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*I.—On some Relations of Geological Work in Canada and the Old World.**By J. W. DAWSON, C.M.G., LL.D., F.R.S., &c.*

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I do not propose in this paper to attempt the impossible task of discussing all the points of contact between the geology of Canada and that of other parts of the world, but merely to notice a few instances likely to be of interest to this section, which have come under my own observation, of the relations of scientific work and workers on the two sides of the Atlantic,—relations which are daily becoming more intimate, and which it may be hoped will be greatly strengthened by the approaching visit of the British Association to Montreal.

Beginning with the older crystalline rocks, one is struck with the large amount of attention at present bestowed on petrology, and especially on the microscopic examination of rocks. I can recall the time when these subjects scarcely excited any interest, and were almost entirely neglected by English geologists. The current now sets strongly in this direction, and many of the younger men are enthusiastic lithologists, while many of the warmest and most earnest discussions in the Geological Society relate to subjects of this kind. In connection with this, the comparison of the pre-Cambrian rocks of Britain with the larger and more complete development of these formations in Canada is pursued by such men as Bonney and Hicks, and has directed much attention to Canadian geology.

Canada has naturally taken the lead in the discrimination and classification of those old pre-Cambrian rocks, of which she possesses so large an area. The distinctions made by Sir W. E. Logan, of the Lower and Upper Laurentian, the Huronian and the Upper Copper-bearing Series of Lake Superior, were in advance of anything done in Europe at that time, and they have been ably followed up by Dr. Hunt and by the officers of the Geological Survey. Corresponding formations are now recognized in Great Britain, and in a recent address delivered by Dr. Hicks, as President of the Geologists' Association, he contends for the existence in the British Islands and other parts of Europe of rocks corresponding to the Lower Laurentian or Ottawa series, to the Middle or Grenville series, to the Norian or Upper Laurentian, to the Huronian and to the Montalban. I had myself an opportunity of noticing the remarkable lithological resemblance of the rocks of the St. Gothard Pass to those of the White Mountains, and I had also the pleasure of recognizing in the gneisses and crystalline schists of Assouan in Egypt, a series identical in mineral character with many portions of the Middle Laurentian of Canada; while overlying deposits, largely made up apparently of igneous products, seemed to occupy the position of the Arvonian series. The quarries, from which the ancient Egyptians obtained their fine blocks of red granite and diorite, are in intrusive dykes and masses penetrating these old stratified rocks.

Nothing can be more remarkable than the strong similarity in mineral character of these ancient rocks in all their wide extension in both continents.

The areas occupied by these pre-Cambrian rocks in Great Britain are so limited, and their stratigraphical complexities are so great, that some controversy still exists as to their arrangement; but the prospect is that they will ere long be admitted on all hands to correspond in their order of occurrence with the Canadian series.

The long-agitated question of the animal nature of *Eozoon Canadense* is now in a somewhat quiescent state; but I have been pleased to find a pretty uniform current of opinion in its favour among those best qualified to judge. Dr. Carpenter has for some time been engaged in a careful re-examination of all the more important specimens, with a view to the publication of an exhaustive monograph on the subject, which is to be illustrated with large and admirably executed figures. I had the pleasure, shortly after my arrival in England, of spending a few days with Dr. Carpenter and aiding him in this work, as well as of furnishing him with notes of the geological relations and mode of occurrence of the specimens.

Thanks to the labours of Hall, Barrande, and Billings, the correlation of the great Silurian series of Europe and America is now in a somewhat complete and satisfactory condition. America, which is so eminent in its representation of the life of the Silurian, is still somewhat behind in the recognition of the Cambrian and the determination of its fossils. We are however steadily advancing in this matter, more especially in Canada, and I hope that the excellent work of Mr. Matthew on these ancient fossils, in connection with this Society, will be continued and enlarged. The re-arrangement and more complete display of the Palæozoic fossils in the new Museum at South Kensington will place the means of comparison with British forms in a more advanced position than formerly.

When in Belgium, I had the pleasure of examining the interesting collections of Devonian plants of that country which have been described by M. Crepin. I was struck with the close correspondence of the forms with ours in Canada,—a correspondence more marked in the specimens themselves than in the published engravings, owing to close similarity of the state of preservation and the containing rock. In Britain also, my friends, the Rev. Thomas Brown of Edinburgh and Mr. Kidston of Stirling, have been extending our knowledge of the Devonian flora, and find, as in this country, the lower portions of that system to be characterized by such forms as *Psilophyton*, *Arthrostroma* and *Prototaxites*, while the ferns of the genus, *Archæopteris*, and Lepidodendroid species are equally noteworthy in its upper members. As yet no flora corresponding in richness to that of our Middle Devonian or Middle Erian has been recognized.

Very remarkable discoveries of millipedes and scorpions have been made by Peach in the Devonian and Lower Carboniferous of Scotland, which place that country far in advance of America, though Nova Scotia afforded the earliest Carboniferous millipede known. That millipedes existed in the Lower Devonian of Scotland is a fact in harmony with the occurrence of winged insects in the Middle Devonian of New Brunswick. Mr. Peach's discoveries also indicate very remarkable affinities between the scorpions and the eurypterid crustaceans, some of which seem to have been aquatic scorpions.

With reference to the Carboniferous flora, I had the pleasure of spending a week with my old friend, Prof. Williamson of Manchester, and of inspecting under the microscope the magnificent series of preparations of structures which he has been accumulating for many

years, and describing and figuring from time to time in the Transactions of the Royal Society. I was able to make many notes of these specimens, which I trust will be useful in advancing the knowledge of this flora in Canada; and I feel convinced that the facts accumulated by Prof. Williamson and those recently obtained by Grand'Eury and others in France are rapidly placing us within reach of a comprehension of the affinities and relationships of the plants of the coal period, much more accurate and definite than we have heretofore obtained. While new and unexpected conclusions may be reached on this subject, I have reason to believe that many of the suggestions and anticipations, which I have ventured to throw out with reference to the plants of the Nova Scotia coal-formation, and which I have based on facts of mode of occurrence as well as of structure, will be verified and confirmed. More especially it will, I think, appear that there have been grouped, under the general name of *Sigillaria*, plants of very different ranks; while definite characters will be found to separate the greater part of the plants known as *Cordaites* from the true conifers of the genera, *Dadoxylon* and *Araucarites*; and the humble plants of the group of Rhizocarps will be discovered to have been more important in the Palæozoic than has hitherto been supposed.

The coal-field of Nova Scotia has afforded a very remarkable group of terrestrial batrachians, not precisely paralleled elsewhere. But recently Fritsch has described, from the so-called gas-coal deposits of the Permo-carboniferous of Bohemia, a number of very similar forms, some of them belonging to the same genera with those of Nova Scotia. The earliest known indications of Carboniferous Batrachians were the footprints discovered by Logan at Horton Bluff and described by me as *Hylopus Logani*; but we have not found actual bones at so low an horizon. I saw, however, in the collections of Dr. Traquair in Edinburgh, a skull of a large batrachian not yet described, from beds of the same age in Scotland.

The peculiar development of the Cretaceous and Laramie rocks in our Western Territories, the rich angiospermous flora which they contain, the insensible gradation upward of the Cretaceous into the Tertiary, and the small relative development of the marine parts of the formations, have given a special and exceptional character to these deposits. Recent discoveries are, however, tending to assimilate the floras of the old and new worlds in the Cretaceous epoch; and in Great Britain, Mr. Starkie Gardner has recently shown that the Eocene flora corresponds more nearly with that of America than had heretofore been supposed, and that certain floras formerly regarded as Miocene are really older.¹ In this way much of the apparent discrepancy will be removed, and we shall probably be no longer told by European palæobotanists that floras, which on stratigraphical grounds or the evidence of animal fossils we know to be Eocene or Cretaceous, are in their estimation Miocene. I had myself occasion to observe in the Cretaceous of the Lebanon, where, however, the marine limestones are very largely developed, a formation with sandstones, shales, and clays, containing shells of *Ostrea* and nodules of ironstone, as well as fossil wood

¹ Since writing the above, I observe that in a paper read before the British Association, Mr. Starkie Gardner has somewhat incorrectly stated the position of Canadian geologists as to the first appearance of the Cretaceous flora, which, as explained in my paper in the Transactions of this Society for last year, first presents Dicotyledonous trees, not in the earliest Cretaceous, but in the Middle Cretaceous. Our Lowest Cretaceous holds a strictly Mesozoic flora, so far as known.

and beds of lignite, and which, in character and geological horizon, may be held to represent the Dakota group or the Lower Belly River group of the West.

The opinions of geologists in England, with reference to the vexed question of the glacial drift, are, I think, gradually diverging from the extreme glacialist views, recently current, to a position of greater moderation. The great submergence of the later Pleistocene, evidenced by the occurrence of marine shells and sea beaches at high levels, has forced itself on the attention of geologists in Great Britain, as it has long since done in Canada, and has produced the general conviction that much of the transport of boulders and drift has been due to the agency of floating ice. My friend, Mr. Milne Home, who has for some time been the chairman of the boulder committee of Scotland, informs me that the careful mapping and study of these travelled masses has thrown much new light on their directions and mode of conveyance, and that a conference between the English and Scottish committees is to be held, and will probably still farther aid in the elucidation of these points. It would seem that a similar committee, or series of committees, might be profitably employed in recording the statistics of Canadian travelled boulders, and much preliminary information might be compiled from the reports of the Geological Survey and the papers published in scientific periodicals.

When in the East, I had an opportunity of satisfying myself as to the occurrence of a great Pleistocene submergence in the Mediterranean regions, parallel to that in Northern Europe and America, and succeeded in like manner by a continental period,—a fact very important with reference to the later geological history and physical geography of the old continent. The details of these observations will appear in the *London Geological Magazine*.

The subject of prehistoric man is at present one of intense interest, and is pursued both by geologists and archæologists. In Canada we are familiar with the fact that our modern aborigines afford, in their manners and implements and weapons, much material for explaining the traces of prehistoric men in older countries. Dr. Daniel Wilson has most ably illustrated this in his admirable volumes on "Prehistoric Man," and I have myself endeavoured to direct attention to it in my little work entitled "Fossil Men and their Representatives"; while by a singular coincidence, M. Quatrefages has adopted almost the same title, "L'Homme fossile et l'Homme sauvage," for his recent valuable work on this subject. The admirable collections now accumulated in public museums, and especially those at St. Germain and at Brussels, and in the British Museum, with such private collections as those of Mr. John Evans and Prof. Boyd Dawkins, bring very clearly before the mind of a Canadian student, the striking resemblance between the arts of the perished peoples of primeval Europe and those so lately universal in the American continent. The Smithsonian Institution, at Washington, has rightly appreciated the importance of collecting extensively and preserving for future reference the monuments of the Stone Age of America. Our efforts in this direction have as yet been comparatively feeble, but it is to be hoped that they will be greatly extended in the time to come.

Some of the most interesting remains of prehistoric man in the world are those of the Lebanon range; both because of the abundance and richness of the cavern deposits of that region, and the fact that some of these antedate the old Phœnician colonization of the coast of Syria. When at Beyrût I had the opportunity of making collections in some of the most interesting caverns of the region, and obtained evidence, which I have given in a

paper read before the Victoria Institute, that the oldest cavern deposits, containing remains of the horse and the rhinoceros, belong to a period in which the physical character of the country was somewhat different from its present condition, and which may be characterized as Post-glacial or Antediluvian. Other deposits come up to the time of the Phœnician colony.

The subjects referred to in this paper have been but slightly sketched; but it may be interesting to bear in mind that we are workers together with so many able men on the Eastern side of the Atlantic, whose works we may study, while we emulate their successful labours. I cherish the hope at some future time to direct your attention more specially to some at least of the subjects cursorily noticed in the present paper.