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THE CANADIAN JOURNAL.

NEW SERIES.

No. XCIV.—APRIL, 1877.

THE PRESIDENT'S ADDRESS.

BY JAMES LOUDON, M.A.,

Professor of Mathematics and Natural Philosophy, University College, Toronto

READ JANUARY 27TH, 1877.

In accepting the honour you have done me in electing me to preside over the meetings of the Canadian Institute, I have thought it would be in keeping with the present occasion that I should devote my remarks to some question which would serve to indicate the objects of our Association. For this purpose, the subject of the Advancement of Science, although perhaps the most difficult, seemed to me the most appropriate. I have accordingly endeavoured, though in a crude and imperfect manner, to treat this comprehensive question from such points of view as were calculated to indicate to us our true position with regard to Science.

It is a prominent feature of our modern civilization, and one indicative of its very advanced stage, that increasing efforts are being made to extend the boundaries of Science in every direction. Unsatisfied by the present range of knowledge, the human mind still strives after universal empire, and in divers ways we still see manifested that restless spirit which prompts men to new ventures, and revives the recollection of the mythical stories of the heroic age. With regard to Science, it is in many respects the beginning of a golden age, wherein the glory of advancing knowledge shall not only be the fond dream of the philosopher, but the proud boast of nations. It is an age, indeed, wherein has already appeared a large measure of the lofty spirit that pervaded the ancient Greek philosophy, and gained for the race, even in a conquered state, the respect and admiration of their masters. It is not the spirit of the ancient Romans. With them universal rule was the object of the national ambition, and in the attainment of that end military and political considerations completely absorbed the energy of the State. Even at the height of Rome's civilization her sweetest bard sang:

> Tu regere imperio populos Romane, memento.
> Hæ tibi erunt artes: pacisque imponere mores,
> Parcere subjectis, et debellare superbos.

Fortunately for the interests of humanity, the foremost nations of the present day have a more lofty ambition. Turning to the most aggressive of these, we behold a people, long engrossed in a political idea, attain to national unity by a rapid series of unparalleled military successes; and yet at the same time the Germans are so occupied with the pursuit of the Arts and Sciences, that their fatherland is looked upon by foreigners as much in the light of a vast university as an immense camp. It is, in fact, to the intellectual prominence of the Germans and their devotion to Science that the recent extension of their boundaries and their political unification are largely due. Such, at any rate, is the opinion of an eminent French physicist, who even goes the length of ascribing the loss of his country's military prestige entirely to the neglect, on the part of the French Government, of scientific development. In an article of great power, Pasteur uses the following language: "The public powers of France have long misapprehended this law of correlation between theoretic Science and the life of nations. Victim, no doubt, to her political instability, modern France has done nothing to maintain, propagate, and develop scientific activity. She has been content with receiving an impulse already received; she has lived on her past, believing herself always great in discovery, because she owes to it her material prosperity. But she has not perceived that her sources have been imprudently permitted to run dry. Neighbouring nations, on the contrary, excited by the stimulus given by France, have turned it to their profit, rendering it fruitful by labours and by sacrifices sagely combined. While Germany multiplied her Universities and established among them the most salutary emulation; while she surrounded her masters and her doctors with honours and with consideration, creating vast laboratories endowed with thousands of instruments for the prosecution of research, France, weakened by her revolutions, always occupied in the barren search after the best form of government, gave only a distracted attention to her establishments of superior instruction." Such a picture is in striking contrast to that presented by France in the days of Lagrange and Laplace. Those were the times, not only of her great scientific superiority, but of her great military successes. The fact that the relative positions of France and her powerful neighbour have been thus changed is calculated to inspire the former, not only to retrieve her military renown, but to regain her old position in the scientific world, wherein she was once *facile princeps*. Where the German has reaped so abundantly, the French will not be slow to cultivate. No political boundaries separate them in the domain of Science, and there, let us hope, they may long contend for the glory of advancing the interests of a higher civilization. A more special interest attends our theme when we consider the attitude of our mother-land towards the question of the encouragement of scientific research. No country in the world owes so much to Science as Britain does. By it her wealth and commerce have been built up; her strength has been developed at home, and her power extended abroad. To it is due her industrial progress. It has created work for her teeming millions. It has developed the skill of her artizans, quickened the intelligence of her people, improved their habits, and multiplied their comforts. It is to the honour of England, and to the credit of her intelligence, that, amidst all her commercial and political successes, she is not unmindful of the original sources of her material strength. The great debt she owes to Science is acknowledged, and out of her abundant store she is ever ready to aid in extending the bounds of knowledge. Her liberality in this direction is unquestioned, and only requires some well considered scheme to guide it in the way of more certain and speedy success. To the departments of Astronomical and Geographical Science more especially has she lent substantial aid. The expeditions of the *Challenger*, and of the *Alert* and the *Discovery*, are the most recent examples of what the Government is willing to do; whilst the readiness with which men are found to undertake such expeditions, is a proof that the spirit which animated Franklin and Livingstone still flourishes on English soil. When we turn to the United States of America, this larger spirit of earnestness in the work of extending Science does not appear to be manifested by the national Government; but such a manifestation is hardly to be expected in so young a country, compelled, in the first instance, to devote its energies to the running of the great political engine, and to the development of the country's agriculture and industries. The aid, however, which the national Government has failed to supply is being bestowed by private liberality; and to such an extent has this been the case, so large and numerous have the bequests to Science been, that the impulse thus developed may fairly be treated as a national one. The restless energy of the people, their character for independent thought, their well known inventive powers, together with their wealth and liberality, all constitute the main essentials for scientific progress. In such soil, Science, if earnestly pursued, is sure to flourish. The work already performed in connection with their museums and astronomical observatories is an indication that "the good seed has not fallen on stony ground."

That the ambition of the foremost nations of the earth should be thus partly in the direction of scientific advancement is an omen of good promise, and an indication that the claims of the investigator shall receive that recognition of his services which has so often been denied him in the past. Unlike the author, he has no property in his discoveries; he seeks no patent to protect them. No man is more truly the servant of posterity. From his labours the practical genius derives his inspiration. Amongst his researches are to be found the germs of future inventions; and yet, even though his discoveries have frequently proved the means of developing untold wealth for the nation, this self-denying genius would often gladly have received in his lifetime such crumbs as his heirs let fall from their tables. In the interests of the investigator, then, it is a subject of congratulation that national governments are taking an increasing interest in the work of advancing Science. One consequence of this is that scientific labour is now more generally esteemed, and it is seldom that the searcher after truth is made rudely acquainted with the "uses of adversity." Notwithstanding his more favourable surroundings, however, it is not to be expected that he will travel in future along a royal road to progress. On the contrary, real advancement is probably now more difficult than ever, so much progress has already been made in every branch of Science. What is of special importance, however, is that the achievements of the investigator are now more immediately recognized and accepted. The discoveries of Faraday were known in the scientific world almost as soon as made; the same may be said of the labours of Kirchoff and Bunsen; and at the present day the news of such successes is transmitted throughout the scientific world with the regularity and dispatch of the newspaper. Even great laws of nature of a new and startling kind are now most rapidly assimilated and absorbed into the body of Science. The principle of the conservation of energy was most readily apprehended and received, and the theory of the evolution of organic forms not less so, by a large part of the scientific world. This adaptability to new ideas is in striking contrast to the struggles and strifes which characterized the early history of Science. Bacon and Newton have long since displaced Aristotle and the schoolmen, and the scientific world has happily emerged from a state of gross darkness and superstition. As in Religion and Politics, so also in Science, there have been a reformation and a revolution; more happy, however, in their results; for the intolerance and passion of the past have almost entirely disappeared, and given place to an earnest desire to work towards one common end. Moreover, the means of carrying on the work have greatly improved. Scientific associations have been largely multiplied, and now form the medium in which intellectual energy is sustained and increased, and through which discoveries are propagated throughout the scientific world. In the transactions of such associations is to be traced the progress of Science for the last two centuries. Even as early as the Restoration in England the necessity for some such organization was felt. At that time the new fields of discovery were rapidly enlarging, and the cultivators of the new philosophy soon perceived that a union of their forces was the best means of strengthening their position and advancing their cause. It was at this period that the Royal Society of London was founded. Although started under the happiest auspices—a very Hercules in its infancy, whose labours were destined to exert a far-reaching influence on the material and intellectual progress of mankind—yet its earliest years were years of bitterness and strife. The new organization was maligned and ridiculed in the most merciless manner. The old scholastic philosophy had not yet been dethroned—the State had just passed through the fires of the Revolution, and within the sphere of Politics and Religion men's minds were still warm and easily disturbed. Under these circumstances the new philosophy was not only viewed with suspicion, but it was openly insinuated that its object was the subversion of the Christian religion, and the Royal Society itself a conspiracy against the political and religious freedom of England. Coarse and violent attacks were made on its members, and most persistent efforts expended by writers of undoubted ability to ridicule and discredit its transactions. Vigorous as these onslaughts were, however, their influence in checking the steady progress of the Society was imperceptible. Whilst the names of her critics were soon forgotten, the subject of their attacks grew in the favour of the nation, and established her reputation at home and abroad. To-day the Royal Society stands in no need of defenders; its historian need not now descend to the task of proving that it was designed neither for the extinction of the Universities nor of the Christian religion. On the contrary, to trace the history of the Royal Society is to describe the rise and progress of scientific discovery in England. The era of its inception saw the birth of many new sciences. The first National Observatory was built at Greenwich, and modern Astronomy incurred the great debt it owes to the immortal Flamsteed. Experimental Chemistry, Mineralogy, Zoology and Botany may be said to have been founded at this time. In the development of these and kindred sciences the Royal Society has played an important part, as a few names from its long roll will amply prove. Amongst these we find Newton, Young and Faraday; Boyle, Dalton and Davy; Brewster, the two Herschels, and scores of others worthy of honourable mention; and in our own day the Society embraces numbers of men like Joule, Thomson and Darwin, whose labours are destined still further to promote its progress and to enrich Science. The example thus furnished by so splendid a record has not been without its influence on other parts of the empire. In Edinburgh, Dublin, and most of the large cities, similar associations have long since been established, and have shared largely in the labours and honours of the pioneer society. The important position thus occupied by the Royal Society and its allies with respect to the advancement of science, has its counterparts in the history of other countries. On the continent there is a similar confederation of scientific societies, at the head of which stands the French Academy. In the number of its illustrious names, in the multiplicity of its labours, and in the splendour of its achievements, this association surpasses all others. Founded about the same time as the Royal Society, it has continued to command the attention and to engross the intellectual activity of the nation. Amongst all the triumphs of the Gaul, the achievements of the philosopher stand pre-eminent; the Institute still holds the sceptre of thought, and commands the loyalty of the fickle Frenchman. The numbers of such associations in other countries it would be impossible to estimate, so numerous are the localities in which they have been established, and so varied the special objects to which they are devoted. Even in the New World their numbers are respectable, and their successes considerable. Washington, Philadelphia, and other American cities can boast of their scientific associations, which are permanently established and actively engaged in continuing the publication of memoirs of acknowledged reputation.

So large a number of societies, the presence of so many workers on the uncertain boundaries of Science, to the uninitiated must appear to involve an immense amount of misspent labour, and the effort may appear disproportionate to the work performed. In a new country such notions are sure to prevail, and therefore it is well to remind those who entertain these opinions, that without such work further progress is impossible. Labour thus spent is not lost, for the greater part of it becomes a store of future energy, destined to benefit posterity in the way that our ancestors have profited us. Moreover, it should be borne in mind that the further extension of Science necessitates an increasing division of labour. The history of scientific progress is no longer the history of an individual, as it once was. No Aristotle now dreams of attaining to universal knowledge. This is an age of special research, and he who wishes to explore new fields of knowledge or to acquire an exact acquaintance with the old, must restrict his labours within a very confined area. The age in this respect contrasts strongly with the past. Up to the time of Newton it is easy to specify the whole ground gained by the new philosophy. Copernicus, Tycho Brahe, Kepler, Descartes, and Huyghens, are names suggestive of laws which the most ordinary intelligence now accepts. When first stated, however, these laws were great discoveries, and were scarcely apprehended by any minds save those which originated them. Familiar as these discoveries are now, they constituted the foundation of Mechanical and Astronomical Science, and led up to that great generalization of Newton whereby an endless and complex series of facts were proved to follow one simple law, and theory and fact were reconciled in a way that has not been exemplified in any other department of Science either before or since.

Concurrently the department of Mathematics received an immense impetus from the invention of the Differential Calculus. The impulse thus acquired was communicated in time to the other branches of Physical Science, as Light, Sound, Electricity, and Magnetism; but in tracing the course of the sciences henceforward, so vast is the area covered by them, so numerous are those who contributed to this expansion, that the historian is obliged to adopt a classification of the sciences, and to treat them as if they were separate and independent developments. In addition to the divisions already mentioned, the Physical Sciences now embrace two others, which have risen into positions of the first importance. The old metaphysical elements—fire, water, air, and earth—have been displaced by the sixty-five simple bodies of the chemist, who traces his elements and observes the laws of their combination and decomposition throughout all the varied transformations of nature. Aided by the telescope and prism, he has successfully essayed to peer into the depths of space, and to search for traces of his elements even in the distant stars. The rapid progress which has characterized the Physical Sciences generally has also been well exemplified in the Science of Heat. In this department, during the last thirty years, a new theory has been developed which has entirely exploded the old notions, and done much towards establishing the identity of all natural action. The brilliant discoveries that have characterized the progress of the Physical Sciences, together with the practical results that have flowed from them, have long since established their reputation. Their influence, moreover, has been felt in every branch of learning, and a corresponding impulse has thus been given to the expansion of the entire system of knowledge. More especially has this influence been exemplified in the case of the Natural Sciences. Even the youngest of us is sensible of the rapid development of this group of sciences during the last quarter of a century, and of the wide range now covered by such departments as Botany and Zoology, Physiology and Comparative Anatomy, Geology and Palæontology. The study of Natural History no longer consists in the description of a few external characteristics of living forms; a comprehensive classification of all animals, living and extinct, is the work to which the student in this department now devotes himself. The botanist is obliged to distinguish several hundred thousand varieties of plants; the various forms of animal life with which the zoologist deals amounts to some two millions; the longest life may be spent in examining the enormous mass of phenomena presented by the fossils in the crust of the earth. Again, the study of Anatomy is no longer confined to the description of the human form, but has branched out into the comprehensive subjects of Comparative Anatomy and Microscopic Anatomy. A like change has taken place in other departments of the Natural Sciences, so that fields which but lately were barren wastes, now yield a bountiful harvest, and afford work to inquiring minds. Nor has the germ of all this activity been without an influence in other fields of knowledge remote from these. The scientific method has been introduced with success into the study of Language; it has penetrated into the departments of Comparative Philology, History, and Archæology; and even mental and social phenomena are measured by its standard guage, and subjected to its searching treatment.

Having thus glanced briefly at some of the main divisions on the map of science, it is well not to leave this part of the subject without guarding against the supposition that the various departments are unconnected and independent of each other. Distinctly bounded they may be, as also remote from one another, and apparently without connection. Still they have many interests in common; and their advancement largely depends on alliances and concerted action amongst them all. In certain cases this mutual dependence is immediately apparent. In the Physical Sciences, for instance, laws of great generality connect the several branches; and in the establishment of the various groups of principles embodied in the several classes, each department derives assistance from the other, and all are indebted to Mathematics. A corresponding relation exists among the various divisions of the Natural Sciences. Moreover, between departments of science apparently unconnected there are points of contact where each acts to the advantage of the other. The history of Science is filled with examples of this inter-connection. Even such divergent subjects as Physiology and Comparative Philology have experienced the advantages of union; so also have Comparative Philology and History, Physiology and Psychology; whilst from the combined discoveries of Physiology and Optics, the department of Opthalmic Medicine has been enabled to advance during the last twenty-five years in a manner that is unparalleled in the progress of the healing art. That the inter-dependence in question is generally recognized by scientific men the world over, the continued existence of scientific associations amply proves. In the circumstances of this country, it is especially important that the existence of such a connection should not be overlooked, and I would therefore seek to give additional prominence to this relationship by appealing to a high authority. In treating of the genesis of Science, Herbert Spencer says: "Perhaps the clearest comprehension of the inter-connected growth of the Sciences may be obtained by contemplating that of the Arts, to which it is strictly analogous, and with which it is inseparably bound up. Most intelligent persons must have been, at one time or other, struck with the vast array of antecedents presupposed by one of our processes of manufacture. Let him trace the production of a printed cotton, and consider all that is implied by it. There are the many successive improvements through which the power-looms reached their present perfection; there is the steam-engine that drives them, having its long history from Papin downwards; there are the lathes in which its cylinder was bored, and the string of ancestral lathes from which those lathes proceeded; there is the steam hammer under which its crank shaft was welded; there are the puddling furnaces, the blast furnaces, the coal mines and the iron mines needful for producing the raw material; there are the slowly-improved appliances by which the factory was built, and lighted, and ventilated; there are the printing engine, and the dye house, and the colour laboratory with its stock of materials from all parts of the world, implying cochineal culture, log-wood cutting, indigo-growing; there are the implements used by the producers of cotton, the gins by which it is cleaned, the elaborate machines by which it is spun; there are the vessels in which cotton is imported, with the building slips, the rope-yards, the sail-cloth factories, the anchor-forges, needful for making them; and besides all these directly necessary antecedents, each of them involving many others, there are the institutions which have developed the requisite intelligence, the printing and publishing arrangements which have spread the necessary information, the social organization which has rendered possible such a complex co-operation of agencies. Further analysis would show that the many arts thus concerned in the economical production of a child's frock, have each of them been brought to its present efficiency by slow steps which the other arts have aided; and that from the beginning this reciprocity has been ever on the increase. It needs but, on the one hand, to consider how utterly impossible it is for the savage, even with ore and coal ready, to produce so simple a thing as an iron hatchet, and then to consider, on the other hand, that it would have been impracticable among ourselves, even a century ago, to raise the tubes of the Britannia Bridge from lack of the hydraulic press, to at once see how mutually dependent are the arts, and how *all must advance that* each may advance. Well, the sciences are involved with each other in just the same manner. They are, in fact, inextricably woven into this same complex web of the arts; and are only conventionally independent of it. Originally the two were one. How to fix the religious festivals, when to sow, how to weigh commodities, and in what manner to measure ground, were the purely practical questions out of which arose Astronomy, Mechanics, Geometry. Since then there *has been a perpetual inosculation of the sciences and the arts.* Science has been supplying Art with truer generalizations and more completely quantitative previsions; Art has been supplying Science with better materials and more perfect instruments. And all along the inter-dependence has been growing closer, not only between Art and Science, but *among the arts themselves* and among the sciences themselves." Such a *consensus* explains and justifies the existence of scientific associations. A combination of energies, an interchange of ideas, a *comparison of results, are all essential instruments in the* work of advancing knowledge. It is in connection with such societies that the means of attaining to this end are provided. By the aid of their machinery labourers in different fields of research and remote quarters of the globe are enabled to communicate with each other. By mutual intercourse the cultivators of different branches are taught to look beyond the narrow limits within which they are wont to work, and to feel that there are other fields of labour equally fruitful, and other intellects equally active. By association of different intellectual energies are maintained a healthy equilibrium and a profitable connection among the various sciences. The most important function, however, performed by an association for the advancement of Science consists in the publication of its transactions. Without such publication investigators would to a large extent be working in the dark, and in many cases would be exhausting their energies on problems already solved. By announcing the work performed such a waste of energy is avoided; one discovery leads to another, and what is not immediately productive may contain the germs of future progress. No better example of the importance of publication can be adduced than that which is furnished by the history of the progress of Astronomy. During the last thirty years there have sprung up, mushroom like, in Europe and America, innumerable observatories, both public and private; but most of these have had a very brief existence, or have contributed nothing to the progress of Astronomy, because their Observations have not been published. The published Observations of astronomers, on the other hand, have not only constituted the foundation of the science and led to its rapid development, but much that is being now done at the great observatories is for the purpose of providing materials for the use of future investigators. What has thus been found essential to the efficiency of observatories is equally so in the case of scientific associations, and any society which neglects this, the main end of its existence, cannot long survive such a state of inanition.

Important as it is that the true aim of such associations should be clearly apprehended, it is even more essential that the common duty of all to aid in compassing these ends should be generally recognized. This duty pertains not only to members of scientific societies, but it devolves on the State, and extends to such academic bodies as are enabled by their wealth to offer appropriate rewards. The question how best to bestow such encouragement is an embarrassing one, and its practical solution is beset, especially in England and America, with many difficulties. Everywhere the tide of man's ambition runs too strongly in unpropitious channels; the age is intensely utilitarian; the industrial applications of Science are all engrossing; the service of the State is more attractive than the pursuit of Science. In the Universities most of the energy is consumed in the work of tuition; whilst the rewards offered to distinguished graduates to continue special studies are not sufficient to retain them permanently. It is under such circumstances as these that the Government and the Universities have been urged in England to devise some comprehensive scheme for the encouragement of research. Without attempting the solution of such an involved problem as this, it seems to me, from general considerations, that the direction in which to search for a satisfactory answer is indicated by an examination of the German University system. Except in a few cases, to the Universities we must look to carry out any scheme; in such institutions are, or ought to be, found the elements essential to the success of any feasible plan—well filled libraries, rich museums, ample laboratories, and abundance of physical apparatus. Even where these advantages exist, however, rapid progress cannot be attained until there is a large increase in the number of teachers, accompanied by a corresponding division of labour. This is the distinguishing feature of the German Universities. In them the teacher is not relieved from the duties of the lecture-room or the work of the laboratory, but his subject lies within narrow limits, and he is thus not only enabled to teach but to devote a lifetime to his special subject. Teaching must ever be the main business of the University, and the original investigator makes the best teacher. By contracting the sphere of his labours you enable him not only to teach, but to discover. In fact, nearly all the great discoveries in Science have been made by teachers, and at the present time the most successful workers are teachers who are devoting themselves to very special branches. Before the German plan, however, can be generally pursued anywhere an enormous revenue must be available; there must be a small standing army of professors, and a highly trained body of recruits. At the great English Universities a plan embracing this peculiar feature of the German system may possibly be some day attempted; but in its operations we should probably miss some excellent characteristics that distinguish the British system. Moreover, notwithstanding all that has been written in favour of radical changes in the English University system, it must not be forgotten that it has not only maintained a high state of culture in the nation, but has contributed largely to the service of the State. Nay, more, from the British Universities theoretical Science has derived very material assistance in the past; and from the liberal interest they now display in every question affecting the progress of knowledge, the most favourable results may be predicted. In addition to their great libraries, museums and laboratories have been provided at immense cost; whilst the labours of such men as Max Müller, Stokes, Cayley, Thomson, Tait, and others, show that they at any rate have not been overburdened by the routine of teaching.

Having thus glanced briefly at the growth of Science and the general conditions of its advancement, it remains for me to say something with regard to its prospects in connection with the Association to which we all are attached. In this Province of Ontario the Canadian Institute has remained in quiet and undisturbed possession of the field for the last quarter of a century, and during that time its Journal has regularly appeared and been exchanged with a large number of similar publications known only in the literature of Science. Our true aims, though never questioned, have been understood by but few. We have not had the misfortune to be attacked as the

Royal Society was at its inception; but, on the other hand, we have missed the notoriety which is frequently sought after for the benefit of new undertakings. Notwithstanding the absence of such adventitious aid, however, we have not only lived, but prospered. We possess not only a "local habitation," but, I venture to say, "a name" —a fact which is perhaps better known abroad than at home. That a comparatively small number of contributors should be thus able to keep alive a purely scientific journal for such a length of time is a proof, not only that our active members were moved by high aims persistently pursued, but that their example has not been without its influence in creating and fostering the self-denying spirit so essential to research. To those older members who thus "cast their bread upon the waters," a debt is due that cannot be repaid. We can only express the wish that those who still remain may long be spared to continue the work thus begun, and to enjoy the satisfaction of seeing that their example has not been set in vain. The work thus commenced by the pioneers of Science in Canada it is our mission and privilege to carry out. The main functions of the Institute are now, as formerly, the publication of its Journal and the holding of meetings for scientific disquisitions. For these purposes there is comparatively a small number on whom to draw, most of our contributors being engaged in academical duties, the performance of which leaves but little time to be devoted to the work of research. Moreover, the prospect of increasing this number is not encouraging, for not only are there but few positions in this country favourable to this kind of work, but with those who are professionally engaged in its pursuit the principle of the division of labour obtains to a very small extent. In this New World the University professor is obliged to profess and teach a range of subjects which in a German University engage the attention of half a dozen professors. In Leipsic there are one hundred and eighty-seven professors. The animated picture presented by such a group contains a wealth of colour and a richness in detail which are in striking contrast to the stereotyped tameness so familiar in the New World. Such a condition as ours is, however, incidental to the growth of every young country, whose first objects are education and the development of its trade and commerce. When more wealth has been gained, and the industrial arts flourish, increased attention will no doubt be devoted to theoretic Science, and more avenues opened up for its advancement. To create such channels is one of the chief obligations of every enlightened community, whilst the neglect on the part of any government to bestow such aid as it can afford in this direction is a sure indication of the existence of a rude and stationary form of civilization. The growth of Science in Canada, though progressive, is still in a rudimentary state, and stands in want of increased stimulus, both from public and private sources. We have yet to see developed the large and liberal spirit that prompts private citizens to devote their fortunes to the endowment of seats of learning and the foundation of museums, observatories, and free public libraries. When such munificence shall be displayed in Canada, it is to be hoped that the bountiful donors will bear in mind that bequests, whether public or private, should be for the general good, and that in the intellectual as in the social world, an indiscriminate liberality may, whilst relieving poverty, beget indolence, and fail to promote progress. The applause attendant on such acts largely depends on the profit that accrues to posterity, in whose interest the broadest liberality will be displayed in creating new forms of energy, favourable to a more abundant husbandry and the cultivation of fresh fields of labour. It is therefore to be hoped that no misplaced liberality will perpetuate the miserable system, so common on this continent, of multiplying seats of learning and increasing the university family by scores of feeble and needy children to whom time can bring neither strength nor prosperity. Such a plan not only fritters away material and intellectual wealth, but is calculated to produce a barren and mediocre uniformity. In this connection the experience of the United States is particularly suggestive, and clearly indicates that our future efforts should be directed to improving the efficiency of existing institutions, and rendering them genuine seats of learning, the home alike of the student and the teacher, of the scholar and the investigator. Whilst thus avoiding the errors into which our neighbours have fallen, we should not be slow to imitate them in such matters as the foundation of great public libraries and the establishment of museums. It is also to be hoped that their efforts on behalf of Astronomy will not be lost on us, and that the time is not far distant when the immortal science shall be enriched by the labours of a Canadian Observatory. How near that time is, how far we are still from the most fruitful sources of modern civilization, is to a large extent indicated by the present condition of this Institute. Its position is the surest index of the extent to which the intellectual resources of the country have been developed.

With regard to our future prospects, it is of course premature to speak with confidence. I think, however, that I see indications of increasing activity amongst our members, several of whom, from different parts of the Dominion, continue to send us the fruits of their labours. I take it also as a favourable sign that our membership is being largely extended; and in this connection it is a promising feature that the additions are being derived not only from those who are professionally engaged in the pursuit of Science, but also from those who, though employed in other occupations, seek relaxation in cultivating some particular branch of knowledge. I may be permitted to express the hope that we may continue to derive an increasing support from the cultivated classes of the community. Even the sympathy of such men is not without its value to us; and, moreover, amongst them are to be found many of high culture and great influence who are peculiarly fitted to discuss philosophical questions of general interest. It is with a view to enlist such support as this that it has been proposed to institute before long popular courses of scientific lectures entirely distinct from the disquisitions which characterize our ordinary meetings. In initiating such a scheme, however, the Institute does not in the least contemplate a departure from her proper objects, which, as I have endeavoured to point out, should continue to command our increasing attention. On the contrary, the Council are of opinion that the institution of such lectures and the enlargement of our library would have the effect not only of spreading a knowledge of Science, but of creating in certain instances a taste which may assist in advancing the higher aims of the Institute. The promotion of Science and the cultivation of an independent spirit of research must continue to be our aim in the future as it has been in the past. The new home within whose walls we are now assembled for the first time, whilst it is a fit subject for present congratulations, should remind us that the work of building up Science has but commenced in this country. The position which this Society has already won may serve as the foundation. For the building up of the superstructure it is to be hoped that neither material means shall be wanting, nor ample stores of intellectual strength and persevering effort. Under such conditions in the future, our seats of learning will prove true foci of illumination, from which shall emanate an active intelligence and a spirit of inquiry worthy of the most enlightened age.

SKETCH OF THE GEOLOGY OF THE ROUTE OF THE INTERCOLONIAL RAILWAY.

BY ROBERT BELL, C.E., F.G.S.,
Of the Geological Survey of Canada.

(Read before the Canadian Institute, February 10th, 1877.)

The following article was written nearly a year ago, at the request of Mr. Sandford Fleming, Chief Engineer of the Intercolonial Railway, and was used by him for reference in preparing the historical sketch of this national undertaking, published last spring. It epitomizes the more recent views of the late Sir W. E. Logan in regard to the "Quebec group" of rocks, and may be found of interest to those who wish for a mere cursory knowledge of these formations, or of the geology generally of the region traversed by this railway. Dr. Dawson is followed in regard to New Brunswick and Nova Scotia. A separate short account is given of the geology of each of the four sections into which Mr. Fleming has divided the railway.

1. *The St. Lawrence District—from Rivière du Loup to the southern end of Lake Matapedia.*

The rocks along this section of the railway belong almost entirely to the Quebec group. The geological position of this series is about the middle of the Lower Silurian system. In the province of Quebec it forms a belt, extending from the northern boundary of Vermont north-eastward to Cape Rosier in Gaspé. Along the south-east side of this belt, especially towards Vermont, the rocks are more or less metamorphosed, and they are supposed by some to be of older date than the fossiliferous portion of the strata within the area indicated, such as that in the neighbourhood of Point Levis.

The Quebec group has been separated into (1) the Lower or Levis division, (2) the Middle or Lauzon division, and (3) the Upper or Sillery division. The bulk of the Levis division consists of limestones and limestone-conglomerates, which are mostly magnesian. A black or dark colour prevails throughout the formation. It is well developed in the neighbourhood of Phillipsburgh on Lake Champlain, where a section of the beds, 4,860 feet in thickness, has been measured. The lowermost 1,285 feet of the strata exposed on the Island of Orleans, belong to this division. They consist generally of grey argillaceous shales with bands of grey dolomitic conglomerates, and are supposed to overlie the rocks of the Phillipsburgh section. The known thickness of this division would therefore be 6,145 feet. The rocks of the Levis division have afforded nearly 200 species of fossils, the majority of which have not been discovered elsewhere. These indicate that the geological age of the division is about equivalent to that of the Chazy formation of Ontario. Throughout the Middle or Lauzon division, the rocks are principally shales, with some sandstones and occasionally small beds of conglomerate and limestone. Their prevailing colour is greenish; but red, purple and grey, and mixed red and green strata also occur. On the Island of Orleans and around Point Levis the lowermost 700 feet of this division is overlaid by 400 feet of greenish arenaceous shale studded with grains of glauconite, but rock of this kind has not been found elsewhere in the Quebec group. On Orleans Island the Lauzon division has a thickness of 3,740 feet; but according to Mr. Richardson, it varies in other localities from 100 up to 4,000 feet. In the Upper or Sillery division, the prevailing rocks are greenish sandstones, passing into fine conglomerates. Red and green shales are also met with towards the base. The total thickness is estimated at about 2,000 feet. The known thickness of the strata of the whole group is therefore 11,885 feet, or more than two miles. The numerous deposits of copper ore in the rocks of the Quebec group belong to two horizons, one at the bottom and the other at the top of the Middle or Lauzon division.

The rocks of the St. Lawrence District of the Intercolonial Railway belong principally to the Lauzon division; their general strike is parallel to the shore of the St. Lawrence, and consequently to the course of the railway. Between Rimouski and the Great Metis river the railway curves inland, and crosses obliquely a small basin of the Sillery sandstones. North-eastward of Metis, in the continuation of the strike of the Quebec group, the Lower or Levis division takes the place of the Lauzon, and is largely developed at a short distance back from the St. Lawrence, all the way to Cape Rosier; while to the south-westward of Rivière du Loup, the Lauzon division, which is only seven miles wide at Rimouski, expands in breadth as it runs up the St. Lawrence, until, opposite St. Thomas, it occupies a belt of country forty miles in width. In this distance, besides small outliers of the Sillery sandstone, two large basins of it rest upon the Lauzon shales. The more eastern of these begins opposite Green Island village and extends south thirty miles, and the other, commencing at St. Roch, runs south-west fifty miles. One of the Sillery outliers referred to occurs on the shore of the St. Lawrence, about two miles below Rivière du Loup, and another includes Cacouna Island and runs to Green Island River.

At Trois Pistoles, Bic and Great Metis, grey sandstones or quartzites and coarse limestone-conglomerates are interstratified with the shales of the Lauzon division. These conglomerates consist of a sandy matrix, with small pebbles of white quartz and masses of limestone and diorite of all sizes. Some of the limestone boulders are very large, one at Metis having been estimated to weigh over twenty-five tons, after a considerable part of it had been removed. On the north-east side of Lake Matapedia a similar conglomerate, associated with dark shales, is met with about two miles from the upper end. In the central portion of this shore of the lake the rocks consist of greenish sandstones, apparently of the Sillery division, interstratified with red shales and cut by trap dykes; while the lower three miles are occupied by a peculiar concretionary diorite containing much epidote. These rocks are overlaid unconformably by the Gaspé series, which occur along the south-west side of the lake. The lower member of the latter group, which occupies this shore of the lake except the uppermost four miles, consists of a whitish and pinkish sandstone, sixty or seventy feet in thickness, dipping westward at a low angle. The rocks in the four miles nearest the head of the lake consist of dark brownish-grey, somewhat arenaceous, limestones, enclosing nodules of a purer character. The surfaces of the beds are uneven, and under the weather become of a lighter grey than the freshly broken rock.

2. *The Restigouche District—from the southern extremity of Lake Matapedia to the Nipisiguit River.*

With the exception of some small sections which will be presently described, the Intercolonial Railway in this district passes over rock:

of the Gaspé Limestone series. These rocks spread over an immense area in the adjacent parts of the Province of Quebec and New Brunswick. The whole area drained by the Restigouche River may be said to be occupied by them, and they run out in belts to the extremity of the Gaspé peninsula. They consist of dark greyish limestones (which are mostly impure), grey and blackish shales and greyish argillites, and their greatest thickness is upwards of 3,000 feet. They are of Upper Silurian age, and may be considered as representing all the strata, from the Clinton to the Lower Helderberg inclusive. On the Matapedia River, they consist mostly of dark grey calcareous shales and slaty strata, with some limestone bands. Just below the "Devil's Elbow" are certain greenish-grey sandstones and argillaceous and arenaceous slates and shales, which are supposed to represent the overlying Gaspé sandstones. Between this point and Lake Matapedia we would therefore have the whole thickness of the Gaspé limestone, since, as we have seen, the base of this formation is met with along its south-western shore.

The mouth of the Restigouche River lies in a basin of Lower Carboniferous rocks, surrounded by the Gaspé Limestone series, which forms the higher ground on both sides. These Lower Carboniferous rocks consist principally of red sandstones and conglomerates, and form part of the Bonaventure formation. Between them and the flank of the high ground on either side there is a belt of amygdaloidal and other trappean rocks, which frequently form conspicuous conical hills. At Dalhousie, the limestones and shales are interstratified with beds of trap and volcanic ash. In 1858, Mr. Richardson and the writer here collected a considerable variety of fossils, which proved the strata to be of the age of the Niagara formation. From Dalhousie to the west side of Nipisiguit Bay the same formation continues, and affords good limestone in several places. A belt of rocks of the Quebec group, and apparently belonging to the Lauzon division, which extends from the State of Maine through New Brunswick, is supposed to come as far as the south-west side of Nipisiguit Bay. Grey granite is exposed at Middle River, close to Bathurst Harbour, and again at Rough Waters on the Nipisiguit, three miles from Bathurst. It is composed of opaque white felspar, colourless translucent quartz and black mica, and resembles some of the granite of the Eastern Townships. The exposures near Bathurst are supposed to be the termination of a long granitic range, which runs north-eastward from Penobscot Bay on the Atlantic coast through Maine and New Brunswick.

3. *The Miramichi District—from the Nipisiguit River to Moncton.*

The most conspicuous feature of the geological map of New Brunswick is the great triangular basin of carboniferous rocks, which occupies about one-third of the whole area of the province. The western shore of the Gulf of St. Lawrence, from the Bay of Chaleur to the Nova Scotia line, may be considered as the base of this triangle; while the apex lies beyond Oromocto Lake, in the south-western part of the province. Bathurst is situated on one side of this area and Moncton near the other, so that the above section of the railway exactly spans this geological region. With the exception of a narrow and irregular border of Lower Carboniferous rocks, the strata within this area belong to the Middle Coal formation or perhaps to the Millstone Grit, and consist principally of greyish and reddish sandstones, interstratified with shales and conglomerates. Notwithstanding their great geographical extent, they appear to be spread almost horizontally over an even floor of older rocks, and have no great thickness, the more ancient strata cropping up through them in numerous places. Only a few thin seams of coal have yet been discovered among these Carboniferous rocks. One of them, occurring on the north-west side of Grand Lake (and which does not average two feet in thickness), is worked along its outcrop in a primitive fashion by the inhabitants. On the south side of the Bay of Chaleur, between Cranberry Cape and Point Dumai, two coal seams, measuring six and eight inches respectively, have been observed among the greenish grey sandstones which form cliffs all along the shore between these points, and have a thickness of about 400 feet. The roof of the uppermost of these seams consists of flaggy bluish-grey shale, containing many ferns and other plants in a beautiful state of preservation. Other small coal seams have been reported as occurring near the Richibucto and Buctouche Rivers.

The horizontal strata around Bathurst belong to the Bonaventure formation, which, as already mentioned, constitutes a part of the Lower Carboniferous series. They consist of about sixty feet of reddish shales and red and white sandstone conglomerates, with a layer of bluish-grey shale about the middle. This layer averages about two feet in thickness, and crops out on the west side of the

Nipisiguit river, about a mile above Bathurst. Some of the plant-remains which it contains are replaced by the vitreous sulphide of copper, which also occurs in small nodules in the same bed. An attempt to work this deposit for copper was made about the year 1843.

4. *The Nova Scotia District—from Moncton to Truro.*

From Moncton to the northern flank of the Cobequid Mountains the general course of the railway crosses obliquely three belts of Lower Carboniferous rocks and one belonging to the productive Coal formation, one of the former being at either extremity of the distance while the higher rocks occupy an intermediate position. The Lower Carboniferous rocks of Nova Scotia have been separated by Dr. Dawson into a Lower Carboniferous marine formation and the Lower Coal measures. The first of these consists usually of thick beds of reddish sandstone, clay and marl, enclosing beds of gypsum and limestone; but in some localities it is represented almost entirely by conglomerates. It is largely developed in different areas throughout the eastern half of Nova Scotia proper and in Cape Breton, and affords all the gypsum exported from Nova Scotia and New Brunswick. The Lower Coal measures, in some localities, consist of grey sandstone and dark shales with thick beds of conglomerates and coarse sandstones toward the base; while in others they present a great thickness of peculiar bituminous and calcareous shales. The most interesting exposures of this division occur in the south-eastern part of New Brunswick. Near Hillsborough, in this region, a vein cutting these shales is filled with the remarkable mineral Albertite, which is so valuable for gas-making. The coal measures proper in Nova Scotia are characterized by the prevalence of grey sandstones and darkly-coloured shales, and by the comparative scarcity of conglomerates. *The coal-field of Cumberland county is situated on the* belt or trough of this formation, which has been referred to as crossed by the railway section under consideration; and the Pictou coal-field appears to belong to an eastward continuation of the same trough.

The Cobequid Mountains are flanked on both sides by rocks which are partially metamorphosed in some places, but on the north side, in the vicinity of the railway, Dr. Honeyman has found fossils by which their age has been determined to be Upper Silurian. On the south side, the strata consist of greyish quartzites and olive-coloured shales. These are cut at a small angle to the stratification and cleavage by a large irregular vein, which crosses the railway with an east and west bearing, and which has been traced for a long distance on either side. Smaller and nearly parallel veins have also been found near the principal one. They are all filled with carbonates and oxides of iron, and constitute the Acadia Iron Mines of Londonderry, which are at present worked by the Steel Company of Canada. This company is now engaged in erecting two large improved blast furnaces, capable of producing upwards of 1,000 tons of metal per week, which is at the rate of more than five times the whole consumption of pig iron in the Lower Provinces. The construction of this section of the railway and of the Pictou Branch will now enable the company to obtain coal for smelting purposes, either from Springhill or New Glasgow, which are nearly equally distant from the iron works. These mines were examined and reported upon by Mr. Selwyn in 1872.

The centres of the highest parts of the Cobequid Mountains are occupied principally by a hard reddish rock, supposed by Dr. Honeyman to be Laurentian gneiss. Examples of this rock are met with on the railway, between Folly Lake and Wentworth.

Between the southern base of the Cobequid Mountains and the neighbourhood of Truro the railway traverses obliquely a trough of Lower Carboniferous rocks.

Cobequid Bay is excavated from a narrow basin of soft bright red sandstone, of Triassic age, which overlies the Carboniferous rocks unconformably. The remains, or the more or less broken margin of this basin, are found all around the shores of the bay, and also extending eastward from Truro, at its head, a distance of four miles up the Salmon River, where the two sides of the narrow basin come to a point.

THE GLACIAL AND INTERGLACIAL STRATA OF SCARBORO' HEIGHTS,

AND

OTHER LOCALITIES NEAR TORONTO, ONTARIO.

(WITH A PLATE.)

BY MR. GEORGE JENNINGS HINDE, F.G.S.

(Read before the Canadian Institute, February 3rd, 1877.)

There is perhaps no other portion of the great inland basin of North America where the strata, showing the different changes which have occurred from the commencement of the Glacial period up to the present, are better displayed than along the shores of Lake Ontario and the country bordering on it. The south shore of the lake in the State of New York is described by Professor Hall as one continuous section; at Niagara the interest attached to the Falls has caused the superficial strata to be closely studied, not only by American geologists, but by such men as Lyell and Ramsay; and a late article by Mr. Thos. Belt, F.G.S.,* shows that their entire history is not yet satisfactorily determined. Between Niagara and Dundas, Ontario, at the western extremity of the lake, the southern shores present glacial beds of great interest, but which have not yet been fully described. On its northern shores, from the commencement of the channel of the St. Lawrence at the Thousand Isles, westwards as far as Scarboro', Ontario, the banks of the lake are generally low and without features of importance, and beyond Scarboro' the shores are again low to the western extremity.

This general deficiency in conspicuous sections along the north shore is more than compensated by the display, perhaps unequalled anywhere round the lake, of glacial strata at the Scarboro' Cliff. This cliff, generally known by the name of the Scarboro' Heights, commences near Port Union, about fifteen miles east of Toronto, and from thence extends along the lake shore, in a general south-westerly direction, for about nine and a half miles. It is low at its easterly end, but gradually

* Quarterly Journal of Science, April, 1875.

rises to an elevation of 170 to 190 feet above the lake, at which elevation it continues till approaching the westerly end, where it again slopes to the lake level. A second terrace, about 100 feet in height, runs for some distance nearly parallel with the lowest or lake terrace, and about a quarter of a mile behind it; but at one place this upper terrace approaches the lower one sufficiently close to form, for a short distance, a continuous section with it. At this place the entire height of the section is about 290 feet above the lake level. The waves of the lake wash the base of the section for the whole distance, and are constantly eroding it; their action is much increased by the undermining influences of the springs which jut out between the layers of the clay and sandy strata, and cause large landslips. As fast, however, as the materials fall to the base of the cliff they are removed by the waves of the lake, and thus, from the summit to the base of the cliff for the greater part of the section, every stratum of the soft beds of clay, sand and gravel of which it is formed, can be traced in a manner rarely met with. The readiness with which the usually soft strata of the Glacial period yield to denuding atmospheric influences, renders good exposures unusual, and then only for short distances; and as generally these beds have been partially eroded at various periods since they were formed, and even entirely removed in certain places, there is great difficulty in deciphering their true history. On this account a section so extended and complete as that at Scarboro' presents most unusual facilities for gaining a knowledge of the succession of the events of the Glacial era in this portion of the continent. As, however, the Scarboro' section does not show the lower portion of the series of the glacial deposits immediately resting on the Palæozoic rocks, it will be necessary, in order to trace the complete succession from below upwards, to refer first to a section facing the lake, where these old rocks are exposed. They may be seen in the low cliffs at the Garrison Common and Humber Bay, west of Toronto, and about twelve miles distant from the Scarboro' Heights.

As far as I am able to ascertain, the geological structure of the Scarboro' Cliff has never been described in a detailed manner. The cliff itself, in reference to its influence on the formation of the island bounding Toronto harbour, formed the subject of two memoirs by Sandford Fleming, Esq., C.E., and Prof. H. Y. Hind.*

It is very curious that Sir Charles Lyell,† who was attracted to

* Canadian Journal (First Series), Vol. II., April, 1854.

† Travels in North America, 1841-2, chap. xx.

Toronto to examine the well-defined terraces between Toronto and Lake Simcoe, should not have searched the lowest and most important of these terraces at Scarboro'; it may be due to the fact that the base of the cliff is only accessible when the lake level is low and the weather fine.

Professor A. C. Ramsay, in his description of the glacial beds of Canada,* mentions the bold cliff of sand, gravel, and clay partly white, with boulders at Scarboro' Heights.

There is no special reference made to this cliff in the "Geology of Canada," by Sir W. Logan (1863), but the superficial strata at Scarboro' an. near Toronto † are stated to belong to his Erie and Saugeen divisions.

In order to understand the conclusions which may be drawn from the character of the pebbles and boulders found in the till or boulder clay of these cliffs, it will be desirable to give a preliminary sketch of the underlying strata, which form the floor on which the glacial beds rest, on the north shore of the lake.

Commencing at its eastern extremity and proceeding westwards, there are—

1st. *The Ridge of Laurentian Rocks*, forming part of the spur connecting the main range of these rocks in Canada, with that of the Adirondack region of New York. From the Thousand Isles, the range in Canada extends nearly due west to the shores of the Georgian Bay. The crystalline gneissoid character of these rocks readily distinguishes them from those of the succeeding divisions.

2nd. *Potsdam Sandstone.*—A hard gray sandstone and conglomerate, of which there is a small area north of Kingston. It also forms some of the islands at the entrance to the channel of the St. Lawrence, and extends south for a short distance in the State of New York.

3rd. *Trenton Limestone* (including the Black River and Bird's-Eye divisions).—For the most part, a blue fossiliferous limestone, the lower beds thick and massive, the upper with some intervening shales. These limestone beds underlie the greater portion of the area between the lake shore and the outcrop of the Laurentian range to the north, and they extend on the lake shore from Kingston westwards as far as the township of Whitby, a distance of one hundred and thirty miles.

* Quarterly Journal of the Geological Society, 1859, p. 203.

† Geology of Canada, p. 904.

4th. *Utica Shale.*—A black bituminous shale filled with fossils. From Whitby, where this shale band rests on the Trenton limestone, the outcrop of this rock reaches on the shore to the vicinity of Port Union, a distance of about fifteen miles.

5th. *Hudson River Group.*—Principally bluish arenaceous flagstones and shales, with a few thin beds of limestone. From Port Union, this group of rocks extends nearly as far as Oakville, or about forty miles, along the lake shore.

6th. *Medina Sandstones and Shales.*—Beds of a deep red colour, with a few thin bands of a greenish tint. These rocks form the lake shore between Oakville and the western extremity, a distance of about eighteen miles.

7th. *Niagara Limestone.*—A very hard magnesian limestone of a gray tint, which forms the summit of the prominent escarpment near the west end of the lake.

These groups of strata, with the exception of the Laurentian, belong to the Cambrian, Cambro-Silurian and Silurian divisions of the Palæozoic age. The strata are nearly horizontal, but have a slight dip to the south-west, and the various beds are apparently all conformable. On account of their extremely regular arrangement, in passing over this area from east to west, or from north-east to south-west, there is the following succession of lithological characters in the underlying strata: first, crystalline gneissoid rock, then a *gray* sandstone, followed by *blue* limestone, *black* shales, *blue* flags, *red* sandstones, and *gray* dolomite. This variation, independent of the fossils which they contain, allows the rock-fragments in the till to be referred without difficulty to their respective sources; and taken in connection with the striæ on the rocks, enables the direction in which the ice moved to be ascertained with certainty. These Palæozoic rocks in this portion of Canada are oftentimes concealed for long distances by the overlying glacial strata; thus, north of Toronto they are hidden for more than forty miles, and a still greater distance may be travelled west from Peterboro', Ontario, without meeting with them. Exposures generally occur along the lake shore or in the lower reaches of the streams which empty into the lake.

The Palæozoic rocks underlying the Scarboro' Cliff belong to the Hudson River group of bluish flags and shales; but at this place, for about twenty miles along the lake shore, they have been eroded to a lower level than the lake; at the Garrison Common and Humber Bay they are again visible.

I propose to describe, first, the lowest glacial beds, or those immediately resting on the Palæozoic strata, and then trace the various changes in ascending order.

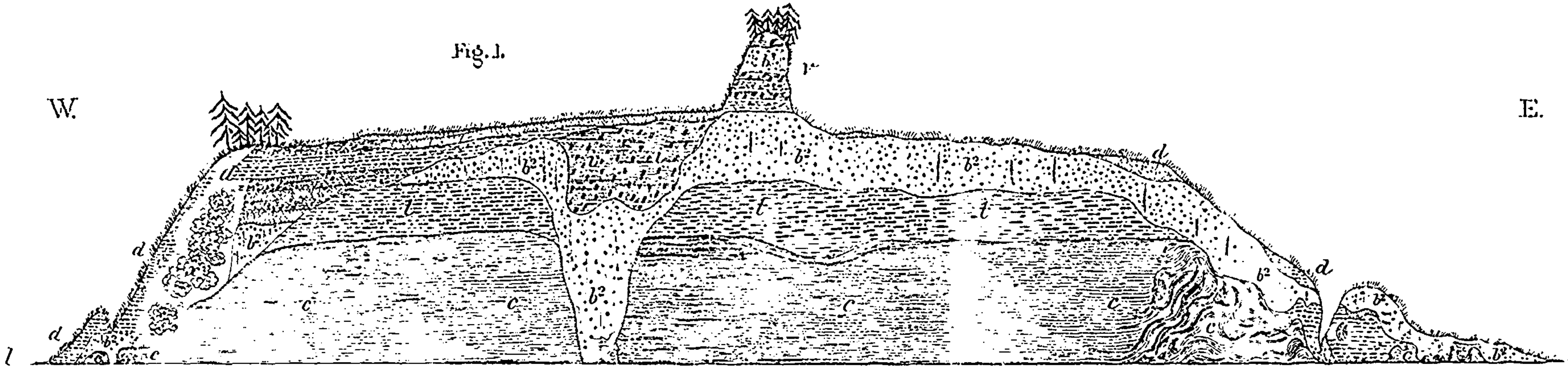
Placed in a tabular form, the order of the strata is as below:—

SUCCESSION OF STRATA AT SCARBORO' HEIGHTS, GARRISON COMMON AND HUMBER BAY, EAST AND WEST OF TORONTO.

	Garrison Common and Humber Bay.	Scarboro' Heights.
7. Stratified sand and gravel, Post-Glacial	15 feet	50 feet.
6. Till or boulder clay, No. 3..................	Absent	30 feet.
5. Laminated clay and sand, Interglacial........	Absent	90 feet.
4. Till or boulder clay, No. 2..................	Absent	70 feet.
3. { Interglacial fossiliferous sand..............	Absent	40 feet.
2. { Interglacial fossiliferous clay	20 feet.	100 feet.
1. *Till or boulder clay, No. 1*	*25 feet*	} *Below*
Palæozoic flags and shales	5 feet exposed	} Lake level.

Palæozoic Rocks.—At the Garrison Common, and indeed for the entire distance between that place and Burlington, Ontario, thirty-two miles to the west, these rocks may be seen, with the exception of a few intervals, along the lake shore. Their upper surfaces have been broken up by the glacial ice in a very uneven manner, and seldom maintain the same level for many yards in succession. The flaggy sandstones forming these rocks do not receive or retain well the glacial markings, and I am not aware that any striæ have been previously noted at this place or anywhere near it. On account of the lake having been at a higher level than usual this last summer, the waves made greater inroads on the cliff, and washed away the till from the surface of the rock beneath, and on this I was fortunate enough to find glacial striæ in several places. The direction of these striæ varied between N. 28° W. and N. 86° W., and the average of nine observations was N. 66° W. Following the extension of these striæ, it will be seen that the glacier must have traversed the basin of Lake Ontario, and its course westwards was up the slope of the country, in the direction of the elevated Silurian plateau of the peninsula of Ontario. That this, and not the opposite, was its true course is shown by the materials of the till, to be presently described. I am unable to find any record of glacial striæ to the west of this place, nearer than the townships of Flamboro' and Beverley, from thirty to forty miles distant; the majority of the observations at these places, recorded in the "Geology of Canada," shows that the path of the

Fig. 1.



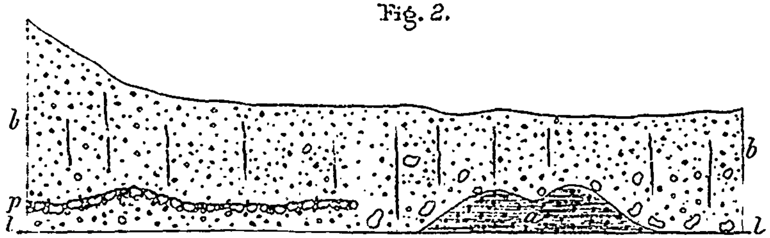
Scarboro' Heights facing Lake Ontario.

c. Interglacial fossiliferous Clays. t. Interglacial fossiliferous Sands *b². b³. Till. i. Laminated Clays.*

d. Sand and Gravel (Post-glacial) x. Beds concealed. l. Lake level.

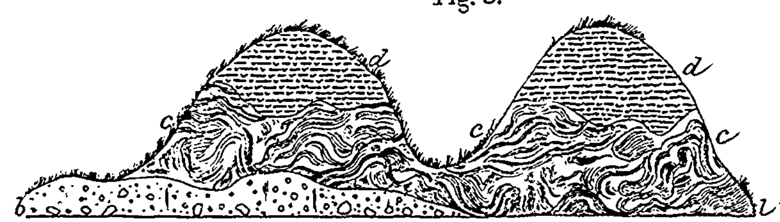
Length of Cliff about 9½ miles. Height 170 to 190 feet, including the second Terrace v 290 feet.

Fig. 2.



Section of Cliff facing Lake Ontario, west of Toronto, showing Pavement of Boulders in Till.
a Cambro-Silurian (Hudson River) Flags and Shales.
b Till or Boulder Clay.
p Pavement of Boulders in Till. l Lake level.
Height of Cliff 10 to 20 feet. Length of Section about one mile.

Fig. 3.



Section at Humber Bay. West of Toronto.
b Till. Lowest Beds resting on the Cambro Silurian Flags.
c. Interglacial fossiliferous Clay. (Beds contorted.) l. Lake level.
d. Sandy Loam (Post-glacial) Height of Cliff 25 feet.
Length of Section 100 yards.

glacier was still in the same direction, that is, to the west, varying a few degrees north and south of it. As these townships are situated on the Silurian plateau, the glacier must have overflowed the escarpment bounding it to the east, which is at an elevation of four hundred feet above the lake.

Till, or Boulder Clay, No. 1.—The beds immediately resting on this uneven striated floor of Palæozoic rocks are of "till"* of a typical character. (*Fig.* 2, *b.*) The matrix is a sticky, bluish, calcareous clay, which on exposure frequently turns to a brownish or yellowish tint; it is entirely unstratified. This clay is filled with slabs of rock, stones and boulders. The slabs are portions of the underlying flags which have been torn up by the ice; some of them have a surface three feet square and are a foot in thickness; their edges have, as a rule, not suffered from abrasion. Many of these slabs stand on their edges in the clay, conclusively showing that they had not been dropped in their present places by an iceberg, or they would not have settled in an upright position; their uninjured edges also show that they have travelled but short distances. Most of the *stones* in the clay are not more than one or two inches in diameter; they are blunt edged, polished and scratched. Though some may have been formed out of the thin bands of limestone which occasionally occur in the underlying Hudson River strata, the greater part resemble more closely the blue Trenton limestone. Mingled with these are many fragments of the black Utica shale, which, though much softer than the limestone pebbles, yet retain the ice-markings very plainly. The presence of these shales in the till bears witness that the path of the glacier, under whose mass they were brought to this place, was from the east, as there are no rocks of this material in the opposite direction. The absence of fragments of the red sandstone or the gray dolomite which crop out to the west of this place, furnishes negative testimony to the same effect.

There are but few large boulders in the lower till at this place; occasionally a large block of Trenton limestone covered with scratches, and a few of Laurentian gneiss. The gneissoid boulders, where they occur, are generally grouped within a short distance of one place;

* I use the term "till" in the same sense as Mr. Jas. Geikie in the second edition of the "Great Ice Age," as synonymous with the "boulder clay." No distinction can be maintained here between the non-stratified clays with striated stones and with or without boulders, resting on the Palæozoic rocks and those of a later date, covering Interglacial deposits. I prefer the term "till;" its use avoids the anomaly of styling beds "boulder clays," in which frequently no boulders are present.

they are mostly two to three feet in diameter, and very often have one portion of their surface smoothed and deeply striated, an ornamentation but rarely seen on the boulders of this rock scattered over the surface of the country. Guided by the direction of the striæ on the rocks beneath, it seems probable that these gneissoid boulders may have been transported across the lake from the Adirondack Mountains of New York, more than one hundred and eighty miles distant.

There is a fine example of the rare (or rarely noticed) phenomenon of "Striated Pavement" in the till at the Garrison Common. I am not aware that it has been previously noted in Canada, but it has been described as occurring in till in the Miami Valley, Ohio. The stones, slabs and boulders which are elsewhere irregularly scattered through the mass of the till, have been here arranged side by side in a nearly level stratum in the clay, forming a sort of mosaic pavement or floor, the pieces of which are of various sizes and shapes. *(Fig. 2, p.)* These pieces are fixed in the blue clayey matrix, and the same material covers the pavement for nearly 20 feet in thickness. The projecting edges of the fragments seen in the cliff section have exactly the appearance of a horizontal layer of stratified rock. In some portions the pavement is formed of but a single layer of stones; in other places the stones are two or three deep; and there are indications for a short distance of a second pavement about two feet below the first. This peculiar floor extends for nearly 800 yards along the cliff; it is not exactly level, but slopes from two to three feet in that distance. In addition to this even, nearly level arrangement, the upper surfaces of the stones and boulders are also covered with striæ running in a uniform direction, similarly to those on the underlying rock, showing that the pavement must have been the floor of a glacier. Some of the stones have also their under surfaces striated, probably resulting from glacial action before they became fixed in the pavement. From compass observations in eleven different places, I found that the striæ on the pavement varied between N. 56° W. and N. 70° W.; the average direction is N. 67° W., which is, within one degree, the average direction of the striæ on the underlying rocks to the east of this place. Though only the jutting edges and small portions of the upper surface of the pavement were exposed in the face of the cliff, yet, where the overlying till had been removed in some small gullies, the pavement could be traced for a short distance inland. From the striæ, it can be seen that these stones had been pressed into the clay below by the weight of a glacier passing over them; but unless some stream of water previously washed the stones out of a bed of till, it is difficult to see how any amount of pressure could have effected the arrangement in which they are now found. There does not appear, however, any evidence of water action, neither in the till above or below the pavement.

I have also discovered a pavement in till similar in all respects to that above mentioned, in the cliff facing the lake between Oakville and Bronté, Ontario, about twenty-three miles to the west of the Garrison Common.

I could not detect any difference in the character of the till above and that below these pavements, beyond that the till underneath contained larger slabs and stones than that above; this difference however existed in those portions of the cliff where the pavement was absent. Dr. Croll believes that similar pavements* indicate an intervening period between the formation of the beds of till above and below; but the striking uniformity in the course of the striæ on the pavement and on the Palæozoic rocks, points to the probability that they were effected by the same glacier in this case.

2. *Interglacial Fossiliferous Clay.*—Next above this lower till there are seen in the cliff to the west of the Humber Bay beds of stratified clay, with some vegetable remains in them. (*Fig.* 3, *c.*) These stratified clays form the most important part of the section at Scarboro' Heights, and I purpose describing them as they occur at that place. My object in mentioning this small patch at the Humber Bay is to show their true position in the series, resting unconformably on the lower till; for at Scarboro' these clays extend beneath the lake level, and they might have been deemed of Pre-Glacial instead of Interglacial age. If a boring were made at Scarboro', it is highly probable that beneath the clays there would be found a till and then the Palæozoic rocks, in the same manner as at the Humber Bay.

The extent to which the present configuration of this country is due to the ordinary forces of denudation previous to the Glacial period, and the degree it is owing to the ice action during that period, is very difficult to determine, and the data for a satisfactory solution are yet wanting. I do not think that the effects of the glacial ice in forming the present features of the country, can be exaggerated; and it

* Climate and Time. American Edition, p. 255.

appears to me doubtful if there are now visible any prominent physical features of Pre-Glacial age in the region of Western Canada underlaid by the Palæozoic rocks. Doubts are yet expressed in some quarters as to the capacity of glaciers to excavate our large lakes, as Lakes Ontario, Erie, Huron and Michigan; and though rock-basins, eroded out of undisturbed Palæozoic strata, their formation is put down by some to a depression of the earth's surface. If the earlier glacier was massive enough to overflow mountains 3,000 and 4,000 feet in height, as is known to have been the case in New England, it ought to have been a comparatively easy task for such a mass to plough out the hollows of our inland lakes to depths of only 300 or 400 feet below the sea level.

I will give a very striking instance of glacial action on the shores of Lake Ontario, which seems to me to furnish strong proof of the basin of this lake at least having been scooped out by the ice. At its easterly end, where the channel of the St. Lawrence commences, I have traced the deep glacial striæ and furrows on one of the islands of Potsdam sandstone from 100 feet above the water's level down to the water's edge, until they disappeared beneath the lake. These striæ, like the generality of those abundantly seen in this district, run towards the south-west. From thence I have crossed the lake to its south-western shores, about one hundred and eighty miles distant from the place where the striæ entered the water. The rocks immediately next the lake here are too soft to retain striæ, but on going back two or three miles to the elevated escarpment of limestone 400 feet above the lake, the rock surface is seen to be covered with striæ running in nearly the same direction as at the easterly end, or S. 35° W. Standing on the edge of this escarpment and looking towards the north-east, whence the ice came, it can be seen at a glance that it must have crossed the basin of the lake; and still further to complete the proof, in the bed of till on the summit of the escarpment there are plenty of striated fragments of the Cambro-Silurian strata (Hudson River) which, from the course of the striæ, must have been brought from the outcrop of these beds in the bottom of the lake. When the path of the glacier can be thus traced following the axis of the lake from north-east to south-west, and masses of till which have been eroded from the rocks outcropping in the area of the lake are met with, heaped up on the banks at its south-westerly end, the only conclusion which can be drawn is that the lake basin is due to the powerful eroding influence of a glacier.

The present basins of the lakes, however, by no means represent all the hollows made in the old rocks by the glacial ice; many of these have been filled up by till and stratified deposits, and until borings are made, remain unknown. Thus Dr. Sterry Hunt has shown that the Palæozoic rocks on the shores of Lake Erie are covered with glacial and stratified clays to a thickness of 100 to 200 feet beneath the lake level; whereas the lake itself in most places is not more than 70 feet in depth. There is, however, to be considered the fact that the present depth of the lakes is probably very much less than their originally excavated depth by the glacier; for stratified deposits of clay and silt brought down by the rivers, &c., have been gradually accumulating in their basins since the time when the glaciers which filled them were dissolved.

At the Scarboro' Heights there is one of these filled-up glacial hollows. The Palæozoic rocks were eroded by the first glacier deeper than the present lake level; without a boring it is impossible to say how deep the hollow may have been. With the exception of a short distance at both ends of the section and a space in the central portion, the basal beds of the Scarboro' Cliff are composed of beds of stratified clay. (*Fig.* 1, *c.*) Their maximum thickness above the lake is about 100 feet; how far they extend below is unknown. They are bluish and ash-gray in colour, and contain more or less of lime and sand in their composition. The beds appear to be entirely free from pebbles, stones or boulders of any kind. There is considerable variation in the thickness of the different strata; whilst some beds are two or three feet in thickness, in others there are over twenty layers in the space of an inch. In the greater part of the section the beds are horizontal; but at either extremity and in the central part, where the clay has been extensively eroded by the succeeding glacier, the lower remaining beds are contorted and twisted in a most remarkable manner. The layers are bent and folded over each other in inextricable confusion, and are also faulted on a small scale. The outlier of this same clay at the Humber Bay is also corrugated in a similar manner. (*Fig.* 4, *c.*)

3. *Interglacial Fossiliferous Sand.*—Before describing the fossils contained in the clay beds, I wish to mention the beds of sand and sandy loam which rest conformably on the upper surfaces of the clayey strata. (*Fig.* 1, *t.*) These sand beds are of a yellowish tint; the strata are horizontal, and appear, like the clays, equally free from pebbles or boulders. Their maximum thickness shown in the cliff is

forty feet, but they have evidently been eroded, and in some places completely removed, and their original thickness may have been much greater. In those parts of the section where the clay beds are contorted, these sands have been completely removed.

There is thus exposed at the Scarboro' Cliff beds of clay and sand of Interglacial age 140 feet in thickness, leaving out of account the extent to which they may reach below the lake level, and the amount which may have been eroded from the upper surface.

Though these strata are covered by beds of till, and, judging by the Humber Bay section, also rest on beds of the same material, indicating the intense action of ice both at periods before and after their deposition, they yet contain no more evidence of ice-action than would be found in the clays now forming beneath Lakes Ontario or Erie, nor indeed so much, for it is very probable that chance boulders might be carried and dropped on the floor of these lakes by shore ice; but so far as my observation extends, I have not detected a single boulder in any of these deposits. There is thus, independent of the evidence furnished by the fossils, sufficient proof in the character of these deposits to show a great difference in the climate at the time they were formed, to that which prevailed in the preceding and following Glacial eras.

The larger proportion of the fossils in these interglacial strata are remains of plants which occur in layers between the beds of clay and sand. Some of these layers are from half an inch to three-fourths of an inch thick; but such layers are unusual, and in general there is but a thin film of fibres covering the surface of each stratum of clay, hardly to be noticed but for their darker tint. Although so delicate, yet in a vertical section each film of plant fibres is distinctly seen as a thin dark line, and in some places there are twenty-one of these layers in the space of an inch. Where the clayey strata are two or three feet in thickness, the fibres are scattered through the beds without arrangement; but their general occurrence is in layers comparatively free from sediment. These plant-layers are nearly entirely formed of minute fragments, from one to two lines in length, of the stems, branches and leaves of mosses and other plants, with occasionally a portion of a branch, an inch or two in diameter, of some coniferous tree. The fragments are flattened by pressure, their edges are worn as if they had been long macerated in water. Though there is but little of the clay or sand in the thicker layers, there are plenty of very thin delicate scales of mica, a material which would take longer to settle in the water than the particles of clay. These layers have been so much compressed that they can be separated from the strata above and below, and there were some fragments on the beach which the lake waves had shaped into flattened cake-like forms, but had failed to disintegrate them. These plant-remains could be traced from the lowest beds of the clay visible at the lake level quite to the summit of the sand and loam beds above; but on account of the looser nature of the upper beds, they could not be so easily seen in these as in the clays below; there were sufficient traces, however, to show that during the whole period in which these beds of clay and sand, 140 feet in thickness, were being laid down, fragments of plants continued to be deposited in them.

A careful search amongst the layers of plant-remains, in which I have been much assisted by the Rev. W. A. Johnson, of Weston, has brought to light specimens of the following genera of plants and animals:—

Diatomaceæ.
- Navicula.
- Stauroneis.
- Pinnularia.

Algæ.
- Chara sp.

Musci.
- Bryum.
- Fontinalis.
- Hypnum commutatum.
- Hypnum revolvens?
- Hypnum sp.

Lycopodiaceæ.
- Spores?

Phanerogams.
- Wood of pine or cedar.
- Portions of leaves of rush and other plants.
- Seeds of various plants.

Crustacea.
- Cypris (of two or three species).

Coleoptera.
- Elytra of Carabid.

Gasteropoda.
- Planorbis.
- Zonites?

The stems and leaves of mosses are very abundant in the layers, and yet retain their microscopic structure very perfectly. I am indebted to Professor Macoun, of Belleville, Ontario, for examining and determining the genera; the more doubtful specimens were submitted to Dr. James, of Harvard University. Hypnum commutatum, determined by Dr. James, has not hitherto been found on this continent further east than the Rocky Mountains; it also grows in England.

There is thus a very peculiar connection in the occurrence of this species fossilized at this place, intermediate between the widely-apart localities where it now grows.

Both the plant and animal remains so far discovered in these strata conclusively show that they are of land and fresh-water origin; not a trace of any marine organism has been found in them. The manner in which the layers of plant fibres are imbedded between the strata of clay seems to indicate that the sediments and plants were brought down by streams at periodical intervals into a lake, in which the clayey sediment first settled and the plants and lighter fragments, such as scales of mica, sank over them. It is not improbable that beds of a similar character to these at Scarboro' are now being deposited in some of the more inland lakes, where the surrounding country is still covered with forest trees. Each spring, the floods from the melting snows wash from the surface of the land, together with clay and sand, the small decaying portions of the stems and leaves of trees and lesser plants; these are carried into the lakes, where the fragments of plants float sufficiently long to allow the sand and clay brought down with them, to settle; but at last they become waterlogged and sink to the bottom, covering the surface of the heavier materials, and are in turn covered the following year by a fresh layer of clay. If this supposition is correct, the winters of that Interglacial period were characterized by abundant falls of snow, which, melting suddenly in the spring, produced flooded streams, thickly charged with sediment and débris, in the same manner as at present.

It is impossible now to determine the bounds of this interglacial lake basin. Considering that these deposits exist at places twenty miles distant from each other, and their thickness of 140 feet above the lake level, it seems improbable that they were deposited in a merely local hollow; and though beds corresponding to those at Scarboro' have not, so far as I am aware, been discovered at other places bordering Lake Ontario, I yet think that the basin in which they were laid down was co-extensive with that of the present lake. This basin had been previously hollowed out of the Palæozoic rocks by the action of the first glacier; and in the hollow left, when, through a changed climate, this glacier was dissolved, there were deposited this extensive series of strata of clay and sand mingled with plants, telling of a long succession of ages in which the climate was similar to the present.

The existence of such extensive lacustrine deposits completely sets at rest the theory of Dr. Dawson, that the large inland lakes were eroded by an Arctic current coming from the north-east, Neither in these deposits nor in any of the later glacial or post-glacial beds of Ontario west of the spur of the Laurentian Mountains, near Kingston, Ontario, has any evidence been found as yet which would lead to the conclusion that the sea has covered this inland basin at any time between the commencement of the Glacial period and the present; the fossils which have been found in these beds are all of fresh-water origin.

4. *Till, or Boulder Clay, No.* 2.—Resting unconformably on the surfaces of the lacustrine beds just described, are beds of till. (*Fig.* 1, b^2.)

The character of this till is equally as well defined as those beds previously described, resting immediately on the Palæozoic rocks. The only respects in which it differs from the lower till are, that it has none of the larger slabs of the Hudson River rock, and the scratched pebbles in it seem to be nearly entirely of the blue Trenton limestone and black Utica shale. As the Scarboro' Cliff is nearer the outcrop of these rocks than the Garrison Common, this result could have been anticipated. There are also very few Laurentian gneissoid pebbles or boulders in it. This till covers the stratified beds beneath, with the exception of a short distance where it has been denuded, from end to end of the section, but its thickness varies considerably in different places. If the lower bed of till has been produced by a glacier, there can be no doubt that this upper till is due to the same cause. The effect of the first glacier in eroding so powerfully the hard Palæozoic rocks, would almost support the belief that no beds of such soft materials as the clays and sands above described, would be able to resist the destructive influence of the passage of a glacier over them. Whilst there is a difficulty in accounting for the preservation of these beds in the Scarboro' Cliff on the theory of this upper till having been produced by a glacier, the very fact of the absence of these beds in other areas round Lake Ontario, in which there is great probability they once existed, is strongly confirmatory of the theory that this second glacier swept away the greater portion of these beds, leaving only in one or two places traces of their existence. But even while these interglacial deposits escaped at Scarboro' the entire destruction which befel them elsewhere, they have retained abundant proof of having been subjected to very powerful eroding forces similar to those which the first glacier produced on the underlying rocks. Thus at both ends of the Scarboro' Cliff only some 10 or 20 feet of the clay is seen, the beds above this, 120 feet in thickness, having disappeared, and in many places all traces of the clay beds have been eroded away down to and beneath the lake level, and the hollows are filled with till. The most striking proof of erosion, however, is seen towards the central portion of the section, where a breach has been made in the fossiliferous clays and sands, more than 100 feet deep and about 450 yards in length. For this distance the stratified beds have been completely removed, and the gap is filled up with the solid blue till, which forms a vertical cliff facing the lake, 100 feet in height. The face of this cliff is seamed with cracks, and shows a pseudo-columnar structure. This till is so far harder than the fossiliferous clays, that the waves of the lake are unable to make so much impression on it, and consequently this portion of the cliff forms a slight promontory. The extraordinary manner in which the clayey strata has been contorted in those portions of the cliff where the erosion has been greatest bears witness to the violence and intensity of the force which effected both the erosion and the corrugation of the strata.

Some of the smaller hollows in the fossiliferous clays at the easterly end of the section appear, however, to have been made by stream erosion, for the channels are partly filled with boulders and large pebbles below, overlaid by imperfectly stratified beds of fine silt and gravel, with striated pebbles. These graduate upwards into true till. It is not improbable that these filled-up channels may have been formed by streams running beneath the glacier. The thickness of the till in those parts of the cliff where the fossiliferous strata beneath are horizontal, varies from 10 to 70 feet; but this difference probably results in part from subsequent erosion.

5. *Laminated Clay and Sand, Interglacial.*—In the central portion of the Scarboro' Cliff there is a great basin formed in the till No. 2 just described. This basin may be due to the unequal deposition of the till, or to subsequent denudation and erosion of its beds. In this hollow there are extensive beds of fine laminated clay. (*Fig.* 1. *i.*) This clay is bluish or ash colour; it contains a larger proportion of lime than the fossiliferous beds below, but resembles them in being laminated and entirely free from stones and boulders. Up to the present I have been unable to find any fossils in these upper inter-

glacial clays. The strata are horizontal, and no corrugations are present. The basin filled by these clays extends for about a mile, and its greatest depth is about 90 feet. These strata form the upper portion of the first or lake terrace; but in the lower portion of the second terrace (*Fig.* 1, *v.*) there is a thickness of 50 feet of loam and sand, which appear to form one series of beds with the clay of the lower terrace. Laminated clays corresponding to these beds in character, and at an equal elevation above Lake Ontario, are seen at Yorkville and in the valley of York Mills, places about eight and twelve miles to the north-west of the Scarboro' Cliff.

These clays have every appearance of being lacustrine deposits, filling hollows in the till. Similar lake basins inclosed by banks of till still exist; Bond's Lake, twenty miles north of Toronto, is an example.

6. *Till, or Boulder Clay, No.* 3.—In the section of the second terrace there is a deposit of till about 30 feet in thickness, covering these laminated clays and sands. (*Fig.* 1, b^3.) There is but a small exposure of this highest layer of till at Scarboro'; but in the extension of this second terrace to the west of Scarboro', its beds are better displayed. The pebbles in this till bear the same marks of scratching and polishing as in the lowest till, but the matrix is of a more sandy character, and in many places there are small veins of gravel running through it. Though this till appears to be the product of a glacier equally as much as the lowest beds, yet the glacier forming it may have been of less dimensions than the early one, and probably may not have had exactly the same direction. It is very likely that this till may not be derived from the direct action of the glacier on the Palæozoic rocks, but rather may have been produced from the till of the earlier periods, which was again ground beneath the later glacier in its onward progress. This till No. 3 is the highest glacial deposit exposed in the Scarboro' Cliff; its summit is about 300 feet above Lake Ontario, or 530 feet above the sea level. Following northwards from the lake, the surface of the country quite up to the watershed between Lake Ontario and Lake Huron, that is, to an elevation of about 1,000 feet above the sea, appears composed of till, the pebbles in which testify to the path of the ice having been from the north-east.

7. *Stratified Sand and Gravel Post-Glacial.*—These beds marked "d" in the section (*Fig.* 1) form the upper portion of the Scarboro' Cliff in some places. They are of very recent date in comparison

with the beds just described, and appear to have resulted from the erosion and re-assorting of the till of the second terrace, when the lake was about 200 feet above its present level. They present the same characteristics as the beds of sand and gravel now forming by the action of the lake on the present lowest terrace. Some of the beds are of large rounded stones and boulders; others of smaller pebbles; but all are water-worn. False bedding is also seen in some of the layers. These sands and gravels rest unconformably over the earlier deposits; their maximum thickness is 50 feet; but they are very local in their distribution, and, fortunately for the agriculturist, the surface of the land for the most part is composed of the till or boulder clay with boulders scattered over it. I have been unable to find any shells in the beds at this place; but in beds of similar age in other parts of the Province, fresh-water shells have been found.

Erratic Boulders.—On the surface of the plateaux formed by the first and second terraces at Scarboro', these boulders occur, though they are not very numerous. Their distribution took place prior to the deposition of the post-glacial sands and gravels above mentioned. These boulders are of very various sizes and shapes, from that of a foot-ball up to blocks two or three feet in diameter. They are mostly of a rounded outline, but very rarely are any marks of striation to be seen on them. They are in this district generally scattered singly on the surface. By far the larger proportion of these boulders here are of Laurentian gneiss, with a few of Laurentian limestone, and of the lower beds of Trenton limestone, which to the north-east of this district rest immediately on the Laurentian rocks. On account of the area covered by the Laurentian rocks being so extensive, and the character of the rocks being very similar over large portions of that area, it is not always practicable to trace the gneissoid boulders to the particular beds whence they have been derived. On this account the evidence of a boulder whose source can be traced to a certain locality is important. I had the good fortune to find at Yorkville, about 250 feet above the lake, a surface boulder of Potsdam sandstone, with the characteristic fossil, Lingula acuminata, abundantly and beautifully preserved in it. As the only outcrop of this rock is at the easterly end of Lake Ontario, this particular boulder, whether carried by glacier or iceberg, must have been transported one hundred and sixty miles to the west of its original home, directly contrary to the present drainage of the country.

It has been generally supposed that these erratic surface boulders have been distributed by icebergs which floated from the glaciers yet remaining on the Laurentian range during the submergence of the last Glacial epoch, but their occurrence in the central portion of the plateau of Western Ontario, at levels of 1,200 feet above the sea, renders this theory improbable, for a submergence sufficient to float icebergs over this area would also be sufficient to cover the greater portion of the Laurentian range, which only averages 1,600 feet above the sea, and thus prevent the formation of a glacier on it. In the lower levels of the country some of these glaciers may have been carried by shore ice during the submergence; but it seems more probable that many of these boulders were left where they are at present when the glacier in whose mass they were imbedded gradually melted. The peculiar absence of striæ on these boulders is not altogether to be explained by the exfoliation which frost and heat produce on some kinds of gneiss, but probably arises from their having become imbedded in the glacier, and not having been exposed to the grinding action beneath it. The enormous number of these Laurentian boulders scattered over Canada and the States for hundreds of miles to the south and west of the range, would be sufficient, if they could be collected, to form a very respectably-sized mountain range, and render improbable the idea that icebergs or coast ice could have accomplished such an immense work.

Probably of contemporary age with the distribution of the erratic boulders, there are in some places in Western Canada extensive ridges of water-worn gravel and boulders, believed to resemble the kames and eskers of Britain. They do not occur in the limits embraced by my paper, and I merely mention their existence as part of the series of glacial and interglacial deposits.

Later than these kames are the terraces seen at various levels round the inland lakes, nowhere more plainly than to the north of Toronto. These terraces are believed to indicate so many intervals, during which the lake continued at a certain elevation sufficiently long to wear back a terrace along its shores in the same manner as it now wears back the Scarboro' Cliff. These terraces are said to exist up to an elevation of 1,000 feet above the sea-level to the north of Toronto, and thus, to have formed them, Lake Ontario must have been 770 feet above its present level, and formed part of a vast inland sea which embraced not only the greater part of Canada, but also the adjoining western and south-western States. From an imperfect examination, however, it appears to me doubtful if the *higher* terraces furnish unequivocal evidence of having been formed by the wearing back of the lake. There is hardly any doubt, however, that the various lake basins of Ontario, Erie, Huron, Michigan and Superior, formed at the close of the Glacial period but one enormous lake or sea, and the evidence is completely in favour of its being fresh water. It has not been ascertained to what extent this surface may have been depressed in relation to the sea level at that period, or whether this great body of water was held in by barriers of glaciers or accumulations of glacial débris which have since been removed.

During the period at which the lake was at the higher levels, the drainage of this portion of Canada reached the sea by way of the *Mississippi Valley, and it is only since its level became lower than* that of Lake Erie that the Niagara gorge commenced to be excavated, a period of very recent date in comparison with that of the formation of the till and the interglacial strata.

The later geological formations gradually merging into those still in progress, are ridges of sand and gravel similar to those at Burlington Heights, Ontario, and the valleys of the present streams. In these comparatively recent strata elephant remains have been found.

If I have rightly interpreted the facts shown in the cliffs at Scarboro' and the Garrison Common, then it appears that from the commencement of the Glacial period there is evidence of the presence of glaciers overflowing this portion of Canada at three different periods at least, with intervals of milder periods between. Following the melting of the first glacier, represented by the scratched rocks and the lowest beds of till, the first interglacial interval continued sufficiently long for the fossiliferous clays and sands, 140 feet in thickness, to be laid down. These deposits testify to a climate similar *to the present one; they are overlaid by glacial till in some places* 70 feet in thickness, during the formation of which an Arctic climate for the second time prevailed. To this Arctic cold there succeeded a milder period, in which the laminated clays, 90 feet in thickness, were deposited; though these clays show no signs of ice action, yet, on the other hand, they are without fossils, therefore the evidence as to the climate of this era is not so clear as that of the first Interglacial epoch; though moderate, it may have been much colder than the present. This second Interglacial interval is again followed by a fresh glacier, bringing with it beds of till, showing the presence of intense cold again. Whether this alternation of climate was repeated, or whether this third period of Arctic cold gradually changed to our present interglacial condition, the Scarboro' Cliffs contain no higher beds to inform us.

The absence of mountain ranges, and the comparative level of the surface of Canada, preclude the idea that these deposits of till of different ages were formed by a mere temporary advance and retrogression of a glacier, descending from mountain summits into valleys in which a genial climate generally prevailed, as might be urged in the case of Switzerland. It would require more than a few seasons of milder and colder temperature to bring about the melting and then the re-forming and advance of a glacier, in a country which is a comparative plain for hundreds of miles. The Interglacial intervals in this country indicate changes of climate lasting through very long periods.

I will now endeavour to show the extent to which the changes shown in the Scarboro' Cliff are corroborated by sections seen in other parts of the interior basin of the continent. There is great difficulty in making a comparison, on account of the very imperfect manner in which the observations of this description of strata have been conducted, and the indefinite sense of the terms employed. For instance, all the beds of the Scarboro' Cliff are summed up in the "Geology of Canada," as belonging to the divisions called the Erie and Saugeen clays, though beds strictly corresponding to the definition of these divisions can hardly be said to be present. The Erie clays are stated to be stratified, of a blue colour, to hold boulders and pebbles in greater or less abundance, and to be without fossils. The Saugeen clay is a stratified brown calcareous clay, with but few boulders or pebbles, and doubtfully containing fresh water shells. The all-important difference of distinguishing between non-stratified till and stratified clays seems hardly to have been made in describing these deposits, and more reliance seems to have been placed on difference of colour than difference of structure. The lower beds are believed to be always blue, and are called the Erie clays; the upper ones brown, and are named the Saugeen clays.* That this classification is generally inapplicable is easily seen when it is considered that the colour and character of these clays depends upon that of the rocks

* Geology of Canada. p. 896.

beneath, or those of the localities from which the ice has travelled, and therefore clays of different colours may be contemporaneous. Thus on this side of Lake Ontario the till is blue, because the rocks to the east and north-east are also blue, but if we cross the lake, the till is of a red or reddish-brown, from having been formed out of the red Medina rocks. Even, however, in a blue clay district the distinction of colour will not hold good, for a chemical change takes place on exposure in some of the blue clays, and they are altered to a brownish or yellowish tint. This alteration is very partial, and I think that many of the beds described as brown Saugeen clays, resting unconformably on blue Erie clays, are merely due to the oxidation of the upper portion of the blue clays. Some very good illustrations of this change of colour may be met with at the Humber Bay Cliff.

There is no necessity to search for beds of till corresponding to those of the Garrison Common. The entire north-eastern portion of the continent has been overflowed by this first glacier, and left the striated surface of the rock and till as witnesses of its presence. It would be impossible, however, to state positively whether deposits of till, even where they rest on the Palæozoic rocks, are due to the first or a succeeding glacier. It is doubtful if any pre-glacial beds newer than the Palæozoic strata have been spared in this part of the continent; the first evidence we have of the life of this region since the time of the long since extinct species of the Devonian rocks is contained in these interglacial clays, the flora and fauna of which are still existent.

It is very probable that these beds of sand and gravel, occurring in some parts of Canada and the adjoining States, stated to be Pre-Glacial on account of being overlaid by till, may in reality be of Interglacial age, and the till covering them may have been produced by a later glacier. If it had not been for the small outlier of the fossiliferous clays at the Humber Bay, the beds in the Scarboro' Cliff might have been regarded of Pre-Glacial age. The buried channels of streams which have been discovered in many places in Ohio are very probably Pre-Glacial; but they may nevertheless have been further hollowed out and deepened by the first glacier. It is significant that in the State of Ohio, which has been surveyed by a staff of excellent geological observers, no loose beds of sand or gravel have been discovered of an age immediately preceding the Glacial epoch; any Pre-Glacial remains which may have existed have been entirely swept away.

I cannot find any notice of the discovery of fossiliferous deposits of Interglacial age corresponding with those at Scarboro', in any part of Western Ontario. Sir W. Logan notices beds of vegetable material near the Grand Sable,* Lake Superior, covered by a great thickness of stratified sand and gravel, but the evidence shows the beds to be of Post-Glacial rather than Pre-Glacial age. Instances of the trunks of trees being found in yellow clay, in wells 10 to 20 feet from the surface, at Toronto, are recorded by Prof. H. Y. Hind,† but these may have occurred in some of the stream channels similar to those seen in the till No. 2 at Scarboro', and belong to a later date. I have examined the cliffs bordering Lake Ontario in many places on the north shore, and the Canadian portion of the south shore, without finding any beds which could be correlated with the fossiliferous clays and sands at Scarboro'. There are, however, some beds of Interglacial age filling the V-shaped sinus in the Niagara escarpment, between St. David's and the Whirlpool, which may be considered to be of contemporaneous age with the Scarboro' beds. This sinus, so ably described by Sir Charles Lyell,‡ and lately by Mr. Thomas Belt, F.G.S.,§ is from one to two miles in width at St. David's, and gradually diminishes, so far as can be ascertained, until it ends in a cul-de-sac near the Whirlpool at Niagara, where it is about the same width as the present Niagara River. This sinus itself is believed by Mr. Belt and some other geologists to have been formed by the erosion of a pre-glacial stream in the same manner as the present gorge; but its character is so entirely different from that which the present Niagara River has made, that it can hardly have been effected by the same agent. Sir Charles Lyell says that "it bears no resemblance to the deep, narrow chasm in which the Niagara flows," and he styles it an ancient valley now filled with drift, giving no opinion as to how it was produced. It may seem rash for me to venture to express an opinion where so great a master of the science was silent, but I think this cul-de-sac has been due to the first glacier which ploughed it out. Valleys of a similar character are to be met with in other places in this escarpment of Niagara dolomite; for instance, the one at the western extremity of the lake in which the town of Dundas, Ontario, is situated; another one occurs at Owen Sound: in all these cases there

* Geology of Canada, p. 906.

† Geology of Canada, p. 904.

‡ Travels in North America, 1841-42, Book II., chap. 19.

§ Quarterly Journal of Science, 1875.

is no evidence of streams having been the means of eroding these wide-mouthed valleys, whilst both near Dundas and Owen Sound there are plain traces of glaciers having passed up them. The fact of the existence of ancient stream beds leading from the south-west end of Lake Erie, in the direction of the Mississippi valley, and showing that the pre-glacial drainage of that area followed that direction, *militates against the theory of a Niagara Falls existing of Pre-Glacial* or Interglacial date, to which this old valley has given rise. The deposits at the Whirlpool filling this ancient St. David's valley, are beds of stratified clay and sand below, overlaid by a conglomerate and beds of true till. These lower deposits are at the same level above Lake Ontario as the interglacial clays and sands at Scarboro'; and though no fossils have been found in the small portions of the beds exposed, it is not improbable that they may have been formed at the same time, whilst the till above them may be contemporaneous with the till No. 2, at Scarboro'.

Some years since Professor *Chapman,* of University College,* Toronto, investigated the superficial strata of western Ontario in order to determine if any marine deposits existed in them. He failed to find any marine shells, but detected shells of fresh water molluscs, in one place 40 feet above Lake Ontario, in another 18 feet above Lake Couchiching. These shells were found in stratified sands and gravels of what Professor Chapman terms "drift deposits." As these, however, are similar in character and composition to the deposits now forming in the present lakes, and are apparently not overlaid by any beds of till or boulder clay of a later date, it is very probable that all these shells are of *Post-Glacial age, and date from* the time when the lakes were at a much higher level than at present.

Similar shelly sands are described by Mr. Robert Bell, F.G.S.,† at elevations of 78 feet above Lake Huron, or 656 feet above the sea, and by Dr. Workman at 30 feet above Lake Ontario. These shell beds belong to a period comparatively modern when compared with the Scarboro' fossiliferous clays and sands.

The glacial deposits in the States of Ohio, *Illinois*, Indiana and Minnesota have been carefully studied and described by Dr. Newberry, Professors Winchell and Orton, Colonel Whittlesey and others, and a succession of beds *resembling in many* respects that at Scarboro'

* Canadian Journal, 1861, p. 221.

† Canadian Naturalist and Geologist, Vol. VI., 1861.

appears to exist throughout these States. Nowhere, however, can I find an account of any exposure on the scale of that of Scarboro'; these geologists have had to study the relative position of the strata from borings for artesian wells or shafts sunk for coal, and small exposures in stream valleys, and consequently the succession of the strata in different places is at present a matter of discussion. But in many places in these States there is evidence of one if not two Interglacial periods, during which deposits of plant remains have been found. In the southern part of Minnesota, Professor Winchell describes beds of peat resting upon and also overlaid by till, or unmodified drift, as he terms it. At Bloomington,* in the central portion of Illinois, there are beds of clay with peaty remains, which appear to resemble those at Scarboro'; these beds are covered with a solid mass of till or "hard-pan," from 50 to 60 feet in thickness.

In Dr. Newberry's very able resumé of the glacial strata of Ohio,† the succession of the lower beds is stated as follows: (1.) Lowest, Till, or boulder clay. (2.) Erie clay, or non-stratified and stratified beds of blue clay. (3.) Forest-bed or peat-bed. (4.) Laminated clays and gravels, &c.

Over the boulder clay in Ohio there is a series of blue clays, the upper portion of which are stratified, but contain no fossils. The forest beds above these clays are the remains of an ancient soil in which coniferous trees grew, and beds of peat 20 feet in thickness in some places. In these beds are found the remains of mammoth, mastodon, the giant beaver and other animals. Laminated clays and gravels cover up these peat beds, Dr. Newberry stating "that there is no satisfactory proof that an ice sheet passed over the State of Ohio after the accumulation of the old forest bed; that it seems scarcely possible that the clay above could have been spread by glaciers, and the forest bed or boulder clay be left so intact over large areas."

This succession resembles that of Scarboro' in the order of the deposits, with the difference that there are only a few feet of peaty soil, instead of the 140 feet of lacustrine clays and sands to testify to the intervening mild period. Dr. Newberry's doubt as to a second glacier having reached that portion of Ohio, seems to have arisen from these incoherent beds of soft materials remaining intact; but the fact is indubitable of the second glacier passing over Canada, and yet sparing some of the fossiliferous clays.

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* Geology of Illinois, Vol. IV., p. 179.
† Geology of Ohio, Vol. II.

In Indiana the forest-bed is believed to underlie the till or boulder clay, and is *thus supposed to be* Pre-Glacial; but it is probable that the true succession is as revealed at Scarboro', and the overlying till is due to the second glacier, which overflowed the country after the mild Interglacial period, during which the central basin of North America was covered with forests.

In Eastern Canada the *marine fossiliferous deposits* which Dr. Dawson has named the Leda clays and Saxicava sands appear to have been *formed towards the close of the* Glacial period, and later than any deposits of till or boulder clay; consequently they are of much more recent date than the interglacial clays and sands of Scarboro', and the forest beds of the Western States. Dr. Dawson,* in his description of these glacial beds, remarks, "that it is not possible to *ascertain the existence of boulder clays of different ages, superimposed* on one another;" a conclusion which may be correct in Eastern Canada, but certainly *will not apply to* the glacial deposits of the inland portion of the continent.

Though the general succession of the later glacial deposits in the Western States appears to have been similar to that of this portion of Canada, the data at present are not sufficient to allow of a detailed comparison.

From the history of the Glacial period in Britain, contained in the admirable work of Mr. James Geikie, F.R.S., "The Great Ice Age," it may be seen that there is evidence of several alterations of Arctic cold, and temperate and even warm climates during that age. There can be but little doubt, that whatever may have been the causes of these successive changes of climate, the entire northern hemisphere was *affected* by them, and the *cold and warm periods happened simultaneously* on both sides of the Atlantic. The succession of Glacial and Interglacial *periods revealed by the* Scarboro' Cliff is only what might have been anticipated from the discoveries made in Britain.

It may be advantageous to give a short summary of the various events which the cliff sections described, show to have taken place.

1. A vast glacier which striated the Palæozoic rocks, eroded the lake-basins, and produced the lowest beds of till. Climate Arctic.

2. Complete disappearance of the glacier; the land covered with vegetation; Lake Ontario filled with fresh water to a higher level by at least 150 feet than at present; in the lake extensive beds of clay

* *Canadian Naturalist and Geologist*, Vol. VI., 1872.

and sand were formed, in which plants and other remains washed off the land were imbedded. Climate temperate, similar to the present.

3. A fresh glacier covered the country and ploughed out the lacustrine deposits of the previous period, leaving another sheeting of till. Climate again Arctic.

4. Disappearance of the glacier, and formation of lacustrine clays in the hollows of the till, but without fossils. Climate probably still cold.

5. Again a glacier, but probably of less dimensions than the previous ones, the till being of a looser character. Climate Arctic.

6. Contemporaneous with the melting of the last glacier occurred the distribution in part of the erratic boulders, followed by the formation of the gravel ridges, or kames and eskers; the submergence of the land; the formation of the lake-terraces and the erosion of the present stream-valleys. The climate during these events may have been similar to the present.

Further investigations in other localities may show that the succession of changes indicated by the Scarboro' Cliff does not embrace all those which have taken place in this portion of Canada during the Glacial period. Very much remains to be done in the way of collecting observations before a complete knowledge of these so-called superficial strata can be obtained. The name given to them indicates the manner in which they have been generally considered. Whilst great attention has been devoted to the Palæozoic rocks, these more recent strata have been deemed hardly worthy of notice. The succession of the Palæozoic rocks in this portion of Canada is so simple and regular, that their history is by this time tolerably well ascertained; but there is plenty of work for those interested in the science of geology to search the records of the post-tertiary strata.

ANALYSES OF IRON ORES AND ANKERITES

FROM THE

ACADIA MINES OF LONDONDERRY, NOVA SCOTIA.

BY E. J. CHAPMAN, PH. D.,

Professor of Mineralogy and Geology in University College, Toronto.

The following analyses of some of the Londonderry iron ores and ankerites may not be without interest, as supplementing, in part, the article by Professor Robert Bell, in the present number of the *Journal.** As regards these analyses—now published for the first time, although made about a year ago—all the samples were of good size, and were regarded as fair representatives of the portions of the vein from which they were taken.

(1.) IRON ORES.

	1.	2.	3.	4.	5.
Fe^2O^3	98.52	84.10	83.17	82.52	77.78
Al^2O^3	0.24	0.30	0.42	0.38	0.21
MnO	0.16	0.23	1.04	0.84	1.17
MgO	0.27	0.11	0.15	0.14	0.12
CaO	0.08	0.18	0.13	0.16	0.20
SiO^2	0.66	3.03	4.12	2.28	6.92
P^2O^5	tr	0.24	0.29	0.22	0.27
SO^3	tr	0.06	0.02	0.04	0.03
Aq.	tr	11.63	10.67	13.36	13.32
Metallic Iron	68.96	58.87	58.22	57.76	54.44
Phosphorus	0	0.106	0.125	0.096	0.118

No. 1.—A specular, red ore, of scaly or micaceous structure, from Martin's Brook, West Mines. Average sp. gr. 4.88. Weight per cubic foot, 304 lbs.

* Additional reference may be made to the "Acadian Geology" of Dr. Dawson, and to Mr Selwyn's report and plan, in the Survey Report for 1872. Also to the writer's "Outline of the Geology of Canada, 1876," in which a brief notice of the district, and its relations to the surrounding country, will be found.

No. 2.—A brown (or partly red) ochreous hematite, labelled "Friable Ore," from Martin's Brook, West Mines. Average sp. gr. 3.57. Weight per cubic foot, 222 lbs.

No. 3.—A brown, earthy-looking and partly ochreous ore, but containing specks and strings of metallic lustre. Average sp. gr. 3.13 (3.01—3.28). Weight per cubic foot, 195 lbs. Labelled "Porous or Spongy Ore," from Martin's Brook.

No. 4.—A brown hematite of fibrous-botryoidal structure and high lustre. Labelled "Kidney Ore," from Martin's Brook. Average sp. gr. 3.85. Weight per cubic foot, 240 lbs. The silica in this ore, and also in No. 3, separated as a gelatinous residuum.

No. 5.—A brown hematite of somewhat open texture, but fibrous-botryoidal in places. From Folly's Mountain, East Mines. Average sp. gr. 3.53. Weight per cubic foot, 220 lbs.

NOTE.—In the Report of Progress of the Geological Survey for 1872, complete analyses of three samples of brown hematite from the Acadia Mines are given by Dr. B. J. Harrington; and of three other samples—one of red, and two of brown hematite—from these mines, by Mr. Christian Hoffman. These analyses, although the samples were mostly taken from other parts of the property, agree, as a rule, very closely in their results with those of the above series; but in a sample from Totten's Brook, Dr. Harrington found rather more than 20 per cent. of carbonate of lime. The amount of phosphorus, also (0.370) found in a brown ore from Cumberland Brook, is higher than in the samples from Martin's Brook.

(2.) ANKERITES.

	1.	2.	3.	4.
CO^2	44.39	44.58	44.64	44.36
CaO	28.69	26.90	27.49	28.48
MgO	11.08	12.44	12.28	11.82
FeO	15.17	15.30	15.03	14.21
MnO	0.61	0.66	0.54	0.44
SiO^2	0.04	0.06	0.04	0.63

These values correspond to:

	1.	2.	3.	4.
$CaCO^3$	51.22	48.02	49.08	50.86
$MgCO^3$	23.28	26.12	25.80	24.83
$FeCO^3$	24.46	24.67	24.23	22.90
$MnCO^3$	0.98	1.08	0.87	0 72

No. 1.—A hard, solid ankerite, from "Blast Furnace Quarry:" almost pure white in colour, but with brownish streaks here and there. Effervesces freely in cold dilute acids, and becomes dark-brown on ignition. Sp. gr. 2.99—3.08. Average weight per cubic foot, 188 lbs. An analysis of another portion of

this sample gave :—$CaCO_3$ 52.12, $MgCO_3$ 23.14, $FeCO_3$ 23.71, $MnCO_3$ 0.96, SiO_2 trace.

No. 2.—A pale-brown, hard, compact ankerite, from Blast Furnace Quarry. Effervesces freely in cold acids, and becomes dark-brown on ignition. Sp. gr. 2.004. Weight per cubic foot, 187 lbs.

No. 3. — A pale-brown ankerite (almost white internally), of cleavable lamellar structure, from Martin's Brook. Other characters as in Nos. 1 and 2.

No. 4.—A white, highly cleavable ankerite, with ochreous stains in places, from Folly Mountain, East Mines. Other characters as above.

Analyses of other samples of Londonderry ankerite, by Dr. Dawson, Dr. C. T. Jackson, and Professor How of Nova Scotia, will be found in the Geological Survey Report for 1872. In the samples analysed by the writer, the average amount of metallic iron, it will be seen, is equal to 11½ per cent. The value of the material as a flux is somewhat lessened, however, by the large percentage of carbonate of magnesia.

THE SYSTEMATIC POSITION OF THE SPONGIADÆ.

BY R. RAMSAY WRIGHT, M.A., B.Sc.,
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The views of naturalists prior to 1820 with reference to this subject are now purely of historical interest, for the late Prof. Grant had not 'till after that date recorded the beautiful series of experiments which gained him early his fame as a zoologist. By these, however, the animal nature of the Sponges was undoubtedly proved, although it was not till much later that these organisms, after having been bandied about from one kingdom to another, at last found a resting-place among the lowest types of animal life. We find, for instance, even Johnston, who contributed so much to the knowledge of the Scotch littoral fauna, drawing fanciful analogies between the Sponges and their namesakes the Fungi: "The Tethea, the naturalist may say, is the sea's copy of the earth-born Scleroderma, and he may remind us that, like the sporules of sponges, the sporules of fungi are equally locomotive."[1]

Although certain distinctively animal characteristics were discovered so early in the present century, it is only within the last few years that sufficient data for accurately determining the relationships of the Sponges have accumulated. The cause of this is partly to be looked for in the predominating attention devoted to their hard parts by systematists, partly also in the fact that naturalists were inclined to assume of the marine forms what had been proved with reference to the anatomy and reproductive phenomena in Spongilla; a form which, from its accessibility, gave rise to the researches of Meyen, Carter and Lieberkühn, but which is now recognized, as is the case with so many fresh-water forms of groups essentially marine, to be aberrant in many respects.

For our increased information we are indebted in great part to the impetus given to the study of development by the evolution-hypothesis,

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[1] Brit. Spong. and Lith. 1842.

but also to the great strides made in the region of histological inquiry by improved methods. I propose in the present paper to consider chiefly the nature of the evidence derived from these sources which bears upon sponge-relationships.

It need not occasion much surprise that the opinions of naturalists with regard to these have varied much, for, apart from the want of adequate information as to structure and development, there is a total want of forms transitional to other groups, such as, *e.g.*, we find between the Vermes and the various large sections of the animal kingdom derived from that group. Attempts have been made, of course, to point out such transition forms: Dr. Carpenter,[2] *e.g.*, indicates the Thalassicollina as leading from the Polycystina to the Spongiadæ; Haeckel, however, has so largely increased our knowledge of these as of the other Radiolaria, that we now know the groups (Radiolaria and Spongiadæ) have little more in common than a skeleton formed partly of silica. Again, Dr. Wallich regards the Dictyochidæ as intermediate between Thalassicolla and the sponges. I quote his arguments from a recent paper:[3] "The basket-shaped framework of the living Dictyocha is never single, but invariably double, the concavities being placed face to face, and the two portions retained in position solely by the sarcode body which fills and surrounds them. . . . . . The most remarkable feature, however, of Dictyocha, and the one which at once establishes its alliance with the siliceous sponges, is that every part of the siliceous framework is tubular." Dr. Wallich seems to have overlooked Haeckel's discovery,[4] that in Aulosphæra, Aulacantha and other Radiolaria the spines are tubular, and are further filled with sarcode derived from the extracapsular soft mass, so that a tubular framework is by no means confined to Dictyocha; and again, a tubular siliceous framework can hardly be said to be a distinguishing characteristic of the Sponges, as such a continuous system of tubes has only been shown to exist in a small section of the Hexactinellida.[5]

After glancing at the present position of our knowledge of sponge structure, we shall again return to the real and supposed affinities of the group. Suffice it to say, that the Spongiadæ form a class bounded

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[2] Introd. Study Foramin.
[3] Am. Mag. Nat. Hist., Feb., '77, p. 174.
[4] Die Radiolarien, 1862, pp. 263, 358.
[5] Marshall, Zeit. für wiss. Zool., B. xxvii., p. 120.

by better marked limits than are found with most sections of the animal kingdom, and further, that the peculiarities of their organization are such as to render it necessary for us to recognize in them a section similar (to give an instance) in value and independence to the Echinodermata.

Many naturalists are disposed to accept, provisionally at any rate, the division of the animal kingdom into Protozoa and Metazoa advanced by Haeckel;[6] and there is no doubt, if developmental characters have that importance allowed to them to which modern zoology points, that Haeckel's division is founded on a firm basis.[7] The characters affirmed of the Metazoa and denied of the Protozoa, according to this arrangement, are the following: 1st, the formation of *germ-lamellæ*, arising from the division of the egg cell into many cells; 2nd, the presence of a true intestine (except in a few retrograded forms) lined by the innermost of these lamellæ; and 3rd, the presence of true tissues differentiated out of the cells of these primary lamellæ. The evidence which I have to bring forward with regard to the Sponges, although unhappily not obtained from all of the sections of the group, and somewhat scanty from the third (histogenetic) point of view, still indicates that in each of these three points they are true Metazoa.

The difficulties which are experienced in tracing out the reproductive phenomena in the Sponges are so great, that the misapprehensions of the earlier spongologists need cause us no surprise. At one time the cells lining the ciliated chambers *were supposed to be concerned* in the reproductive process; at another, a peculiar sort of internal gemmation was suspected from the escape of the larvæ by the oscula. It is especially within late years that the generative elements have been detected and described by various authors, and in fact the appearance of Haeckel's account of the development of the calcareous sponges,[8] and the indications there presented of his famous Gastræa-Theory, turned the attention of a number of naturalists to the study of the development of these much-neglected forms. First, Metschnikoff[9]

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[6] Die Gastræa-Theorie.

[7] Van Beneden has recently indicated a third sub-kingdom, the Mesozoa, for the reception of the peculiar genus Dicyema, which lives parasitically upon the spongy renal organs of Cephalopoda. There is here no digestive or body-cavity; the entoderm is represented by a single axial cell, covered by a flat epithelium of ectodermal cells, and this differentiation into two kinds of cells *takes place after cleavage of the egg.*

[8] Die Kalkschwämme.

[9] Zeit. für wiss. Zool., B. xxiv., p. 1, *et seq.*

challenged the accuracy of Haeckel's statements; then Oscar Schmidt[10] followed with an account of observations which seemed to sap the very foundations of the Gastræa-Theory. The distinguished histologist, F. E. Schulze,[11] however, in a paper on the structure and development of Sycandra raphanus, showed that the gastrula-stage does exist in the ontogeny of the calcareous sponges, while his observations have been confirmed and extended by the researches of C. Barrois[12] on the embryology of certain sponges of the British Channel.

It is still uncertain what form the male generative elements assume in the Sponges, and most attempts to discover anything answering to these have failed. They have been asserted to take the ordinary spermatozoid-form, and Lieberkühn figures those of a Spongilla possessed of oval heads and short tails. Carter[13] has described spermatozoids from a Microciona (with pyriform heads and long tails attached to the broad end of the pear), and again from Sycandra compressa (the latter in a dead condition with conical heads and long tails.)

Barrois (Loc. cit.) has described from an Isodictya certain bodies which possibly represent the mother cells of the male elements. These are found in the mesoderm along with the eggs, and appear as clear cells closely opposed while in situ, and each provided with a large nucleus; when separated from the sponge by teasing, they are seen to be arranged in rows, clear plastic threads intervening between the individual cells. The transformation of these cells in granular balls Barrois considers preliminary to the formation of sperm cells, and draws a parallel between this and the development of the spermatozoids in Hydra as described by Kleinenberg. If future researches should show that the eggs are actually impregnated by the products of these granular balls, an important point of agreement between Hydra and the Sponges will have been demonstrated, and the conviction will be strengthened that it is here (at the base of the cœlenterate series) that the inter-relationships of Sponges and Cœlenterata find their strongest expression.

The ova of the calcareous sponges have been recognized for some time, and are characterized by the absence of any investing membrane,

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10 Zeit. für wiss. Zool., B. xxv., Supp. p. 127, *et seq.*

11 Zeit. für wiss. Zool., B. xxv., Supp. p. 247, *et seq.*

12 Ann. des Sci. Nat. Zool., T. iii. 1876.

13 Ann. Mag. Nat. Hist., V. xiv., p. 105 *et seq.* 1874.

so that although generally rounded or oval (measuring 0.04 – 0.05 m.m. in diameter) they often assume a singularly amœboid appearance; so much so, Haeckel says, as to have been taken for parasitic Amœbæ. They possess a germinal vesicle surrounded by granules and containing a nucleolus. Similar to these in all essential particulars are the eggs of the siliceous sponges, which in addition, however, are characterized by the presence of pigment even before cleavage, as well as of certain bodies interpreted as nutritive by Barrois, and compared by him to the pseudocells of Hydra.

The ova are always formed in the mesoderm, sometimes (Calcispongiæ) immediately under the entodermal cells of the ciliated chambers, sometimes (Fibrospongiæ) with some thickness of mesoderm between them and any of the branches of the canal system. Their fecundation by thread-like spermatozoids is described by Haeckel in Sycortis quadrangulata, but has escaped the notice of other observers. It is probable, as eggs have been observed without a germinal vesicle, that fecundation is followed by its disappearance and the formation of a new embryonic nucleus prior to the appearance of the first cleavage-plane, which curiously has an undulating optical outline in Halisarca.

A summary of Barrois' results from a study of the development of the different groups will serve to indicate the frequent important points of divergence between these.

Calcispongiæ :—

The cleavage is total, regular, and a cleavage-cavity is soon formed When sixteen cells have resulted, a differentiation into two kinds is observed, better expressed, however, at the completion of cleavage: a hollow embryo of Haeckel's amphiblastula type results, in which the anterior cells are long, slender and hyaline, the posterior rounded, granular and opaque. This passes to a transitory amphigastrula stage, in which the posterior cells, having been invaginated into, and thus filling up the cup formed of the anterior cells, project from its mouth by their further growth. At this stage the embryo bursts through the entoderm of the mother, and makes its way to the outside by the agency of the long cilia now developed on the anterior region. These help to give a characteristic appearance to the free larva, the posterior cells of which undergo a further differentiation into a crown of cells (the indication of the future mesoderm) next the mouth of the gastrula and a posterior mass, the cellular nature of which becomes gradually less and less distinct. Fixation and flattening follow, no trace of the cavity of the gastrula is left, and the two regions of the larva are only recognizable as two distinct layers, an upper (formed of the anterior cells) clear, nucleated, with pores and amœboid processes which corresponds to the ectoderm of the adult sponge, and a lower (formed of the posterior cells), granular and opaque, which corresponds to the mesoderm and entoderm of the adult. The sponge next contracts into a cylindrical form and bristles with spicules, the straight spicules appearing before the rayed forms; these latter have a definite arrangement, an odd ray pointing towards the base of the sponge. The osculum is formed afterwards, but as it does not correspond to the gastrula-mouth, and indeed may be formed in different ways, it is of little morphological significance.

Myxospongiæ—Halisarca:—

In this group the cleavage is total and regular, resulting in the formation of a blastula with a very large cleavage cavity. It is not till the embryo becomes free that there is any difference between its anterior and posterior regions. This difference is first expressed by the posterior cells becoming large and granular, and in their pushing out short and stout cilia which contrast with the long delicate cilia of the anterior cells; a constriction between the two regions follows, and the further stages are practically the same as in the Calcispongiæ. The layers formed by flattening are absolutely homologous to those in the former group, and the development of the ciliated chambers and canals in the lower layer, entirely independently of each other, is alone worthy of remark.

Fibrospongiæ—Verongia:—

The differentiation of the egg into two regions is early marked by the aggregation of pigment posteriorly: when the blastula-stage is arrived at, the posterior cells may be distinguished from the anterior by being destitute of cilia and deeply pigmented, while the limit between the two regions is indicated by a row of mesodermal cells provided with long stout cilia.

Halichondrida:—

Here, as in the Myxospongiæ, the two regions are differentiated but slowly; the posterior of these is pigmented and destitute of cilia:

it forms a granular mass, filling up the cavity formed by the anterior cells, and frequently projected at one or more points through this layer: mesodermal cells with strong cilia are formed from it, and in these, even while the larva is in a free state, the spicules appear. After fixation, which may happen at any of the exposed parts of the internal granular mass, flattening into two layers takes place, in the lower of which the ciliated chambers appear as independent closed sacs, and after these the fissures which represent the future canal system. The oscula, one or more in each young sponge, seem to be formed simply by the collection of water between the two layers which transitorily gives rise to a tubular projection of the outer layer with a blind end. This being eventually burst, the osculum is established, and the tube collapses from the contraction of the ectoderm; the connection with the canal system is merely secondary. From this it becomes apparent that the osculum is no mouth, nor does it correspond to the "person." The horny fibres are only formed after fixation, and are primarily derived from the ectoderm; afterwards they extend into the lower layer and surround the spicules.

Such are the developmental phenomena ascertained for the Spongiadæ, and they undoubtedly demonstrate the fact that these animals are true Metazoa. Beyond this, however, they are of interest as indicating the way to a true conception of the individuality of the sponge, and are indeed of still wider significance from a comparative point of view.

It has been and still is with some a question whether a sponge is to be considered as an individual or a colony of individuals, but indeed it is necessary in many classes to use the word with some caution, from the different constructions put upon it zoologically.

If we accept Huxley's term "zoological individual" as equivalent to "the total result of the development of a single egg," it is evident that, except where concrescence of two young sponges has taken place, the sponge is such an individual. But this expression is highly undesirable, being in the first place frequently incongruous with the ordinary notion of an individual (as where, through asexual multiplication of some kind or another, perfectly independent and completely organized individuals are ultimately produced from a single egg); and, in the second place, involving a conception of an antithetical relation between asexual and sexual multiplication which does not exist in nature.

The Cœlenterate group offers many suggestions for a proper restriction of the word. There we meet with colonies composed of numerous individuals, all of which are sometimes anatomically and *physiologically complete*, and *again others of which the members are* individuals only from a morphological point of view; physiologically they are nothing but organs. In fact, we have to look to form and not to function in estimating the individuality of the members of a colony. Here we are brought face to face with a difficulty in applying this standard to the Sponges, for in their fixed condition they are as a rule totally destitute of a ground-form, and well merit the name of Amorphozoa applied to them by the older naturalists. This renders any distinction between growth and continuous budding impracticable in the Spongiadæ, for typical form and size are both absent; whereas in the Hydroida, for instance, the individuals can only grow *till they reach a certain size, any excess of nutriment being expended* in the formation of new buds. Unless it be true, then, that certain of the simplest calcareous sponges (Asconidæ) retain the larval ground-form throughout life, and are capable of repeating it by a process of continuous gemmation (forming an "Ascon-stock"), we have no data for applying the terms individual or colony to the group, as they are applied in the Hydroida.

Haeckel considered that a plurality of oscula indicated a plurality of individuals, on the ground of homology between the osculum of the young sponge and the mouth of the gastrula, the formation of further oscula in the adult form being, according to him, only a homo*logical repetition of the first through asexual multiplication.* This view must now be abandoned, as Barrois' researches conclusively show that the osculum has nothing to do with the mouth of the gastrula, and indeed, like the inhalant apertures of these organisms, is only secondary in its nature.

The idea of the colonial nature of the sponge, founded on the conception that the cells lining the ciliated chambers are the animals of the sponge (Spongozoa—Carter), is now entirely untenable, for besides leaving unaccounted for the bulk of the soft parts of the organism, it is quite incongruous with the course of development from the egg.

It does not come within the limits of the present paper to do any*thing but indicate the suggestiveness, from a general point of view,* of the ontogeny of the Sponges. Two points strike me as being worthy of remark: the evident derivation of the mesoderm or skeletogenous layer from the primary entodermal cells, and the formation of the generative elements in that same layer so derived.

The presence of an alimentary canal may be regarded as an essential element in the definition of the Metazoa, being invariably present except in such cases which (in conformity with their parasitic habits —like the Tapeworms—) distinctly show a retrograde descent from forms possessed of such a canal.

That an alimentary region exists in the sponges is beyond all doubt; its disposition, however, in most members of the group has certain characteristic peculiarities. Haeckel has shown us in his monograph how we may pass by easy transitions from the simplest calcareous sponges (the Asconidæ) where the entoderm forms a continuous layer, lining, as in a Hydra, the whole of the cavity of the animal, to the most complicated forms (the Syconidæ), where, instead of being continuous, it is restricted to certain globular dilatations of the canal system, which is hollowed out in the mesoderm. It may be argued that if the osculum of a sponge does not represent the primitive mouth of the embryo while in its transitory gastrula-stage, the ciliated chambers cannot represent the gastral cavity of the embryo, and consequently are not homologous with the alimentary canal of other Metazoa. Now the possibility of such a homology is not done away with by the fact that the osculum would seem to be little more than a specialized pore; it is quite conceivable that the gastral cavity should be temporarily obliterated by the increase in number and size of the entodermal cells, and that when these are scattered into groups by the growth of the quickly developing mesoderm, they should again tend to separate and form a cavity.

That the cells of the ciliated chambers are the true food-absorbing cells of the sponge has been incontestably demonstrated by Mr. Carter; that their peculiar form, however, or even the peculiar action of the flagella in whipping food particles into them,[14] can be considered any proof of their being individual Flagellate Infusoria is by no means necessary. As well might we assert that the amœboid cells met with in higher animals are true Amœbæ on account of their form and their conduct in the ingestion of particles. It is probable that the contractile vesicles described by Prof. James Clark in the entoderm cells of Leucosolenia botryoides, are the vacuoles described by F. E. Schulze in Sycandra raphanus.[15]

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[14] H. James Clark, Mem. Bost. Nat. Hist. Soc., N. S., Vol. I., p. 326.

[15] Loc. cit., p. 257.

There is still a wide field for histologists in the investigation of the elements of the sponge flesh. It has been ascertained that we have to do with a body composed of three layers (ectoderm, mesoderm and entoderm), in each of which the constituent cells are discoverable occasionally without the use of special reagents.

The entoderm cells especially can be detected without any trouble, and present the form of cylindrical epithelial cells, broad at the base, and invested by a delicate layer of hyaline protoplasm, which forms at the free end a marginal frill of the shape of a wine glass, from the centre of which there projects a flagellum formed of the same layer. In the basal portion of the cell is lodged a distinct vesicular nucleus, surrounded by granules, and occasionally by vacuoles.

The ectoderm cells are formed of a thin flat epithelium with distinct globular nuclei, and two to three bright refractive nucleoli, discoverable in the Calcispongiæ[16] without reagents, but necessitating the silver method in the Fibrospongiæ.[17] These cells abut upon each other with the intervention of but little intercellular substance. This layer is not confined to the outer surface, but extends into the canal system through the oscula (Schulze).

The great bulk of the sponge flesh unquestionably belongs to the mesoderm, and constitutes indeed what has been called the sarcode of the sponge. It was understood at one time to be entirely structureless, and Lieberkühn was the first to prove its cellular character by showing that heating to the point of coagulation of albumen separates the cellular elements of the flesh of Spongilla. It has been suspected for some time, and is now apparent from the researches of Schulze and Metschnikoff, that we have here to do with a substance similar to the gelatinous connective tissue (Gallert-Gewebe) of the Medusæ, and like it containing frequently specialized contractile elements. The cells, which give rise to the intercellular jelly-like matrix, are usually provided with straggling processes which may anastomose; and there have been detected in addition to these amœboid cells, similar to the wandering connective tissue corpuscles which we meet with in higher forms.

The contractile elements observed in the mesoderm are of the ordinary spindle-shaped character, and have been especially noticed in the Corticate group. O. Schmidt, however, has also discovered

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[16] F. E. Schulze loc. cit., p. 250.

[17] Metschnikoff Zeit. für wiss. Zool., Book xxvii., p. 279.

them at an early stage of development in the larva of Amorphina, lying transversely immediately under the ciliated exoderm.

The origin of the spicules in this, which is unquestionably the skeletogenous layer, requires further investigation.

From the above-adduced considerations, it is evident that the sponges are true Metazoa, although by no means of a specialized type; in fact, they must be regarded as having diverged early from the base of the metazoan series. We must look to the lowest of the series for their nearest relations, and thus confirm what Leuckart suspected years ago from a comparison of the canal system of the Sponges with the gastro-vascular apparatus of the Cœlenterata. If we compare the groups, however, as to development, structure and form, their divergent characteristics become immediately apparent. Perhaps this is best seen from a comparative study of the Sponges and Hydra which, with Greeff's Protohydra, forms the least specialized cœlenterate form. Such a comparison will suggest in the sponges many points of resemblance to this cœlenterate group, and yet others of departure. Among the former may be noticed the structure of the eggs, the presence of pseudocells, (the resemblance of the spermatozoids), and lastly, development of the generative elements in a layer (interstitial) intervening between ectoderm and entoderm. Among the latter may be noticed the total absence of typical form in the sponges, the greater differentiation of the body layers, and the greater specialization of their tissues.

Phylogenetically, this may be taken to indicate that the groups of the Spongiadæ and Cœlenterata are of independent origin, and that indeed we may represent the primordial Metazoa (Gastræades-Haeckel) as branching off by three different roads: those where the ground-form is lost in the adult (Spongiadæ); those where the tendency is to assume a radial form (Cœlenterata); and lastly, those in which bilateral symmetry predominates (the remaining Metazoa).

APPENDIX.

Since writing the above an important contribution to the literature of the Sponges, in the form of a paper on the structure and development of Halisarca, by F. E. Schulze, has reached me.[18] The discovery that the ectodermal cells are ciliated in this group, necessitates a dis-

[18] Zeit. für wiss. Zool., B. xxviii., p. 1-48.

tinction between these and the "collar-cells" of the entoderm. Of great interest also is the discovery of true spermatozoids. Halisarca lobularis is diœcious. The generative elements are developed in the mesoderm, each egg and sperm-mother-cell being provided with a capsule formed of flattened, endothelium-like cells. The form of the spermatozoids is characteristic, the head being pear-shaped, and the tail (measuring 0.08 m.m. in length) set on to it at right angles. The course of development indicated by Schulze corresponds with Barrois' description, with the exception that the posterior end of the free larva is figured as possessing longer cilia than the anterior part.

SYNOPSIS OF THE FLORA OF THE VALLEY OF THE ST. LAWRENCE AND GREAT LAKES,

WITH DESCRIPTIONS OF THE RARER PLANTS.

BY JOHN MACOUN, M.A., *Botanist to the Geological Survey.*

(*Continued from page 364.*)

POTENTILLA, L. Cinque-foil.

P. Norvegica, L.

Indigenous. Fields. New Brunswick (Dr. Fowler). Labrador coast (Butler). Common in Quebec (Brunet). West coast of Newfoundland (Dr. Bell). River Rouge (D'Urban). Near St. Anne (Prof. Bell). Common in Eastern Ontario (Billings). Common in Central Canada, New Road, Thunder Bay, Lake Superior (Macoun). Nicolet, Chippawa (Maclagan). Common in Western Ontario (Logie, Ellis, Saunders, Gibson). Mississagui and Drummond Islands, Lake Huron (Dr. Bell). From Lake Superior across the plains to Quesnelle in British Columbia (Macoun). Arctic America and Sitcha (Torr. & Gray).

P. Norvegica, L. Var. hirsuta, Michx.

Indigenous. On rocky ground. Tadoussac, Quebec (Brunet).

P. paradoxa, Nutt.

Indigenous. Lake shores. Burlington Bay, Lake Ontario (J. M. Buchan).

P. Canadensis, L. Common Cinque-foil.

Indigenous. Dry soil. New Brunswick (J. F. Mathews). Vicinity of Quebec; St. Hyacinthe (Brunet). Common in Eastern Ontario (Billings). Montreal Island (Dr. Holmes). Common in Central Canada (Macoun). Common in Western Ontario (Logie, Saunders, Ellis, Gibson). River du Loup (Dr. Thomas). Plains of the Saskatchewan (Bourgeau).

P. Canadensis, L. Var. simplex, Torr. & Gray.

Indigenous. Moister soil than the last. North shore of Lake Superior (Agassiz).

P. argentea. L. Silvery Cinque-foil.

Indigenous. Dry barren fields. New Brunswick (Dr. Fowler). Sea shore, River du Loup (Dr. Thomas). Toronto (Prof. Ellis). Colborne; fields near Picton, Prince Edward County; near Kingston (Macoun).

P. Pennsylvanica, L.

Indigenous. Dry gravelly soil. St. Croix; River du Loup (Brunet). St. Roche des Autruts, Quebec (Maclagan). Lake Superior (Prof. Ellis). Oak

Point to Edmonton and westward to the Rocky Mountains (Macoun). Saskatchewan Plains (Bourgeau). Through British America to Kotzebue's Sound (Torr. & Gray).

P. arguta, Pursh.

Indigenous. Rocky and gravelly hills. New Brunswick (Mathews). Devil's Rapids, River Rouge (D'Urban). Common in Central Canada; 11 miles up the Kaministiquia (Macoun). From Fort Garry westward through Peace River Valley to the Rocky Mountains (Macoun). British America to lat. 65° N. (Richardson).

P. Anserina, L. Silver-weed.

Indigenous. Brackish marshes and river banks; shores of the lakes. New Brunswick (Dr. Fowler). Quebec and Labrador (Brunet). West coast of Newfoundland (Dr. Bell). River du Loup (Dr. Thomas). Common throughout Central and Western Canada. North shore of Lake Superior (Agassiz). Saskatchewan Plains (Bourgeau). Fort Edmonton; shore of Little Slave Lake, and along Peace River to the Rocky Mountains (Macoun). Arctic America and Greenland (Torrey & Gray). Islands of Lake Huron (Dr. Bell).

P. fruticosa, L. Shrubby Cinque-foil.

Indigenous. Wet grounds. River Restigouche; Island of Anticosti (Brunet). West coast of Newfoundland (Dr. Bell). New Brunswick (Mathews). Belmont Lake, Peterborough County, Ont., scarce; very abundant along Lakes Huron and Superior (Macoun, Gibson). Plains of Saskatchewan (Bourgeau). Montreal Island (Dr. Holmes).

P. tridentata, Ait. Three-toothed Cinque-foil.

Indigenous. Rocky ground and gravelly soil. New Brunswick (Dr. Fowler). Cape Rouge, Cape Tourmente, Straits of Belle Isle (Brunet). South coast of Labrador (Butler). Newfoundland (Torr. & Gray). River du Loup (Dr. Thomas). Three Rivers and Belœil (Maclagan). Tadoussac (Drummond). Marquette, Lake Superior (Dr. Bell). Abundant around Lake Superior; Lake of the Woods; Fort Edmonton; Fort Assinaboine; Little Slave Lake (Macoun). Saskatchewan Plains (Bourgeau). To lat. 64° N. and Greenland (Torr. & Gray).

P. palustris, Scop. Marsh five-finger.

Indigenous. Cool bogs and marshes. Labrador (Butler & Brunet), and Anticosti (Brunet). New Brunswick (Mathews). River du Loup (Dr. Thomas). Chain Lake, River Rouge (D'Urban). Island of Montreal (Dr. Holmes). Frequent in Central Canada (Macoun). Common in Eastern Ontario (Billings). Frequent in Western Ontario (Buchan, Ellis, Saunders, Gibson). Islands in Lake Huron (Dr. Bell). Thunder Bay, Lake Superior; marshes along the Dawson Route; Deer Mountains west of the Arthabasca; Upper British Columbia (Macoun). Saskatchewan Plains (Bourgeau). Arctic Circle, Kotzebue's Sound and Greenland (Torr. & Gray).

P. maculata, Poir.

FRAGARIA, Tourn. Strawberry.

F. Virginiana, Ehrhart. Common Wild Strawberry.

Indigenous. Rich woodlands and meadows. Common from Newfoundland (Richardson) and Labrador (Butler) to Lake Superior (Macoun). From Lake Superior to Edmonton, and westward through Peace River to the Rocky Mountains (Macoun). To Arctic America, lat. 64° (Richardson).

F. vesca, L. Wood Strawberry.

Indigenous. Fields and rocky places. Frequent in Ontario and Quebec New Brunswick (Dr. Fowler). River du Loup (Dr. Thomas). North shore of Lake Superior (Agassiz). Bruillé Portage, Dawson Route (Macoun). St. Joseph's Island, Lake Huron (Dr. Bell).

DALIBARDA, L.

D. repens, L.

Indigenous. Wooded banks. New Brunswick (Dr. Fowler). Common at Quebec (Brunet). River Rouge (D'Urban). Near Hamilton (Logie). Nicolet, Montreal (Maclagan). Victoria County, Elliott's Falls (Macoun). Gore Bay, Lake Huron (Dr. Bell).

RUBUS, Tourn. Bramble.

R. odoratus, L. Purple Flowering Raspberry.

Indigenous. Woods and thickets. Quebec, St. Joachim (Brunet). Lake Grenville, River Rouge (D'Urban). River du Loup (Dr. Thomas). Montreal, Nicolet, Niagara (Maclagan). Common in Eastern Ontario (Billings). Abundant in Central Canada (Macoun). Common in Western Ontario (Buchan, Saunders, Ellis, Gibson). St. Joseph's Island, Lake Huron (Dr. Bell). Goulais Bay, Lake Superior (Prof. Bell).

R. Nutkanus, Mocino.

Indigenous. Rocky thickets. Shore of Lake Superior (Dr. Pitcher). North shore of Lake Superior (Prof. Ellis). From Thunder Bay to Sault Ste. Marie, Shebandowan Lake, Dawson Route; in woods near Fort St. John, Peace River, and westward through the Rocky Mountains to Quesnelle (Macoun). Saskatchewan Plains (Bourgeau).

R. chamæmorus, L. Cloud-berry.

Indigenous. Sphagnous swamps. Labrador (Brunet, Butler). West coast of Newfoundland (Dr. Bell). New Brunswick (Mathews). Common at River du Loup (Dr. Thomas). Deer Mountains, west of the Arthabasca; Portage between Little Slave Lake and Peace River (Macoun). Greenland, Behring Straits, Unalaschka, Lake Winnipeg (Torr. & Gray).

R. arcticus, L.

Indigenous. Stem low, herbaceous, sometimes diœcious, unarmed, somewhat pubescent, mostly erect, 1-2 flowered; leaves trifoliolate; leaflets rhombic-ovate or obovate, petiolulate, glabrous, obtusely serrated; stipules ovate; sepals lanceolate, acute; petals roundish entire or emarginate; flowers of a deep rose-colour, large; fruit purplish-red. Labrador and Anticosti (Brunet). Newfoundland (Torrey & Gray). North-west angle of Lake of the Woods; marshy thickets west of Fort Pitt, Saskatchewan River; Peace River Plains (Macoun). Rocky Mountains (Bourgeau). Greenland and Kotzebue's Sound (Torr. & Gray).

R. triflorus, Richardson. Dwarf Raspberry.

Indigenous. Cedar swamps and low wet woods. Common throughout Ontario and Quebec. New Brunswick (Mathews). North shore of Lake Superior (Agassiz). Labrador (Butler). West coast of Newfoundland (Dr. Bell). From Thunder Bay, Lake Superior, westward across the continent to Quesnelle in Upper British Columbia (Macoun). Hudson Bay (Torr. & Gray).

P. strigosus, Michx. Wild Red Raspberry.

Indigenous. Thickets and hills. Common in Ontario and Quebec. Newfoundland (Dr. Bell). Labrador (Butler). New Brunswick (Dr. Fowler). Lakes Huron and Superior (Bell, Gibson, Macoun). From Lake Superior westward by Peace River Valley to Quesnelle in Upper British Columbia (Macoun).

R. neglectus, Peck.

Indigenous. Thickets and woodlands. One mile below Shannonville, Hastings County, and frequent in the Counties of Northumberland and Victoria; common at Owen Sound (Macoun). Doubtless frequent through Central and Western Canada.

R. vecidentalis, L. Black Raspberry. Thimbleberry.

Indigenous. Rich moist woods and cultivated fields. St. Joachim and Cape Tourmente (Brunet). Island of Montreal (Dr. Holmes). Common in Eastern Ontario *(Billings). Below the Mountain, Hamilton (Logie).* Chippawa, Malden (Maclagan). County Huron, Ont. (Gibson). Abundant in Central Canada; Owen Sound (Macoun).

R. villosus, Ait. *Common or High Blackberry.*

Indigenous. Borders of thickets and woods. Common throughout Ontario and Quebec. New Brunswick (Dr. Fowler). Mississagui Island and Bruce Mines, Lake Huron (Dr. Bell). Loon Portage, Dawson Route (Macoun). West coast of Newfoundland; *Mississagui Island and Bruce Mines (Dr. Bell).*

R. villosus, Ait. Var. frondosus, Gray.

Indigenous. Trailing over rocks in thickets and along fences. Abundant along the Grand Trunk Railway at Shannonville, Hastings County; and at the Carrying Place at the head of the Bay of Quinté (Macoun).

R. Canadensis, L.

Indigenous. Thickets and rocky hills. New Brunswick (Mathews). Rich woods, River du Loup (Thomas). Quarantine Station, Quebec (Brunet). Sandy and rocky places along the River Rouge, Quebec (D'Urban). Borders of woods east of Belleville; and at the Nepigon River, Lake Superior *(Macoun).* Navy Island, Niagara River (Maclagan).

R. hispidus, L.

Indigenous. Trailing amongst grass in beaver meadows. New Brunswick (Mathews). Woods north of Prescott Junction, rare (Billings). Beaver meadows and marshy flats throughout the northern portions of Addington, *Hastings* and Peterboro' Counties (Macoun). Nicolet and Niagara (Maclagan). Common in swamps at London (Saunders).

R. castoreus, Fries. (?)

Indigenous.

ROSA, Tourn. Rose.

R. setigera, Michx.

Indigenous. Borders of thickets. Malden (Maclagan).

R. Carolina, L.

Indigenous. Borders of lakes and marshy streams. New Brunswick (Mathews). Weller's Bay Lake, Ontario; North River, Belmont, Peterboro' County; Partridge Lake and Gull Lake, Addington County; swamp near Belleville, Hastings County; shores of Lake Isaac and Pike River, Bruce Peninsula (Macoun). Near Komoka, twelve miles from London (Saunders). St. Catharines, Chippawa and Malden (Maclagan). Whiskey Island, Lake Huron (Dr. Bell). County Huron, Lake Huron (Gibson).

R. lucida, Ehrhart. Dwarf Wild Rose.

Indigenous. Dry soil, or along margins of swamps. New Brunswick (Mathews). Borders of woods, Quebec, Charlesbourg and Labrador (Brunet). Newfoundland (Torr. & Gray). Common in Eastern Ontario (Billings). Rare on Rice Lake plains (Macoun). Fields west of Hamilton (Logie). St. Catharines, Malden (Maclagan). Grand Island, Lake Superior (Prof. Bell). Cape Smyth, Lake Huron (Dr. Bell).

R. blanda, Ait. Early Wild Rose.

Indigenous. Rocks and banks. Common throughout Ontario and Quebec. New Brunswick (Mathews). Newfoundland (Dr. Bell; Torr. & Gray). Manitoulin Islands, Lake Huron (Dr. Bell). North shore of Lake Superior (Macoun). From Fort Garry westward to Quesnelle in Upper British Columbia (Macoun). To Great Bear Lake (Richardson).

R. rubiginosa, L. Sweet Brier.

Naturalized from Europe. Roadsides and thickets. Frequent throughout Ontario and Quebec. New Brunswick (G. F. Mathews).

R. micrantha, Smith. Smaller-flowered Sweet Brier.

Naturalized from Europe. Roadsides and thickets. Vicinity of Hamilton (J. M. Buchan).

R. stricta, Lindl.

Indigenous. Much branched; stems armed with numerous setaceous scattered, often deciduous prickles; flowering branches mostly naked; leaflets 7-9, oval, firm, glabrous, not shining; the petiole glandular-hispid; stipules lanceolate, mostly glandular-ciliate; flowers 1-3, on glabrous or glandular-hispid peduncles; calyx-segments spreading; fruit ovoid, pendulous. *Lindley-Ros. p. 42, t. 7.* North shore of Lake Superior (Agassiz). North and east coast of Lake Superior (Macoun). Plains of the Saskatchewan (Drummond), Whiskey Island, Lake Huron (Dr. Bell). From Fort Garry to Lac la Nun (Macoun).

CRATÆGUS, L. Hawthorn. White Thorn.

C. Oxyacantha, L. English Hawthorn.

Introduced from Europe. More or less spontaneous. New Brunswick (Mathews). Charlesbourg (Brunet). Bank of St. Lawrence, two miles west of Brockville (Billings). Frequent in the Counties of Hastings and Peterborough (Macoun).

C. coccinea, L. Scarlet-fruited Thorn.

Indigenous. Thickets and rocky banks. Common throughout Ontario and Quebec. Up the Kaministiquia River, Lake Superior; Mud Portage, Dawson Route (Macoun). Saskatchewan Plains (Bourgeau). West coast of Newfoundland (Dr. Bell).

C. tomentosa, L. Black Thorn.

Indigenous. Thickets. New Brunswick (Mathews). Lobinière and Montreal (Brunet). Near Prescott (Billings). Rather rare in Central Canada (Macoun), Hamilton (Logie). Rather rare, vicinity of London (Saunders). Rare on eastern coast of Lake Huron (Gibson). Nicolet, Chippawa, Malden (Maclagan). Saskatchewan Plains (Bourgeau).

C. tomentosa, L. Var. pyrifolia, Gray.

Indigenous. Thickets. Michipicoten Island, Lake Superior; American Portage, Dawson Route (Macoun).

C. tomentosa, L. Var. punctata, Gray.

Indigenous. Thickets. Abundant in Ontario. Shallow Lakes. West of Fort Ellice, Saskatchewan Plains (Macoun).

C. Crus-galli, L. Cockspur Thorn.

Indigenous. Thickets. Beaufort, Quebec (Brunet). Niagara and Malden (Maclagan). London, common (Saunders). County Huron, Ont., rare (Gibson). Whiskey Island, Lake Huron (Dr. Bell). Owen Sound (Macoun).

PYRUS, L. Pear. Apple.

P. coronaria, L. American Crab-Apple.

Indigenous. Glades, &c. Common, London (Saunders). Prince's Island, Lake Medad (Logie). Chippawa and Malden (Maclagan). Kettle Point, Lake Huron (Gibson).

P. arbutifolia, L. Var. melanocarpa, Gray.

Indigenous. Damp thickets. New Brunswick (Mathews). Newfoundland (Torr. & Gray). Common, Quebec, Charlesbourg (Brunet). River du Loup (Dr. Thomas). Port St. Francis; St. John's, Quebec; Thousand Islands (Maclagan). Common in Ontario (Macoun, Logie, Saunders, Gibson). North shore of Lake Superior (Agassiz). South shore of Labrador (Butler). St. Joseph's and Cockburn Islands, Lake Huron (Dr. Bell). Sturgeon Lake, Dawson Route (Macoun).

P. Americana, DC. American Mountain-Ash.

Indigenous. Swamps and rocky woods. New Brunswick (Dr. Fowler). Newfoundland (Dr. Bell). Quebec and Charlesbourg (Brunet). River du Loup, common (Dr. Thomas). River Rouge (D'Urban). Nepean Township (Billings), Sparingly found in woods, Hastings and Northumberland Counties; Owen Sound and north shore of Lake Superior (Macoun). St. Joseph and Cockburn Islands (Dr. Bell). Labrador (Butler). Maline Rapids, Dawson Route (Macoun). Saskatchewan Plains (Bourgeau).

AMELANCHIER, Medic. June-Berry.

A. Canadensis, T. & G. Var. Botryapium, Gray. Service Berry.

Indigenous. Along streams. Very common throughout Ontario and Quebec. New Brunswick (Mathews). Newfoundland (T. & G.) North shore of Lake Superior (Agassiz, Macoun). Manitoulin Islands, Lake Huron (Dr. Bell).

A. Canadensis, T. & G. Var. oblongifolia, Gray.

Indigenous. Along streams. Cape Rouge (Brunet). New Brunswick (Dr. Fowler). Common at River du Loup (Dr. Thomas). Lake Medad (Logie). Along the Kaministiquia River, Lake Superior, westward through Peace River Valley (Macoun).

A. Canadensis, T. & G. Var. oligocarpa, Gray.

Indigenous. Along streams, swamps, &c. Cape Rouge (Brunet). New Brunswick (Dr. Fowler). Common at River du Loup (Dr. Thomas). Cedar swamp north of Norwood, rare; Fishing Islands, Lake Huron (Macoun). South coast of Labrador (Butler). Newfoundland, Hudson's Bay, Saskatchewan Plains (Torrey & Gray). Loon Portage, Dawson Route (Macoun).

SAXIFRAGACEÆ.

RIBES, L. Currant or Gooseberry.

R. Cynosbati, L.

Indigenous. Abundant in thickets and pasture fields. Common at Lotbinière (Brunet). Common in rocky woods, River Rouge (D'Urban). Nicolet, Montreal? Kingston, Niagara, Malden (Maclagan). Common throughout Ontario as far west as the Bruce Peninsula.

R. oxyacanthoides, Linn.

Stems usually clothed with bristly prickles; subaxillary spines 1-3 often united at the base; leaves roundish; subcordate 5-lobed pubescent or nearly glabrous, the lobes deeply toothed or crenate; peduncles very short, about 2-flowered, calyx-tube cylindraceous, pubescent at the base within; the segments spreading, rather longer than the stamens, and about twice the length of the obovate petals; style cleft to the middle, hairy at the base, a little exceeding the stamens, fruit smooth. Indigenous. Rocky margins of rivers and lakes. Abundant in New Brunswick (Fowler). Quarantine Station and Anticosti (Brunet). Red Bay, Lake Huron; Sault Ste. Marie; Thunder Bay and Pie Island, Lake Superior; Island in the Lake of the Woods; Saskatchewan Plains and westward to Stewart's Lake, Upper British Columbia (Macoun).

R. hirtellum, Michx.

Indigenous. In wet meadows and swamps, also amongst rocks in the north. New Brunswick (Fowler). Quebec, on rocks, Saguenay, and at the Quarantine Station (Brunet). Along the sea shore, River du Loup (Thomas). Common in marshy meadows around Belleville; Owen Sound; around Lake Superior; Fort Edmonton on the Saskatchewan and Fort Assinaboine on the Arthabasca (Macoun). Mississagui, St. Joseph and Cockburn Islands, Lake Huron (Dr. Bell).

(To be Continued.)

SOME CANADIAN NOMS-DE-PLUME IDENTIFIED: WITH SAMPLES OF THE WRITINGS TO WHICH THEY ARE APPENDED.

BY HENRY SCADDING, D.D.

(Continued from page 348.)

[My specimens of the writings of Patrick Swift should have preceded those given of the productions of Legion and Cinna.]

About the year 1826 or 1827, there appeared in the *Colonial Advocate,* a well-known Canadian paper of the day, a name which became subsequently a *nom-de-plume* of great note, if not notoriety, in Upper Canada. In the first instance, I believe, Patrick Swift figured simply as an interlocutor in an imaginary conference on public affairs, held in a private parlour at Toronto, or York, as the place was then called. But he afterwards appeared as the supposed compiler of a remarkable almanac, which for several successive years found its way into probably every house in Upper Canada. This publication had a purpose, independently of the use implied by its title. It was intended to advocate a radical reform in the government of the country. Patrick Swift addressed himself especially to the yeomen voters of Canada; and his pages bristled, not only with statistics of almost every kind, but with grievances and abuses, curtly and pointedly stated. At the same time the remedies were named as clearly and as plentifully. On looking calmly back now on the times in which this almanac was issued, we shall all allow that Mr. Patrick Swift was not so bad a counsellor of the public as he was once represented to be. Borrowing an idea from Benjamin Franklin, the earlier numbers of this publication were entitled "Poor Richard," with the secondary heading of "The Yorkshire Almanac," with reference possibly to the Canadian county of York, in which York or Toronto was situated. The name of the author or editor is given on the title-page, thus: "Patrick Swift, late of Belfast, in the Kingdom of Ireland, Esq., F.R.I., grand-nephew of the celebrated Doctor Jonathan Swift, Dean of St. Patrick's, Dublin, etc. etc." In later issues it appears as "Patrick Swift, Esq., M.P.P., Professor of Astrology, York." The Almanac for 1834 has dropped the "Poor Richard," and also the reference to "Yorkshire," and exhibits the fuller title of "A New Almanac for the Canadian True Blues, with which is incorporated the Constitutional Reformer's Text Book, for the Millennial and Prophetical year of the Grand General Election for Upper Canada, and total and everlasting downfall of Toryism in the British Empire."

I now proceed to give a specimen or two of Patrick Swift's style as a propagandist of Reform. After giving a long and most minute enumeration of taxes imposed in England, Scotland and Ireland, he tells the Canadian yeomanry: "In short, everything that has an existence on the face of the earth, or under the earth, or in the firmament of heaven, is heavily taxed; and these enormous taxes are laid on and expended by a body called the House of Commons, the majority of the members of which are neither directly nor indirectly the representatives of the people, but are the nominees of lords, bishops, and wealthy gentlemen. So that, if the representatives of every great county, city and populous borough in England, Ireland and Wales, were to vote for a reduction of standing armies, tithes and taxes, and for retrenchment and economy, the rotten borough and Scots close county members could and would outvote them, and uphold corruption. Yorkshiremen in Upper Canada," Swift exclaims, "think on these things! Laws grind the poor, when rich men make the laws." This, it must be noted, was written in 1831.

Then, after an analysis of the Upper Canada Parliament of 1831, showing the nationality of each of its fifty members and the numbers represented by each member respectively, he points out an injustice which seems to result from the existing distribution of seats: "The population of Upper Canada," he says, "is estimated at 215,750, which is under the actual number of souls. Assuming the fact," he continues, "that the property is in proportion to the population, and then taking population as the basis of representation, fifty members would give one representative to every 4,315 inhabitants. But, according to the present mode of proportioning the members, the minority pass laws to bind the majority. For: The members of the four towns, and for the counties of Simcoe, Durham, Essex, Kent, Wentworth, Norfolk, Oxford, Stormont, Dundas, Ottawa, Haldimand, Frontenac, and Hastings, are in number 26—the population they represent being 70,500—while the remaining counties of the province, containing 145,250 inhabitants, are represented by only 24 members, or less than half the house. Thus the representatives of less than one-third of the people are more in number than the representatives of the other two-thirds. Again: the counties of Norfolk, Dundas, Hastings, Frontenac, Simcoe, Haldimand, and Essex, and the towns of Brockville and Niagara, with half the county of Durham, possess a population of 33,250, and send 15 members to the House of Assembly—while the counties of York and Carleton, with a population of 33,500, send only three members; so that, if by a popular legislative body it is meant to obtain an expression of public opinion on matters of government, the three votes of Messrs. Morris, Ketchum and Mackenzie are a greater indication thereof than the fifteen votes given for the places before mentioned."

In the Almanac of 1834 an elaborate scheme is presented for a thorough organization of the Reformers of Upper Canada. Directions are given for the formation of "Central Committees, Town, County and Provincial Conventions, and Regular Nominations," as "the sure legal Weapons by which Reformers may Triumph." The closing exhortation is: "It must not discourage the Reformers of any township, if they happen to find themselves in the minority as compared to the other inhabitants. Let them meet, few and small as they may be, and observe the above usages, the same as if *they* counted thousands. Time, which does much, is in their favour: they may be sure that Upper Canada will form no exception to the other parts of this continent: liberal principles must prevail: freedom is indigenous in our soil." To the whole document is quaintly added: "*Sic subscribitur.* Patrick Swift."

A brief summary of principles given just before will be of interest, as it will be seen that all of them have been accepted and incorporated in our existing provincial constitutions, with the exception of the one which Patrick Swift himself at the moment did not care to press. "The Reformers," he says, "are to be known by their principles, which are: the control of the whole revenue to be in the people's representatives; the Legislative Council to be elective; the representation of the House of Assembly to be as equally proportioned to the population as possible; the Executive Government to incur a responsibility; the law of primogeniture to be abolished;

the principle of Mr. Perry's Jury Bill to be adopted; the Judiciary to be independent; the Military to be in strict subordination to the Civil authority; equal rights to the several members of the community; every vestige of church-and-state union to be done away; the lands and all the revenues of the country to be under the control of the country; and education to be widely, carefully, and impartially diffused. To these I would add that we ought to choose our own Governors; but I know that there are some Reformers who have not made up their minds upon that question: I therefore advise it be not pressed." In regard to the exception named, he expressed himself in another part of the Almanac, thus: "Patrick Swift would very willingly exchange General Colborne for a Governor such as is pictured in the following anecdote: A late number of the *London Courier* contains the following extract of a letter from America: 'I am travelling in Vermont State for pleasure and information. I have journeyed 500 miles in my own carriage, by easy stages, and have not seen a single person in my progress to whom I should have dared to offer alms! As I was detained an hour or two a few days since, I saw a sturdy-looking farmer pass the inn, driving a one-horse cart loaded with wool, on which he was seated. He drove to a store, shouldered his bales of wool, one after another, and placed them in the merchant's shop. Who do you think he was? Palmer, the present Governor of the State of Vermont.'" This story would, of course, be well relished by the majority of those for whom the Almanac was prepared. The second edition of the number for 1834 has an exasperating dedication. It is addressed to three gentlemen who were the writer's most formidable political antagonists; two of them in England, one here. It reads thus: "To E. G. Stanley and R. W. Hay, Secretaries of State for the North American Colonies, and John Beverley Robinson, Judge and Tory Politician, at York, in Upper Canada, to whose uniform support of oppression and misrule in Church and State, and steady friendship for Canada's and Ireland's oppressors, the public are chiefly indebted for this extra edition of twenty thousand 'Canadian True Blue Almanacs:' it is specially dedicated and inscribed by their trusty and well-beloved cousin and councillor, Pat. Swift." "E. G. Stanley" was subsequently the well-known Earl of Derby. It is scarcely necessary to mention, after all this, that Mr. Patrick Swift was Mr. William Lyon Mackenzie, editor of the *Colonial Advocate*, and many times elected a member of the Provincial Parliament of Upper Canada.

[My notice of "Reckoner," "Mentor" and "Mercator," should have been inserted before, among the writers on miscellaneous subjects.]

I regret that I am unable to give a sample of "Reckoner," the author of seventy essays on various subjects, said to have appeared in the *Kingston Gazette, circa* 1811. This writer was the Rev. Dr. Strachan, while yet a resident at Cornwall. I have seen communications from the same pen, in the *Christian Recorder* and the *Canadian Magazine,* signed N. N., the finals of the writer's real name. I must record also the pseudonym of "Mentor," appended to a series of letters in the *Kingston Herald,* 1839–44, afterwards collected in pamphlet form. They are a contribution to the literature of Canadian jurisprudence on the subject of discrepancies in lines of survey, arising from variations in the magnetic needle in successive years; a curious and dry subject, but yet of much interest, in Canada, to the numerous patentees and grantees of land, and even affording occasion now and then for a rhetorical burst, as, for example, here: "This province was the asylum," Mentor says, "provided by his Majesty George the Third, of revered memory, for faithful and attached subjects, who, after their settlement in a wild and uncultivated wilderness, soon experienced the liberality of a generous and just sovereign. His munificent donations of land, in compensation for their losses in property, and supplies for the three first years of the settlement, amidst obstacles and difficulties nearly insuperable, are not equalled in the history of any people or nation under any other government. With a recollection of these rewards, and under a sense of their legal and just rights, the author, under the signature of Mentor, is fully aware and sensible that the Loyalists, their heirs and descendants, do and will regard usurped occupancy, and illegal possession, and encroachment upon their patented rights and estates, with feelings of indignation and discontent towards the holders by injustice and spoliation; but towards the Government they will cherish the feelings of gratitude and loyalty; and moreover, they will justly appreciate the legacy of land left to them by their fathers, and to which they will adhere with associations of fond attachment." "Mentor" is understood to have been the Rev. George Okill Stuart, heir to lot 24 in the first concession of Seigniory No. 1. (afterwards known as the township of Kingston), as surveyed by Deputy Surveyor-General Collins, in 1783.

The series of letters signed "Mercator," addressed to the *Montreal Herald* in 1807, in the "Contest between the Earl of Selkirk and the Hudson's Bay Company on the one side, and the North West Company on the other," and afterwards issued in pamphlet form, was from the pen of the Right Hon. Edward Ellice.

I notice next one or two writers under pseudonyms whose object was the promotion of emigration and the instruction of emigrants. I enclose them in my list, however, not on this account, but because the productions themselves, being of a superior character in point of matter and style, may be said to have entered into our Canadian literature. First I name the "Backwoodsman," author of a volume entitled "Statistical Sketches of Upper Canada;" published in London by John Murray, Albemarle Street, in 1832, but dated from Goderich, on Lake Huron. The nine chapters of the little work are filled with useful statistics and matter-of-fact information, but all cleverly spiced throughout with pleasant humour. Backwoodsman undertook its composition because he was constantly in the receipt of inquiries, couched of course in polite terms, and expressing the writer's sincere sorrow for taking up so much of his valuable time: "After having filled some reams in answer," Backwoodsman says, "and when every other packet brought one, and no later than last week I had two to answer, things began to look serious, and so did I; for I found that if they went on at this rate, I should have no 'valuable time' to devote to my own proper affairs. And therefore, it being now midwinter," Backwoodsman says, "and seeing no prospect of my being able to follow my out-of-door avocations for some weeks, I set myself down in something like a pet to throw together and put in form the more prominent parts of the information I had been collecting, to the end that I might be enabled in future to answer my voluminous correspondents after the manner of the late worthy Mr. Abernethy, by referring them to certain pages of *My Book*."

Here is one of Backwoodsman's reasons why emigrants from the British Islands should prefer Canada to the United States:

"It is to many who happen to have consciences no light matter to forswear their allegiance to their king, and declare that they are willing to take up arms against their native country at the call of the country of their adoption; and unless they do so, they must remain aliens for ever; nay, even if they do manage to swallow such an oath, it is seven years before their apostasy is rewarded by the right of citizenship. In landing in His Majesty's dominions, they *carry with them their rights of subjects, and, immediately on becoming 40s. freeholders, have the right of voting* for a representative."

Some tables at the end of the volume, showing the resources and estimates of the Province of Upper Canada in the year 1832, would, if quoted at length, amuse probably as well as instruct, in these days when, to a Canadian minister of finance even in a province, such figures must seem a mere bagatelle. Here are Backwoodsman's conclusions on a review of these tables. He considers the prospects they hold *out to be encouraging*. He indulges, at the same time, in a little banter on the wisdom of the Upper House, which, it would seem, had just stopped the supplies, and *that* too at an inopportune moment. The remark about the consequent increase in the surplus is probably a joke.

"From these statements it will appear," he says, "that the revenues of the colony are in a very flourishing state; as last year we paid off 10 per *cent.* of the public debt, and this year, the Upper House having rejected the supplies on nearly the last day of the Session, when the mischief could not be remedied, it is probable the surplus will be considerably greater. It has been eloquently said of the Earl of Chatham, that he 'advanced the nation to a high pitch of prosperity and glory by commerce, for the first time united with, and made to flourish by war.' In like manner, though by no means Chathams, the legislators of Upper Canada have, for the first time I suspect, succeeded in uniting revenue with debt, and making it flourish by debt; for it will be seen that the debts of the province have been contracted chiefly for the purposes of public improvement, and that the public works, as they develop themselves, will not only repay the money expended on them, but become a permanent source of revenue to the colony. Of the £47,490," he goes on to say, "of taxes raised on the subject, directly and indirectly, we may estimate that £10,000 is paid by the United States for British goods smuggled across the frontiers, leaving £37,490 as the whole of the provincial taxes to be paid by 300,000 people,—that is to say, in even money, about 2 shillings sterling a head. So that, it appears, Brother Jonathan, with all the apparent economy of his institutions, pays to his general and particular governments ten times as much as we do; and unfortunate John Bull, who, poor fellow, is much worse able to afford it, just about twenty-five times as much."

"Backwoodsman" was Dr. William Dunlop, a distinguished contributor *to Blackwood* and *Fraser* long before his settlement in

Canada,—to the *former*, under the *nom-de-plume* of Colin Ballantyne, R.N. His early life was full of adventure in India, and, previously, on this continent, as a surgeon in the Connaught Rangers, during the war of 1812–13–14. He was also widely known by the sobriquet of the *Tiger*, for his having succeeded in clearing the island of Saugur, in India, of that pest. Dr. Dunlop died at Lachine in 1848. A fine portrait of him exists in Toronto, the property of the late Capt. Dick. It was to be seen at the Queen's Hotel in Toronto.

In 1849, a writer assuming the pseudonym of a "Pioneer of the Wilderness" produced two volumes of notes on Upper Canada, under the general title of "The Emigrant Churchman." Richard Bentley was the publisher. As a well drawn picture of western Canada at the time, it retains considerable value. "The Pioneer" was a man of superior education, a keen observer, and a skilful writer. Here is what he had to say of Brockville and the Thousand Islands: "A few miles steaming, after leaving Prescott, brought us to Brockville, which, to the author's taste, presents one of the prettiest and most interesting localities on the river side in all Canada. It is situated upon rather a steep bank, the approach to the town being prettily overshadowed by trees, amongst which the church stands a conspicuous object. A little further on, the river abounds with the prettiest rocky islets, most of them wooded more or less, among which, on a fine summer afternoon, the white sails of tiny pleasure-skiffs may be seen gleaming here and there, giving visions of health and innocent aquatic recreation. What a spot for a few Cambridge or Oxford eight-oars to turn out in! The effect of the handsome boating uniforms of the crews, and perfect appointment of the galleys of Cam or Isis, with the gay blazonry of their silken ensigns floating in the wind, the boats dashing bravely up to their stations, or shooting with racer-like velocity through the varied scene of isle and wooded bank and river, amidst the cheers of admiring thousands, was all that was wanting to complete the vision to the eye of an English University man. I am not aware," the Pioneer adds, "whether this right manly and gallant exercise is followed with any ardour by the University of Toronto. The open shores of Lake Ontario are wanting, however, in the diversity of beauty presented by the scenery around Brockville; and while we yet muse we are dashing and splashing on till islet after islet, rocky and grove-crowned, sweeping into view in lovely and still varying succession, proclaims our approach to the far-famed Lake of the Thousand

Islands. Of all the exquisite scenery that it has been the author's privilege to gaze upon, nothing that he can remember approaches this in beauty. As we shot through the open narrow and intricate channels of this watery paradise, the scene was reposing in all the luxurious softness of a gorgeous Canadian autumnal sunset. And as the glowing beams poured their bright torrents of radiance through natural watery vistas, or turned the liquid expanse to molten gold, the glorious islets seemed at times to float in light, realizing the dream of some fairy scene of paradise. Sometimes we would shoot past a spot of exquisite beauty, almost touching the shore; anon, just as our liquid pathway appeared entirely closed in, we would sweep off at an angle and open another unexpected channel, or catch a glimpse of the main-land as we wended by some bay of surpassing outline, heavily fringed with wood, all gloriously parklike to the water's side, holding forth happy visions of many a calm retreat and home of peace and love, when the axe and the plough of the colonist should have carved out an abode where the lines were fallen indeed in pleasant places. Around on the other side, a long sweep of a bay would open up towards the American shore, where it is too difficult at times to distinguish earth from water, or air from either, so softly were the lights and shadows blended; and then the channel would narrow again, until at length we brought up to take in wood at the wild-looking settlement of Gananoque."

This "Pioneer of the Wilderness," who travelled over the country with a *bonâ fide* intention of selecting a home within its borders, was a clergyman of the Church of England, named Rose. His decease occurred not long after his settlement here.

Also, in 1849, there was published in London by David Bogue, Fleet Street, a volume of "Sketches of Canadian Life, Lay and Ecclesiastical"—having on its title page, as the designation of its author, "A Presbyter of the Diocese of Toronto." This was a work intended for the benefit and information of emigrants, not of the humblest class. It is a series of pictures, cleverly and vividly drawn from the life, linked together by means of a story, giving the supposed experiences of Harry Vernon, an English gentleman's fourth son, who takes a "lot" of land in a backwoods township called Monkleigh. The following passage describes an unfortunate species of settler, still perhaps not unknown in certain parts of Canada: "They were generally persons of education, and members of highly respectable families, who had been brought up to do nothing, and who, on arriving at man's estate, found *that* an occupation in which they could not afford to continue. As they found themselves fit for nothing in England, they, or their friends for them, resolved that Canada should have the benefit of their talents and usefulness; but, alas! in a majority of instances, those who were fit for nothing at home were observed to possess the very same characteristics abroad. Others of them, again, had acquired wild and repulsive habits, and after nearly rendering their fathers bankrupt, both in purse and patience, were sent out with a few hundred pounds to Canada, to reform and provide for themselves—a most sage and sagacious plan! and one which, almost without an exception, was productive of but one result, namely, the utter ruin of the class alluded to. Freed entirely from all restraint, they gave way to the most miserable dissipation, and then wrote home romantic fictions of their exertions and good behaviour, in hopes thereby to 'do the governor' out of a fresh remittance. Many of these young men, under the impulse of novelty, set to work vigorously along with their men, but being utterly unaccustomed to such employments, the solitary charm which it possessed soon disappeared, and they were glad to seek excitement and amusement wherever it could be found. Almost the only place where it could be looked for was at each other's shanties, where they would frequently congregate," etc. "The Presbyter of the Diocese of Toronto," who embodied the results of his own observation in these truthful and graphic sketches, was the Rev. W. Stewart Darling.

The educational question in Canada some thirty or forty years since presented a tangled web of difficulties to statesmen and philanthropists. How to maintain with consistency the theories of public education which hitherto had been almost exclusively acted on in the mother country, and how at the same time to meet the evident necessities of the composite people which was rapidly taking possession of British North America, was a problem discussed again and again, and the most gloomy consequences were foretold of variation from established traditions and routine. Happily at last the *solvitur ambulando* method was applied to the question; with the results—surely not disastrous—which we see around us at this day. Of the *noms-de-plume* attached to contemporary brochures on the subject of education of more than ordinary note, I select three: "Graduate," "Scotus," "British Canadian." Graduate's memorable brochure, entitled "The University Question Considered," appeared in 1845, and it essentially helped to defeat a bill which was brought into the House in that year affecting the charter of King's College. The sample which I give of Graduate speaks of the necessity of repose for the well-being of learned societies. I do not know that the delightful dream indicated was ever realized by the learned society whose tranquillity was at the moment disturbed. "Frequent changes are injurious to any establishment," Graduate says, "but ruinous to a University. It is impossible that the objects of such an institution can be attained if it be subjected to repeated modification. Alterations, if often introduced even by its own authorities, are most prejudicial to its welfare; but the very anticipation of external interference in its management would produce the most mischievous effects. *Non solum adventus mali, sed etiam metus ipse affert calamitatem.* Repose is absolutely essential to its success; if disturbed, or even liable to be disturbed, it must fail. Its pursuits are such that they cannot be successfully prosecuted without peace and tranquillity. They require a devotion of the mind which cannot exist if apprehensions of change are constantly obtruding themselves, and every member of the establishment would feel the pernicious influence of this dread. The governing body would shrink from the responsibility of adopting any system as permanent which they knew not when they might be compelled to change; the professors would be paralysed in the discharge of even their routine duties, and instead of enjoying the liberty, or feeling the inclination to prosecute the favourite subjects of their study during their leisure hours, would be reduced to the miserable necessity of employing them in efforts to conciliate or struggles to resist the spirit of innovation; whilst the students would refuse to submit to discipline attempted to be enforced by those whose authority they knew might be abrogated or superseded by a power capable of revolutionizing the whole system and establishment." The "Graduate" who thus, at a troubled period of our local history, urged on legislators and others the indispensable necessity of establishing tranquil surroundings for a seat of learning, is to be identified with the writer whom we have already seen, as "Maple-leaf," inaugurating amongst us a higher literature, the Rev. Dr. McCaul.

A noticeable series of letters on educational topics appeared in the *Hamilton Gazette* about the year 1850, subscribed by the *nom-de-plume* of Scotus. They were exceedingly well written, and deserved to be collected, as they were, in pamphlet form. They repay perusal still, being a valuable contribution, on the conservative side, of the vexed question of religious education. As a specimen of Scotus, I select a passage containing a view somewhat opposed to a popular notion on the subject of education; and also the statement of a fact connected with Scotland which is not generally realized:

"In order to raise up a national system of education in any country," Scotus says, "instead of beginning at the bottom and ascending upwards, you must reverse the order and begin at the top and descend downwards; or, in other *words, you* must first erect a noble university, filling its chairs with men illustrious in science and literature, and thereby create in the public mind a TASTE for learning in its highest departments; and afterwards, the inferior schools will follow as a matter of course. Or, to make use of a simile, the supplying of a country with education may be likened to the supplying of a great city with water,—the first step in the business is to erect a great reservoir or fountain-head, from which the lesser streams may be diffused in all quarters. The foundation on which I rest my argument is, I humbly conceive, sound and obvious. Literature and science are things for which there is naturally no demand, GENERALLY, in the public mind in any country. A taste for these refinements of civilization must, therefore, be first created by, as it were, a forcing process, and until that taste is so created, you may set about the erection of Common or District Schools till the end of time, but will find that all your labours have been vain and fruitless. * * * I am quite aware." Scotus then goes on to say, "that it is quite common to hear persons state, in reference to Scotland, that she owes all her education to her Parish Schools. A more ignorant assertion was never made. Scotland, and I flatter myself I know her well, owes all her education, PRIMARILY, to her Universities; and it may with safety be affirmed that had not these venerable fountain-heads of learning been first erected by the piety and munificence of her Kings and Churchmen, such an establishment as a parish school in Scotland would never have had an existence."

Our Scotus was Mr. David Burn, formerly Deputy Registrar for the county of Wentworth. The pamphlet containing his collected letters is entitled "Colonial Legislation on the Subject of Education."

I next mention the *nom-de-plume* of "British Canadian," attached to a long series of communications in the *Hamilton Spectator* some twenty years ago: treating ably of a great variety of public matters; among them, of education. I give as a specimen of "British Canadian" a short extract, which will serve to show the agitated state of the public mind on the subject of education in 1851. He strongly opposes, under the circumstances of the country, the retention of a faculty of theology in the national university. He says: "It is with difficulty that the great English universities retain their exclusive religious character: and surely it is needless to attempt to raise up such an institution in Canada, after the experience we have already had. Canada, which glories in its British parentage, is happily placed at such a distance from the seat of empire, that we can contemplate the throes of church and state corruption, if not without fear, at least not without warning: for just in proportion as the church derives support from the state, *i.e.* from the endowments of public property, so is the danger of religious commotion and sectarian enmity. This cannot be fostered by surer means than by the establishment of an exclusive university." "British Canadian," nevertheless, advocates a genial intermingling of religion with common affairs. On this point, he delivers himself thus, in Letter cxvii., wherein he draws a picture of the ways of the world, only too truthful: "Many persons, I am aware," he says, "are opposed to the introduction of religion in politics. Not because they are averse to religion, but because they consider it a subject too sacred to be mixed up with the news of the day. Politics with them is the business of the day: religion relates to eternity. In other words, all their talents and energies they devote to those objects which seem to promise worldly prosperity: and their hours of ease and lassitude they devote to religion. How mistaken such persons are, in separating religion from the more immediate business of their lives, I need scarcely point out. Suffice it to say, that by so doing they run the risk of losing the substance, while they are pursuing the shadow. Six days they labour, with no higher object in view than to increase their worldly store: the seventh day they generously devote to their soul's ease. They go to the house of God for an hour or so, and having criticised the sermon, the duties of religion they consider fulfilled: and they devote the rest of the week to secular affairs and politics. I admit that a newspaper is not the place where we should look for a sermon or discourses on the necessity of prayer and the virtues of a holy life; but there are circumstances connected with religion which render it not only proper, but which imperatively call upon us to take notice of them, and to urge them upon the consideration of our fellow-subjects. These circumstances exist in Canada West at the present moment." (This in January, 1851.)

The letters of "British Canadian" were from the pen of the late Mr. Edward Ermatinger, of St. Thomas, author of a valuable and interesting "Life of Colonel Talbot, and History of the Talbot Settlement."

I am now, finally, to identify some *noms-de-plume* which from time to time in the past have been appended to poetical productions of note in our Canadian periodicals, and to give samples of each. In accomplishing both portions of this part of my undertaking, I shall aim at brevity.

1. The first of my poetical *noms-de-plume* is that of "Roseharp." In 1823, a literary magazine was issued for a short time at York (Toronto), entitled "The Roseharp; for the Encouragement of Loyalty, Genius and Merit;" and in Fothergill's *Weekly Register* there were occasional communications in verse, subscribed "Roseharp." Here is a specimen, dated Jan. 8, 1824:

O where was Prudence, cautious power,
  When first my venturous youth began?
She came not to the Muses' bower,
Where passed I many an idle hour,
  To tell of life's short fleeting span;
Nor did she prophesy of woe
To chill my heart's impetuous glow.
  "But thou, O Hope, with eyes so fair,
    What was thy delighted measure?
    Still it whispered promised pleasure,
  And bade the lovely scenes at distance hail."
This was my favourite minstrel's song.
  My morn like his was fair and bright—
Then Hope with Pleasure danced along,
  And gave me visions of delight;
Then wildly throbbed each pulse at thy sweet smile:
O linger yet, sweet Hope, with me awhile.

The originator of the "Roseharp" miscellany, and the writer of the "Roseharp" pieces, was Mr. James M. Cawdell, attached for a time, in some capacity, to the Law Courts at Toronto, and formerly an officer in the army.

2. In 1825, also from the press of Charles Fothergill, appeared a rather elaborate poem entitled "Wonders of the West, or a Day at the Falls of Niagara," by "A Canadian." The *dramatis personæ* of the story are some French tourists. The metre and style are those of Scott's *Lady of the Lake.* Incidentally we have the following

lines in honour of Col. Nichol, recently killed by accidentally driving in the darkness of the night over the precipice at Queenston.

Nichol, the sympathetic tear shall flow
From all who knew thee, and from all who know
That, snatched in the prime of life from all that binds
The heart to earth, and gives to human minds
A wish to lengthen out existence here,
From fortune, friends, and family most dear,
Ambition's prize, nay, merit's claim, in sight,
Which thou had'st amply earned, both day and night,
With unremitting toil and anxious care,
Serving the country both in peace and war.
When thou had'st reached the summit and prepared
To cease thy toil, and reap thy just reward,
Thou wast, that moment, from the summit hurled
To be rewarded in another world.
Thy widowed mourner weeps, nor weeps alone—
A country's grief re-echoes to her moan;
Weeps for her statesman and her hero dead,
Nor hopes to find an equal in his stead.

"A Canadian" was Mr. James Lynne Alexander, afterwards a Clerk in Holy Orders.

3. "Erie-us" was a signature attached to poetical pieces in our local periodicals in and before 1838. I quote part of a "Eulogy on Sussex Vale in New Brunswick," thus subscribed:

Fanatic and hypocrite, disfigured in face,
Rant, cant, sect and radical, here find no place
The social relations to set all ajar,
And the sweets of a rational intercourse mar.
The politeness of kindness, the confidence fair,
Of integrity meek, unassuming,—the air,
The port, manner, habit, and action of truth
And true manliness, wrought into childhood and youth.
The graces of goodness unshackled by art;
The large hospitality warm from the heart;
The walk circumscribed by the duties of life;
These duties fulfilled without envy and strife.
Oh, sweet vale of Sussex! such things did I see
In thy children, the loyal, the happy and free;
And I praised the good ways that our forefathers trod,
For the building of man in the peace of his God.

I give another sample of Erie-us, taken from a poem of his of considerable length, written in 1818, and entitled "Talbot Road." It commemorates the patriotism and energy of Col. Talbot, the local eponymous hero: it describes the rise and progress of the settlement; its devastation by invaders in 1812; its rapid recovery. I select the writer's brief recapitulation towards the end of his poem. It reads like a passage from Drayton's *Polyolbion.* Occasionally a primitive local name, as Catfish Creek, is ill-adapted to poetic purposes. Thus Erie-us sings:

In Norfolk county, first the Talbot street,
East, makes its course through Middleton complete;
Thence into Middlesex, through Houghton gore,
And thence through Bayham, (where was marked before
A bridle-path)—thence Otter Creek comes down
From Norwich, lengthwise, nearly through the town,
On which, e'en now, the oar fair Commerce plies
And the first efforts of her empire tries—
Earnest of future wealth. Next, alongside
Is the fine thriving town of Malahide,
In which famed Catfish has its eastern source
And spreads the richest bottoms in its course.
Wellington mills, late-built, on Catfish stand,
To answer agriculture's loud demand;
A work substantial, such as should be found
Where a fine growing country stretches round.
In order next upon the list appears
Yarmouth, whose fame has filled ten thousand ears,
For beauteous plains, rich soil, translucent rills,
Its rolling surface and its verdant hills;
Its waving cornfields and its meadows gay,
Where bleating flocks already bound and play;
A town, St. Thomas, is in Yarmouth laid,
On a bold bank by Kettle river made,
O'erlooking the broad vale which 'neath it lies—
A striking picture in the traveller's eyes.
Southwold succeeds, in which the North Branch road
Turns off to Westminster, as has been show'd:
Next Dunwich, ending Talbot Road the East,
From whence it is denominated West.
Next Aldbro'. Now the reader must be sent
From Middlesex into the county of Kent:
Then follows Orford, &c.

"Erie-us" was Adam Hood Burwell, afterwards Col. Burwell, after whom Port Burwell on Lake Erie is named..

4. I have already given a poetical quotation from "Cinna," and identified the writer. That was from a piece in the style of Hood. I now give a few lines from a song in graver strain, by the same hand:

I trembled when her warbling voice
  Poured forth the tide of song,
And bade the admiring hearts rejoice
  Of all the listening throng.
Wealth ceased the while to sum his
  To catch the thrilling lays; [pelf,
And pride forgot his dream of self
  To utter words of praise.
The worm the rose's petals fold,
  Gnaws at its inmost core,
And love that never must be told
  Consumes the heart the more.

5. In 1843, "Plinius Secundus" published at Toronto his "*Curiæ Canadenses;* or, the Canadian Law Courts: being a Poem describing the several Courts of Law and Equity," &c. The writer adopts the Hudibrastic style. Thus he proceeds:

A Common Pleas was there erected,
Where Subject's Rights should be protected.
Then a Queen's Bench forthwith arose,
The Suitors' injuries to dispose,
With a Chief Judge and Puisnes four,
At every Term to ope the door:
Four times a year beginning Monday,
And always ending next to Sunday;
Cum Banco Sittings for Judgments, Pleadings
To be digested after readings,
And as *mortalium nemo sapit,*—
Appeal Court then the Record *capit,*
Where great and gravest heads do meet,
To make the Law still more complete.
Then skill and science to acquire,
Experience and forensic fire,
A Practice Court behold appended,
That Forms and Rules may be amended
Now, too, is heard from legal forts
A regular volley of *Reports,*
After command from Osgoode's Benches,
And charge from Chiefs in open Trenches.

The following lines enumerate the places of public resort to which the Judges may betake themselves, if they will, during Vacation:

Thrice happy soil, where, without measure,
Enjoyment may flow o'er with pleasure!
For Saratoga, or its drinks,
The Whirlpool or Niagara's brinks,
Or Caledonia's far-famed springs,
Or the ten hundred sparkling Rings
That deck St. Lawrence mighty river,
Guarding its spangled tide for ever,
The Judge from toil may well relieve,
Until his wonted strength retrieve.

"Plinius Secundus" was Mr. John Rumsey, an English attorney, who made Canada his home for a short time.

6. A writer in our periodicals in 1843 assumed the name of the poet who figures in Sir Walter Scott's *Pirate*, who had "once taken a pinch of snuff out of glorious John Dryden's snuff-box, and never suffered his friends to forget it"—Claud Halcro. I transcribe his "Crusaders' Hymn before Jerusalem:"

Now onward! for our banners in the wind are waving free,
The Sultan's troops are streaming forth like to a surging sea;
"God wills it!" is our battle-cry—Jerusalem our prize;
We couch the lance, we wield the sword beneath our monarch's eyes.
Hark! from the city of our God, our Saviour's hallowed shrine,
The Saracen's bold music floats, the silver crescents shine!
The Infidels have stalled their steeds within her sacred walls;
To draw the sword, our Christian faith—our knightly honour, calls!
The sun is up—on tower and wall he gilds the flashing spear;
But the Lord of Hosts is with us! Shall Christian warriors fear?

Raise not the lance, nor stay the sword from slaughter of the foe—
Peace offerings to the Holy Shrine the Moslem's blood shall flow!
Think on the weary pilgrim, o'er the long and toilsome way
Who dragged his limbs to Salem's walls his pious vows to pay!
Just Heaven! the blighting breath of war surrounds the sacred fane!
His humble prayer is laughed to scorn, his march of toil is vain!
Look on the holy city, that hath kissed a Saviour's feet,
E'en there the unbelieving dog with scorn our prayers would greet!
Then spur the steed, and brace the arm, and fling defiance high,
For the trumpet call hath sounded, and the turbaned host is nigh!

They come, they come, with hourrà wild, and many a bristling spear,
And the war-shout of the Paynim band breaks on the startled ear!
They call, with words of mystery—high-shouted, earnest prayer—
On Mahomet, their prophet false, his followers to spare!
But we unto the living God our hopeful incense send,
And the shouts of rival hosts with words of adoration blend!
Lo, in their van the crescent of bold Saladin, afar
Gleams brightly from the lesser host, and lights them to the war!
But our lion-hearted monarch waves aloft his trusty sword—
Then onward, we will triumph in our arm of strength, the Lord!

"Claud Halcro" was Mr. John Breakenridge of Belleville. Shortly before his early death, his poems appeared in a collected form.

7. Some forty years since, many Canadian readers were familiar with the *nom-de-plume* of "Zadig," subscribed to numerous fugitive pieces of graceful verse on historical and patriotic subjects. I tran-

scribe some stanzas by this writer, on the "Martial Music of England," which is described as perpetually encircling the habitable globe:

'Tis morn on green Australia's woods:
The broad Pacific's kindling floods,
  Flush'd with warm sunlight, glow;
A trumpet wakes the silent dawn,
A war-drum sweeps its summons on—
  Far, far, the glad sounds flow.
O'er spicy wave and Indian isle,
Such strains still greet the day-god's smile,
  Break the bold Briton's rest;
Fort William's stern reveillé beats,
O'er realm and main the brave sound fleets,
O'er the wild Afghan's far retreats
  To Ghuznee's vanquish'd crest!
Awake! pale giant of the Cape,
The sunlight gilds thy phantom shape!
Wake Mount of Lions, stern and hoar,
'Tis morn on Afric's golden shore;
  Then the bold echoes ring;
Answers the Spaniard's aerial height—
Gray Malta's tempest-scoffing might,
Ionia's isles of song and light,
  Hear the wild music sing.
Nor silent sleeps th' Atlantic wave—
  The chorus bursts once more
Up from the Gallic Thunderer's grave—
  Bermuda's summer shore.
Fair England's voice is swelling now
Round old Quebec's embattled brow;
  On, on the war-strains sweep,
O'er Erie's wave, o'er soft St. Clair,
Fresh clarions waft the burden there
  O'er Huron's giant deep.
Lone wood and lake the glad sounds wake,
  Till Columbia's rushing river
Sweeps its tribute song to the main along—
  Old England's might forever!

It was understood that "Zadig" was the *nom-de-plume* of Mr. J. H. Hagarty; since, the Hon. Chief Justice Hagarty.

8. I regret that I am not able to give a sample of "Isidore," an admired writer of verse some seventeen years since in Montreal periodicals. His pieces have been collected in book-form under the general title of *Voices from the Hearth*. They are said to evince poetic feeling, melody of diction, and happiness of expression. The

author's real name is Ascher. Though called to the Bar in the Lower Province, he has taken up his abode in England.*

9. One who, as a poet, appears to have sought to be known among us chiefly as "he who sang the Song of Charity," has, besides the composition bearing that title, contributed to our literature several pieces of permanent interest. I quote the close of a poem of his, entitled "A Canadian Summer's Night." It is a picturesque description of the sights and sounds and suggestions of a night spent on the waters of Lake Couchiching.

The lights upon the distant shore
That shone so redly, shine no more:
The Indian fisher's toil is o'er.

Already in the eastern skies,
Where up and up new stars arise,
A pearly lustre softly lies.

And time it were for us to take
Our homeward course across the lake
Ere yet the tell-tale moon awake.

O Night—where old shape-hauntings dwell,
Though now, calm-eyed:—for thy soft spell,
O soothing Night! I thank thee well.

Just before, a canoe had been passed, evidently bound for Rama. A momentary contest of speed between it and the white man's craft is described:

Swifter and swifter on we go;
For though the breeze but feigns to
 blow,
Its kisses catch us, soft and low.

But with us now, and side by side,
Striving awhile for place of pride,
A silent dusky form doth glide.

Though swift and light the birch canoe,
It cannot take the palm from you,
My little boat, so trim and true.

"Indian, where away to-night?"
"Homewards I wend: yon beacon-light
Shines out for me:--Good night!" "Good
 night!"

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* I have never observed a copy of Mr. Ascher's poems exposed for sale at any of the booksellers' in Toronto. The absence of inter-communication between publishers in the Canadian cities is a curious phenomenon. Books published in Quebec, Montreal and Halifax are by no means, as a matter of course, to be seen in Toronto; and, in like manner, books published in Toronto are not, as a matter of course, to be seen in Quebec, Montreal and Halifax. In a recent editorial of a literary paper of wide circulation published at Montreal (the *Canadian Illustrated News*), it was amusing to have the writer confessing that he had never seen Mr. Watson's "Legend of the Roses," although he had reason, he said, to believe it "a work of the highest character;" and two years had elapsed since its presentation to the public. This was because Mr. Watson's book happened to be printed at Toronto, and not in Montreal. It is probable that M. Edmond Lareau, of Montreal, had in 1874 never chanced to form the acquaintance of the *Canadian Journal*, published now for more than twenty years at Toronto, under the auspices of the Canadian Institute. We should otherwise have seen in his "Histoire de la Littérature Canadienne," some reference to the many valuable contributions to Canadian science, literature, and history which are to be found in its pages. M. Lareau's enumeration of Franco-Canadian writers is copious and interesting. On the issue of a new work in any Canadian town, might not a few copies be sent to the principal booksellers in each of the other Canadian towns for the inspection of customers; to be taken back if not sold within a given time? This practice would perhaps produce more buyers than the customary newspaper notices do at present.

He who sang the "Song of Charity," it is probably no serious breach of secrecy to state, was *Professor Chapman of the University of* Toronto.

10. To one more poetic *nom-de-plume* of distinction Canadian literature may in some sort put in a claim, namely, that of "Wil. D'Leina, Esq., of the Outer Temple." It is to be observed that the recent edition of a collection of "Spring Wild Flowers," to which that pseudonym was at first prefixed, is dated from Toronto; and some pieces now included in it will be recognized as having once graced the pages of the *Canadian Monthly*, published in Toronto. The author, speaking in his own name, in the new edition refers to these productions as "sins of his youth." *Splendida peccata*, will be *the reader's observation after a study of the volume. I give* brief samples:

Oh, to be in Scotland now
When the mellow autumn smiles
So pleasantly on knoll and howe;
Where from rugged cliff and heathy brow
Of each mountain height you look down defiles
Golden with the harvest's glow.

Oh, to be in the kindly land,
Whether mellow autumn smile or no,
It is well if the joyous reaper stand
Breast-deep in the yellow corn, sickle in hand;
But I care not though sleety east winds blow,
So long as I tread its strand.

To be wandering there at will,
Be it sunshine or rain, or its winds that brace:
To climb the old familiar hill;
Of the storied landscape to drink my fill,
And look out on the gray old town at its base,
And linger a dreamer still.

* * * * * *

Oh, to lie in Scottish earth,
Lapped in the clods of its kindly soil;
Where the soaring laverock's song has birth
In the welkin's blue; and its heavenward mirth
Lends a rapture to earthborn toil—
What matter! Death recks not the dearth.

And here is the opening of a colloquy between "Earth and Sea."

Sitteth the green Earth and hearkeneth to the Sea,
Ever as its moaning waves croon lullabie;
Ever as its troubled waves ask: "Earth! Earth!
Where wert thou, mother auld, afore my birth?
Where wert thou then, and what wilt thou be
In the coming time o' Eternitie?"
Answereth the Earth to the vexed Sea:
"I was a maiden afore I bore thee;
In the formless void, where nae sun had shone,
I was a maiden, and dwelt all alone;
As like to sic home as a babe could be
Fresh come frae the womb of Eternitie."
"And what did'st thou in thy long, long home?"
Answereth the green Earth: "Long did I roam;
But Eternitie's wider than Chaos's pall,
An' God's eye's above, and his hand 'neath all;
And I heard far-off sounds that whispered to me
In the crooning chimes o' Eternitie;
An' the life divine was aye brooding o'er me,
Till Time woke frae dreaming when I bore thee.
Within th' eerie caves of thy dark, deep womb,
Strange types of being fand kindly home,
Till in forms of beauty young life gat free
Frae the lone, lang dream o' Eternitie."

This garland of spring-flowers, which, after the lapse of perhaps a quarter of a century, has been presented to the world afresh by the Messrs. Nelson of Edinburgh, was put together by the hand of Professor Daniel Wilson, now of Toronto, of whose name Wil. D'Leina is a partial anagram.

I might add the *nom-de-plume* of "Fidelis," and identify it. Distinguished as it has now become amongst us, in the departments of poetry, of prose-fiction, of metaphysical discussion, it has won and will retain a place in our nascent literature. But it was no part of my design to glean in recently opened spaces in the Canadian field of letters, but to confine myself to products of the first clearings. Possibly hereafter a Canadian Warton, a Canadian Hallam, a Canadian Taine, desirous of seeing of what kind were the very first shootings forth of cultivated Canadian intellect, will be thankful for the enumeration of pseudonyms now given, and for samples of the writings to which they are appended.

In the future, I suppose, there will still from time to time be appearing, under feigned names, discussions of political, social, and general subjects, and works of fiction in prose and poetry, all so strongly stamped by cleverness and good sense, and so remarkable for the vigour, and purity, and beauty of their conception and execution, as to induce a general curiosity, and even pride, in relation to their authorship. But I think the fashion of writing in a veiled way will probably not again come into vogue to the extent in which it was prevalent during the reign of the Georges and previously. We have now to congratulate ourselves, not only on the settlement of numerous exasperating questions—which set our grandfathers at home and here by the ears, and the open discussion of which brought with it peril to life and limb—but also on the possession of a free press, and consequent upgrowth amongst us of a greater liberality of sentiment and a more charitable public opinion. Milton's doctrine has prevailed: "What advantage is it to be a man," asks Milton in his Areopagitica (ii. 78), "over it is to be a boy at school, if we have only escaped the ferula to come under the fescue of an imprimatur? if serious and elaborate writings, as if they were no more than the theme of a grammar-lad under his pedagogue, must not be uttered without the cursory eyes of a temporizing and extemporizing licenser? He who is not trusted with his own actions—his drift not being known to be evil, and standing to the hazard of law and penalty—has no great argument to think himself reputed in the commonwealth wherein he was born for other than a fool or a foreigner."

Writers here and in Britain will probably more and more hereafter, deliver what they have to say, over their own names, fearlessly and without reproach, enjoying the *kudos* and the gratitude which communities are ever ready to accord to those who will embody in apt language for them their own latent thoughts, and conveniently supply to them "aids to reflection," and sensible views of their surroundings in the universe. Such is the choice of the contributors to the modern influential periodicals, the *Contemporary* and the *Fortnightly*, each writer signing his own name, and "standing," as Milton speaks, "to the hazard of law and penalty." Or else, as we see done in the grave pages of the old Quarterlies, in the ever-ready, masterly daily leaders of the London *Times*, and in the multitudinous free-lance onslaughts of the *Saturday Review*, they will prefer to discuss questions wholly in the abstract, putting out of the way altogether the disturbing consideration of authorship, and letting words and arguments go exactly for what they are worth.

CANADIAN INSTITUTE.

ANNUAL REPORT OF THE COUNCIL FOR THE YEAR 1875-6.

The Council of the Canadian Institute have the honour to submit the following Report of the proceedings of the Society during the present year.

This year has been an important one to the Institute on account of the commencement of the new building, which is now nearly completed. At a special general meeting, held on the 6th of May last, the Council were authorized to take the necessary steps for the erection of a new building. On the 27th of June, the Council accepted tenders for the proposed work, and immediately afterwards the books and furniture of the Institute were removed to the School of Practical Science. A special general meeting, held on the 5th of July, authorized the Council to mortgage the premises of the Canadian Institute, in order to raise money for the contemplated undertaking; and the corner stone of the new structure was laid by His Honour the Lieutenant-Governor, on the 11th of August, 1876.

MEMBERSHIP.

It will be seen from the last Annual Report, that the members at the close of last Session numbered 342. During the past Session 27 new members have been elected, there has been one death, and one member has withdrawn. Hence the present Membership is nominally as follows:

Members at the commencement of the Session, Dec. 1st, 1875 ..		342
Members elected during the Session, 1875-6		27
		369
Deduct:		
Deaths	1	
Withdrawn	1	
	—	2
Total Membership Dec. 1st, 1876		367
Composed of:		
Honorary Members		2
Life Members		12
Corresponding Members		1
Ordinary Members		352
Total		367

Unfortunately, however, this number does not represent the actual Membership of the Canadian Institute, for of these 367 nominal members only 126 are in good standing, and receive copies of the Journal.

It is highly gratifying to note a large increase in the number of new Members elected during the past year. The number of new Members is one-third greater than in any year during the past thirteen years, and more than twice the average number. The Council would take this opportunity of urging upon Members the necessity of exertion in this direction, as upon the number and character of new Members introduced the future welfare of the Institute must depend.

Annexed will be found the Statement of the Treasurer, and an Appendix containing the titles of the books, pamphlets and papers received during the year.

COMMUNICATIONS.

The following valuable and instructive papers and communications were read and received from time to time, at the ordinary meetings held during the Session:

December 4, 1875.—Prof. Daniel Wilson, LL.D., on "The Esquimaux and the Post-Glacial Man of Europe."

December 18, 1875.—Rev. W. H. Withrow, M.A., on "The Antiquity of Man from a Conservative point of view."

December 18, 1875.—W. H. Ellis, M.A., M.B., on "Some remarkable Nitro-Glycerine Explosions."

January 15, 1876.—Rev. Dr. Scadding, on "Some Canadian Noms-de-plume identified."

January 22, 1876.—Andrew Elvins, Esq., on "The Cause of Planetary Rotation."

January 29, 1876.—W. Oldright, M.D., on "Legislation and Sanitary Science."

February 5, 1876.—Prof. R. Ramsay Wright, B.Sc., on "Haeckel's Anthropogenie."

February 12, 1876.—Prof. E. J. Chapman, Ph.D., on "The Detection of Titanium in Iron Ores," and one on "Some new Canadian Minerals."

February 19, 1876.—W. H. Ellis, M.A., M.B., on "A Borax Deposit of California."

February 26, 1876.—Dr. C. B. Hall, on "The Causes of Epidemics."

March 4, 1876.—Rev. W. H. Withrow, M.A., on "Types in Creation."

March 10, 1876.—Prof. J. Loudon, M.A., on "Lecture Notes," consisting of—

1. An Apparatus to illustrate the Recomposition of Light.
2. On a Method of determining the Differential Expression for Components of Acceleration.

March 18, 1876.—R. W. Phipps, Esq., on "The Possibilities of Canadian Nationality."

March 25, 1876.—Prof. Daniel Wilson, LL.D., on "Some traces of the Pre-Aryan Races of Europe."

April 1, 1876.—Dr. J. McCaul, LL.D., on "The Egyptian Memnon."

ADDITIONS AND DONATIONS TO THE LIBRARY OF THE CANADIAN INSTITUTE.

RECEIVED FROM DECEMBER 1ST, 1875, TO DECEMBER 1ST, 1876.

CANADA.—

Journal of Education, Quebec, for 1876.
Journal of Education, Ontario, for 1876.
Canadian Naturalist, Montreal, Vol. VII., Nos. 7 & 8: Vol. VIII., Nos. 1, 2. *The Society.*
Annuaire de L'Institut Canadien. De Quebec. *The Institute.*
Souvenir de La Societé St. Jean Baptiste. De Montreal.
Canadian Entomologist for 1876. *The Society.*
Canadian Journal of Medical Science, 1876. *The Publishers.*
Statutes of Ontario, 39th Victoria.
Report of the Minister of Public Instruction, Province of Quebec, 1873-4. *The Department.*
Pharmaceutical Journal of the Ontario College of Pharmacy. *The College.*
Annual Report of the Entomological Society, Province of Ontario, for 1875. *The Society.*
Journal De L'Instruction Publique. Quebec.
Report of Progress for 1874-5, Geological Survey of Canada. *The Department.*
Annual Calendar of McGill College and University, Montreal.
Proceedings and Transactions of the Nova Scotian Institute of Natural Sciences, Halifax, for 1874-5.
Meteorological and Magnetic Reports of the Dominion of Canada. Supplement No. 3, 1876.
Histoire De L'Ile D'Orleans. Par L. P. Turcotte. *The Author.*
Le Canada sans L'Union. Par L. P. Turcotte. *The Author.*
Toronto of Old. By Rev. H. Scadding, D.D. *The Author.*
A Synopsis of the Family Unionidæ. By J. Lea, LL.D. *John Notman.*

ENGLAND.—

Proceedings of the Royal Colonial Institute, Vol. VI. 1874-5.
Report of the Council of the Royal Colonial Institute on the Newfoundland Fishery Question. 1875. *The Institute.*
Remarks on a New Map of the Solar Spectrum. By J. Norman Lockyer. *The Author.*
Journal of the Anthropological Institute of Great Britain and Ireland. Vol. V., Nos. 2, 3; Vol. VI., Nos. 1, 2. 1875.
Free Trade and the European Treaties of Commerce. *The Author.*
The Creed of Free Trade. By D. A. Wells, LL.D. *The Author.*
Annual Report of the Royal Asiatic Society of Great Britain and Ireland. 1875. *The Society.*
Journal of the Royal Asiatic Society of Great Britain and Ireland. Vol. VII., Part 2; Vol. VIII., Part 1. *The Society.*
List of the Geological Society of London, 1874-5. *The Society.*

Quarterly Journal of the Geological Society of London. Vol. XXX., Parts 4, 5; Vol. XXXI., Parts 1, 2, 3, 4. *The Society.*

Proceedings of the Royal Geographical Society of London. Vol. XIX., Parts 1-7; Vol. XX., Part 1. *The Society.*

Journal of the Royal Geographical Society of London. Vol. XLIV. 1874. *The Society.*

Proceedings of the Literary and Philosophical Society of Liverpool. Vol. XXIX. 1874-5. *The Society.*

Bibliotheca Orientalis. By B. Quaritch. 1876. *The Author.*

The Science of the Weath r. By B. 1867. *The Author.*

On the Tides of the Arctic Seas. By Rev. S. Haughton, D.C.L., F.R.S. *The Author.*

History of Free Trade in Tuscany. By J. Montgomery Stuart. 1876. *The Author.*

Annual Report of the Leeds Philosophical and Literary Society for 1875-6. *The Society.*

Proceedings of the Linnæan Society, Session 1874-5. *The Society.*

Additions to the Library of the Linnæan Society. *The Society.*

Journal of the Linnæan Society. Botany. Vol. XV., Nos. 81-84. *The Society.*

Journal of the Linnæan Society. Zoology. Vol. XII., Nos. 60-63. *The Society.*

SCOTLAND.—

Proceedings of the Society of Antiquarians, Scotland. Vol. IX.. Part 2; Vol. X., Parts 1, 2, 1873-4-5; Vol. XI., Part 1. *The Society.*

Transactions of the Royal Scottish Society of Arts. Vol. VIII., Part 5; Vol. IX., Parts 1, 2, 3, 1874-5. *The Society.*

Proceedings of the Royal Physical Society of Edinburgh, Session 1874-5. *The Society.*

Proceedings of the Royal Society of Edinburgh, Session 1874-5. *The Society.*

Transactions of the Royal Society of Edinburgh. Vol. XXV., Part 3. 1874-5. *The Society.*

Proceedings of the Philosophical Society of Glasgow. Vol. X., No. 1. 1875-6. *The Society.*

IRELAND.—

Proceedings of the Dublin University Biological Association. Vol. I., No. 1. 1874. *The Association.*

Proceedings of the Royal Irish Academy. Vol. I., Nos. 4-10; Vol. II., Nos. 1-3.

Transactions of the Royal Irish Academy. Vol. XXIV., Parts 19, 16, 17; Vol. XXV., Parts 1-19. *The Academy.*

Journal of the Dublin Royal Society. Vol. VII., No. 44. 1875. *The Society.*

UNITED STATES.—

Proceedings of the Academy of Natural Sciences, Philadelphia. Parts 2, 3, 1875; Part 1, 1876. *The Academy.*

Check List of Ferns of North America, north of Mexico. By John Robinson, Esq., Salem, Mass. *The Author.*

Memoirs of the Peabody Academy of Sciences. Vol. I., No. 4. 1876. *The Academy.*

Proceedings of the American Antiquarian Society. Oct. 1875; April, 1876. *The Society.*

Proceedings of the Boston Society of Natural History. Vol. XVIII., Parts 2 & 3. 1875-6. *The Society.*

Memoirs of the Boston Society of Natural History. Vol. II., Part 4, No. 4. *The Society.*

Journal of the Franklin Institute, Philadelphia. Vols. CI., CII. 1876. *The Institute.*

Transactions of the Academy of Science, St. Louis. Vol. III., No. 3. 1876. *The Academy.*

The Ninth Annual Report of the Peabody Institute, 1876. *The Institute.*

Memoirs of the Historical Society of Pennsylvania. Vol. XXXI. *The Society.*

Catalogue of Paintings and other objects of interest belonging to the Historical Society of Pennsylvania. *The Society.*

Historical Map of Pennsylvania. *The Society.*

The Inauguration Discourse, delivered at the opening of the New Hall. By J. W. Wallace, Esq., Pres. 1872. *The Society.*

Bulletin of the Essex Institute. Vol. VII. 1875. *The Institute.*

Proceedings of the Davenport Academy of Natural Sciences. Vol. I. 1867-76. *The Academy.*

Biographical Sketch of William Penn. *Hist. Soc. of Pennsylvania.*

Charities conducted by Women. Reported before the Committee of the United States Senate, 1876.

Twenty-sixth Annual Report of the New York State Museum of Natural History. 1874. *The Museum.*

Fifty-seventh Annual Report of the New York State Library. 1875. *The Library.*

Life History of Birds of Eastern Pennsylvania. By J. G. Gentry, Esq. Vol. I. 1876. *The Author.*

India.—

Records of the Geological Survey of India. Vol. VIII., Parts 1-4; Vol. IX., Part 1. 1876.

Palæontologia Indica. Sec. 9, Parts 2, 3 & 4.

Memoirs of Geological Survey of India. Vol. II., Part 2.

France.—

Le Valhalla des Sciences Pures et Appliqués. Par Leopold Hugo. Paris, 1875. *The Author.*

Bulletin de la Société Geologique de France. Tomes XXII.-XXIV. *The Society.*

Annales Des Mines. Tomes VIII., IX.

Memoires Des Sciences Naturelles De Cherbourg. Tome XVIII.

Lectures Courantes des Ecoliers Français. Par Graumont. Paris, 1876. *The Author.*

ITALY.—

Cosmos. By Guido Cora. 1874-5-6.

SPAIN.—

Anuario Del Observatorio De Madrid. Año XI., XII. 1871-2.

Resumen De hos Observaciones Meteorologicas Efectuades en la Peninsula. Madrid. 1869-70.

Observaciones Meteorologicas en Observatorio De Madrid. 1870-71.

NETHERLANDS.—

Archives Du Musée Teyler. Vols. I., IV. 1875-6.

Archives Neerlandaises des Sciences Exactes et Naturelles. Tome X., XI. 1885-6.

On the Osteology of the Tasmanians. By J. B. Davis, M.D. F.R.S. 1874.

Zur Speciesfrage. Von H. Hoffman. 1875.

Révision Des Espéces Synancéoides. Par B. Bleeker. 1874.

Nederlandsch Meteorologisch Jaarboek. Voor 1871.

VIENNA.—

Verhandlungen der Kaiserlich Königlichen Zoologisch Botanischen Gessellschaft in Wien. Band XXV. 1876.

Mitheilnngen der Kais. Kongl. Geographischen Gessellschaft Wien. 1875.

BREMEN.—

Abhandlungen herausgegeben vom Naturwisseuschaftlichen Vereine zu Bremen. Bd. IV., V. 1875-6.

Beilage No. 5 do. do. 1875.

HAMBURGH.—

Verein für Naturwissensch. Unterhaltung, Verhandlungen. Bd. II. 1875.

KÖNIGSBERG.—

Physikalisch-Oekonomischen Gessellschaft. Schriften X.-XV. 1869-74.

STOCKHOLM.—

Kongl. Svenska Vetenskaps Akademien Handlinger. Bd. 1870-1-2-3.

Bihang, 1, 2, 3. Ofversigte, 28-32. 1871-5.

Lefnadsteckningar, 1, 3. Études Echinoidèes. Par S. Lovén.

BRAZIL.—

Archives De Museo Nazional. Vol. I. 1876.

The Devonian Trilobites and Molluscs of Erere, Province of Para. By Prof. T. Hart.

SOMERS ISLAND.—

Witchcraft in the Somers Island. Parts 1 & 2. By Major-General Lefroy.

MONTHLY METEOROLOGICAL REGISTER, AT THE MAGNETICAL OBSERVATORY, TORONTO, ONTARIO—DECEMBER, 1876.

Latitude—43° 39'4 North. Longitude—5h. 17m. 33s. West. Elevation above Lake Ontario, 108 feet.

Day.	Barom. at temp. of 32°.				Temp. of the Air.				Excess of Mean above Average	Tension of Vapour.				Humidity of Air.				Direction of Wind.				Velocity of the 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.	MEAN		6 A.M.	2 P.M.	10 P.M.	M'N.	6 A.M.	2 P.M.	10 P.M.	M'N.	6 A.M.	2 P.M.	10 P.M.	Res'l-tant.	6 A.M.	2 P.M.	10 P.M.	Res'l-tant.	MEAN		
1	29.415	29.387	29.359	29.4002	0.9°	9.1°	13.1°	8.63°	−21.90°	.044	.058	.071	.060	94	89	90	91	N W	N W	N W	N 44° W	6.6	9.5	8.7	9.82	10.00	...	0.7
2	.427	.552	.703	.6803	16.7	21.2	20.0	19.07	−10.95	.078	.087	.091	.085	85	75	84	82	N W	N W	N W	N 26 W	21.0	18.0	12.2	15.91	15.94	...	0.1
3	.700	.830	.900	.8483	19.0	24.0	24.6	22.60	− 6.06	—	—	—	—	—	—	—	—	N W	N	N	N 24 W	7.1	7.4	9.3	9.40	9.66	...	...
4	.935	.911	.903	.9160	17.1	23.6	19.4	19.23	− 9.87	.086	.098	.088	.086	92	77	83	83	N	N	W	N 33 W	2.2	10.0	6.4	6.82	7.33	...	...
5	.874	.796	.705	.7802	21.2	30.2	23.6	25.43	− 3.20	.090	.104	.098	.104	86	63	77	76	W	W	S W	S 81 W	5.6	10.5	13.0	7.74	8.23	...	...
6	.611	.336	.202	.3700	27.2	34.0	29.0	29.95	+ 1.78	.124	.161	.133	.136	84	82	83	82	S W	W	S W	S 63 W	10.6	16.2	8.0	12.93	13.15	...	...
7	.224	.168	.202	.1988	24.5	29.2	23.0	25.48	− 2.23	.121	.097	.109	.105	92	60	84	77	S W	S W	N W	S 68 W	12.0	11.5	7.8	10.63	11.29	...	0.1
8	.184	.023	28.893	.0238	22.1	21.7	16.4	20.42	− 6.87	.105	.092	.063	.086	89	69	70	77	S W	S W	W	S 67 W	13.0	13.2	12.5	10.03	10.87	...	...
9	28.902	.280	29.055	.3187	10.6	7.3	−1.3	4.00	−21.97	.057	.040	.032	.045	84	74	80	82	W	N W	N	N 78 W	20.9	37.0	3.6	22.10	23.90	...	...
10	29.860	.800	.670	.7717	−9.0	7.0	13.0	4.17	−22.27	—	—	—	—	—	—	—	—	N	N E	S E	N 71 E	7.0	11.2	18.3	5.28	9.87	...	3.0
11	.606	.483	.326	.4653	8.4	19.6	25.0	18.57	− 7.48	.061	.091	.120	.096	96	87	96	91	N E	S E	S E	S 86 E	10.3	16.3	7.8	6.81	10.35	...	2.1
12	.221	.355	.397	.3362	25.4	30.5	34.0	30.07	+ 4.42	.131	.163	.166	.144	95	95	78	86	N	S W	S W	S 66 W	2.0	7.4	10.0	4.94	6.96	...	1.4
13	.142	.280	.448	.2952	35.5	38.6	33.7	35.83	+10.67	.193	.167	.152	.168	93	71	79	80	S W	W	W	S 65 W	14.5	11.0	2.0	11.30	12.48	...	...
14	.427	.310	.354	.3957	33.3	35.6	27.0	30.76	+ 5.90	.142	.141	.113	.127	74	68	77	72	S W	S W	W	S 61 W	7.0	15.0	28.5	12.86	13.85	...	0.2
15	.014	.395	.011	.3005	14.0	21.4	28.2	21.33	− 3.22	.075	.084	.093	.059	87	74	60	77	W	S W	S W	S 56 W	7.5	30.0	33.0	19.99	20.96	...	0.1
16	.403	.798	.990	.7763	0.4	−0.6	−2.1	1.13	−23.10	.044	.035	.031	.034	76	85	80	76	N W	W	W	N 79 W	30.0	14.6	14.0	20.91	23.06	...	1.3
17	30.200	30.000	.900	30.0217	−3.0	4.0	13.0	4.83	−19.07	—	—	—	—	—	—	—	—	N	N E	E	N 62 E	4.0	12.0	21.0	7.73	11.16	...	6.5
18	29.481	29.651	.636	29.5893	4.0	6.2	16.0	9.37	−14.23	.050	.052	.074	.058	95	90	83	86	N	W	S W	N 23 W	15.0	6.2	20.0	6.37	12.73	...	4.0
19	.439	.690	30.012	.7457	11.3	15.6	7.9	10.48	−12.85	.057	.061	.048	.053	78	70	80	76	S W	W	W	S 75 W	23.5	13.0	2.0	13.46	15.10	...	0.2
20	30.106	30.036	29.813	.9768	−1.3	8.1	10.4	6.65	−16.62	.035	.033	.069	.045	85	63	76	75	N	N E	E	N 27 E	10.8	7.6	11.4	6.83	8.13	...	8
21	29.680	29.493	.453	.5088	18.1	16.0	16.0	16.68	− 7.17	.088	.074	.081	.075	89	83	89	85	N E	N E	N	N 43 E	7.5	9.0	8.6	6.61	7.84	...	1.5
22	.355	.280	.428	.3678	19.2	24.8	20.0	21.03	− 1.68	.098	.105	.087	.096	92	78	80	84	N	N	N W	N 7 W	4.6	6.4	8.6	5.62	6.79	...	0.6
23	.604	.650	.840	.7407	10.0	21.2	15.3	15.18	− 7.23	.061	.094	.071	.072	88	83	80	82	N	S W	W	N 64 W	6.0	9.5	13.0	6.19	7.71	...	0.2
24	30.080	30.130	30.120	30.1167	1.0	10.0	4.2	5.07	−17.14	—	—	—	—	—	—	—	—	N	N	N	N 3 W	2.4	7.6	6.4	7.22	7.42	...	...
25	30.000	29.820	29.700	29.8400	10.0	16.0	25.0	17.00	− 6.04	—	—	—	—	—	—	—	—	N	N E	S E	N 47 E	10.3	12.0	13.2	10.69	12.54	...	1.5
26	29.688	.685	.624	.6027	19.6	22.7	19.0	20.62	− 1.25	.098	.102	.085	.096	92	83	80	86	N E	S W	W	S 85 W	6.5	11.8	8.6	4.13	8.22	..	1.2
27	.614	.669	.768	.6957	20.0	20.3	20.0	19.73	− 2.00	.101	.078	.081	.085	92	70	76	79	S W	S W	S W	S 62 W	10.5	12.5	12.0	9.59	10.01	...	...
28	.774	.733	.709	.7416	12.7	24.6	22.8	20.23	− 1.38	.064	.107	.090	.087	84	81	72	79	W	W	N E	N 68 W	4.8	4.6	6.8	3.64	5.67	...	0.5
29	.554	.276	28.983	.2442	22.1	17.4	14.2	17.50	− 4.02	.102	.080	.080	.090	86	94	96	93	N E	N E	N	N 30 E	14.0	20.5	23.0	17.32	18.38	...	10.1
30	.074	.335	29.524	.3350	14.5	18.3	14.6	16.47	− 4.98	.079	.035	.073	.081	95	84	87	88	N W	W	S W	N 69 W	26.0	17.5	12.0	16.89	18.75	...	0.7
31	.660	.700	.790	.7250	14.6	21.0	16.0	17.08	− 4.31	—	—	—	—	—	—	—	—	N W	W	W	S 80 W	5.4	15.5	7.5	9.19	9.77	...	0.6
	29.6703	29.6780	29.6857	29.6814	14.11	19.38	18.34	17.24	− 7.62	.086	.092	.088	.088	88	78	81	82	...	...	...	...	10.66	13.05	11.91	...	11.83	...	36.5

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR DECEMBER, 1876.

NOTE.—The monthly means of the Barometer and Temperature include Sunday observations. The daily means, excepting those that relate to the wind, are derived from six observations daily, namely, at 6 A.M., 8 A.M., 2 P.M., 4 P.M., 10 P.M., and midnight. The means and resultants for the wind are from hourly observations.

Highest Barometer..........30.200 at 6 a.m. on 17th. } Monthly range
Lowest Barometer..........28.810 at 1 a.m. on 16th. } 1.390.

Self-registering Ther.
- Maximum temperature .... 40°1 on 13th. } Monthly range
- Minimum temperature .... —9°5 on 10th. } 49°6.
- Mean maximum temperature ....24°15. } Mean daily range
- Mean minimum temperature .... 9°96. } 14°19.
- Greatest daily range..........33°1 from a.m. to p.m. of 16th.
- Least daily range.......... 6°5 from a.m. to p.m. of 2nd.

Warmest day ....13th; mean temperature..........35°83 } Difference=34°70.
Coldest day..........16th; mean temperature .... 1°13 }

Maximum Radiation { Solar .... 121°0 on 19th. } Monthly range
{ Terrestrial .... —15°0 on 10th. } 136.0.

No Aurora observed.

Possible to see Aurora on 9 nights; impossible on 22 nights.

No rain fell.

Snowing on 23 days; depth, 36.5 inches; duration of fall 158.8 hours.

Mean of cloudiness, 0.74.

WIND.

Resultant direction N. 68° W.; resultant velocity 5.68 miles.

Mean velocity 11.83 miles per hour.

Maximum velocity 40.0 miles, from 1 to 2 a.m. of 16th.

Most windy day 9th; mean velocity 23.90 miles per hour.

Least windy day 28th; mean velocity 5.59 miles per hour.

Most windy hour 3 p.m.; mean velocity 13.12 miles per hour.

Least windy hour 6 a.m.; mean velocity 10.56 miles per hour.

Solar halos on 10th, 15th, 19th, 24th and 28th.

Lunar halos on 1st, 2nd and 24th.

COMPARATIVE TABLE FOR DECEMBER.

YEAR.	TEMPERATURE. Mean.	TEMPERATURE. Excess above averge	TEMPERATURE. Maximum.	TEMPERATURE. Minimum.	TEMPERATURE. Range.	RAIN. No. of days.	RAIN. Inches	SNOW. No. of days.	SNOW. Inches.	WIND. Resultant. Direction.	WIND. Resultant. Vel'y	WIND. Mean Velocity. Miles.
1848	29.1°	+3.3°	48.8°	1.1°	47.7°	7	2.750	7	16.5	S 63° W	1.12	6.44
1849	26.6	+ 0.7	40.8	— 6.5	47.3	5	0.840	12	9.6	N 82 W	2.56	6.23
1850	21.7	— 4.1	48.8	— 9.0	57.8	2	0.190	18	29.5	N 44 W	2.93	7.40
1851	21.5	— 4.3	44.0	—14.8	58.8	6	1.075	15	10.7	N 82 W	4.00	7.37
1852	31.9	+ 6.1	51.0	13.2	37.8	7	3.995	10	20.1	S 69 W	1.03	6.54
1853	25.3	— 0.5	46.4	— 8.4	54.8	4	0.625	13	22.3	N 35 W	2.39	4.98
1854	21.9	— 3.9	44.8	— 7.0	51.8	5	0.690	12	17.2	N 44 W	4.30	8.56
1855	26.8	+ 1.0	47.0	— 5.2	52.2	6	1.845	10	29.5	S 88 W	5.29	11.38
1856	22.9	— 2.9	42.2	— 9.1	51.3	6	1.790	20	16.3	S 87 W	4.62	11.56
1857	31.9	+ 6.1	46.0	4.7	41.3	7	3.205	14	9.0	N 89 W	2.50	6.84
1858	27.4	+ 1.6	45.4	4.2	41.2	11	1.657	18	10.4	N 78 W	1.66	9.36
1859	17.9	— 7.9	54.8	— 6.0	60.8	3	1.035	23	37.4	N 53 W	4.29	10.77
1860	24.0	— 1.8	39.0	— 7.0	46.0	3	1.362	21	13.6	N 62 W	4.66	10.14
1861	31.1	+ 5.3	55.2	5.5	49.7	6	0.560	8	6.8	N 72 W	3.50	7.96
1862	28.8	+ 3.0	50.1	— 3.4	53.5	5	1.945	8	10.4	N 73 W	3.17	7.58
1863	27.0	+ 1.2	53.4	— 1.5	54.9	10	2.960	17	7.1	N 41 W	1.61	9.40
1864	24.7	— 1.1	50.4	—10.4	60.8	9	2.045	18	27.1	S 82 W	4.94	9.98
1865	27.7	+ 1.9	54.2	5.7	48.5	7	1.727	11	5.2	S 81 W	3.07	7.33
1866	25.1	— 0.7	61.0	— 5.0	66.0	7	2.790	13	15.5	S 88 W	4.98	9.91
1867	21.0	— 4.2	49.5	—12.8	62.3	7	1.408	21	13.6	S 81 W	4.82	10.32
1868	22.5	— 3.3	44.2	— 3.2	47.4	1	0.065	18	15.5	N 71 W	4.05	9.80
1869	28.7	— 2.9	45.0	6.0	39.0	10	2.600	9	7.1	S 80 W	2.31	8.44
1870	26.5	+ 0.7	45.2	— 5.8	51.0	6	2.430	16	15.9	N 89 W	5.06	11.46
1871	19.9	— 5.9	48.2	—21.0	69.2	4	0.940	20	14.2	S 70 W	6.91	11.52
1872	18.7	— 7.1	40.0	—13.8	53.8	3	0.390	4	38.0	N 87 W	5.51	9.06
1873	29.8	+ 4.0	48.2	6.4	41.8	10	0.935	12	19.2	WEST	2.95	5.93
1874	25.7	— 0.1	44.0	— 7.5	51.5	5	0.050	15	11.1	S 84 W	5.93	8.72
1875	27.2	+ 1.4	61.0	—13.2	74.2	9	1.620	13	18.7	N 54 W	1.75	10.42
1876	17.2	— 8.6	40.1	— 9.5	49.6	0	0.000	23	36.5	N 68 W	5.68	11.83
Res'lts to 1875.	25.79	...	47.81	—4.42	52.23	5.83	1.552	13.86	15.07	N 77 W	3.42	8.73
Excess for '76	— 8.55	...	— 7.71	— 5.08	— 2.63	— 5.83	— 1.552	+ 9.14	+ 21.43	...	...	+ 3.10

GENERAL METEOROLOGICAL REGISTER

FOR THE YEAR 1876.

GENERAL METEOROLOGICAL

MAGNETICAL OBSERVATORY,

Latitude 43° 39′ 4″ North. Longitude 5h. 17m. 33s. West. Elevation above

	JAN.	FEB.	MAR.	APR.	MAY.	JUNE.	JULY.
Mean Temperature	29.03°	23.76°	26.02°	38.24°	51.47°	65.53°	68.78°
Difference from average (36 years)	+ 6.26	+ 1.21	− 3.12	− 2.48	− 0.22	+ 3.80	+ 1.39
Thermic anomaly (lat. 43° 40′)	− 3.77	−10.94	−14.09	−11.76	− 6.63	+ 0.93	+ 0.08
Highest temperature	57.5	44.1	50.5	57.2	81.9	87.2	92.9
Lowest temperature	5.1	− 3.9	− 2.9	17.0	30.4	44.2	46.2
Monthly and Annual Ranges	52.4	48.0	53.4	40.2	51.5	43.0	46.7
Mean maximum temperature	36.85	30.17	33.35	45.59	60.42	74.39	78.30
Mean minimum temperature	22.47	16.07	18.85	31.73	41.85	56.30	58.75
Mean daily range	14.38	14.10	14.50	13.86	18.57	18.09	19.55
Greatest daily range	37.0	42.1	41.9	24.5	35.5	29.2	31.4
Mean height of the Barometer	29.6316	29.6573	29.5994	29.5859	29.6377	29.5402	29.5975
Difference from average (35 years)	−.0158	+.0311	−.0025	−.0008	+.0677	−.0339	+.0048
Highest barometer	30.216	30.350	30.168	30.109	29.988	29.763	29.813
Lowest barometer	28.703	28.863	28.729	28.939	29.271	29.237	29.343
Monthly and Annual Ranges	1.513	1.487	1.439	1.170	0.717	0.526	0.470
Mean humidity of the air	81	81	79	69	70	76	76
Mean elasticity of aqueous vapour	0.134	0.111	0.116	0.165	0.261	0.478	0.536
Mean of cloudiness	0.78	0.73	0.70	0.61	0.53	0.58	0.50
Difference from average (23 years)	+ .04	+ .03	+ .08	+ .01	− .02	+ .06	.00
Resultant direction of the wind	S 79 W	N 63 W	N 29 W	N 69 W	N 22 W	S 7 W	N 78 W
" velocity of the wind	6.31	3.71	3.43	4.11	1.41	1.51	1.63
Mean velocity (miles per hour)	11.79	12.45	12.04	9.87	8.36	6.32	6.31
Difference from average (28 years)	+ 3.36	+ 3.72	+ 2.90	+ 1.56	+ 1.37	+ 0.99	+ 1.22
Total amount of rain	1.960	2.300	1.250	1.815	3.230	1.690	3.290
Difference from average (36 years)	+0.754	+1.452	−0.319	−0.623	+0.098	−1.264	+0.142
Number of days rain	12	7	6	13	13	8	15
Total amount of snow	8.2	20.1	44.1	0.3	...	...	...
Difference from average (33 years)	−14.29	+ 1.74	+31.12	− 2.23	− 0.15	...	...
Number of days snow	9	15	14	3	...	...	...
Number of fair days	11	10	13	15	18	23	16
Number of Auroras observed	0	2	1	3	0	0	3
Possible to see Aurora (No. of nights)	9	11	14	17	17	18	24
Number of Thunderstorms	0	2	0	2	5	3	6

REGISTER FOR THE YEAR 1876.

TORONTO, ONTARIO.

Lake Ontario 108 feet. Approximate elevation above the Sea, 350 feet.

Aug.	Sept.	Oct.	Nov.	Dec.	1876.	1875.	1874.	1873.	1872.	1871.	1870.
70.24° + 4.01 + 1.74	57.40° − 0.68 − 4.04	42.76° − 3.06 −11.04	37.29° + 1.50 − 5.91	17.24° − 8.55 −18.76	43.98° − 0.01 − 7.01	40.77° − 3.22 −10.23	44.30° + 0.31 − 6.70	42.94° − 1.05 − 8.06	42.92° − 1.07 − 8.08	43.81° − 0.18 − 7.19	45.93° + 1.94 − 5.07
88.8 45.0 43.8	77.8 38.5 39.3	61.6 23.0 38.6	58.8 5.4 53.4	40.1 − 9.5 49.6	92.9 − 9.5 102.4	88.0 − 16.0 104.0	95.0 − 7.5 102.5	89.5 − 18.4 107.9	96.0 − 13.8 109.8	89.5 − 21.0 110.5	88.4 − 6.6 95.0
80.39 59.66 20.73 32.2	64.75 50.39 14.36 24.2	50.24 34.74 15.50 24.4	42.30 31.97 10.33 17.9	24.15 9.96 14.19 33.1	... ... 15.68 42.1	... ... 17.38 46.0	... ... 17.43 46.5	... ... 16.93 37.9	... ... 17.59 37.8	... ... 16.46 34.6	... ... 15.71 36.2
29.6704 +.0467	29.5999 −.0656	29.5382 −.1060	29.5782 −.0341	29.5814 −0.0676	29.6017 −.0147	29.6151 −.0013	29.6452 +.0288	29.5964 −.0200	29.6079 −.0085	29.6066 −.0098	29.5950 −.0208
29.889 29.334 0.555	29.965 29.181 0.784	29.976 28.929 1.047	29.970 28.968 1.002	30.200 28.810 1.390	30.350 28.703 1.647	30.271 28.751 1.520	30.416 28.538 1.878	30.246 28.797 1.449	30.231 28.789 1.442	30.388 28.673 1.716	30.212 28.186 2.046
67	70	74	83	82	76	76	74	78	75	73	76
0.505	0.353	0.213	0.194	0.088	0.263	0.236	0.255	0.257	0.259	0.242	0.279
0.46 − .02	0.68 + .18	0.70 + .08	0.89 + .16	0.74 − .02	0.66 + .05	0.62 + .01	0.63 + .02	0.60 − .01	0.59 − .02	0.64 + .03	0.62 + .01
S 31 W 0.23	N 6 W 2.97	S 81 W 4.63	N 20 W 0.52	N 68 W 5.68	N 51 W 1.98	N 70 W 2.31	N 61 W 2.67	N 58 W 1.98	N 72 W 2.91	N 72 W 2.49	N 45 W 1.61
6.57 + 1.25	9.22 + 3.60	9.19 + 2.88	7.44 − 0.30	11.83 + 3.10	9.29 + 2.14	8.96 + 1.81	8.03 + 0.88	7.98 + 0.81	6.78 − 0.37	8.24 + 1.09	7.33 + 0.18
R −2.864 2	2.455 −1.120 16	1.435 −0.946 12	1.748 −0.999 13	0.000 −1.552 0	21.063 −7.241 117	18.980 −9.324 103	17.574 −10.730 103	20.232 −8.072 110	18.588 −9.716 115	22.771 −5.533 110	33.898 +5.594 116
... ...	... ...	0.1 − 0.79 5	9.1 + 5.0 7	36.5 +21.43 23	113.4 +41.83 76	107.5 +35.93 70	67.7 − 3.87 75	113.8 +42.23 79	67.5 − 4.07 77	99.6 +28.03 84	122.9 +51.33 77
31	14	15	12	8	186	201	197	170	185	187	185
2	0	1	1	0	13	17	28	60	67	55	77
24	12	10	6	9	171	212	197	203	236	209	206
1	0	0	0	0	19	26	23	22	23	22	34

TEMPERATURE.

	1876.	Average of 36 years.	Extremes.	
Mean temperature of the year	43.98	43.99	46.36 in '46.	40.77 in '75.
Warmest month	August.	July.	July, 1868.	Aug., 1860.
Mean temperature of the warmest month	70.24	67.39	75.80	64.46
Coldest month	December.	February.	Feb., 1875.	Feb., 1848.
Mean temperature of the coldest month	17.24	22.55	10.16	26.60
Difference between the temperature of the warmest and the coldest months	53.00	44.84	...	...
Mean of the deviation of monthly means from their respective averages of 35 years, signs of deviation being disregarded	3.01	2.47	3.50 in 1843.	...
Months of greatest deviation, without regard *to sign*	December.	January.	Feb., 1875.	...
Corresponding magnitude of deviation	8.55	3.96	12.4	...
Warmest day	July 9.	...	July 14, '68.	July 31, '44.
Mean temperature of the warmest day	82.67	77.63	84.50	72.75
Coldest day	Dec. 13.	...	Feb. 6, 1855. Jan. 22, 1857.	Dec. 22, '42.
Mean temperature of the coldest day	1.13	—1.59	—14.38	9.57
Date of the highest temperature	July 8.	...	Aug. 24, '54.	Aug. 19, '40.
Highest temperature	92.9	90.94	99.2	82.4
Date of the lowest temperature	Dec. 10.	...	Jan. 10, '59.	Jan. 2, '42.
Lowest temperature	—9.5	—12.34	—26.5	1.9
Range of the year	102.4	103.28	113.2	87.0

BAROMETER.

	1876.	Average of 35 years.	Extremes.	
Mean Pressure of the year	29.6017	29.6164	29.6770 in 1849.	29.5602 in 1864.
Month of the highest mean pressure	August.	Sept.	Jan. 1849.	Jan., 1864.
Highest mean monthly pressure	29.6704	29.6655	29.8046	29.6525
Month of the lowest mean pressure	October.	May.	March, 1859.	Nov., 1849.
Lowest mean monthly pressure	29.5382	29.5700	29.4143	29.5886
Date of the highest pressure in the year	Feb. 5.	...	Jan. 8, 1866.	Jan. 14, '70.
Highest pressure	30.350	30.365	30.940	30.212
Date of the lowest pressure in the year	Jan. 9.	...	Jan. 2, 1870.	Mar. 17, '45.
Lowest pressure	28.703	28.684	28.166	28.939
Range of the year	1.647	1.681	2.133 in 1866.	1.303 in 1845.

RELATIVE HUMIDITY.

	1876.	Average of 34 years.	Extremes.	
Mean humidity of the year	76	77	82 in 1851	73 in 1858
Month of greatest humidity	November.	January.	Jan., 1857.	Dec., 1858.
Greatest mean monthly humidity	83	83	89	81
Month of least humidity	August.	May.	Feb., 1843.	April, 1849.
Least mean monthly humidity	67	71	58	76

EXTENT OF SKY CLOUDED.

	1876.	Average of 23 years.	Extremes.	
Mean cloudiness of the year	0.66	0.61	0.66 in '69 '76	0.57 in 1856.
Most cloudy month	November.	December.	...	...
Greatest monthly mean of cloudiness	0 89	0.76	0 89	0.73
Least cloudy month	August.	August.	...	...
Least monthly mean of cloudiness	0.46	0.48	0.29	0 50

WIND.

	1876.	Result of 28 years.	Extremes.	
Resultant direction	N 61° W	N 61° W	...	...
Resultant velocity in miles	1.98	2.00	...	...
Mean velocity without regard to direction	9.29	7.15	9.29 in '76.	5.10 in '53.
Month of greatest mean velocity	Feb. 7.	March.	March, 1874.	Jan., 1848.
Greatest monthly mean velocity	12.45	9.14	13 24	5.82
Month of least mean velocity	July.	July.	Aug., 1852.	Sept., 1860.
Least monthly mean velocity	6.31	5.09	3.30	5.79
Day of greatest mean velocity	Jan. 10.	...	Nov. 15, '71.	Dec. 2, 1848.
Greatest daily mean velocity	28.88	23.99	32.16	15.30
Day of least mean velocity	Oct. 31.	...	...	...
Least daily mean velocity	1.23	...	...	...
Hour of greatest absolute velocity	Dec. 16, 1 a.m.	...	Dec. 27, '61. 9.10 a.m.	Mar. 14, '53. 11 am to Noon
Greatest velocity	40.0	40.0	46.0	25.6

RAIN.

	1876.	Average of 36 years.	Extremes.	
Total depth of rain in inches	21.063	28.304	43.555 in '43.	17.574 in '74.
Number of days in which rain fell	117	109	130 in 1861.	80 in 1841.
Month in which the greatest depth of rain fell	May.	September	Sept., 1843.	Sept., 1848.
Greatest depth of rain in one month	3.230	3.575	9.760	3.115
Month in which the days of rain were most frequent	September	October.	June, 1869, Oct. 1864.	May, 1841.
Greatest number of rainy days in one month	16	13	22	11
Day in which the greatest amount of rain fell	Sept. 18.	...	Sept. 14, '43.	Sept. 14, '48.
Greatest amount of rain in one day	1.250	1.987	3.455	1.000

SNOW.

	1876.	Average of 33 years.	Extremes.	
Total depth of snow in inches	113.4	71.6	122.9 in '70.	38.4 in 1851.
Number of days in which snow fell	76	64	67 in 1859	33 in 1848.
Month in which the greatest depth of snow fell	March.	February.	March, 1870.	Dec., 1851.
Greatest depth of snow in one month	44.1	18.4	6[illegible].4	10.7
Month in which the days of snow were most frequent	December.	January.	Dec., 1872.	Feb., 1848.
Greatest number of days of snow in one month	23	14	24	8
Day in which the greatest amount of snow fell	March 28.	...	Mar. 28, '76.	Jan. 10, '57.
Greatest fall of snow in one day	16.2	9.9	16.2	5.5

DIFFERENCE OF CERTAIN METEOROLOGICAL ELEMENTS FROM THE NORMAL VALUES FOR EACH QUARTER, AND THE YEAR.

Quarter.	Barom.	Temper.	Rain.	Days Rain.	Snow.	Days Snow.	Velocity of Wind.	Clouded Sky.
	inches.	°	inches.		inches.		miles.	
Winter	+ .0043	+ 1.45	+ 1.887	+ 10.21	+ 18.57	+ 1.14	+ 3.33	+ 0.05
Spring	+ .0110	+ 0.37	− 1.789	+ 0.55	− 2.38	− 1.25	+ 1.31	+ 0.02
Summer	− .0048	+ 1.58	− 3.842	+ 0.09	...	...	+ 2.02	+ 0.05
Autumn	− .0692	− 3.44	− 3.497	− 3.02	+ 25.64	+ 11.92	+ 1.89	+ 0.07
Year	− .0147	− 0.01	− 7.241	+ 7.83	+ 41.83	+ 11.81	+ 2.14	+ 0.05

PERIODICAL OR OCCASIONAL EVENTS, 1876.

January 8. Bay frozen again.
February 9. Water in Bay very high *Ft. 7.6 above zero.* 10th. First thunderstorm.
" 20. Red woodpeckers.
March 4. Song sparrows. 5th. Crows numerous.
" 12. *First schooner arrived.*
" 14. Robins seen.
April 5. First schooner left with cargo.
" 12. Bay clear of ice. 14th. Blue birds.
" 20. Swallows seen; numerous on 26th.
" 22. *City of Toronto* arrived. First trip to Niagara, 24th.
" 30. Last snow of spring.
May 2. Frogs noisy. 11th. Last ice of season.
" 8. Maples in flower. 15th. Plum trees in flower.
" 14. Humming birds seen. 18th. Baltimore bird and Virginia nightingale.
" 23. Last frost of season. 24th. Flowering currant in blossom.
" 30. Apple trees in blossom. Wild strawberries in flower.
June 1. Chestnut trees in flower. Lilacs in flower.
" 23. Night hawks. 24th. Fire flies.
July 25. Humming birds numerous.
August 29. Swallows appear to be all gone. The want of rain severely felt—grass scorched, wells dry.
October 1. First frost of season. 7th. First snow of season.
" 8. First ice of season.
" 28. Last trip *City of Toronto.*
Novem'r 26. First sleighing.
December 1. Bay frozen.
" 15 and 28. Beautiful display of double halos and parhelia, followed on both occasions *by furious snowstorms.*

MONTHLY METEOROLOGICAL REGISTER, AT THE MAGNETICAL OBSERVATORY, TORONTO, ONTARIO—JANUARY, 1877.

Latitude—43° 39'4 North. Longitude—5h. 17m. 33s. West. Elevation above Lake Ontario, 108 feet.

Day.	Barom. at temp. of 32°.				Temp. of the Air.				Excess of Mean above aver'ge	Tension of Vapour.				Humidity of Air.				Direction of Wind.				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.	MEAN		6 A.M.	2 P.M.	10 P.M.	M'N	6 A.M.	2 P.M.	10 P.M.	M'N.	6 A.M.	2 P.M.	10 P.M.	Res'l-tant.	6 A.M.	2 P.M.	10 P.M.	Res'l-tant.	MEAN		
1	29.727	29.519	29.423	29.6433	16.4	20.3	14.4	16.60	— 4.73	.076	.096	.062	.078	83	88	76	84	W	N E	N E	N 33 E	5.0	7.8	12.0	2.96	7.44	...	1.0
2	.453	.533	.629	.6493	9.1	17.1	10.9	12.55	— 8.73	.064	.073	.061	.067	98	79	86	88	N	N W	N E	N 30 W	7.6	12.5	6.0	8.56	9.67	...	...
3	.653	.673	.754	.7026	2.7	6.8	4.4	4.07	—17.18	.042	.042	.045	.042	80	72	84	80	N	N W	W	N 37 W	6.0	6.0	11.0	6.32	[illegible]	...	...
4	.749	.753	.756	.7578	7.7	16.2	10.6	10.95	—10.28	.051	.058	.061	.037	85	69	87	81	W	W	W	S 79 W	7.8	13.0	5.2	6.79	6.88	...	...
5	.772	.752	.733	.7642	11.3	21.0	18.9	16.65	— 4.57	.067	.081	.087	.079	94	78	84	85	W	S	S	S 51 W	4.0	7.8	2.2	4.77	5.29	...	0.1
6	.673	.685	.371	.5353	22.1	30.8	31.1	28.42	+ 7.20	.108	.134	.167	.136	92	75	96	86	S W	S E	E	S 43 E	6.4	6.8	5.0	1.92	4.07	...	...
7	.020	.200	.340	.2033	30.0	33.0	27.0	29.17	+ 7.49	—	—	—	—	—	—	—	—	N	W	W	N 67 W	2.8	20.0	10.2	6.90	8.75	...	0.7
8	.306	.423	.637	.4988	18.1	10.6	1.1	9.23	—11.98	.083	.049	.044	.059	84	84	97	87	W	N W	N W	N 61 W	5.9	14.8	3.6	8.82	9.04	...	0.4
9	.735	.851	.799	.7905	5.0	10.9	14.6	10.30	—10.92	.048	.050	.055	.052	90	69	67	76	W	W	S	S 54 W	12.2	11.8	14.0	8.51	10.22	...	...
10	.662	.568	.665	.6322	19.2	23.0	20.7	20.78	— 0.48	.089	.097	.093	.093	86	80	82	83	S W	S W	S W	S 42 W	19.0	7.5	9.0	12.04	12.54	...	S
11	.684	.520	.834	.6092	24.3	27.2	12.7	20.02	— 1.30	.111	.118	.058	.095	84	84	74	83	S W	S W	N W	N 85 W	15.6	2.5	21.0	7.07	10.65	...	3.5
12	30.144	29.975	.686	.9297	-11.0	—4.0	—3.9	-6.12	—27.48	.021	.034	.036	.031	77	90	100	90	N	N E	N	N 15 E	9.6	14.0	14.8	12.36	12.94	...	1.7
13	29.744	.520	.311	.5112	1.3	13.5	14.9	10.72	—10.70	.041	.075	.069	.061	92	79	80	85	W	S W	W	S 65 W	9.2	20.5	27.0	14.43	15.88	...	S
14	.500	.700	.730	.6017	16.0	12.0	10.0	12.60	— 8.95	—	—	—	—	—	—	—	—	W	N	N E	N 61 W	14.0	6.0	8.7	6.36	11.46	...	0.3
15	.669	.496	.258	.4227	14.9	16.4	13.6	15.33	— 6.17	.075	.091	.079	.080	87	83	98	92	N E	N E	N E	N 40 E	12.0	14.5	17.0	12.88	12.92	...	4.0
16	.357	.681	.936	.6997	10.2	15.6	8.4	10.68	—10.90	.066	.066	.051	.059	96	76	82	83	N	N W	N W	N 26 W	10.0	9.0	4.6	6.86	7.74	...	1.5
17	30.077	30.126	30.091	30.0983	—1.0	20.0	13.8	11.23	—10.38	.040	.102	.068	.067	97	80	85	88	N W	S W	S W	S 84 W	1.0	5.2	8.0	3.11	3.94	...	...
18	30.033	29.949	29.911	29.9635	9.6	24.6	24.6	20.85	— 0.83	.059	.116	.127	.105	89	83	96	91	W	W	W	S 76 W	2.8	0.4	3.0	2.46	2.46	...	0.1
19	29.816	.623	.320	.5588	24.3	30.4	33.0	29.62	+ 7.67	.123	.166	.174	.164	95	90	92	93	W	S W	S W	S 41 W	0.8	9.0	17.5	7.13	7.48	...	0.1
20	28.984	.165	.555	.2469	35.8	22.1	16.0	23.80	+ 1.98	.198	.074	.074	.111	94	68	83	79	S W	W	S W	S 62 W	15.8	31.0	12.7	19.08	20.29	R	...
21	29.680	.760	.800	.7650	10.0	16.6	14.0	13.42	— 8.45	—	—	—	—	—	—	—	—	S W	S W	S W	S 58 W	13.0	12.0	6.0	11.40	11.64	...	...
22	.811	.831	.881	.8485	16.0	25.0	19.4	19.47	— 2.47	.074	.082	.084	.070	83	61	80	76	S W	W	W	S 84 W	4.0	21.5	4.0	8.58	8.83	...	...
23	.918	.557	.605	.7828	12.7	14.6	13.8	13.68	—13.67	.058	.060	.068	.061	75	64	84	75	W	S W	S W	S 65 W	10.6	17.0	18.6	14.63	15.33	...	...
24	.461	.700	.788	.6712	15.3	12.7	11.1	12.62	— 9.45	.071	.038	.059	.054	61	52	82	70	W	N W	W	N 86 W	17.0	30.5	16.5	18.14	19.27	...	S
25	.817	.800	.799	.8140	10.6	16.4	16.4	14.80	— 7.32	.057	.068	.069	.064	84	69	77	76	W	W	W	S 75 W	10.8	11.5	6.8	8.11	8.46	...	S
26	.749	.611	.496	.6068	16.7	29.7	31.1	26.68	+ 4.66	.085	.133	.138	.120	92	80	79	82	W	S W	S W	S 59 W	3.4	12.6	20.0	10.43	10.58	...	...
27	.493	.714	.911	.7317	23.9	31.6	18.0	24.07	— 1.83	.109	.120	.089	.104	84	75	86	79	W	N W	N W	N 79 W	7.0	16.0	10.0	8.67	10.22	...	...
28	.920	.700	.460	.7000	16.0	32.0	30.0	25.67	+ 3.30	—	—	—	—	—	—	—	—	N W	S W	W	S 52 W	4.6	21.8	5.4	6.46	8.72	...	...
29	.727	.776	.912	.8265	16.7	34.8	24.6	25.90	+ 3.62	.085	.156	.114	.119	92	70	85	83	W	S E	N E	S 74 W	2.4	5.0	3.6	0.47	3.05	...	...
30	30.050	30.102	30.046	30.0693	23.6	32.0	31.6	29.16	+ 6.72	.118	.164	.170	.150	94	91	95	93	N E	E	E	N 57 E	7.8	6.6	4.0	4.93	6.08	...	...
31	29.910	29.706	29.679	29.7165	30.1	32.9	29.7	31.48	+ 9.00	.164	.180	.162	.169	98	91	98	95	E	E	S	S 68 E	6.5	12.3	2.6	5.46	5.70	.030	...
	29.6868	29.6828	29.6811	29.6881	14.76	20.83	17.33	17.56	— 4.13	.081	.093	.088	.087	89	77	80	84	....	....	....	....	8.17	12.30	9.98	...	9.60	.020	13.4

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR JANUARY, 1877.

Note.—The monthly means of the Barometer and Temperature include Sunday observations. The daily means, excepting those that relate to the wind, are derived from six observations daily, namely, at 6 A.M., 8 A.M., 2 P.M., 4 P.M., 10 P.M., and midnight. The means and resultants for the wind are from hourly observations.

Highest Barometer .... 30.144 at 6 a.m. on 12th. } Monthly range
Lowest Barometer .... 29.020 at 6 a.m. on 7th. } 1.124.

Self-registering Ther.:
- Maximum temperature .... 40.8 on 20th. } Monthly range
- Minimum temperature .... —13.9 on 12th. } 54°7.
- Mean maximum temperature .... 24.32 } Mean Daily range
- Mean minimum temperature .... 9.99 } 15°33.
- Greatest daily range .... 26.0 from a.m. to p.m. on 20th.
- Least daily range .... 5.4 from a.m. to p.m. on 31st.

Warmest day .... 31st; mean temperature ...... 31.48 } Difference=37°60.
Coldest day .... 12th; mean temperature ...... —6.12 }

Maximum Radiation { Solar .... 125.0 on 16th. } Monthly range
{ Terrestrial .... —19.0 on 12th. } 144.0

No Aurora observed.

Possible to see Aurora on 13 nights; impossible on 18 nights.

Raining on 2 days; depth, 0.030 inches; duration of fall, 4.5 hours.

Snowing on 15 days; depth, 13.4; duration of fall, 83.6 hours.

Mean of cloudiness, 0.69.

WIND.

Resultant direction, S. 87° W.; resultant velocity, 5.20 miles.

Mean velocity, 9.50 miles per hour.

Maximum velocity, 35.0 miles per hour, from 1 to 2 p.m. of 20th.

Most windy day, 20th; mean velocity, 20.29 miles per hour.

Least windy day, 29th; mean velocity, 3.08 miles per hour.

Most windy hour, 2 p.m.; mean velocity, 12.30 miles per hour.

Least windy hour, 1 a.m.; mean velocity, 7.79 miles per hour.

Solar halos on 2nd, 9th, 20th, 24th, 31st.

Lunar halos on 3rd, 21st, 23rd, 25th.

Fog on 29th and 31st.

COMPARATIVE TABLE FOR JANUARY.

YEAR.	TEMPERATURE.					RAIN.		SNOW.		WIND.		
	Mean.	Excess above Average.	Maximum	Minimum.	Range.	No. of days.	Inches	No. of days.	Inches.	Resultant. Direction.	Resultant. Velocity.	Mean Velocity.
1849	18.5	— 4.4	39.5	—14.2	53.7	4	1.175	10	9.2	N 63° W	3.06	6.71
1850	29.7	+ 6.8	46.4	9.9	36.5	5	1.250	8	5.2	N 37 W	0.69	5.80
1851	25.5	+ 2.6	43.4	—12.8	56.2	4	1.275	10	7.8	S 77 W	3.26	7.69
1852	18.4	— 4.5	37.3	—10.6	47.9	0	0.000	19	30.9	N 68 W	3.14	7.67
1853	23.0	+ 0.1	40.9	— 9.7	50.6	1	0.290	6	7.5	N 27 W	2.52	6.34
1854	23.6	+ 0.7	46.4	— 5.4	51.8	7	1.270	11	7.5	N 77 W	2.44	6.91
1855	25.9	+ 3.0	49.0	— 5.4	54.4	5	0.525	13	23.3	N 73 W	1.91	7.26
1856	16.0	— 6.9	34.4	—12.0	46.4	0	0.000	14	13.0	N 75 W	5.24	10.69
1857	12.8	—10.1	37.2	—20.1	57.3	3	inap	16	21.8	N 70 W	4.96	10.31
1858	30.0	+ 7.1	47.4	6.5	40.9	6	1.152	11	4.0	N 71 W	2.33	7.40
1859	26.4	+ 3.5	43.2	—26.5	69.7	6	1.449	19	16.4	S 81 W	3.17	8.76
1860	23.4	+ 0.5	46.4	— 6.8	53.2	6	0.740	16	8.7	N 89 W	6.09	9.37
1861	19.9	— 3.0	37.0	—11.2	48.2	4	0.685	23	20.0	N 86 W	2.92	9.30
1862	21.7	— 1.2	44.5	— 2.6	47.1	5	0.115	19	27.4	N 26 W	2.69	8.83
1863	28.1	+ 5.2	47.0	—14.0	61.0	10	1.122	17	20.6	N 61 W	1.13	7.23
1864	22.8	— 0.1	44.2	— 9.0	53.2	5	1.165	14	26.3	S 73 W	6.00	10.22
1865	17.7	— 5.2	37.2	— 9.0	46.2	1	0.440	18	14.8	N 85 W	4.80	9.39
1866	20.7	— 2.2	44.0	—14.0	58.0	4	0.522	19	10.3	N 75 W	2.98	9.34
1867	17.6	— 5.3	43.8	— 4.8	48.6	1	inap	21	42.0	N 55 W	3.27	6.96
1868	19.0	— 3.9	39.0	— 7.0	46.0	2	inap	21	14.6	S 83 W	3.97	8.91
1869	27.7	+ 4.8	45.0	— 1.0	46.0	4	0.887	12	9.8	N 72 W	3.40	9.21
1870	24.4	+ 1.5	45.0	— 3.2	48.2	8	3.412	18	21.3	S 89 W	2.63	8.98
1871	21.3	— 1.6	40.4	—13.2	59.6	8	0.864	23	43.6	S 49 W	2.56	9.84
1872	22.4	— 0.5	41.8	— 2.5	44.3	5	0.220	15	3.9	S 87 W	4.73	8.87
1873	17.7	— 5.2	46.0	—18.4	64.4	4	1.110	17	39.2	N 78 W	2.96	10.01
1874	24.8	+ 1.9	57.5	— 4.0	61.5	13	2.820	15	12.2	N 61 W	3.42	8.58
1875	16.1	— 6.8	39.0	— 8.8	47.8	1	inap	17	32.3	N 88 W	4.06	9.54
1876	29.0	+ 6.1	57.5	5.1	52.4	12	1.960	9	3.2	S 70 W	6.31	11.79
1877	17.5	— 5.4	40.8	—13.9	54.7	2	0.030	15	13.4	S 87 W	5.20	9.50
Res'lts to 1876	22.91	......	43.60	—8.02	51.82	4.92	1.227	14.05	17.07	N 80 W	3.23	8.54
Excess for 1877	— 5.30	......	— 3.00	— 5.88	+ 2.88	— 2.92	— 1.197	+ 0.95	— 3.67	...	...	+ 0.96

MONTHLY METEOROLOGICAL REGISTER, AT THE MAGNETICAL OBSERVATORY, TORONTO, ONTARIO—FEBRUARY, 1877.

Latitude—43° 39'4 North. Longitude—5h. 17m. 33s. West. Elevation above Lake Ontario, 108 feet.

Day.	Barom. at temp. of 32°.				Temp. of the Air.				Excess of Mean above Av'rage.	Tension of Vapour.				Humidity of Air.				Direction of Wind.				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.	MEAN		6 A.M.	2 P.M.	10 P.M.	M'N.	6 A.M.	2 P.M.	10 P.M.	M'N.	6 A.M.	2 P.M.	10 P.M.	Resultant.	6 A.M.	2 P.M.	10 P.M.	Result't	MEAN		
1	29.489	29.632	29.654	29.6705	36.5°	39.8°	35.8°	37.25°	+14.70°	.169	.171	.173	.177	87	70	82	80	S W	W	W	S 63° W	11.5	12.5	2.6	7.49	8.25	...	...
2	.644	.618	.711	.6722	33.7	38.0	34.4	35.37	+12.76	.176	.174	.174	.176	90	76	88	85	S W	E	E	N 86 E	0.5	4.5	4.2	1.25	2.65	...	...
3	.792	.872	.090	.8933	34.8	37.6	33.7	35.35	+12.65	.177	.175	.153	.167	88	77	79	81	N W	N W	N W	N 36 W	5.4	6.8	7.4	7.73	7.78	...	...
4	30.030	.960	.880	.9600	32.0	30.0	21.0	27.00	+ 4.28	—	—	—	—	—	—	—	—	W	S W	S W	S 79 W	2.6	5.4	1.8	3.11	4.06	...	...
5	29.710	.602	.656	.6547	25.4	25.9	30.1	27.16	+ 4.37	.125	.120	.150	.134	91	90	89	90	N W	W	S W	S 84 W	4.1	3.7	7.8	3.67	3.94	...	...
6	.664	.575	.490	.5658	32.6	34.6	34.4	33.73	+10.90	.165	.155	.158	.160	88	77	79	82	W	S W	S W	S 65 W	6.2	12.5	11.0	10.93	11.12	...	...
7	.466	.507	.732	.5772	34.4	38.0	29.0	32.70	+ 9.80	.175	.152	.133	.146	87	66	83	78	S W	W	N W	S 86 W	8.0	14.0	17.0	11.03	13.38	...	...
8	.825	.790	.752	.7025	14.6	25.4	24.8	21.62	— 1.43	.069	.071	.091	.079	82	61	68	63	N W	W	W	N 60 W	3.5	4.2	5.5	4.87	5.67	...	...
9	.808	.797	.780	.7793	15.6	31.9	27.9	24.95	+ 1.92	.073	.114	.117	.102	82	63	77	75	W	S W	S W	S 69 W	2.6	3.0	0.4	3.38	3.77	...	...
10	.689	.644	.741	.7005	28.6	38.3	29.0	32.45	+ 9.38	.131	.166	.133	.142	83	67	83	77	S W	S W	N W	S 44 W	9.2	7.6	4.2	4.60	5.96	...	...
11	.800	.740	.600	.7183	21.0	40.0	40.0	33.92	+10.76	—	—	—	—	—	—	—	—	N	S	S W	S 34 W	3.0	9.8	13.0	4.63	6.61	...	...
12	.647	.856	30.180	.8065	39.4	17.6	13.5	21.60	— 1.65	.192	.080	.049	.093	80	84	60	72	N W	N W	N W	N 56 W	22.0	30.0	24.5	20.06	23.23	...	0.3
13	30.309	30.329	30.316	30.3168	7.0	18.9	14.2	13.65	— 9.67	.054	.054	.070	.060	91	51	86	76	N W	N	N	N 23 W	7.4	10.6	11.0	11.14	11.43	...	...
14	30.218	30.101	30.014	30.0953	10.6	26.6	18.9	18.43	— 4.97	.057	.091	.067	.076	83	62	84	75	N W	S	N E	N 29 W	5.5	4.5	4.4	1.24	4.22	...	...
15	29.862	29.759	29.716	29.7656	18.6	29.7	32.0	27.70	— 4.20	.085	.147	.164	.130	86	89	90	88	N	S W	S W	S 66 W	5.0	6.0	5.4	2.60	6.18	...	S
16	.570	.512	.601	.5635	35.1	33.7	22.6	30.18	+ 6.60	.074	.129	.085	.119	85	67	70	69	S W	W	W	S 28 W	9.0	20.0	6.8	2.39	13.26	...	0.1
17	.528	.637	.729	.6376	21.8	18.9	16.4	18.35	— 5.35	.099	.060	.076	.076	84	58	83	75	W	N W	W	N 63 W	10.6	19.0	6.0	10.98	11.98	...	S
18	.700	.560	.496	.5733	14.0	25.5	24.0	20.75	— 3.06	—	—	—	—	—	—	—	—	W	S	N	S 84 W	3.7	4.0	4.6	2.45	3.25	...	2.4
19	.463	.620	.628	.5470	9.5	20.1	21.5	17.30	— 6.60	.059	.066	.093	.072	89	61	79	75	N	N W	N W	N 31 W	5.4	21.0	11.8	12.00	12.61	...	0.1
20	.703	.614	.369	.5500	14.7	31.1	31.9	25.88	+ 1.63	.070	.087	.122	.086	84	60	66	60	N W	S W	W	N 82 W	15.0	10.5	20.0	9.60	12.92	...	...
21	.310	.280	.282	.2973	30.8	42.7	34.9	35.67	+11.35	.126	.155	.160	.144	73	56	78	60	S W	S W	S W	S 61 W	5.6	8.2	5.6	8.19	8.73	...	...
22	.338	.377	.462	.3973	33.7	43.4	35.5	37.23	+12.92	.129	.159	.176	.150	67	56	85	68	W	S W	N E	S 48 W	8.7	7.0	5.6	4.21	6.19	...	...
23	.411	.357	.402	.3928	37.3	39.2	40.5	39.12	+14.63	.146	.145	.137	.138	64	59	64	67	N E	E	N E	N 60 E	12.0	18.0	17.0	14.42	14.63	...	...
24	.355	.358	.438	.3897	37.6	40.9	36.9	38.20	+13.58	.164	.166	.145	.164	68	64	66	66	N E	N E	N	N 80 E	9.0	6.8	11.2	4.32	9.40	...	...
25	.620	.650	.740	.6567	30.0	31.0	31.0	30.60	+ 5.69	—	—	—	—	—	—	—	—	N W	N W	N W	N 27 W	10.0	15.0	6.0	12.96	13.47	...	...
26	.807	.853	.898	.8633	29.7	31.9	30.1	30.40	+ 5.37	.154	.100	.114	.117	93	58	67	60	N W	N W	N	N 33 W	8.2	12.5	8.8	9.80	9.99	...	...
27	.952	.924	.860	.9078	25.0	36.4	29.6	29.76	+ 4.58	.089	.121	.120	.107	66	56	73	65	N	S E	W	N 3 E	9.0	6.0	4.2	2.33	5.92	...	...
28	.807	.705	.814	.8063	24.6	36.9	29.0	30.65	+ 6.25	.114	.122	.117	.112	86	52	74	67	N W	W	S W	N 70 W	9.8	14.0	6.6	8.13	9.02	...	...
	29.6597	29.6831	29.7118	29.6977	26.02	32.29	28.67	28.81	+ 5.17	.124	.124	.125	.122	82	65	77	74	....	....	....	....	7.60	10.67	8.37	....	8.91	...	2.9

REMARKS ON TORONTO METEOROLOGICAL REGISTER FOR FEBRUARY, 1877.

NOTE.—The monthly means of the Barometer and Temperature include Sunday observations The daily means, excepting those that relate to the wind, are derived from six observations daily, namely, at 6 A.M., 8 A.M., 2 P.M., 4 P.M., 10 P.M., and midnight. The means and resultants for the wind are from hourly observations.

Highest barometer ....30 352 at 9 a.m. on 13th } Monthly range=
Lowest barometer ....29.282 at 4 p.m. on 21st } 1.070.

Self-registering Ther.
{ Maximum temperature........................ 41°9 on 22nd } Monthly range=
{ Minimum temperature........................ 4°9 on 13th } 40°0.
{ Mean maximum temperature .... 36°01 } Mean daily range=
{ Mean minimum temperature.................. 20°94 } 15°07.
{ Greatest daily range.................28°9 from a.m. to p.m. of 12th.
{ Least daily range .... 4°1 from a.m. to p.m. of 26th.

Warmest day ....23rd; mean temperature................ 39°12 } Difference=25°47.
Coldest day.................13th; mean temperature................ 13°65 }

Maximum { Solar ....111°0 on 21st } Monthly Range=
Radiation { Terrestrial ....—2°0 on 14th } 113°0.

No Aurora observed.

Possible to see Aurora on 14 nights; impossible on 14 nights.

No Rain fell during month.

Snowing on 6 days; depth, 2.9 inches; duration of fall, 22.6.

Mean of cloudiness, 0.80.

WIND.

Resultant direction, N. 64° W.; resultant velocity, 4.02 miles.

Mean velocity, 8.91 miles per hour.

Maximum velocity, 35.6 miles from 11 a.m. to noon of 12th.

Most windy day, 12th; mean velocity, 23.23 miles per hour.

Least windy day, 2nd; mean velocity, 2.68 miles per hour.

Most windy hour, 3 p.m.; mean velocity, 11 01 miles per hour.

Least windy hour, 5 a.m.; mean velocity, 7.60 miles per hour.

Fog on morning of 5th

Lightning on 6th.

Solar halos on 8th, 9th, 11th, 20th and 23rd.

Lunar halos on 23nd, 24th and 25th.

COMPARATIVE TABLE FOR FEBRUARY.

YEAR	Temperature: Mean.	Temperature: Excess above aver'ge	Temperature: Maximum	Temperature: Minimum.	Temperature: Range.	Rain: No. of days	Rain: Inches	Snow: No. of days	Snow: Inches	Wind: Resultant Direction.	Wind: Resultant Velo'y	Wind: Mean Velocity.
	°	°	°	°	°					°		
1840	19.5	— 3.1	40 6	— 9.8	50.4	2	0.210	13	10.2	N 41 W	1 48	6.58
1850	26 0	+ 3.4	49.6	2.2	47.4	7	1.235	9	23.1	N 80 W	3 48	7 61
1851	27.6	+ 5.0	50.2	2.0	48.2	7	2.600	4	2.4	N 64 W	1 99	6.94
1852	23.4	+ 0.8	41.2	— 6.2	47.4	3	0.651	11	13 0	S 75 W	3 34	6 42
1853	24.1	+ 1.5	43.4	— 1.4	44 8	4	1 030	15	12 6	N 49 W	2.51	7.30
1854	21.1	— 1.5	42.8	—10.8	53 6	5	1.400	15	18.0	N 7 E	1 73	6 91
1855	15 4	— 7 2	39.0	—25.4	64.4	2	1 770	14	21.8	N 40 W	4.34	8 17
1856	15.7	— 6 9	37.8	—18 7	56 5	0	0.000	8	9.7	N 81 W	7 70	10.17
1857	28.5	+ 5.9	52.4	— 5.9	58.3	11	3.050	11	11 7	S 78 W	3.68	9 82
1858	17 0	— 5 6	42 4	— 7.3	49 7	1	Inap	10	26 7	N 72 W	3.22	9 12
1859	26.0	+ 3.4	46.2	2 1	44.1	6	0.455	14	8.3	N 54 W	2 72	8 50
1860	22.8	+ 0.2	50 2	— 8.5	58 7	7	1.330	13	18 8	N 61 W	3 28	8 73
1861	26 1	+ 3.5	46.0	—20 8	66.8	4	0 815	17	20.7	N 77 W	3 86	10.58
1862	22.5	— 0.1	37.8	— 5 2	43.0	3	0.180	17	23 1	N 55 W	3 93	8 52
1863	22 4	— 0 2	41.5	—19 8	61 3	7	1.455	12	22.0	N 23 W	2 27	10 13
1864	24 3	+ 1.7	45.0	—15.0	60 0	2	0 307	14	9.5	S 84 W	6.48	10.11
1865	22.4	— 0.2	42.2	—10.0	52 2	5	0.810	11	16.8	N 23 W	3.96	8.23
1866	22 5	— 0.1	45.0	— 8.0	53 0	3	0.830	12	16 9	S 80 W	5.14	9.40
1867	28.9	+ 6.3	44 0	0.2	43.8	8	1.328	13	13.4	N 67 W	1 58	8 85
1868	17.2	— 5.4	45.0	—11.5	56.5	1	0.040	10	32.8	N 69 W	3.23	10.84
1869	25.0	+ 2.4	46.0	— 1.0	47.0	2	0.165	10	39 7	N 34 W	4 18	10.04
1870	21.5	— 1 1	40.6	— 6.6	47.2	2	0 520	18	20.1	N 29 W	2.84	8.10
1871	24 3	+ 1 7	48 0	—15.8	63.8	3	0 040	15	23.0	N 70 W	4 26	9.87
1872	20.7	— 1 9	45.2	— 3 6	48.8	5	0.350	9	7 3	N 61 W	3 32	8 93
1873	21.5	— 1.1	43 0	—10 5	53.5	0	0 000	11	10.4	N 68 W	4 29	10 21
1874	22.8	+ 0.2	42.0	0 4	41.6	6	1 150	15	10.1	N 24 W	2 46	8.12
1875	10.2	—12.4	47.6	—16 0	63.6	5	0 470	9	9 1	S 88 W	6.67	9 91
1876	23 8	+ 1.2	44.1	— 3 9	48.0	7	2.300	15	20 1	N 63 W	3.71	12 45
1877	28.8	+ 0.2	44 9	4 9	40.0	0	0.000	6	2 9	N 64 W	4.02	8 91
Results to 1876	22 58	...	44.24	—8.39	52.63	4.08	0.889	12 46	18 41	N 67 W	3.26	8.85
Excess for '77	+ 6.23	..	+ 0 66	+ 13.29	— 12.63	— 4 08	— 0 889	— 6.46	— 15 51	...	..	+ 0.06

PROSPECTUS

OF THE

ENCYCLOPÆDIA BRITANNICA,

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Edited by THOMAS SPENCER BAYNES, LL.D., Professor of Logic, Rhetoric, and Metaphysics, in the University of St. Andrews.

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