NOTICE OF THE NATURAL HISTORY COLLECTIONS OF THE McGILL UNIVERSITY.

The collections of the University in Natural History, which have been accumulating under the care of Dr. Dawson, are now placed in the new rooms provided by the liberality of Mr. Molson, though the naming of the specimens has not been quite completed, and will still require much time.

The principle of arrangement adopted has been that of disposing in flat and wall glass cases, suites of specimens illustrative of the subjects of the lectures in Natural History, in the order in which they are taken up in the lecture room. Geographical collections, and duplicate and extra specimens are placed in drawers under the cases in which objects of similar character are arranged. The greatest possible facilities will thus be afforded to the elementary student, while there will also be opportunity for farther and more detailed study.

The whole collection numbers about 10,000 specimens, of which about 2000 have been collected by Principal Dawson, or contributed from his private collection. The remainder have been procured by purchase or exchange, or by donations from friends of the University. The specimens may be grouped under the following heads:

1. *Mineralogy.*—The basis of this department is the collection of about 2000 Canadian and foreign minerals acquired from the late Dr. Holmes. To this have been added several species and varieties by donation and purchase.

2. *Geology and Palæontology.*—In this department are the fossils of the Holmes collection: the collections of rocks and fossils presented by Sir W. E. Logan, and numbering 475 specimens; collections of British fossils presented by H. Chapman, Esq., G. Evans, Esq., and others; collections of tertiary and carboniferous fossils, and local collections from the Azores, Murray Bay, Lake Superior, Lake Huron, &c., contributed by the Principal; with a great number of miscellaneous specimens, donations from friends and students. This collection is still very incomplete in Permian, Triassic, and Tertiary rocks and fossils.

3. *Zoology.*—In this department there are about 300 specimens of Vertebrate animals, selected as far as possible with a view to illustrate orders and families. Many of these specimens have been acquired by purchase, a few have been collected for the College, and there are valuable donations from J. Barnston, Esq., and others. In Articulates we have the Couper collection of 2400 specimens of Canadian insects, the Coleoptera of which, numbering nearly 700 species, have been catalogued by Le Conte; a miscellaneous collection of insects arranged by Mr. D'Urban to illustrate the orders and families; and a collection of British Hymenoptera presented by the same gentleman. In Arachnida, Crustacea, and Annelida, the collection is still incomplete, though there are a number of valuable specimens, collected by the Principal, or con-

tributed by Mr. R. J. Fowler and other friends. In Mollusks the basis of the collection consists of specimens presented by H. Chapman, Esq., the valuable collection of South Sea shells presented by Sir Wm. Dennison, 100 species of fresh-water shells acquired from Mr. Anthony, and duplicates from the Principal's collection. There are also a valuable collection of Norway shells presented by R. McAndrew, Esq., the commencement of a local Canadian collection, some rare and specially interesting species obtained by purchase, and donations from several friends. The collection of Radiates consists of specimens procured by the Principal, with donations from the Smithsonian Institute, Mrs. J. Redpath, Miss Carey, Rev. C. C. Carpenter, Mr. Fowler, Mr. Packard, and other friends. It is more full in Echinoderms than in any other class, and is still very incomplete in corals and their allies.

4. *Botany.*—The principal part of this collection is the Holmes Herbarium of 500 Canadian plants, exclusive of the grasses and carices, which though named and revised by Col. Munro, have not yet been catalogued. There is also a collection of sixty specimens of Canadian woods collected by the late Dr. Barnston; a collection of Canadian woods presented by D. Davidson, Esq.; a collection of Australian woods presented by Sir. Wm. Dennison, and collections of mosses, lichens, fungi, and algæ. The whole of these are now very conveniently arranged in a separate room. Only the commencement of a collection of exotic plants has as yet been made.

5. *Ethnology, &c.*—In this department there are a number of Indian relics from Montreal, presented by the Principal, several valuable casts of antiques presented by Mr. Blackwell, and a number of miscellaneous objects. It is not intended however to develop the collection much in this direction, as the available space is not more than sufficient for the specimens required in Natural History proper.

Measures are now in progress which it is hoped will tend to supply some of the principal deficiencies, and add useful geographical collections, so as to make the Museum all that it is intended to be, a small but thoroughly serviceable collection for the purpose of instructing students, and facilitating the research of local naturalists, for which purposes it will be in constant use. No attempt will be made to amass a large general collection like that of the Natural History Society, or to rival either that institution or the Geological Survey in the departments in which they are eminent. After securing a sufficient general collection of types for educational purposes, any farther additions will be made as far as possible in objects not adequately represented in the other collections in the city. Its arrangement in the new building will much facilitate the labors of the professors of Natural History and Mineralogy, and it is hoped, add new interest to the subject in the minds of students.

It is intended that every specimen shall be labelled with its name, locality, and donor, and this work has been already in great part accomplished, so that it is hoped that the Museum may be opened to students at the commencement of next session on the 6th September.

some general thoughts which a very short study of Canadian land and fresh-water shells, etc., has suggested to my own mind. It has appeared to me that in order to speculate rationally on the geographical range of the mollusca in Lower Canada, we must take into consideration all the physical changes which have occurred since these creatures were first created. In other words, we should study the post-pliocene fossils of the district in question, and institute a careful comparison between them and the recent shells of the country. Knowing the difficulty of access to scientific works in Canada, I have made a short summary of Edward Forbes's famous essay, and have shortly epitomized Mr. Lubbock's paper on the Swiss Pfahlbauten, hoping that attention drawn to the subject, may possibly result in the discovery of works of human art in our Canadian tertiary or post-tertiary deposits.

NATURAL HISTORY SOCIETY OF MONTREAL.

First Annual Conversazione.

The society having determined to hold an annual conversazione, as a literary, scientific and social reunion of its friends, a committee, consisting of Mr. Stanley Bagg, Mr. Becket, Mr. Robb, and Mr. Rose, with Mr. Leeming, the recording secretary, was appointed to make arrangements, and the meeting was accordingly held in the Society's Rooms on the evening of Tuesday, February 3rd. The following addresses were delivered on the occasion, after which the company enjoyed themselves in examining the Museum and a large collection of works of art, microscopes, etc., furnished for the occasion by friends of the Society.

Principal Dawson, in opening the proceedings of the evening, said:—I have much pleasure this evening in inaugurating a new feature in the progress of this Society—our Annual Conversazione—an occasion on which the members of this Association, with all its beasts, birds and creeping things, announce themselves "at home," and invite their friends to a scientific and intellectual feast, which we hope will continue to grow in interest in each succeeding year, and will remain as one of the permanent institutions of the society and of the city. The last occasion on which we thus entertained our friends was that of the opening of this building, an event of the utmost importance in the history of the society, and which has more than realized the most sanguine anticipations of those who promoted the remo-

val of the Society's collections, and the erection of our new and commodious apartments. Since that time, our collections have been largely augmented; many new members have been added to our list; and our monthly meetings have been amply supplied with interesting communications, many of them marking important steps of progress in the natural history of Canada. We have now connected with this Society, as members and correspondents, nearly all the working naturalists and geologists of British America; and our proceedings, published in the *Canadian Naturalist*, have extended the reputation of the Society throughout the world, and added an immense mass of valuable facts to the natural history of this country. The seven large volumes of our *Naturalist*, and the numbers constantly appearing, now form an indispensable part of the library of every one who studies the natural history of North America. Our labours have also been appreciated at home. The circulation of the *Naturalist* in Canada, and the fact that it is self-supporting, the large attendance at our monthly meetings and public lectures, and the recognition of the Society by the government of the country, as a recipient of a portion of the sums which Canada, in emulation of the wise liberality of older countries, annually grants for scientific and literary purposes, all testify to this. We all wish, however, that the advantages which we offer were still more largely used. Our philosophy is not of that kind which shuts itself up in pedantic exclusiveness. We regard the study of nature as the common heritage of all, and desire to open up to every one, from the little child upward, its beauties and its uses. Placed as I am at the head of an educational institution in which all branches of learning are represented, it does not become me, on ordinary occasions, to magnify my own special office as a teacher of natural science, or to insist on the reasons which have induced me to prefer in my own case the study of nature to other means of improving my mental powers and rendering myself useful to my fellow men. But here, as an officer of this Society, I may be permitted, without disparagement to other kinds of useful knowledge, to state some special claims of the study of nature. And first I would say on this subject, that the study of nature is eminently fitted to develop all our higher powers. Reasoning on first principles, this is absolutely undeniable, and might be stated still more strongly. Man is the only creature on our globe fitted to comprehend nature, and in his primitive state of innocence it was his

only book; and as among lower creatures, every one is specially adapted to its condition of life, so there is a special adaptation of the powers of man, created in the image of his Maker, to that system of things proceeding in all its parts from the same Almighty mind. Practical experience confirms this inference. What more fitted than natural objects to call forth the exercise of the powers of observation, what to develope a more nice power of discrimination, what to train to all the intricacies of contingent reasoning. The man who has disciplined his mind by the thorough study of any department of nature, who has gathered together and scrutinized its minute facts, who has by careful induction learned from them general truths, who has mastered, as far as our limited intellects may, the plans of the Creator in any portion of his works, has thereby aquired a mental training more godlike in its character than any that can be gained from art or human literature, because he has been following in the footsteps, not of man, but of God. Farther, natural science grasps within itself the essence of many other departments of culture. All the higher literature and more especially the literature of the sacred books and of the more ancient nations, is imbued with nature. All true art has its foundation in the higher art of creation. The principles of mathematical and physical science have some of their highest applications in the mineral, the plant and the animal; and geology presses into its service the results of almost every kind of inquiry as to material things. For this reason, while nothing can be more simple than the mere elements of the knowledge of nature, nothing can be more intricate or abstruse than its higher questions; nothing is more suited to convince a man of his own ignorance, or to prevent him from resting in a limited range of acquirement, or from remaining satisfied with the rude attempts of man to imitate the perfect beauty and adaptation of natural things. Again, the modes of investigation in natural history bear a direct relation to those modes of thought which are most necessary in the ordinary work of life. Observation, comparison, reasoning from cause to effect,—and these in relation to the means by which the Author of nature carries on his vast operations,—are the leading pursuits of the naturalist; and their effect in producing an acute, yet comprehensive style of thought, is conspicuous in the lives and works of all eminent students of nature. Nor is there anything in natural history calculated to engender pedantry or conceit. The naturalist works in

the presence of mysteries of life and structure which he cannot fathom, and which, therefore, teach him humility. He is only the interpreter of that which he cannot imitate; and he is willing, in collecting his facts, to sit at the feet of any one who can inform him in respect to the thousands of ordinary phenomena open to the investigation of every person who observes. Lastly, the revelation of God in nature, like that in his word, is thrown around us in such a way that while a little child may learn much of it, the powers of the highest intellect are tasked in reaching its higher truths, and in correcting the errors in which carelessness and ignorance envelop it. These two great revelations are twin products of the Divine mind: the one the study of man in innocence; the other the safety of man fallen:—and it is true that he who loves God most, will appreciate nature most; he who knows nature best, must best understand its Author. To disparage the study of nature as inferior to any other means of culture, is to evince the littleness of a mind dwarfed by the study of man's doings and blind to those of God, or the impiety of a soul that has no wish to magnify the works which men behold, as the external manifestation of the spiritual Creator.

But I must not follow such thoughts further, and now close by earnestly inviting all who are present this evening, to unite with us in exploring the wonders that are spread everywhere around us in nature, and assuring them that in this matter a little knowledge is not a dangerous, but on the contrary, a pleasant and profitable thing; and that while in Canada, there is scope for many more workers than we now have, there is still more ample scope for all who may desire to understand and enjoy the results of their labors.

Rev. A. F. Kemp next addressed the audience. He said it afforded him great pleasure to be there. Yet he had come there unexpectedly to himself, after rather severe labours during the preceding week; but being a great lover of natural science, he could not shrink from the invitation, and from saying such words as he might be enabled to offer on a subject so deeply interesting to him. Natural science was a most interesting part of human learning: most people liked it: it had a greater charm than most other departments. Amongst children there was a great taste for natural objects. They liked to touch things, and were curious in their inquiries about them. Curiosity was the faculty which in natural science was brought to bear upon nature. Some people,

as they grew old, seemed to lose this; and their inquiry as to anything new, was merely as to its utility, and whether it would pay. But those who retain the freshness and vigour of their youth have higher conceptions of the wonderful things with which they are surrounded. I have a great admiration too for what I may call the scientific method of thinking and reasoning. This method could not be satisfied without seeing, knowing, and thoroughly understanding, if possible, all about the objects of nature that lay within the compass of human apprehension. It was close and searching. It can be satisfied only with facts carefully observed and defined as the basis of its conclusions. If anything were omitted in the inquiry, the conclusions would be all wrong: the induction would fall to the ground, like a house of cards. But when it had got all the facts and their relations to one another it could then by the inductive process reach conclusions which might be regarded as reliable and certain. There was an infinite variety in the departments of natural science. Every taste could thus be gratified. Some loved entomology; but, for himself, he did not like to stick pins into butterflies and other insects. The study of animal life was certainly full of interest, but to him there always appeared to be something rather painful, if not cruel, about it. He preferred that department of natural science which had to do with what they might term, insentient life, or that of the vegetable. It was very easy to undertake, and exceedingly delightful. To its student the mighty forests were open, whose trees lifted their heads to heaven, and if he choose he could turn to the more lowly flowers of the field. Wooing them upon the river's banks, he would be repaid with unalloyed healthy pleasure. I profess to have turned my attention a little in this direction. Dr. Dawson had said, the study of natural science made men humble. Then he (Mr. Kemp) must be so, for his part was to study the humblest forms of nature, namely, marine and freshwater plants, many of which could only be observed by means of the microscope; and he would say, that he had felt true exhilaration of mind, and pure pleasure, when he had been in the field engaged in such pursuits. In that employment, he had roamed amongst the cliffs of Bermuda, and been charmed with the sight of that climate's most brilliant marine flora. "I have sometimes had amusing adventures there. One day I remember, when looking round in the hope of discovering some new species, I saw as I conceived one of the more brilliant red plants gleaming

bright, at a considerable depth in the water; it moved gracefully with every motion of the waves. I feasted my eyes on its beauty, and thought if only I could secure it without injury how glad I would be. To dive so deep and bring it up was not possible for me, so I got a long branch of a neighbouring tree, and up to the knees in water, on a rock near by, I worked till at last I caught it, and with joy pulled up my prize. But what do you think it was? Why, nothing but a bit of a soldier's red coat! (Laughter.) I was very much disgusted you may be sure. But yet it was so amusing that I enjoyed "the sell" amazingly.

"I do not need to go far for the objects of my study. They are everywhere—on the damp soil, the water spout, the pool, the high-way,—in the streamlet, the river, and the ocean. Pools of stagnant water, covered with a green mantle, were no contemptible fields for investigation. They were not unhealthful, and they were filled with objects, than which few were of greater interest. When upon a large scale, they emitted carbonic acid gas, or miasma the little things which covered them fed upon that gas, and absorbed it, leaving globules of pure and healthy oxygen. Some of these plants were exceedingly complicated and curious, and, to his mind, the most beautiful in the vegetable kingdom. Mr. Kemp here exhibited drawings of *Spyrogyræ* and *Rivulariæ*, and explained the structure and growth of these minute plants, which were constantly to be found growing in stagnant pools or on the banks of streams, and were objects of great interest to naturalists. They were exceedingly prolific, and he considered their peculiar manner of propagation as a proof of the permanency of species, in opposition to the Darwinian theory. Little and lowly they were, yet on examining their structure, and studying their economy, we were led into regions of life most wonderful and mysterious exhibiting the wisdom, goodness, and power of the Creator. Whence life came we could not tell; what it was the microscope could not discover. God concealed himself amidst his works, even while he revealed his power and skill in the outward aspects which they presented. In observing even these minute forms of life one could not but feel the truth of the saying: "Canst thou by searching find out God, canst thou find out the Almighty unto perfection?" For the speaker's part, though his special study was, from choice and profession the Bible, yet he felt bound, at the same time, to unfold and read the wondrous pages of creation. He did not believe it possible for a man to be an infidel, whilst

he paid scientific attention to nature. He was glad to see his audience there. The society had left its former humble rooms; and with the occupation of better ones, seemed to have improved in spirit. Let those who were not already members, become so, and begin and prosecute the study of the works of their beneficent Creator.

The CHAIRMAN then rose and thanked Mr. Kemp for his excellent address, saying, that the poet had said, there were "tongues in trees; books in the running brooks, and sermons in stones," but Mr. Kemp had found sermons in stagnant pools.

Selections of music, from Verdi and Donizetti, were then performed by the Band. When these were over, the Chairman introduced the Rev. Dr. De Sola, who said:—

I believe that no member of the Natural History Society will regret that it was decided to hold this pleasant social meeting here, when he looks around and sees how readily and numerously the friends of the Society have come forward this evening, to show their interest in us. And I am sanguine enough to believe that all who have come to-night are friends of the Society, and wish us God-speed in our efforts to promote its objects. And I am also sanguine enough to believe as a consequence, that those days in which the Natural History Society only vegetated, and in which even this vegetative existence was scarcely known to the public, are past, for ever past, without recall. At the same time, I do not forget that though the claims of natural science are becoming better understood, still much misconception as to its ends still exists, and some branches which this institution favors, are even now regarded with suspicion, if not with positive dislike, by many worthy persons who unaccountably fancy that the cause of revealed truth may be injured by them. This is no occasion fully to examine such an objection. We can only say to such timid persons, "Become members of this Society, and judge for yourselves, what powerful support science has given revelation." With reference to this misconception, I may go further and say that had carpers at holy writ been better naturalists, and possessed greater knowledge of physical science, they had not advanced half the fallacies they have. Thus, if the writer of a recent most crude and unfortunate publication, entitled "A critical examination of the Pentateuch and Book of Joshua,"—called critical,

perhaps, because there is no evidence of fair criticism in it, on the same principle that a worthy son of Erin called himself rich, because his money could not be counted,—if this writer, I say, had only been a working member of the Natural History Society of Montreal, I am sure that at least some of his objections would not have been started, but he would have recoiled at their absurdity. As an example, when he puzzles himself with one of his favorite arithmetical propositions,—"If 600,000 men in London require so much fuel, how much did 600,000 Israelites require in the desert, where trees are few," a member might remind him that the *genus homo* amidst the fogs, damp and cold of London, requires a little more caloric than the *genus homo* travelling under the burning sun of Arabia—that to cook the bread and beef of old England requires a little more fuel than did the manna, the food of the Israelites, which was melted by the mere heat of the sun. We could also whisper to him a few secrets about animal fuel, such as the Arab even now prepares in the desert, and the prophet Ezekiel refers to. We might say something too of the changes taking place on the face of the physical world,—of Lebanon, now barren and once covered with trees—of the present sterility of parts of Palestine, formerly most productive and prosperous, and show that even the wood-fuel they had was not absolutely required; nay, we might give him a rule-of-three sum in return, and say, if 600,000 persons required so much fuel in Arabia, and so much in London, how is it that the same number of persons in these northern regions of Canada, can find cord-wood enough for their supply, when so vast a proportion of these are needy persons, and have not wherewith to supply their wants from day to day? We will volunteer the reply also. The reply is one which all the researches of this Society into the Eternal's works of the natural order, as well as the holy book gives us, and it is that the hand of God never waxeth short, but every thing, and every one, bears incontrovertible testimony to the infinite power, wisdom and benevolence of the Creator of nature. I trust my reference may be excused. But I desired to employ this opportunity to state my humble opinion that if biblical students and religionists will not avail themselves of the advantages conferred by the study of natural science, there is a certain personage who well knows how to use them, as he has ever used them, for the attainment of his own ends. And I desired to illustrate the needlessness of the alarm of some timid

ones, and to demonstrate the truth that science is the true friend and supporter of religion, and that therefore, this and kindred institutions should enjoy the unbounded confidence of the community.

In inviting an accession of numbers to our ranks, we think that this Society, as pioneer in the development of natural history in this country, as originator of the present Geological Survey of Canada—for this Natural History Society was certainly first to move here—we believe it has some claims on every Canadian. A certain amount of progress has followed on its efforts, an accession of scientific talent has been made; and when I mention the name of a Dawson, a Logan, a Hunt, and a Billings, I think you will conclude with me that we number among us those of whom any Society even in Europe might be proud. We know that in a young community like ours, where nearly all are engaged in those pursuits which leave little time for scientific researches, we need not hope for a very large number able to take an active part in the primary objects of this Society. But this will not always be the state of things, and we should therefore do something for posterity. We can at least lay up materials for instruction, ready for use when they shall be wanted; and if we only do this, we shall be doing an important work, for which coming generations will thank us. But we are in fact doing more than this. The efforts of the members as they are becoming progressively greater, are also becoming better appreciated. The Society is becoming so favorably known that we may hope to see it yet bearing the same relation to all the British American Provinces as the British Museum bears to the mother country. We therefore ask all who can, to come and aid us in realizing our aspirations, which are chiefly those of the original founders of the Society—that of extending the knowledge of Natural History in particular, and of the physical sciences in general around us, so that our labors may redound to the credit not only of this growing city, but of this colony; and above all, that these labors may be additional testimony to the truth that "the hand that made us is Divine," even the hand of Him whose power, wisdom and benevolence are clearly revealed to us in all that is around.

ORDINARY MEETING, Oct. 24, 1862.

After routine busiuess the following communications were then read and discussed:—

1. A letter from Prof. Hall on the limits of the Catskill Group of New York, showing that a large proportion of the area, more especially in Delaware county, hitherto supposed to be occupied by the Catskill Group, really consists of rocks of the Portage and Chemung Groups.

2. A letter from Dr. Van Courtlandt, on the occurrence of *Gasterosteous gymnetes*, and of a supposed New *Leuciscus* in a lake tributary to the Ottawa.

3. A paper by C. Robb, Esq., C.E., on the distribution of the Superficial Deposits in C.W., and on some phenomena connected with the Mineral Springs of that region; more especially on the fresh-water drift of Upper Canada, and on the local subsidences and peculiar deposits on organic matters produced by some of the Springs.

4. Rev. A. F. Kemp made some remarks on the proposed use of the *Zostera marina* as a substitute for cotton, and on the occurrence of this plant in Eastern America.

Several papers we announced for next and subsequent meetings; and recommendations of the Council in relation to the better, arrangement and labelling of certain departments of the collection, were reported by the Secretary, Mr. Leeming, and adopted.

A number of new members were proposed, and the meeting adjourned.

ORDINARY MEETING, Nov, 24, 1862.

Principal Dawson, vice-President in the chair.

L. H. Parkes, Esq., of Birmingham, England, Microscopist, was unanimously elected a corresponding member; and Col. Dunlop, R.A., Messrs. J. E. Pell, J. S. Millar, Alex. Cowan, and H. G. Vennor were elected ordinary members.

After the general business, the following papers were read;

1. On the habits of the pine-boring Beetles of the genus *Monohammus*; by E. Billings, Esq.. F.G.S.—After some general remarks on the commercial value of our timber trees, and on the numerous insects which attack them, the author noticed the species of *Monohammus* known in North America, and gave a particular account of the habits of *M. Confusor*, with especial refe-

rence to its ravages on the timber of the white and yellow pine; and mentioned some very remarkable illustrations of the number of the insects, and the rapidity with which timber is destroyed by them.

2. On a New Crustacean from the Potsdam Sandstone; in a letter from Prof. Hall to Dr. Dawson—Prof. Hall referred to the paper on the footprints of Limulus recently read before the Society, and stated his belief that a new crustacean recently described by him before the Albany institute, but not yet published, answered to the conditions implied in the formation of Protichnites as illustrated by the modern Limulus.

3. On the Acton Copper Mines; by T. McFarlane, Esq.—In the absence of the author this paper was read by Mr. Robb. It contained an elaborate account of the mine and of the bed containing the ore, with its various disturbances; and entered into the probable origin of the deposit, and the modes of extracting and dressing the ores; being altogether the most complete and detailed account of this remarkable deposit which has yet appeared. The thanks of the Society were voted to Mr. McFarlane.

The following donations were presented to the Society:—

From P. McFarlane, Esq.—Specimens of minerals from the Giants' Causeway.

From James Ferrier, Junr. Esq.—A pair of *Fuligula albida;* and fishes for the aquarium.

From Mr. Gavin.—Two specimens of *Coluber sirtalis* (alive).

From Mr. Miller.—Specimens of Copper Ore from the Bruce Mine.

The Dublin Nat. Hist. Review, 6 Nos,; Proceedings of the Dublin University Zoological Association, 2 Nos; Journal of the Franklin Institute; Proceedings of the Entomological Society of Philadelphia, 6 Nos.; and several other periodicals and pamphlets were presented by the editors and publishers.

Ordinary Meeting, Feb. 2, 1863.

Principal Dawson, the vice-President in the Chair. The following papers were read:

1. On the Land and Fresh-water Mollusca of Lower Canada, with thoughts on their connections with the Post-pliocene fossils of the St. Lawrence Valley, and on the general geograpical distribution of Animals and Plants in Canada; by J. F. Whiteaves Esq. F.G.S.

2. On the parellelism of the Quebec group with the Lower Llandeilo of England and Australia; and on some new or little known species of Palœozoic Fossils. By E. Billings, Esq. F.G.S.

3. On the gold deposits of Canada and the manner of working them. By Dr. T. Sterry Hunt, F.R.S.

The following donations were received:

From L. Thomson, Esq.—Specimen of the Trumpeter Swan.

From G. Barnston, Esq.—Specimens of Fishes and Reptiles.

From Mr. E. C. David—Specimen of Wild Rice from the Prairies.

From B. Gibb, Esq.—Horn of African Rhinoceros.

From Mr. J. O'Brien—Specimen of the great horned Owl.

From Mr. Hunter—Thirty-two specimens of the sternum or breast-bone of Canadian birds.

From S. Bagg, Esq.—Bye-laws of the Numismatic Society of Montreal, and a paper read before the Society.

From T. Roy, Esq.—Pictorial description of the *Victoria regina*.

From J. Ferrier jun., Esq.—Japanese work on fishes, with coloured drawings.

From Various Societies, &c.—Proceedings and publications.

BOTANICAL SOCIETY OF CANADA.

The first meeting of the third session was held in the University Hall, Kingston, on Monday evening, 26th January, Prof. J. R. Dickson, M.D., Vice-President, in the chair.

The Society then proceeded to the election of office-bearers for the ensuing year, when the following were elected:—

Patron—His Excellency Viscount Monck, Governor General.

President—Very Rev. Principal Leitch, D.D.

Vice-Presidents—Prof. Litchfield, M.D.; Thos. Briggs, Jr., Esq.; Prof. Dickson, M.D.; Rev. Prof. Williamson, LL.D.

Council—John Carruthers, Esq.; Rev. W. Bleasdell, A.M., Rector of Trenton; Professor Kennedy, M.D.; B. Billings, Jr., Esq., Prescott; Prof. Fowler, M.D.; M. Flanagan, Esq., City Clerk; Mr. J. Macoun, Belleville; Prof. Hincks, F.L.S., Toronto; Prof. H. Yates, M.D.; Hon. W. Sheppard, D.C.L., Drummondville, L.C.; W. Ferguson, Esq.; J. Duff, Esq.; M. Sullivan, M.D.; Rev. H. Mulkins; Professor Octavius Yates, M.D.; Prof. Lavell, M.D.; Judge Logie, Hamilton; Augustus Thibodo, Esq.; Rev.

Prof. Weir, A.M.; John Watkins, Esq.; J. Creighton, Esq., Mayor; Rev. Prof. Mowat, M.A.

SECRETARY—Professor Lawson, LL.D.
AUDITOR—Andrew Drummond, Esq.
TREASURER—Professor Murray.
LIBRARIAN—Mr. R. V. Rogers, B.A.

HERBARIUM COMMITTEE—Mr. A. T. Drummond, B.A.; Mr. W. B. Ferguson, Jr., B.A.; Mr. John Bell, B.A.; Mr. Robt. Jardine, B.A.; Mr. John McMorine; Mr. James B. Ferguson, B.A.; Mr. Josiah Jones Bell.

Professor Lawson stated that through the kindness of Professor Caruel, formerly of Florence, now at Pisa, an ample supply had been obtained of living cocoons of the new Chinese silk moth, *Saturnia Cynthia*, which yields the Ailanthine silk, now so successfully raised in France and Italy. The eggs, which may be obtained from the moths in May next, it is proposed to distribute to such members of the Botanical Society as may desire to aid in the experiment of rearing them in Canada. This silk worm feeds on the *Ailanthus glandulosa*, a tree that is quite hardy in Canada. Members desirous of obtaining eggs were invited to send in their names to Professor Lawson, who stated that although there had hitherto been experienced great trouble in unwinding the cocoons, the process of soaking in caustic potash which Mrs. Lawson had found to answer so well with the Canadian Cecropia cocoons, was no doubt equally applicable to the new Ailanthine silk. Professor Lawson likewise exhibited samples of cloth made in the Indian prisons from the floss of the Indian silk weed or mudar plant, a material precisely similar to the floss contained in the pods of Canadian silkweeds.

Mr. Rogers, the Librarian, presented the following donations to the Society's Library:—

1. From the Montreal Natural History Society—The Canadian Naturalist and Geologist, from February 1862, to January, 1863.

2. From the American Philosophical Society—Nos. 66 and 67 of their proceedings.

3. From the Boston Society of Natural History—Their proceedings, Vol. 8, pages 1 to 128.

4. Proceeding of the American Academy of Arts and Sciences, Boston, Vols. 1, 2, 3, 4, and 5,—from the Academy.

5. Annals of the Lyceum and Natural History of New York, Vol. 8. Nos. 10 and 12,—from the Society.

6. Treasures of the Deep or Scottish Sea-weeds,—from Mr. Hubbert, Knox's College, Toronto.

7. Observations on North American and other Lichens, by Ed. Tuckerman,—from the author.

8. Physical features of central part of British North America, by James Hector, M. D.,—from the author.

9. Alpine and Arctic plants. by Principal Dawson,—from the anthor.

10. John E. LeConte, a necrology, by Wm. Sharswood,—from the author.

11. From Robert J. Drummond,—Botanical sketches of the 24 orders of Linnæus; Sir J. Banks and the Royal Society; Linnæus and Jussieu, or the Rise and Progress of Systematic Botany; annual Report of the Natural History Society of Montreal, for 1862; Constitution and By-Laws of Natural History Society of Montreal.

12. From the Geological Survey—Descriptive Catalogue of Economic Minerals, &c., of Canada, sent to the London International Exhibition, 1862.

Donations of dried specimens were announced from Mr. John Bell, B. A., Mr. Josiah J. Bell, Mr. C. I. Cameron, Mr. John Macoun, Mr. John K. McMorine, Mr. Donald Ross, M. A.

The following communications were read:

1. On plants collected in Canada, by Philip W. Maclagan, M. D; Berwick upon Tweed.

Referring to the recent establishment of the Botanical Society, Dr. Maclagan observed:—Entertaining, as I always must do, a warm affection for Canada, and my many kind friends there, I was delighted to see that Botany was taking its right place among them. I wish that there had been any movement in this direction during my residence, for I often had to regret the want of some companion to share the pleasure of botanical researches. Pondering in what way I could best show my sense of the compliment paid to me by your Society, I resolved to send you a complete list of the plants I had myself collected, and of which I have specimens, during a residence in Canada extending over twelve years, in the course of which I had been stationed in various parts of the country.

Dr. Maclagan's detailed observations, which were contained in two M.S. volumes, and embraced original information respecting nearly 900 species of Canadian plants will be published in the

Society's annals. A cordial vote of thanks was accorded to the author.

2. On the Physical Character of the East Riding of Northumberland, with a list of the plants of Mr. John Macoun, Belleville. Read by the Rev. Prof. Mowat, M. A.

This was likewise a very valuable paper and will appear in the Annals. Mr. Macoun's list embraced about 800 species. The account of the physical character of the country, and the indications of its former condition, shown by ancient lake-terraces, &c., excited much interest, and the Society's thanks were voted to Mr. Macoun.

3. Account of an Exploration of Gaspé during the past summer, by John Bell, B.A.

Mr. Bell, as one of a party of the Geological Survey, spent the summer in exploring the wild spruce woods of Gaspé, and gave a very interesting account of the vegetation. Mr. Bell has added greatly to our knowledge of Gaspé plants, and obtained some species that had not previously been observed. The Society accorded him warm thanks. Mr. Bell is preparing a complete list of his collections, which were very extensive, and the list will be printed in the Society's Annals.

4. On Ailanthine, the silk yielded by the *Saturnia*, or *Bombyx Cynthia*, with remarks on the *Ailanthus glandulosa*, or false Varnish Tree, of China, upon which the Worm feeds, by Robt. Patterson, M.D., Read by the Rev. Prof. Murray.

In illustration of this elaborate and valuable paper which will be published, the author sent a very interesting series of specimens, which were exhibited to the meeting, showing the eggs, the larvæ in various stages, the cocoon, and the perfect moths, male and female. The Society's best thanks were voted to Dr. Paterson for his communication.

5. List of plants collected in Ramsay and adjoining localities, during 1861-62, by John K. McMorine.

6. List of plants collected chiefly at Fort Garry, Red River Settlement, by John C. Schultze, M.D.

7. List of Plants of Beckwith and Ramsay, C.W., by Josiah Jones Bell.

8. List of Plants collected at Wellington, during the summer of 1862, by John A. Kemp, M.D.

The above lists were laid on the table and authorized to be

printed. The reading of several papers was delayed till next meeting, to be held on the evening of Friday, 13th of February.

The second meeting of the third session, was held on Friday evening, 13th Feby., the Very Rev. Principal Leitch, D.D., President, in the chair. There was a full attendance of members.

Professor Lawson, the secretary, called attention to the proposal of the Home Government, to publish under the direction of Sir William Hooker, the Queen's Botanist, Floras of the colonies of the British Empire, and a communication was read from Judge Logie of Hamilton, on the subject. Application having been made by the Colonial Secretary for the approval and concurrence of the Canadian Government, with a view to the early publication of the Canadian Flora, several of the members expressed strongly their opinion of the importance of the scheme, both in a scientific and commercial point of view, and as affording a most effectual means of making known to Canadians, as well as to the inhabitants of European countries, the nature of the products of our rich Canadian forests, which would stimulate to new branches of industry, and to the development of commercial enterprise.

Dr. Dickson, V. P., moved the appointment of a committee to bring before the Legislature, by petition and otherwise, the importance of Sir William Hooker's proposed publication, and expressed a belief that, if the Government declined to grant the small sum required, persons would be found in Canada ready to raise the amount, in a very short time, by private subscription. Committee: Principal Leitch, Prof. Dickson, Rev. Mr. Mulkins, A. Drummond, Esq., Judge Logie, and Professor Lawson.

The following papers were read:—

1. On the *Selandria Æthiops* and its destructive effects on Pear Trees. By the Very Rev. Principal Leitch, D.D., President.

2. Additional remarks on Dr. Patterson's paper on Ailanthine, by the Very Rev. Principal Leitch, who gave a very interesting detail of the rearing of the Ailanthine Silk Worm in Dr. Paterson's garden at Leith.

3. Poem.—The Pines. By Charles Mair, Lanark, C. W. Read by Joshua Fraser, B. A.

4. A chapter on Fungi. By James Hubbert, Knox's College, Toronto.

The Society then adjourned until Friday, March 13.

ANNUAL ADDRESS OF THE PRESIDENT OF THE NATURAL HISTORY SOCIETY OF MONTREAL, *May*, 1874.

By Principal Dawson, LL.D., F.R.S.

The scientific work of this Society in the year which closes to-night, is not so remarkable for its variety as for the interest and importance of the subjects to which it relates. A list of the papers read is appended to this address; but I shall confine myself principally to two subjects embraced in their scope. One is the bearing of the dredging operations of our colleague, Mr. Whiteaves, on the Post-pliocene Geology of Canada, in connection with other oceanic and geological researches. The second is the growth of our information as to the geological structure of those great plains of the West, whose profitable occupancy is now so important a problem for our statesmen.

Mr. Whiteaves in the past summer was chiefly occupied with the exploration of the great southern Bay of the Gulf of St. Lawrence, a basin of shallow water nearly semicircular in form, and in which is set the beautiful Island of Prince Edward. It is protected to some extent by the encompassing land, by its limited depth, and by the islands and shoals stretching across its mouth, from the influence of those cold northern currents which pervade all the middle and northern parts of the Gulf, and give to its fauna an almost Arctic character: it thus forms a peculiar and exceptional zoological province. The marine animals of Northumberland Strait were those with which I was myself most familiar in early youth, and I still possess many drawings of the more minute forms, made under the microscope for my amusement, before I had received any scientific training in natural history. In my cabinet there has been for the last thirty years a nearly complete representation of its mollusks, and I was even then aware from the observations of Gould and others in New England, of the specially southern character of this group of animals, though at that time I had no means of publishing my observations, and the importance of these peculiarities of distribution had scarcely dawned upon the minds of

geologists. In later years, however, Mr. Whiteaves and Prof. Verrill have, in connection with the dredging operations carried on in the interest of our fisheries, more fully worked up the relations of these faunæ, and we are now in a position to speak with some certainty of the facts, and to appreciate their significance.

If we draw a straight line from the northern end of Cape Breton through the Magdalen Islands to the mouth of the Bay des Chaleurs, we have to the southward an extensive semicircular Bay, 200 miles in diameter, which we may call the great *Acadian Bay*, and on the north the larger and deeper triangular area of the Gulf of St. Lawrence. This Acadian Bay is a sort of gigantic warm-water aquarium, sheltered, except in a few isolated banks which have been pointed out by Mr. Whiteaves, from the cold waters of the Gulf, and which the bather feels quite warm in comparison with the frigid and often not very limped liquid with which we are fain to be content in the Lower St. Lawrence. It also affords to the more delicate marine animals a more congenial habitat than they can find in the Bay of Fundy or even on the coast of Maine, unless in a few sheltered spots, some of which have been explored by Prof. Verrill. It is true that in winter the whole Acadian Bay is encumbered with floating ice, partly produced on its own shores and partly drifted from the north; but in summer the action of the sun upon its surface, the warm air flowing over it from the neighbouring land, and the ocean water brought in by the Strait of Cansean, rapidly raise its temperature, and it retains this elevated temperature till late in autumn. Hence the character of its fauna, which is indicated by the fact that many species of mollusks whose headquarters are south of Cape Cod, flourish and abound in its waters. Among these are the common oyster, which is especially abundant on the coasts of Prince Edward Island and northern New Brunswick, the Quahog or Wampum shell, the *Petricola pholadiformis*, which along with *Zirfea crispata*, burrows everywhere in the soft sandstones and shales; the beautiful *Modiola plicatula* forming dense mussel-banks in the sheltered coves and estuaries; *Cytherea* (*Callista*) *convexa*; *Cochlodesma leana* and *Cummingia tellinoides*; *Crepidula fornicata*, the slipper-limpet, and its variety *unguiformis*, swarming especially in the oyster beds; *Nassa obsoleta* and *Buccinum cinereum*, with many others of similar southern distribution.

Nor is the fauna so very meagre as might be supposed. My own collections from Northumberland Strait include about 50 species of mollusks, and some not possessed by me have been found by Mr. Whiteaves. Some of these, it is true, are northern forms, but the majority are of New England species.

The causes of this exceptional condition of things in the Acadian Bay carry us far back in geological time. The area now constituting the Gulf of St. Lawrence seems to have been exempt from the great movements of plication and elevation which produced the hilly and metamorphic ridges of the east coast of America. These all die out and disappear as they approach its southern shore. The tranquil and gradual passage from the Lower to the Upper Silurian ascertained by Billings in the rocks of Anticosti, and unique in North America, furnishes an excellent illustration of this. In the Carboniferous period the Gulf of St. Lawrence was a sea area as now, but with wider limits, and at that time its southern part was much filled up with sandy and muddy detritus, and its margins were invaded by beds and dykes of trappean rocks. In the Triassic age the red sandstones of that period were extensively deposited in the Acadian Bay, and in part have been raised out of the water in Prince Edward Island, while the whole Bay was shallowed and in part cut off from the remainder of the Gulf by the elevation of ridges of Lower Carboniferous rocks across its mouth. In the Post-pliocene period, that which immediately precedes our own modern age, as I have elsewhere shown,* there was great subsidence of this region, accompanied by a cold climate, and boulders of Laurentian rocks were drifted from Labrador and deposited on Prince Edward Island and Nova Scotia, while the southern currents flowing up what is now the Bay of Fundy, drifted stones from the hills of New Brunswick to Prince Edward Island. At this time the Acadian Bay enjoyed no exemption from the general cold, for at Campbelltown, in Prince Edward Island, and at Bathurst in New Brunswick, we find in the clays and gravels the northern shells generally characteristic of the Post-pliocene; though perhaps the lists given by Mr. Matthew for St. John and by Mr. Paisley for the vicinity of Bathurst, may be held to shew some slight mitigation of the Arctic conditions as compared with the typical deposits in the St. Lawrence valley. Since

* Notes on Post-pliocene of Canada, *Canadian Naturalist*, 1872.

that time the land has gradually been raised out of the waters, and with this elevation the southern or Acadian fauna has crept northward and established itself around Prince Edward Island, as the Acadian Bay attained its present form and conditions. But how is it that this fauna is now isolated, and that intervening colder waters separate it from that of southern New England. Verrill regards this colony of the Acadian Bay as indicating a warmer climate intervening between the cold Post-pliocene period and the present, and he seems to think that this may either have been coincident with a lower level of the land sufficient to establish a shallow water channel, connecting the Bay of Fundy with the Gulf, or with a higher level raising many of the banks on the coast of Nova Scotia out of water. Geological facts, which I have illustrated in my Acadian Geology, indicate the latter as the probable cause. We know that the eastern coast of America has in modern times been gradually subsiding. Further, the remarkable submarine forests in the Bay of Fundy show that within a time not sufficient to produce the decay of pine wood, this depression has taken place to the extent of at least 40 feet, and probably to 60 feet or more.* We have thus direct geological evidence of a former higher condition of the land, which may when at its maximum have greatly exceeded that above indicated, since we cannot trace the submarine forests as far below the sea level as they actually extend. The effect of such an elevation of the land would be not only a general shallowing of the water in the Bay of Fundy and the Acadian Bay, and an elevation of its temperature both by this and by the greater amount of neighbouring land, but as Prof. Verrill well states, it would also raise the banks off the Nova Scotia coast, and extending south from Newfoundland, so as to throw the Arctic current further from the shore and warm the water along the coasts of Nova Scotia and Northern New England. In these circumstances the marine animals of Southern New England might readily extend themselves all around the coasts of Nova Scotia and Cape Breton, and occupy the Acadian Bay. The modern subsidence of the land would produce a relapse toward the glacial age, the Arctic currents would be allowed to cleave more closely to the coast, and the inhabitants of the Acadian Bay would gradually become isolated, while the northern animals of Labrador would work their way southward.

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* Acadian Geology, p. 29.

Various modern indications point to the same conclusions. Verrill has described little colonies of southern species still surviving on the coast of Maine. There are also dead shells of these species in mud banks, in places where they are now extinct. He also states that the remains in shell-heaps left by the Indians indicate that even within the period of their occupancy some of these species existed in places where they are not now found. Willis has catalogued some of these species from the deep bays and inlets on the Atlantic coast of Nova Scotia, and has shown that some of them still exist on the Sable Island banks.*

Whiteaves finds in the Bradelle and Orphan bank littoral species remote from the present shores, and indicating a time when these banks were islands, which have been submerged by subsidence, aided no doubt by the action of the waves.

It would thus appear that the colonisation of the Acadian Bay with southern forms belongs to the modern period, but that it has already passed its culmination, and the recent subsidence of the coast has no doubt limited the range of these animals, and is probably still favouring the gradual inroads of the Arctic fauna from the north, which, should this subsidence go on, will creep slowly back to reoccupy the ground which it once held in the Post-pliocene time.

Snch peculiarities of distribution serve to show the effects of even comparatively small changes of level upon climate, and upon the distribution of life, and to confirm the same lesson of caution in our interpretation of local diversities of fossils, which geologists have been lately learning from the distribution of cold and warm currents in the Atlantic. Another lesson which they teach is the wonderful fixity of species. Continents rise and sink, climates change, islands are devoured by the sea or restored again from its depths; marine animals are locally exterminated and are enabled in the course of long ages to regain their lost abodes; yet they remain ever the same, and even in their varietal forms perfectly resemble those remote ancestors which are separated from them by a vast lapse of ages and by many physical revolutions. This truth which I have already deduced from the Post-pliocene fauna of the St. Lawrence Valley, is equally taught by the molluscs of the Acadian Bay, and by their Arctic relatives returning after long absence to claim their old homes.

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* Acadian Geology, p. 37.

Still another lesson may be learned here. It appears that our present climate is separated from that of the glacial age by one somewhat warmer, which was coincident with an elevated condition of the land. Applied to Europe, as it might easily be, this fact shows the futility of attempting to establish a later glacial period between the Post-pliocone and the present, in the manner attempted, as I must think on the slenderest possible grounds, by Prof. Geikie in his late work "The Great Ice Age."

The grandeur of those physical changes which have occurred since the present marine animals came into being, is well illustrated by some other facts to which our attention has been directed. Recent excavations in the Montreal mountain have enabled Mr. Kennedy to observe deposits of Post-pliocene marine shells at a still higher level than that of the old beach above Cote des Neiges, which was so long ago described by Sir Wm. Logan and Sir Charles Lyell. The new positions are stated to be 534 feet above the sea. Let us place this fact along with that recorded by Prof. Bell in the Report of the Geological Survey for 1870-71, of the occurrence of these same shells on the high lands north of Lake Superior, at a height which, taking the average of his measurements, is 547 feet above the sea level. Let us further note the fact, that in the hills behind Murray Bay and at Les Eboulements I have recorded the occurrence of these remains at the height of at least 600 feet. We have then before us the evidence of the submergence of a portion of the North American continent at least 1000 miles in length and 400 miles in breadth to a depth of more than a hundred fathoms, and its re-elevation, without any appreciable change in molluscan life.

Another important and impressive fact in this connection has recently been brought out by Dr. Hunt in a paper on the Geology of the South-eastern Appalachians.* He there shows that in these mountains, which lie to the south of the region of the great Post-pliocene submergence, the gneissose rocks have been decomposed in place to enormous depths, without any of the material being removed—a most striking contrast to the generally bare and scraped condition of similar rocks in the north. I was struck very much with this fact several years ago, when, under the guidance of my friend Dr. Tyson, I had an opportu-

* Proceedings American Association, 1873.

nity of examining the crystalline rocks near Baltimore, and I have also in my notes on the Post-pliocene of Canada, pointed out that in some places, as at Les Eboulements and on the southern side of our own mountain, where the rocks have been sheltered from the northern currents, extensive evidence of old sub-aerial disintegration may be seen.

It is most instructive to compare in connection with this point the condition of the Silurian rocks on the north-east and south sides of the Montreal mountain. On the former they show no signs of sub-aerial waste, but are polished and striated in the most perfect manner. The striae are N.E. and S.W., or in the direction of the river valley, and that the force producing them acted from the N.E. is shewn by the manner in which projecting trap dykes are ground on the N. E. side and left rough on the opposite one. The striae vary in direction, having evidently been produced by many successive impacts of heavy bodies moving from the north-east but not always in precisely the same lines. It seems absolutely impossible that anything except floating ice running from the N. E. or against the present drainage of the country could have produced these striations.* On the limestone slopes which front the mountain, all is different. In the vicinity of the reservoirs, for example, the coarse earthy limestone, where it has been protected by hard trap dykes, is in many places decomposed to a great depth, and shows no signs of glacial action.

What does this teach us? The same truth which we learn from the wholesale transference of boulders, sand and clay to the south-west over our country, namely, that *the great agent in denuding it of all its decomposed and broken rock has been the Arctic current passing over it when submerged.* The boulders which have been swept away from our Laurentian hills are merely the harder and less decomposed parts of rocks which had been disintegrated long before the glacial period, but became the prey of water and ice when the land was submerged. Geologists will not learn to understand fully the Post-pliocene period,

* I saw last autumn on St. Helen's Island a very instructive instance of striation on Utica shale produced by the ice-shove of the previous spring. This was in the direction of the river valley, but the evidence of the force acting from the south-west was plain, while a miniature moraine of rock fragments in advance of the markings shewed the agent by which they had been effected.

until they are prepared to admit that the power of the heavy Arctic currents passing over the submerged land and carrying with them their burden of ice, is vastly greater as an agent of denudation than either the rivers or glaciers. Nor must we confine this to the Post-pliocene period. Prof. Hall has shewn that the whole of the vast thickness of the Palæozoic rocks of the Appalachians may be attributed to the carrying power of the same currents which are now piling up banks of Arctic sand and stones along the American coast. Nay more, the history of the land of the Northern Hemisphere throughout geological time has been that of a series of elevations and depressions or gigantic pulsations of the earth's crust, so regular that we cannot hesitate in referring them to some constantly operating law. Every elevation exposed the land to sub-aerial disintegration. Every subsidence scraped and peeled it by the action of the Arctic currents, and thus the carriage of material and the growth of the continents have ever been to the south-west. I cannot leave this subject without according to Dr. Carpenter much credit for contending as he has done for the reality, power, and true causes of these great sub-oceanic rivers, which have played and are playing so important parts as geological agents, that without them it is impossible to account either for the Palæozoic deposits or the Post-pliocene deposits of our North American continent.

But it is time to turn to the second topic which I have marked out for myself in this discourse. In the past summer three lines of geological reconnaissance have been pushed out from the Laurentian and Huronian country of Lake Superior over the plains of Manitoba. One of these, under Mr. Selwyn, followed the line of the North Saskatchewan. The second was that of Prof. Bell on the south branch of the same river and its tributaries. The third was that of Mr. G. M. Dawson on the 49th parallel. All of these have been brought under the notice of this Society in the course of the winter. This great western plain presents first a wide expanse of Cretaceous rocks, apparently not highly fossiliferous and not well exposed, but containing some limestone layers rich in Foraminifera and Coccoliths precisely similar to those of the English chalk. Some of these have been described by Mr. Dawson in our Journal. This is succeeded by vast estuarine and lacustrine deposits of clay and sand, holding brackish-water and fresh-water shells, and beds of lignite with abundant plant remains. The general geological

history of these great prairie lands is thus as plain and simple as their own superficial features. First, we have a great Cretaceous Mediterranean, extending from the Gulf of Mexico perhaps to the Arctic sea. Then we have this dried up into estuaries, lakes and marshes, and becoming clothed with a rich vegetation similar in general character to that of the west coast at present, and indicating a mild and genial climate. Then we have the great Post-pliocene subsidence, with its trains of gravel and ice-borne boulders; and lastly the re-elevation into the prairie lands of to-day, with perhaps an intervening age of modern forests. The final results are a vast expanse of fertile soil, and great stores of mineral fuel, which may one day make these now lone lands the seats of extensive manufacturing industries. Detailed reports of the explorations of the past year are in progress, and will greatly increase our precise and definite knowledge of regions which have hitherto been known to us principally through the vague impressions of unscientific travellers.

Simple though the structure of these Western regions is, it has already given rise to controversies, more especially with reference to the age of the plants and animals whose remains have been found in these formations south of the United States boundary. In looking over these controversies, I am inclined in the first place to believe that we have in the West a gradual passage from the Cretaceous to the Tertiary beds, and that these last may scarcely admit of a definite division into Eocene and Miocene. We may thus have in these regions the means of bridging over what has been one of the widest gaps in the earth's history and of repairing one of the greatest imperfections in the geological record.

Physically the change from the Cretaceous to the Tertiary was one of continental elevation—drying up the oceanic waters in which the marine animals of the Cretaceous lived, and affording constantly increasing scope for land animals and plants. Thus it must have happened that the marine Cretaceous animals disappeared first from the high lands and lingered longest in the valleys, while the life of the Tertiary came on first in the hills and was more tardily introduced on the plains. Hence it has arisen that many beds which Meek and Cope regard as Cretaceous on the evidence of animal fossils, Newberry and Lesquereux regard as Tertiary on the evidence of fossil plants. This depends

on the general law that in times of continental elevation newer productions of the land are mixed with more antique inhabitants of the sea; while on the contrary in times of subsidence older land creatures are liable to be mixed with newer products of the sea. Thus in Vancouver's Island plants which Heer at first regarded as Miocene have been washed down into waters in which Cretaceous shell-fishes still swarmed. Thus Cope maintains that the lignite-bearing or Fort Union group contains remains of cretaceous reptiles, while to the fossil botanist its plants appear to be unquestionably Tertiary. Hence also we are told that the skeleton of a Cretaceous Dinosaur has been found stuffed with leaves which Lesquereux regards as Eocene. At first these apparent anachronisms seem puzzling, and they interfere much with arbitrary classifications. Still they are perfectly natural, and to be expected where a true geological transition occurs. They afford, moreover, an opportunity of settling the question whether the introduction of living things is a slow and gradual evolution of new types by descent with modification, or whether, according to the law so ably illustrated by Barrande in the case of the Cephalopods and Trilobites, new forms are introduced abundantly and in perfection at once. The physical change was apparently of the most gradual character. Was it so with the organic change, That it was not is apparent from the fact that both Dr. Asa Gray and Mr. Cope, who try to press this transition into the service of evolution, are obliged in the last resort to admit that the new flora and fauna must have migrated into the region from some other place. Gray seems to think that the plants came from the north, Cope supposes the mammals came from the south; but whether they were landed from one of Sir William Thomson's meteors, or produced in some as yet unknown region of the earth, they cannot inform us. Neither seems to consider that if giant Sequoias and Dicotyledonous trees and large herbaceous mammalia arose in the Cretaceous or early Tertiary, and have continued substantially unimproved ever since, they must have existed somewhere for periods far greater than that which intervenes between the Cretaceous and the present time, in order to give them time to be evolved from inferior types; and that we thus only push back the difficulty of their origin, with the additional disadvantage of having to admit a most portentous and fatal imperfection in our geological record.

The actual facts are these. The flora of modern type comes into being in the Cretaceous of the West without any known ancestors, and it extends with so little change to our time that some of the Cretaceous species are probably only varietally distinct from those now living. On the other hand the previous Jurassic flora had died out apparently without successors. In like manner the Cretaceous Dinosaurs and Cephalopods disappear without progeny, though one knows no reason why they might not still live on the Pacific Coast. The Eocene mammals make their appearance in a like mysterious way. This is precisely what we should expect if groups of species are introduced at once by some creative process. It can be explained on the theory of evolution, only by taking for granted all that ought to be proved, and imagining series of causes and effects of which no trace remains in the record.

The problems for solution are, however, much more complicated than the derivationists seem to suppose. Let us illustrate this by the plants. The Cretaceous flora of North America is in its general type similar to that of the Western and Southern part of the continent at present. It is also so like that of the Miocene of Europe that they have been supposed to be identical. In Europe, however, the Cretaceous and Eocene floras, though with some American forms, have a different aspect, more akin to that of floras of the Southern Hemisphere. There have therefore been more fluctuations in Europe than in America, where an identical group of genera seems to have continued from the Cretaceous until now. Nay, there is reason to believe that some of the oldest of these species are not more than varietally distinct from their modern successors. Some that can be traced very far back are absolutely identical with modern forms. For example, I have seen specimens of a fern collected by Dr. Newberry from the Fort-Union group of the Western States, one of those groups disputed as of Cretaceous or Tertiary date, which is absolutely identical with a fern found by Mr. Dawson in the Lignite Tertiary of Manitoba, and also with specimens described by the Duke of Argyle from the Miocene plant beds of Mull. Further it is undoubtedly our common Canadian sensitive fern—*Onoclea sensibilis*. There is every reason to believe that this is merely one example out of many, of plants that were once spread over Europe and America and have come down to us unmodified throughout all the vicissitudes of the Tertiary ages. But while

this is the case, some species have disappeared without known successors, and others have come in without known predecessors. Nay whole floras have come in without known origin. Since the Miocene age the great Arctic flora has spread itself all around the globe, the distinctive flora of North-Eastern America and that of Europe have made their appearance, and the great Miocene flora once almost universal in the Northern Hemisphere has as a whole been restricted to a narrow area in Western and warm temperate North America. Even if with Gray, in his address of two years ago before the American Association, we are to take for granted that the giant Pines (Sequoias) of California are modified descendants of those which flourished all over America and Europe in the Miocene, Eocene and Cretaceous, we have in these merely an exceptional case to set against the broad general facts. Even this exception fails of evolutionary significance, when we consider that the two species of Sequoia, which have been taken as special examples, are at best merely survivors of many or several species known in the Cretaceous and Tertiary. The process of selection here has been merely the dropping out of some out of several species of unknown origin, and the survival in a very limited area of two, which are even now probably verging on extinction: in other words, the two extant species of Sequoia may have continued unchanged except varietally from Mesozoic times, and other species existed then and since which have disappeared; but as to how any of them began to exist we know nothing, except that, for some mysterious reason, there were more numerous and far more widely distributed species in the early days of the group than now. This is precisely Barrande's conclusion as to the Palæozoic Trilobites and Cephalopods, and my own conclusion as to the Devonian and Carboniferous plants. It is rapid culmination and then not evolution but elimination by the struggle for existence.

The argument deduced from these successive floras reminds one of certain attempts which have been made in England to invalidate Barrande's law in his own special field. With a notice of one of these, which emanates from a successful collector of Primordial fossils, I shall close. He says, after referring to the different species of Paradoxides and allied genera in the Cambrian:—

"Other species show various gradations in the eyes and in the pygidium until we attain to *P. Davidis*, which has small eyes, a small

pygidium, and the greatest number of thoracic segments. Indeed there are forms to represent almost every stage, and there can I think be no doubt that in the fauna of the Tremadoc group, which is separated from the earlier Cambrian by several thousand feet of deposits indicating a period of very shallow water in which large brachiopods and phyllopod crustaceans were the prevailing forms of life, we witness a return to very much the same conditions as existed in the earlier Cambrian periods, and with these conditions a fauna retaining a marked likeness to the earlier one, and in which the earlier types are almost reproduced, though of course greatly changed during their previous migrations. The *Niobe(?)* recently found in the Tremadoc rocks is truly a degraded *Paradoxides*, retaining the glabella and head spines, but with the rings of the thorax, excepting eight, consolidated together to form an enormous tail. Instead therefore of having here, as stated by M. Barrande, "a very important discord between Darwinism and facts," we find in these early faunas facts strongly favouring such a theory, and in support of evolution.

This is an exquisite piece of evolutionist reasoning, worthy of some of the greater masters of this peculiar logic. It is assumed that specific differences are "gradations" and the word "almost" covers the gaps between these. It is taken for granted that Paradoxides, which disappears with the Menevian age, has only gone upon its travels to parts unknown, and after the deposition of several thousand feet of beds, returns disguised as the Niobe of the Tremadoc,—and not only changed but "degraded",—a sorry result certainly of the struggle for existence in the interval, and holding out small prospect that the creature can be promoted in any subsequent age into a fish or even into a Decapod. If Barrande's reasoning can be met only in this way, he need not fear for the result. Seriously, one scarcely knows whether to be amused or grieved at the phases which the doctrine of derivation assumes in the writings of some modern naturalists. It is at least devoutly to be hoped, in order that science may not fall under the contempt of all thinking men, that the advocates of this hypothesis may become more careful in their treatment of facts, and more modest in their demands on our faith.

In the meantime the record of the rocks is decidedly against them in the particular point to which I have above adverted, namely, the abrupt appearance of new forms under several specific types and without apparent predecessors. They should direct their attention in this connection to the appearance of Foraminifera in the Laurentian, of Sponges, Brachiopods, Trilobites,

Phyllopods, Crinoids, and Cephalopods in the older Palæozoic; of Land Snails, Millipedes, Insects, Fishes, Labyrinthodonts, Acrogens and Gymnosperms in the middle and later Palæozoic: of Belemnites, Dinosaurs, Ornithosaurs and other Reptiles, and of Marsupial Mammals and Dicotyledonons trees in the Mesozoic; of Placental Mammals and Man in the Tertiary and modern. When they shall have shewn the gradations by which these, out of the many cases which may be cited, have been introduced, and this without assuming an imperfection in the record incredible in itself and destructive of its value as a history of the earth, they may be in a position to rebuke us for our unbelief.

But it may be asked:—Have we no positive doctrine as to the introduction of species? In answer I would say that it is conceivable that the origin of species may be one of those ultimate facts beyond which science by its own legitimate methods cannot pass, and that all we can hope for is to know something of the modes of action of the creative force and of the modifications of which species when introduced are susceptible. In any case it is by searching for these latter truths that we may hope successfully to approach the great mystery of the the origin of life. It is with reference to these truths also that the discussion of modern theories of derivation has been chiefly valuable, and in so far as established they will remain as substantial results after these theories have been exploded. Among such truths I may mention the following: We have learned that in geological time species tend to arise in groups of like forms, perhaps in many parts of the world at once; so that genera and families culminate rapidly, then become stationary or slowly descend, and become restricted in number of species and in range. We have learned that in like manner each specific type has capacities for the production of varietal and race forms which are usually exercised to the utmost in the early stages of its existence, and then remain fixed or disappear and re-appear as circumstances may arise, and finally the races fall off one by one as it approaches extinction. Many of these races and varieties constitute conventional species as distinguished from natural species, and in so far as they are concerned, descent with modification occurs, though under very complex laws, and admitting of retrogression just as much as of advance. We have also learned that in the progress of the earth's history embryonic, generalised and composite types take precedence in

time of more specialized types, and thus that higher forms of low types, precede higher types and are often replaced by them. We are further, as the relation of varieties and species is investigated and their extension in time traced, becoming more and more convinced of the marvellous permanence of specific types, and of their powers of almost indefinite propagation in time. Lastly, vast stores of facts are being accumulated as to the migration of species from one area to another and as to the connection of the great secular elevations and subsidences of continents with their introduction and extinction. All these are substantial gains to science, and the time is at hand when they will lead to more stable theories of the earth than those now current. If I am not greatly mistaken, these considerations or some of them will be found to cover the case recently so much insisted on of the Tertiary predecessors of the modern Horse; a case which includes a great number of complicated and curious successions and relations, which we may hope to consider at a future time, when the American facts relating to them have been more fully elaborated.

I have however digressed from my special subject, and in returning to it, and in closing this address, would express my thankfulness that here in America we have a field for work on so broad a scale that there is little temptation to abandon the ever fresh and exciting exploration of new regions and the discovery of new facts, and the working out of legitimate conclusions, for that process of evolving worlds out of our own consciousness which seems to be the resource of those who have access only to the often ransacked treasuries of nature in smaller and older countries. Placed on a continent which in its geological development is the grandest and noblest of all, and which may be made a type for all the rest, let us push forward the conquests of legitimate science, and bear in mind that our present aim should be above all things the diminution of that imperfection of the geological record of which so much complaint is made.