	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	29.914	29.173	29.174	30.1	31.7	26.0	.148	.149	.115	.89	.84	.87	W N W	W S W	W S W	299.04	4.0	...	1.10	Cu. Str. 10.	Snow.	Snow.
2	202	259	425	24.2	28.2	27.3	111	135	127	86	85	87	W	W b S	W b S	299.30	3.0	...	1.58	Do. 10	Cu. Str. 10.	Cu. Str. 10.
3	552	741	756	26.1	32.1	30.0	123	143	155	87	79	92	W b S	S b W	W	248.00	3.5	...	...	Do. 8	Do. 4.	Do. 10.
4	817	704	736	26.1	28.2	25.5	115	129	117	83	82	87	N E b E	N E b E	N E b E	106.44	3.0	...	...	Do. 10	C. C. Str. 4.	Do. 10.
5	579	498	682	23.0	27.2	21.3	106	111	090	86	75	78	N W b N	S	W b N	287.30	3.5	...	...	Do. 10	Cu. Str. 10.	Do. 10.
6	558	572	674	14.1	21.5	13.8	067	090	063	81	75	82	W b N	E S E	S E b E	59.30	4.0	...	...	C. C. Str. 6.	Do. 10.	Clear.
7	745	810	714	18.2	20.2	12.6	082	075	060	84	70	80	N E b E	N E b E	S b E	45.40	2.5	...	Inap.	Cu. Str. 10.	C. C. Str. 4.	Cu. Str. 10.
8	479	30.050	934	14.0	34.2	13.9	067	034	059	81	73	75	N E b E	S S W	S E	35.30	2.5	...	...	Do. 10.	Cu. Str. 4.	Clear. Zod. lt.
9	30.076	29.800	30.137	15.4	30.0	17.4	070	136	072	82	81	76	S S W	W S W	W S W	42.00	2.0	...	...	C. C. Str. 4.	Do. 2.	Do. A. B. & Z.l.
10	29.918	501	29.400	8.8	17.5	21.1	060	078	085	86	83	78	N E b E	N b W	N E b E	243.50	3.5	...	3.31	Snow.	Snow.	Snow.
11	562	679	782	20.1	15.5	8.8	091	061	042	85	78	73	N N W	W N W	W N W	228.31	2.5	...	0.27	Do.	Cu. Str. 10.	Clear.
12	514	302	476	10.4	14.6	11.6	054	061	051	78	73	70	S S W	W S W	E S E	97.20	2.5	...	0.75	Cu. Str. 10.	Snow.	Cu. Str. 4.
13	373	035	889	9.4	9.0	1.0	051	042	034	78	76	80	W S W	W	W S W	66.70	2.0	...	...	C. C. Str. 4.	C. C. Str. 2.	Clear.
14	30.203	30.346	30.510	10.0	0.0	7.5	016	030	325	60	69	80	W	W	W	0.10	2.5	...	...	Clear.	Clear.	Do.
15	451	411	392	− 8.1	6.0	− 3.0	020	035	052	60	61	80	N E b E	N E b E	S W b S	17.30	2.0	...	...	Cu. Str. 10.	Do.	Cu. Str. 10.
16	007	29.969	056	−11.8	13.0	16.2	020	054	074	76	71	83	N E b E	S S W	S W b S	25.80	2.0	...	...	C. C. Str. 2.	C. Cum. 2.	Do. 10.
17	259	30.265	378	6.2	9.5	2.3	047	080	046	80	76	85	W	S S W	S S W	172.50	2.0	...	...	C. Str. 8.	Clear.	C.C. Str. 2. Z.l.
18	507	545	649	− 6.0	8.0	− 8.9	023	028	024	81	58	79	N E b E	N E b E	N E b E	88.60	2.0	...	...	Clear.	Do.	Clear. Zod. lt.
19	389	209	226	− 9.0	4.0	20.1	023	038	091	77	78	85	N E b E	N E b E	E b S	169.10	3.0	...	4.40	C. C. Str. 10	Snow.	Cu. Str. 10.
20	204	30.109	132	32.4	34.0	19.0	175	183	142	94	90	88	E b S	N E b E	N E b E	214.20	5.0	0.714	2.18	Rain.	Do.	Nimb. 10.
21	29.694	551	29.645	26.1	22.3	12.9	123	084	054	87	71	71	W S W	W S W	W	140.51	3.0	...	...	Cu. Str. 10.	Cu. Str. 10.	Clear.
22	483	29.802	845	19.0	31.2	19.1	087	149	087	84	84	84	N E b E	N E b E	W b S	113.10	4.8	...	3.20	Snow.	Snow.	Cu. Str. 10.
23	996	30.029	30.104	6.0	19.7	7.2	043	081	045	73	77	76	S W	W S W	W S W	88.90	2.0	...	...	Clear.	Clear.	Clear.
24	30.116	30.048	178	2.0	17.2	11.6	034	063	057	71	67	79	W S W	W	W	248.40	2.0	...	...	Cu. Str. 4.	Do.	Cir. Str 4. L. H.
25	164	093	089	9.2	19.8	13.1	051	081	088	77	78	92	W	S S W	S W	43.60	2.5	...	Inap.	C. C. Str. 10.	Snow.	Cu. Str. 10.
26	253	248	242	14.2	29.9	23.9	067	123	100	81	77	79	S W	S W	W S W	34.50	2.5	...	Inap	Do. 10.	Do.	Do. 10.
27	317	301	424	19.1	25.4	17.8	087	111	072	84	81	75	W S W	W S W	W S W	7.60	2.0	...	...	Do. 10.	Cu. Str. 10.	Do. 10.
28	468	415	503	17.3	28.4	18.9	074	129	077	77	82	76	W S W	W S W	S b W	5.80	2.0	...	...	Do. 10.	Do. 10.	Hazy.
29	510	344	328	16.1	19.3	16.8	074	071	070	83	69	80	N E b E	N E b E	N E b E	60.40	2.5	...	...	Do, 10.	Do. 10.	Clear. Zod. lt.
30	323	272	220	17.0	31.2	31.4	078	155	185	83	89	89	N E b E	S E b E	S S E	102.09	4.5	...	4.80	Snow.	Snow.	Cu. Str. 10.
31	259	240	268	19.1	24.1	20.9	082	100	038	84	79	78	W S W	W S W	S W	257.50	4.5	...	...	Cu. Str. 10.	Cir. Cul. 4.	Do. 10.

MONTHLY METEOROLOGICAL REGISTER, ST. MARTIN, ISLE JESUS, CANADA EAST—JANUARY, 1861.

(NINE MILES WEST OF MONTREAL.)

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

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

Day.	Barom. corrected and reduced to 32°. 6 A.M.	2 P.M.	10 P.M.	Temp. of the Air.—F. 6 A.M.	2 P.M.	10 P.M.	Tension of Vapour. 6 A.M.	2 P.M.	10 P.M.	Humidity of Air. 6 A.M.	2 P.M.	10 P.M.	Direction of Wind. 6 A.M.	2 P.M.	10 P.M.	Horizontal Movement in Miles in 24 hours.	Mean of Ozone. t'nths	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	30.071	29.981	30.038	21.4	28.0	19.8	.096	.117	.031	.85	.76	.77	s w	w s w	N b E	168.30	5.0	...	0.70	Snow.	Cu. Str. 6.	Fog.
2	29.850	901	065	19.4	31.8	13.8	097	140	037	92	84	72	s w	N W	N E	223.90	4.0	...	...	Cu. Str. 10.	Str. 10.	Cu. Str. 10.
3	151	30.087	29.913	1.0	7.3	7.3	036	010	045	84	67	76	N E b E	N E b E	N N E	286.20	3.0	...	0.50	Do. 10.	Cu. Str. 10.	Do. 10.
4	000	29.954	30.009	8.4	10.1	2.5	064	061	042	[illegible]	73	86	w s w	w s w	w s w	97.20	3.5	...	...	Do. 10.	Clear.	Cl. Zo.L. A.B.
5	29.985	30.027	024	10.5	26.0	22.7	050	111	095	89	81	79	s b w	w s w	w b s	184.40	2.0	...	...	Do. 10.	Cu. Str. 10.	Cu. Str. 10.
6	30.299	147	075	11.0	10.6	7.3	062	059	045	89	89	78	W	W N W	W N W	136.50	5.0	...	0.57	C. C. St. 9.	Do. 10.	Do. 10.
7	29.878	29.805	29.898	4.6	10.6	7.4	016	018	051	87	69	87	N E b E	N E b E	N E b E	446.50	3.0	0.100	1.10	Cu. Str. 10.	Snow.	Rain & Sleet.
8	30.066	30.076	30.065	5.0	24.1	20.0	041	094	081	74	73	77	N	w s w	w s w	199.60	3.5	...	...	Do. 10.	C. C. Str. 4.	C. C. Str. 4.
9	035	29.928	29.853	−5.0	4.0	1.5	029	030	031	81	59	70	N b W	N E b E	N E b E	82.90	5.0	...	...	Do. 10.	Cu. Str. 2.	Cir. Str. 10.
10	29.540	337	552	2.7	19.0	5.0	040	077	032	84	76	14	N b E	W	W	239.20	3.5	...	0.75	Do. 10.	Snow.	Cl. Zo.L. A. B.
11	980	078	30.075	23.0	−10.6	−20.6	004	015	032	25	55	33	W	w s w	s w b s	245.50	3.0	...	...	Clear.	Clear.	Clear. Zod. L.
12	30.096	30.191	204	−34.7	−5.1	−17.0	002	026	006	22	70	40	W	s s w	s s w	27.20	2.0	...	...	Do.	Do.	Do. do.
13	473	503	555	26.6	1.6	−16.9	008	029	008	37	56	71	s E b E	s w b s	s s E	17.20	2.0	...	...	Do.	Do.	Do. do.
14	337	245	080	13.8	6.4	3.0	018	010	015	74	87	72	N E b E	s	N E b E	74.70	3.0	...	...	Cu. Str. 10.	Cu. Str. 4.	Cu Str. 10.
15	077	29.910	010	7.0	21.7	20.0	045	090	036	76	78	81	N E b E	N E b E	N b E	169.90	5.0	...	...	Do. 10.	Do. 10.	Do. 8.
16	29.891	614	29.552	22.3	24.2	14.8	101	085	082	86	79	87	N E b E	N b E	N E b E	363.90	5.5	...	5.46	Do. 10.	Snow.	Snow.
17	750	939	30.107	16.0	17.0	5.0	074	078	078	83	83	74	N E b E	N E b E	N E b E	164.70	5.5	...	...	Do. 10.	Clear.	Clear. Zod.Lt.
18	30.130	30.080	29.750	−2.0	6.8	8.7	030	043	042	80	75	79	N E b E	N b E	N E b E	139.20	4.0	...	...	Clear.	Cu. Str. 10.	Cu. Str. 10.
19	29.600	29.550	729	12.2	18.9	15.3	063	077	052	81	76	82	N E b E	N E b E	N E b E	998.10	5.5	...	11.15	Snow.	Snow.	Snow.
20	690	674	810	13.1	19.9	10.0	063	077	070	81	76	68	w s w	W N W	w s w	103.20	5.0	...	...	Clear.	Clear.	Cu. Str. 10.
21	900	938	30.081	5.1	14.7	11.1	041	061	045	74	73	70	w b s	W	W	372.80	2.5	...	...	Cu. Str. 4.	Cu. Str. 10.	Do. 10.
22	30.317	30.359	524	4.3	17.4	5.6	036	072	057	73	76	73	W	w s w	w s w	574.40	2.0	...	...	C. C. Str. 6.	Clear.	Clear.
23	020	626	687	−16.1	9.6	−4.6	009	045	033	43	68	82	w b s	s b w	s	111.90	2.5	...	...	Clear.	Do.	Do.
24	410	166	29.873	−8.4	6.3	24.1	056	040	026	79	70	86	N E b E	N E b E	s E b E	65.40	4.0	...	6.40	Cu. Str. 4.	Snow.	Snow.
25	29.630	29.830	912	21.4	22.1	20.1	083	081	111	78	71	72	w s w	s w	w s w	90.60	5.5	...	2.15	Clear.	C. C. St. 8.	Cu. Str. 10.
26	30.090	30.050	30.107	19.0	20.8	20.4	087	142	074	84	88	85	s s w	s w	s b E	92.10	5.0	...	...	Cu. Str. 4.	Cu. Str. 10.	Do. 10.
27	29.999	29.920	29.810	16.0	30.6	24.6	074	130	091	83	78	80	s E b E	w b s	w b s	7.10	0.0	...	...	Do. 10.	Do. 10.	Do. 10.
28	700	810	671	22.1	26.2	19.1	090	105	105	73	73	81	s s E	w s w	w s w	103.10	5.0	...	1.00	Do. 4.	Snow.	Snow.
29	510	517	761	21.1	23.1	19.0	096	084	087	84	71	84	w s w	w s w	s w	379.40	2.5	...	1.10	Cu. Str. 10.	Cu. Str. 10.	Cu. Str. 10.
30	857	872	870	8.7	16.8	18.4	012	068	082	86	75	82	W	w s w	w s w	346.40	2.0	...	...	C. C. Str. 8.	Do. 10.	Do. 10.
31	884	920	930	14.7	21.9	18.1	061	080	052	75	71	84	w s w	w s w	w s w	69.50	2.0	...	...	Cu. Str. 10.	Do. 10.	Do. 4.

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

Barometer	Highest, the 18th day	30.649
	Lowest, the 1st day	29.173
	Monthly Mean	29.918
	Monthly Range	1.476
Thermometer	Highest, the 20th day	34°.0
	Lowest, the 14th day	—13°.0
	Monthly Mean	18°18
	Monthly Range	47° 0
Greatest Intensity of the Sun's Rays		51°.7
Lowest Point of Terrestrial Radiation		—14°.1
Mean of Humidity		.786

Rain fell on 1 day, amounting to 6.714 inches; it was raining 14 hours and 10 minutes.
Snow fell on 12 days, amounting to 21.56 inches; it was snowing 84 hours and 54 minutes.
Most prevalent wind, the W.
Least prevalent wind, the S.
Aurora Borealis visible on 1 night.
Lunar Halo visible on one night.
Zodiacal Light bright.
The Electrical state of the Atmosphere has indicated moderate intensity.

REMARKS ON THE ST. MARTIN, ISLE JESUS, METEOROLOGICAL REGISTER FOR JANUARY, 1861.

Barometer	Highest, the 23rd day	30.687
	Lowest, the 10th day	29.357
	Monthly Mean	29.983
	Monthly Range	1.350
Thermometer ...	Highest, the 2nd day	31°8
	Lowest, the 12th day	—34°7
	Monthly Mean	10°43
	Monthly Range	66°5
Greatest intensity of the Sun's rays		33°4
Lowest point of Terrestrial Radiation		—36°0
Mean of Humidity		.752

Rain fell on 1 day, amounting to 0.100 of an inch; it was raining 4 hours 10 minutes.
Snow fell on 11 days, amounting to 31.88 inches, it was snowing 69 hours and 30 minutes.
Most prevalent wind, the N. by E.
Least prevalent wind, the N.
Most windy day, the 19th day; mean miles per hour, 42.08.
Least windy day, the 27th day: mean miles per hour 0.30.
Zodiacal Light very bright and well defined.
Aurora Borealis visible on 2 nights.
The Electrical state of the Atmosphere has indicated constant and moderate intensity.

MEAN RESULTS OF METEOROLOGICAL OBSERVATIONS AT HAMILTON, C.W., FOR THE YEAR 1860.—By Dr. CRAIGIE.

MONTHS.	THERMOMETER. Mean at 9 A.M.	Mean at 9 P.M.	Mean of both.	Highest.	Lowest.	BAROMETER. Mean.	Highest.	Lowest.	DAYS. Rainy.	Slight Showers.	Dry.	YEARS. Mean Temperature of
	°	°	°	°	°							°
January	25.90	27.90	26.90	58	-5	29.603	30.08	29.12	4	7	20	1848...49.295
February ..	23.93	25.52	24.72	58	-2	613	.06	28.94	5	7	17	1849...48.105
March	36.20	37.40	36.80	70	13	.534	29.90	29.10	2	4	25	1850...48.732
April	42.30	42.20	42.26	70	19	.590	30 22	.00	0	11	19	1851...48.756
May	58.50	57.50	58 04	82	33	.593	29.88	.22	2	10	19	1852...48.248
June	67.93	66.40	67 16	89	45	.574	.91	28.97	3	6	21	1853...49.474
July .. .	69.38	68.67	69.03	88	48	.609	.87	29 30	2	5	24	1854...49.103
August	68.61	69.10	68.85	92	49	.645	.92	.33	1	12	18	1855...47.316
September..	58.80	58.93	58.86	87	30	.740	30.10	.30	2	7	21	1856...44.888
October.. ...	49.03	50.67	49.85	77	32	.686	29.95	.12	5	7	19	1857...45.868
November...	39.60	40.53	40.06	67	4	.508	87	28.88	3	9	18	1858...48.142
December...	25.51	26.10	25.80	48	0	.660	30.17	.86	4	8	24	1859...46.996
Mean temperature of year...47.35; Mean height...29.613									33	88	245	