SCIENTIFIC BOOKS.

Status of the Mesozoic Floras of the United States. By LESTER F. WARD. Second Paper, with the collaboration of WILLIAM FONTAINE, ARTHUR BIBBINS and G. R. WIELAND. U. S. Geological Survey, Monograph XLVIII., 1905. Part I., text, pp. 616; Part II., plates I.–CXIX. 4to.

This valuable contribution to the paleontology of North America, and particularly of the United States, appears as a sequel to an earlier publication on the Older Mesozoic,[1] and forms the second in a series of which the third is yet to appear. Like the previous publication, the present one deals with the floras of widely separated localities and with a somewhat similar range of horizons. It is divided into three parts: Part I. deals with the Triassic Flora as presented by the Older Mesozoic of Arizona; Part II. discusses the Jurassic Flora of Oregon, Wyoming and the Black Hills, as well as the transition floras of Alaska, California, Montana and Oregon; Part III., which occupies the largest share of the volume, is devoted to the Cretaceous Flora as presented in the Queen Charlotte Islands, the Kootanie of Montana and British Columbia, the Lakota (Kootanie) of the Black Hills, the Trinity of Texas and the Older Potomac of Maryland and Virginia. The flora of the Black Hills having been dealt with somewhat fully in a previous paper,[2] the present account is somewhat brief, discussing supplementary data which are, nevertheless, of considerable importance. If any estimate of comparative value were to be made, it would be in favor of Part III., because of the important results reached with respect to evidence bearing upon the correlation of the Potomac in various localities and its precise relations to the Jurasso-Cretaceous.

The opening chapter deals somewhat briefly with the Triassic, or the Older Mesozoic flora of Arizona, based upon data secured by an expedition executed in May and June of 1901. While the results obtained were especially rich in vertebrate paleontology, some important observations were made with respect to the occurrence of plant remains which were, nevertheless, found to be exceedingly scanty. This appears to be accounted for by the great abundance of gypsum that prevails throughout all the beds of the region, a material which is fatal to the preservation of more delicate plant remains, and in consequence it is only the silicified wood that seems to have escaped its influence. Furthermore, such silicified woods are mainly deposited in beds of sand, coarse gravel or conglomerate, which in themselves are unfavorable to the preservation of plant impressions. As the petrified forests have been reported upon at length on a former occasion,[3] and as the structure of the woods has been worked out by Knowlton,[4] at least in part, they do not claim special attention. Nevertheless, there are frequent references to the abundant occurrence of fossil woods which would presumably afford an opportunity for an important extension of our knowledge respecting extinct species; but the impression conveyed to the reader is that the investigator gave somewhat scant heed to this most important material, attaching far more value to mere leaf impressions, fruit and other forms of remains. The impression thus gained is heightened by the want of any sort of reference to the working up of the wood, except such as may be found in the statement that 'The only species that has yet been described from the silicified wood of Arizona is *Araucarioxylon arizonicum* of Knowlton, based on specimens from these two trunks.'[5]

[1] Ward, Lester F., 'Status of the Mesozoic Floras of the United States.' First Paper: The Older Mesozoic. U. S. Geol. Surv., XX., Part II., 1898–1899, pp. 215–430, pl. XXI.–CLXXII.

[2] Ward, Lester F., 'The Cretaceous Formation of the Black Hills as Indicated by the Fossil Plants.' U. S. Geol. Surv., XIX., 1897–1898, pp. 527–712, pl. LVII.–CLXXII.

[3] Ward, Lester F., 'Status of the Mesozoic Floras of the United States.' U. S. Geol. Surv., XX., 1898–1899, pp. 316–332.

[4] Knowlton, F. H., 'New Species of Fossil Wood (*Araucarioxylon arizonicum*) from Arizona and New Mexico,' *Proc. U. S. Nat. Mus.*, XI., 1888, pp. 1–4.

[5] This reference is to two great logs taken to the National Museum in 1880 or 1881, from Lithodendron Creek, by an expedition headed by Lieut. J. T. C. Hegewald in the spring of 1879.

The conditions prevailing in the petrified forest are interesting and deserving of somewhat special notice. The deposits of the Grand Cañon region, usually spoken of as a single great group of beds, are reduced by Ward to three entirely distinct formations. The lowest, presenting their full development at the mouth of the Mœncopie Wash, are known as the Mœncopie beds; the second and thickest member of the series is termed the Shinarump—a name already employed in this connection by Major Powell; while the third and highest member is designated the Painted Desert beds.

The Mœncopie beds are almost entirely barren of animal and plant remains; for apart from reported fern impressions, the occurrence of which could not be verified, the only evidence of plant remains were to be found in a few impressions from the very base of the formation, and possibly not Mœncopie at all, but of an earlier horizon. These presented little evidence of structure, though they seemed to represent the characteristics of coniferous twigs and short branches, possibly of an Araucarian type.

The Shinarump formation within which the remains of trees are chiefly found, is separable into a lower or Lithodendron member, and an upper or Lereux member—the former embracing conglomerates, sandstones, clay and argillaceous shales forming brilliantly colored banded cliffs, while the latter consists at its base of a somewhat similar formation upon which are superimposed beds of sandstone, limestone, mortar beds with flints and calcareous marls. Apart from silicified tree trunks, the only observable plant remains consist of raised casts of twigs lying in all positions, and stems with whorled branches, all of which show Araucarian structure. These forms occur on the faces of sandstone rocks and shales, and they are provisionally designated as *Araucarites shinarumpensis*. The figures given of this material do not lead one to hope for any very definite knowledge of the plants they represent. The logs derived from the silicified trunks of trees do not, in all probability, represent the original distribution of the forest, since, as shown in the original report (*op. cit.*), there is evidence that they were drifted some distance before being laid down; and in spite of previous statements to the contrary, there is little evidence to show that any of them are erect and *in situ* except in the variegated marls just above the conglomerates, where a very careful examination led to the conclusion that a group of twenty or more stumps were actually in the places of original growth, although in a sedimentary bed. Many of the smaller buttes appear to have been developed by reason of the logs which weighted down the underlying marls and tended to prevent the latter from being blown or washed away, with the result that such logs may now be seen lying on the tops of the buttes, down the slopes of which the disintegrating material is continually rolling.

One remarkable specimen which requires further explanation, is met with in certain remains designated as *Araucarites monilifer*, in allusion to the peculiar necklace-shaped rows of resin drops which occur in the interior of the trunks, where they may often be seen in considerable numbers. According to the facts obtained, these bodies which have a stratiated surface, are resinous exudations into the interior of the stem, much as resin blisters are formed in the outer bark of the common balsam fir.

In the Painted Desert formation, the only remains of trees appear to be represented by tree trunks, the original structure of which has been wholly replaced by black sand, so that they resemble deposits of manganese or limonite.

The Jurassic Flora of Douglas County, Oregon, by Professor Fontaine, occupies some 99 pages of descriptive text and deals with no less than 77 species and varieties, of which fully 31 per cent. are new—the new species lying chiefly among the ferns and cycads. Among the conclusions to which a study of these plants points, we may note as of particular interest that there is a remarkably large proportion which are also common to the distant and widely separated regions of Yorkshire, England, and eastern Siberia. Professor Ward shows that there are fourteen species common to the Jurassic of Yorkshire,

and sixteen also common to the Jurassic of Siberia, a difference which will hardly justify conclusions based on numerical grounds alone, as to the probable connection between such regions. Professor Ward nevertheless infers from such evidence, that a definite land connection existed in Jurassic time, between Asia and northwestern America, and this opinion is strengthened by reference to the remarkable similarity with respect to number and kinds, of the types of *Ginkgo* found both in Siberia and Oregon. In this connection, however, it is instructive to recall the conclusions of Asa Gray with respect to similar relations as exhibited by the existing floras of the three regions mentioned.

From a study of Japanese plants collected by the Perry Expedition in 1852–1854, supplemented by subsequent collections, he found that out of a total of 580 Japanese plants, about 120 also occurred in western North America; 134 in eastern North America, and 157 in Europe. A further analysis of these relations showed that 'there has been a peculiar intermingling of the eastern American and eastern Asian floras, which demands explanation'; but upon a critical examination of the positions occupied by representative species, there is found abundant evidence in support of the view also held by Bentham, that the 'interchange between the temperate floras even of the western part of the old world and of the new has mainly taken place via Asia.' Gray further observes that such considerations 'suggest an ancient continuity of territory between America and Asia, under a latitude, or at any rate with a climate, more meridional than would be effected by a junction through the chains of the Aleutian and the Kurile Islands.'[6] Two independent chains of evidence are thus found to contribute to the same conclusion, while it is further clear from the paleobotanical evidence, that the continental connection thus indicated must have existed until at least the close of the Jurassic, and possibly later. As further justifying the position held by Professor Ward and also showing that the continental connection was not disturbed until after the close of the Jurassic, attention may be directed to the fact 'that the Oregon strata rival those of eastern Siberia in the development of ginkgos; while nearly all the more important species made by Heer from the Siberian beds have similar forms in the Oregon strata,' forms which also have been found to extend into the Lower Cretaceous of the United States and British Columbia.

One noteworthy feature of the Jurassic Flora as now presented is the addition of some 600 specimens of cycads from Wyoming, to the list previously reported by Ward[7] and then embracing descriptions of all the Jurassic Cycads from Wyoming known at that time.

In discussing a number of plants from Alaska, which show very strong evidence in favor of Lower Cretaceous age, but which are held to represent the Jurassic because of the strong representation of Jurassic types of *Ginkgo,* reference is made to some of the work of the late Sir William Dawson, with respect to which exception is taken to the identification of *Ginkgo lepida* Heer, a species which Ward holds must be a *Baiera.* Some doubt is also thrown upon the correct identification of *Ginkgo sibirica* Heer, both of these species having been recognized by Dawson in the Kootanie of Canada. Attention is drawn to this opinion at the present time because, as shown by recent studies of the Kootanie flora, Dawson's determinations were correctly made; and although, as stated by Ward, the ginkgos had become nearly extinct on the American continent in Lower Cretaceous times, even in those parts where they had been so prominent in the Lower Oolite, there is not wanting abundant evidence to show that, even though the only ginkgos of the Lower Cretaceous of the northwestern region are to be found solely in the Kootanie of Canada, this formation bears a representation of the genus which shows a very important extension from the Jurassic, abundantly confirming the earlier conclusions of Sir William Dawson. Recent collections from the eastern slope of the Rocky Mountains as well as from the Crow's Nest Pass, show an extension of the Kootanie flora

[6] 'Scientific Papers,' II., p. 135 et seq.

[7] U. S. Geol. Surv., XX., 1900, Part II., pp. 382–417.

not heretofore known. Among the well-defined species from these areas are a large number of ginkgos represented by leaves, male inflorescences and also by the fruit. The leaves, which furnish the most reliable data, show *Ginkgo sibirica* to be not only well characterized but abundant, while *G. lepida* is also present. A much less abundant, but none the less distinguishable type, is *G. huttoni* (Sternb.) Heer. We can not, therefore, longer regard *G. sibirica* as the sole survivor of this genus in the Lower Cretaceous. It must nevertheless be conceded that the occurrence of these three species in the Kootanie of British Columbia and Alberta not only emphasizes the basal character of that formation, but it directs attention to the probability that its lowest portion may even represent a transition series—a conclusion which would bring it into agreement with the views recently expressed with respect to its equivalent in the United States, the Lower Potomac.

Our knowledge of the Shasta-Chico series of California, originally defined in detail by Diller and Stanton,[8] receives a fresh interest by virtue of the treatment of the Shasta group at the hands of both Professor Ward and Professor Fontaine. The more recent recognition of this series in Oregon is of interest in connection with the lately made observations that it is also to be met with in British Columbia, where a newly described element of the flora of this series as developed in California (*Gleichenia gilbert-thompsoni* Font.) has been recognized.

In discussing the Kootanie formation, the valuable work of Sir William Dawson and Dr. George Dawson is fully recognized, and correlations with the United States horizons are established. The value of this discussion is greatly enhanced by the introduction of a list of all the Kootanie plants recorded up to 1895. More recent studies of this formation have extended this list in important particulars, while they have also brought out the fact that the Kootanie flora of British Columbia and Alberta is more widely distributed on the eastern slope of the Rocky Mountains than has been hitherto recognized.

[8] *Bull. Geol. Soc. Amer.*, 1894, pp. 435–460.

Somewhat less than half the entire volume (257 out of 599 pages) is devoted to a discussion of the Older Potomac Flora, a term which is here employed in the same sense as in his previous paper on the Potomac Formation (Fifteenth Ann. Rept. of the U. S. Geological Survey), representing in the main the Potomac as it occurs in Virginia, and including all beds of the same age occurring in other states, but excluding those higher beds in which the flora is mainly dicotyledonous. A very large proportion of this part of the subject is devoted to an interesting and valuable historical survey of our knowledge of the Older Potomac Formation.

In deriving conclusions from his examination of the flora, Professor Fontaine endeavors to establish a correlation between the Potomac formations of Maryland and Virginia, and in doing so he points out that the term Lower Potomac, as consistently used by him, embraces the four members recognized by Ward as (1) James River, (2) Rappahannock, (3) Mount Vernon and (4) Aquia Creek—the second being identical with what he had designated as Fredericksburg, and the last or fourth being the same as his Brooke beds. On the other hand, the Maryland Geological Survey has divided the entire formation into (1) Patuxent, (2) Arundel, (3) Patapsco and (4) Raritan in ascending order, but in neither of these is there a question of division into Lower and Upper Potomac. Under these circumstances, Professor Fontaine finds it necessary to explain what is meant by Lower Potomac. The Potomac of Maryland differs from that of Virginia in the absence of the Mt. Vernon member, but the chief difference which appears to distinguish the formation of the two states seems to lie in the absence of the Raritan from Virginia, while it is in force in Maryland, and if the Raritan is to be regarded as Potomac, about which Professor Fontaine appears to have some doubt, then it constitutes the Upper Potomac, while all below is Lower Potomac. This conclusion is apparently based upon the observation that there is essentially only one great break in the continuity of the flora, and that occurs in passing from the underlying beds to the Am-

boy Clays. There are, of course, well-defined changes between the lower beds of the Potomac, but such changes are gradual, due to the diminution of old types, accompanied by the increase and introduction of more modern forms, while the flora as a whole presents essential continuity. But in passing to the Amboy Clays the case is wholly different, and a wholesale change occurs whereby few of the older types survive. At the same time a great number of new plants appear, and dicotyledons overwhelmingly predominate. In view of this very striking change in the character of the flora, Professor Fontaine puts the very pertinent question, 'Why give the name Potomac to this Group?'

With respect to the much-debated question of the precise relation which the Lower Potomac bears to the Jurassic on the one hand, and to the Cretaceous on the other, there can be no doubt as to the transitional character of the flora as presented by many of its components, but the real 'question as to the Jurassic or Lower Cretaceous age of the Lower Potomac hinges upon the position of the Wealden formation.' Previous studies of the Lower Potomac plants by Professor Fontaine[9] had led him to express the opinion that they indicated a Lower Cretaceous age agreeing with the Neocomian. This conclusion was based on the strong affinity of its flora with that of the Wealden, it being assumed that the view generally held as to the position of the Wealden is correct, that is, that it is the non-marine equivalent of the Neocomian. In spite of the view held by Professor Marsh, Professor Fontaine finds that there has been no evidence sufficient to cause a change of his former expression of opinion, but, on the contrary, a good many facts have come to light that confirm its correctness.

These studies of the Potomac flora indicate that the Potomac formation had a widespread development on this continent, since it is not only recognized in Virginia and Maryland, but to the south and west it extends to Tlaxiaco in Mexico; while on the north and west it reappears in the Shasta of California, the Lower Cretaceous of Queen Charlotte Islands and in the Kootanie of Montana, British Columbia and Alberta.

[9] U. S. Geol. Surv., Monograph XV., 1889, p. 348.

D. P. PENHALLOW.

MONTREAL,
April 27, 1906.

A Respiration Calorimeter with Appliances for the Direct Determination of Oxygen. By W. O. ATWATER and F. G. BENEDICT, of Wesleyan University. Washington, D. C., The Carnegie Institution of Washington. 1905. 4to, pp. 193, 49 figs.

The apparatus for investigations in human nutrition described in this monograph has been in process of development for about twelve years and in its perfected form may be safely characterized as the most elaborate instrument for physiological research at present in existence. Descriptions of the apparatus in its earlier form, and of the various improvements and modifications introduced from time to time, as well as accounts of investigations carried on with it, have been published by Professors Atwater, Woods, Rosa and Benedict as bulletins of the Office of Experiment Stations of the U. S. Department of Agriculture and also as a memoir of the National Academy of Sciences.

The apparatus as described in the publications just mentioned consisted of a Pettenkofer, or 'open circuit,' respiration apparatus, the chamber of which was so constructed as to serve likewise as a calorimeter. With this instrument very accurate determinations were possible of the income and outgo of carbon, hydrogen, nitrogen, mineral matter and energy in man, but the results were incomplete, inasmuch as no direct determination of the amount of oxygen consumed by the subject could be made. With the aid of a grant from the Carnegie Institution, therefore, the authors undertook a reconstruction of the apparatus with this object in view.

For this purpose they have reverted to the earlier type of respiration apparatus, originated by Regnault & Reiset and often designated as the 'closed circuit' type, in which the air after leaving the chamber of the apparatus is freed from respiratory products, re-