or in science. The geographical position of California suggests some of the main lines of research—all that is in or around the Pacific Ocean. As the greater part of the researches could be conducted most profitably at various spots within this area, so the course of instruction, or rather the direction of the research, in any subject would be undertaken wherever the professor happened to be. For example, the professors of geology, botany, zoology and anthropology, with their students, might be for one year in some island in the Pacific. The professor of comparative religions and his students might make investigations from Kamchatka to Australia.

The ordinary European academic mind would stand aghast at the upsetting of traditional methods and would say promptly that, even supposing such a scheme were in any way desirable, it would be unworkable. Personally I believe it would prove most stimulating and valuable and I have no doubt that American wits could devise a working scheme.

Alfred C. Haddon.

Cambridge, England, July 10, 1902.

SHORTER ARTICLES.

STRATIGRAPHY VERSUS PALEONTOLOGY IN NOVA SCOTIA.

The recent discussion of the Upper Paleozoic formations in the region of the Bay of Fundy brings the value of fossils as means of age determination, even as between two major time divisions, somewhat acutely in question. Beds which on stratigraphical grounds have been classed as Middle Devonian appear on the evidence of floras and faunas to be Carboniferous.

Certain fossiliferous terranes at Riversdale and on the Harrington River, Nova Scotia, are referred by Dr. R. W. Ells and Mr. Hugh Fletcher, statigraphers, to the Middle Devonian, and are correlated with the 'fern ledges' (Little River group) at St. John, which were regarded by Sir William Dawson also as Middle Devonian. The correlation of the Nova Scotia beds with the St. John 'fern ledges' is agreed to by Mr. Robert Kidston, the foremost British authority on Paleozoic Plants, and the writer; but each of us, quite independently and without knowledge of the other's views, unhesitatingly referred the plant beds, both at St. John and at the Nova Scotian localities, to the Caribonferous. The St. John flora, which is more complete, is regarded by the writer as probably of Upper Pottsville age and by Mr. Kidston as belonging to the Lower Coal Measures, the latter in Great Britain appearing to closely correspond paleobotanically to the uppermost Pottsville of the northern Appalachian district.

The gist of our conclusions has been given by the Nova Scotian geologists; but the paleontological evidence has been published only in part. Mr. Kidston submitted a report from which extracts have been made by Dr. Ami, who is personally not responsible for silence in regard to the rest of it. The evidence in the writers hands, which concerns the detailed study of the species and their geographical and vertical range in other portions of this continent, cannot properly be presented in full in advance of the publication of his monograph of the floras of the Pottsville formations, but an examination of the material from St. John described by Sir William Dawson and a comparison of it with the Paleozoic floras as yet made known in other regions of the world is in itself sufficient to prove the Carboniferous age of the beds to most paleobotanists.

The paleontological data for the age determination are not, however, confined to fossil plants. The beds in question contain vertebrates, crustacea, insects, pelecypods, ostracods and annelids. Collections of these fossils have been made and forwarded to various specialists, but of the results of the examinations by the faunal experts and of the conclusions communicated very little indeed has been made public, though reports seem long ago to have been submitted. From a short unofficial article* published by Dr. H. M. Ami, we learn that the ostracods were submitted to Professor T. Rupert Jones, and the crustacea to Dr. H. Woodward; and that *Hylopus Logani, Sauropus Dawsoni, Bellinurus grandævus, Prestwichia* sp., *Leaia tricari-*

* *Proc. N. S. Inst. Sci.*, Vol. X., pt. 2, pp. 162–178, 1900.

nata, L. Leidyi var. *Baentschiana, Estheria Dawsoni, Anthracopalæmon* n. sp., *Carbonia* sp., *Anthracomya elongata, A. obtusa,* and *Spirorbis eriana,* were among the fossils collected. Further, Dr. Ami, who in 1897 and 1898 seems to have made extensive collections, states that although he constantly made search for Devonian fossils in the beds under consideration, only Carboniferous types were discovered. He therefore distinctly refers the beds to the Carboniferous, although, for stratigraphical reasons apparently, he places them in the Lower Carboniferous.

At this time, perceiving that the paleontologists were going astray and that by referring the beds in question to the Carboniferous they had 'hindered not helped in mapping the comparatively simple geological structure of these formations' in Nova Scotia, Mr. Fletcher in a paper* on 'Geological Nomenclature in Nova Scotia,' sounded a note of warning, and stated the real age and 'simple geological structure' of the beds as he considers these to have been irrefragably established stratigraphically by Dr. Ells and himself. By means of the parallel column he graphically displays the supposedly ridiculous blunders of the paleontologists, among whom the paleobotanists receive special attention. As Mr. Fletcher had misconstrued certain statements of the writer besides erroneously crediting him with a probably erroneous correlation of the Union beds, the writer, in an article† on 'Some Paleobotanical Aspects of the Upper Paleozoic in Nova Scotia,' expressed his views more explicitly and suggested that there might have been a mistake either in tracing the beds or in interpreting the structure. The region is one of metamorphic and locally of closely folded strata which are extensively covered by drift. It is therefore one in which stratigraphic work, when at variance with the paleontology, does not command unqualified confidence. The heresy of these suggestions is illuminated in the contributions and communications published by Dr. G. F. Matthew and Dr. Ells during the last twelve months.

Since the burden of this criticism and correction is addressed to the paleobotanists, and since the vehemence, volume and ubiquity of the communications may lead casual readers to conclude that the question is settled and that the paleontologists have abandoned faith in the faunal and floral evidence in the beds as means of discriminating Carboniferous from Middle Devonian, it becomes a duty to notice these articles and to point out some obstacles in the way of so speedy a termination of the discussion.

In a communication, 'Are the St. John Plant Beds Carboniferous?' Dr. Matthew* states the sequence of the Upper Paleozoic formations in eastern New Brunswick, and very briefly outlines the geological history of the region as prevailingly interpreted. He also argues that the St. John genus *Megalopteris* assuredly existed before the Pottsville (Millstone Grit), it having been found, he says, by Andrews in earlier beds in Ohio, and by Lesquereux in beds of Mauch Chunk shale chiefly in the southern and the Mississippi states. This *Megalopteris* proof is founded on a false premise, the beds of the South and of Ohio being in the Pottsville, lower than which the genus does not seem to have been found in any part of the world.

In the next paper, on 'The Devonian of the Acadian Province,' Dr. Ells† repeats the conclusions of the stratigraphers that the St. John plant beds (Little River) are beneath not only the Lower Carboniferous Limestone, but also the 'lower sandstone group' (which is generally regarded as Lower Carboniferous, but which Dr. Ells seems to regard as Devonian) and a great portion, at least, of the underlying Perry beds of eastern Maine. The paper contains no stratigraphical details. Dr. Ells lays great stress on Sir William Dawson's conclusion that the St. John plants are Middle Devonian, and even uses it as argument to show that the Riversdale plants also are Middle Devonian, though Sir William's insistence that the latter were not Devonian, but Carbonifer-

* *Trans. N. S. Inst. Sci.,* Vol. X., pt. 2, pp, 235–244.

† *Can. Rec. Sci.,* Vol. VIII., No. 5, January, 1901, pp. 271–280.

* *Amer. Geol.,* June, 1901, pp. 383–386.

† *Can. Rec. Sci.,* Vol. VIII., No. 6, pp. 335–343.

ous (Millstone Grit), precipitated the present controversy.* Also Dr. Ells agrees with Mr. Fletcher in placing the Horton, which Dawson referred to the Lower Carboniferous and correctly correlated with our Pocono, in the Devonian, the 'Carboniferous limestone' being made the lowest formation of the Carboniferous.† A considerable portion of Dr. Ells's article and the whole of the communication by Dr. Matthew, which immediately follows it in the same magazine,‡ are devoted to proof that Dawson's reference of the St. John plants to the Middle Devonian was not due to the influence of his statigraphical colleagues. This point, on which I seem to have been mistaken, is a matter of history of opinion, and, though interesting as such, does not affect the geological facts of the region.

The latest contribution to the discussion, 'A Backward Step in Paleobotany,' by Dr. Matthew,§ demands respectful attention both for its matter and its dignified place of publication. In part it attempts to meet a call for conclusive stratigraphical proof that the St. John plant beds are Middle Devonian. The first half of the paper contains a statement of the stratigraphical arguments in a form more extended than in the *American Geologist* for June, 1901. Here again the strongest argument seems to be the metamorphism seen in the Little River group and other beds supposed by Dr. Matthew to be older than Carboniferous. The first of the profile sections included to show the stratigraphy of the plant beds is conclusive as to Middle Devonian, if it is correct both as to stratigraphy and as to correlation; but in view of the small portion of the diagram occupied by rocks above sea level, the incompleteness of the exposures, and the paleontological evidence I find myself unwilling to admit so simple a structure. The second of the two sections presents what seems an isoclinal structure involving a fault which is not shown. Any one of several interpretations may be put upon it. Dr. Matthew perhaps understands the true structure; but the diagram is too equivocal to demonstrate it.

The remaining half of Dr. Matthew's paper is devoted to proof by paleobotany itself. Here again, as in his former article, his chief argument that the *Megalopteris* plant beds of the Mauch Chunk in the Appalachian region carried the St. John flora across from the Middle Devonian to the Pottsville, falls flat when we recall that the *Megalopteris* beds supposed to constitute the bridge are now recognized by the stratigraphers as not in the Mauch Chunk at all, but as lying within the Pottsville. The discussion of other paleobotanical aspects of the St. John plant beds, and especially the doubtful identifications of the older types reported in the latter, requires greater space than is here available; but before passing on it may be noted that probably over 60 per cent. of the valid plant species found at St. John are also in hand from the Pottsville in the Appalachian trough, while it is very doubtful if three species recognized elsewhere as characteristic Devonian plants are present.

The paleobotanists do not contend that there are no beds of Middle Devonian age in southern New Brunswick, or that all the rocks of Nova Scotia that have been correlated with or mapped as representing the plant-bearing formation at Riversdale are Carboniferous. But, after reading the statements and inspecting the profiles lately published, it still seems proper to inquire whether, in the closed folding and faulting inevitably indicated though not explained in the section from the vicinity of St. John, some segments of Carboniferous terranes have not been thrown in a false position as well as altered; and whether in tracing the Devonian formations through the largely

* H. Fletcher, *Trans. N. S. Inst. Sci.*, Vol. X., pp. 236–237.

† The suggestion made by the writer (*Can. Rec. Sci.*, Vol. VIII., p. 279) that this limestone 'may be much younger than is generally supposed,' by which it was meant that, if the Riversdale plants were actually beneath the limestone, the latter must at least occupy a high place in the Lower Carboniferous, is interpreted by Dr. Ells as necessitating the reference of the 'Carboniferous rocks proper' to the place now assigned to the 'Permocarboniferous, or possibly the horizon of the Cretaceous.' This seems a needless alarm.

‡ *Can. Rec. Sci.*, Vol. VIII., No. 6, pp. 344–345.

§ *Trans. Roy. Soc. Can.*, 1901, sec. IV., pp. 113–122. Dated 1901, but printed in 1902.

drift-covered region of Nova Scotia an error has not been committed in correlating them with the beds carrying Carboniferous fossils at Riversdale and Harrington River.

Speaking for himself only, the writer does not regard the evidence yet adduced by the stratigraphers as sufficiently complete to show beyond doubt that this remarkable assemblage of plants, consisting largely of types which nowhere else in the world have been found below the Waldenburg stage or the Pottsville (Millstone Grit) of the Upper Carboniferous, existed in eastern Canada during and from Middle Devonian time. Many of the species and several of the genera are, so far as known, peculiar to and characteristic of the Upper Carboniferous. A small portion of the flora is common to the Lower Carboniferous; but very little of this element is characteristic of the latter, while a close examination of the material from St. John tends to bring into doubt the identification of the few forms published as characteristic Devonian species.

No trace of this extraordinary paleobotanical anomaly appears in the thoroughly studied magnificent section of the Devonian near the Gulf of St. Lawrence, nor have any signs of such a condition yet been found in the Devonian of eastern Maine, New York, or any other region of the world. It is a remarkable fact if a flora almost exclusively composed of characteristic Carboniferous species, most, by far, of which are typical of the Upper Carboniferous, was isolated in the region of the Bay of Fundy both in and after Middle Devonian time; but it is still more remarkable if this flora were accompanied there by a likewise isolated Carboniferous molluscan fauna. Conditions producing isolation of a land flora are not generally readily reconcilable with contemporaneous and continued isolation of the invertebrates of the same region.

As to the precise characters of the faunas of the beds in question and as to the weight of their evidence in the age determination of the formations, we are but partially informed, since the reports and opinions of the several specialists to whom the materials were communicated for examination, or whose paleontological views were solicited, have not been made public. As has already been noted, materials representing vertebrates, crustacea, polecypods, and ostracods were during several seasons gathered in some quantity and placed in the hands of experts. These reports and opinions are awaited by paleontologists and geologists alike. We are in a general way informed that all the fossils gathered are more or less distinctly indicative of Carboniferous age, all efforts to discover Devonian types in the beds being unsuccessful; and it is perhaps fair to assume that had one or more of the experts, to whom some class of fossils was sent, reported in favor of their Devonian (not to say Middle Devonian) age the stratigraphers would not have omitted mention of the fact. The circumstances attending the discussion suggest a trial at which the testimony of the faunal witnesses has not been admitted.

What is at present most needed is a thorough investigation of the faunas as well as of the floras of the terranes in question, especially in Nova Scotia. If the plants are misleading the paleobotanists to overconfidence and if we are mistaken as to the non-existence of such a remarkable flora, containing so large a proportion of Upper Carboniferous types, in the Middle Devonian and living in isolation until Upper Carboniferous time, there is no one to whom the truth means more or who realizes more fully than the paleobotanist the importance of the fact. If the testimony of the plants is false, the evidence of the faunas will correct it; and if the beds in question are Middle Devonian the fossils themselves will prove it. Let us have a thorough paleontological study of the beds, and the paleontological question will settle itself.

DAVID WHITE.

PRELIMINARY STUDIES ON THE RUSTS OF THE ASPARAGUS AND THE CARNATION: PARASITISM OF DARLUCA.

DURING the past two years, the writer has been carrying on a series of experiments at the University of Nebraska, in cooperation with the United States Department of Agriculture, in inoculations with the asparagus rust (*Puccinia asparagi* DC.) and the carnation rust (*Uromyces caryophillinus* (Sch.) Schroet).