ON FOSSIL PLANTS

FROM THE

MACKENZIE AND BOW RIVERS.

By SIR J. WILLIAM DAWSON. LL.D., F.R.S., &c.

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V.—*On Fossil Plants collected by Mr. R. A. McConnell, on Mackenzie River, and by Mr. T. C. Weston, on Bow River.*

By SIR J. WILLIAM DAWSON, LL.D., F.R.S., &c. [Plates X & XI.]

(Read May 7, 1889.)

I.

SPECIMENS FROM MACKENZIE RIVER.

The fossil plants collected on the Mackenzie by Dr. Richardson, were described by Heer in the "Flora Fossilis Arctica", Vol. I, in 1868. Subsequently, in 1880, in the continuation of the same work, he published descriptions of additional specimens collected by Dr. Rae, Messrs. R. H. Scott and W. Hardesty and Bishop Bompus. In the same publication Schroeter describes fossil woods collected on Mackenzie River.

The species described in these papers are not numerous, being twenty-three in all, inclusive of a minute parasitic fungus, besides three species of fossil wood. A list of these species is given in my paper on Laramie Plants (Trans. Roy. Soc. Canada, Vol. I, 1882, p. 32), and which I repeat here for reference, with some emendations :—

1. Xylomites borealis, *Heer* (growing on leaves).
2. Glyptostrobus Ungeri, *Hr.* *
3. Sequoia Langsdorffi, *Brongt.* *
4. Taxodium distichum, (Miocenum.) *
5. Smilax Franklini.
6. Populus arctica, *Hr.* *
7. P. Richardsoni, *Hr.* *
8. P. Hookeri, *Hr.* *
9. Salix Raeana, *Hr.* *
10. Betula macrophylla, *Gpt.*
11. Corylus McQuarrii, *Forbes.* *
12. Quercus Olafseni, *Hr.*
13. Platanus aceroides, *Hr.*
14. Juglans acuminata, *Brongt.*
15. Viburnum Nordenskioldiii, *Hr.*
16. Pterospermites spectabilis, *Hr.*
17. Pt. dentatus, *Hr.*
18. Tilia Malgreni, *Hr.*
19. Phyllites aceroides, *Hr.*
20. Hedera MacClurei, *Hr.*
21. Magnolia Nordenskioldii, *Hr.*
22. Carpolithes seminulum, *Hr.*
23. Antholithes amissus, *Hr.*

On referring to my notices of plants of the Laramie in Dr. G. M. Dawson's "Report on the 49th Parallel," 1875, and to my paper in the Transactions of this Society in 1887, it will be seen that these plants are in great part identical with those of the Upper Laramie series of our Northwest Territory. I have, in the above list, added an asterisk to each species found in the Lignite Tertiary, Fort Union or Upper Laramie series on the 49th parallel, and at the Souris River, Calgary, etc. It is also just possible that some of the others may be species found in these places, though known by different names.

The present collections furnish little that is new ; but the specimens are in a fine state of preservation. As the Upper Laramie or Fort Union Group is still held by some palæobotanists to be Miocene, and as it is equivalent to beds in Greenland, Alaska, etc., also until recently called Miocene, it may be interesting to note the localities of the spe-

cies collected by Mr. McConnell, and which certainly represent the more abundant trees of the region in this period.

The matrix of most of the plants is a light-coloured shale or indurated clay, resembling that of the Laramie in many other localities. In the case of some slabs, however, the heat of burning lignite has converted the clay into a sort of terracotta of reddish and yellowish colours.

In the present paper I shall refer merely to the geographical distribution of the species in connection with the evidence for the Laramie age of the Mackenzie River beds, which will be described more in detail by Mr. McConnell in his forthcoming Report.

PTERIS SITKENSIS, *Heer.* (Pl. X, Fig. 1.)—This fern, not previously collected on the Mackenzie, was originally collected near Sitka in Alaska, and constitutes another link of connection between the flora of the Pacific coast and that of the interior region in the early Eocene age.

GLYPTOSTROBUS UNGERI, *Heer.*—If this species be the same with *G. Europæus* and *G. Œningensis*, which seems probable, it is very widely distributed in Europe and America. It is found in Alaska, Greenland and Spitzbergen; also in the Upper Laramie of Porcupine Creek (G. M. D.) and in the Fort Union group of Dakota. (Newberry).

SEQUOIA LANGSDORFII, *Brongt.*—This species is very widely distributed in time and space, if all the forms referred to it are really of one species. It ranges from the Upper Cretaceous into the Miocene, and in reality is not very remote in its characters from the living *Sequoia sempervirens* of California, which may be a modern variety. It occurs in Greenland, in the Laramie of various places in the United States, and is widely distributed in Europe. Both leafy twigs and remains of cones occur in the Mackenzie collections. In the Belly River Group of Canada, the species *S. Reichenbachii*[1] replaces it, and the species referred to *S. Langsdorfii* from the Upper Cretaceous of Nanaimo, Vancouver Island, appears to be *S. Smithiana*,[2] which also occurs in the Kootanie of the Rocky Mountains. It seems therefore uncertain if in Canada it is as old as the Cretaceous, and it may in any case be regarded as specially characteristic of the Upper Laramie or Eocene flora.

TAXITES OLRIKI, *Heer.*—This large and beautiful Taxine plant occurs in the Eocene of Europe, and is found also in Alaska and in Greenland. It is abundant in the collections of Dr. Selwyn from Souris River, described by me in the Report of the Geological Survey of Canada (1879-80).[3] It does not seem as yet to have been recognized in the United States, and is probably a distinctively northern form. It is said by Schimper to resemble closely a species of Cephalotaxus found in China and Japan.

PLATANUS ACEROIDES, *Heer.*—This is the Eocene representative of the modern *Platanus occidentalis* of America, to which it is very nearly allied. It occurs in the Tertiary

[1] Flora of Cretaceous of British Columbia and Northwest Territory, Trans. R. S. C., 1882.
[2] Mesozoic Flora of Rocky Mountains, Trans. R. S. C., 1885.
[3] Fossil Plants of Laramie, Trans. R. S. C., 1886.

of Europe as high as the Miocene of Oeningen, and is found in the leaf beds of Mull, that is if, as seems likely, the *P. Hebridicus* of Forbes is this species. It also occurs at Atanekerdluk in Greenland, in Iceland and in Spitzbergen.

It seems probable that *P. Gulielmæ*, Goept, is merely a variety. It occurs with the former in Switzerland and Greenland. Farther, Schimper suggests that *P. Raynoldsii* and *P. Haydenii*[1] of Lesquereux, both Upper Laramie species, and found plentifully in the sandstones on Bow River, near Calgary, may be varieties of this somewhat variable species.

POPULUS ARCTICA, *Heer.* (Pl. X, Figs 2, 3 & 4.)—This is much the most abundant species in Mr. McConnell's collection, and seems to show that then, as now, this genus was dominant. This is an European as well as American and Greenland species, and presents a great variety in the size and forms of the leaves, which have given rise to the formation of several species. Mr. McConnell's specimens show a great number of gradations in form, from broad oval to a very broad reniform, and in size from one inch to four in diameter. Its occurrence in the Laramie of Western Canada is noticed in my paper as Laramie Plants, (Trans. Roy. Soc. Can., 1886).

There seems to be some uncertainty as to the reference of this leaf to *Populus*. Saporta, thinks that it may really be a Menospermum allied to the modern *M. virginicum*. If a poplar, it is remarkable that its nearest living ally seems to be *P. Euphratica* of the banks of the Euphrates and Jordan.

POPULUS HOOKERI, *Heer.* (Pl. X, Fig. 5).—This species, found thus far only at Mackenzie River, has small leaves, resembling those of *P. arctica* in form, but differing somewhat in venation, in which it approaches slightly to *P. tremuloides*, the common aspen. [2]

POPULUS RICHARDSONII, *Heer.*—A large and fine species, quite different from the preceding, and allied to the modern aspens. It is found in the Fort Union Laramie of the United States, and in the Greenland and Spitzbergen collections, also in Canada in the Upper Laramie, on Bow River. Its nearest relation in modern Canada is *P. grandidentata*, the great-toothed aspen, the leaves of young shoots of which species greatly resemble those of the ancient form. [2]

CORYLUS MCQUARRII, *Forbes.*—This species is found in the Mull leaf-beds and elsewhere in Europe, also in Alaska, Iceland, Spitzbergen and Greenland, and in the Upper Laramie of the western plains, both in Canada and the United States, though it seems to be less common than further north. Further south than Mackenzie River, this species is associated with leaves not distinguishable from those of the modern hazel, *C. rostrata.* [2]

NORDENSKÖLDIA BOREALIS, *Heer.* (Pl. X, Fig. 6).—This is a beautiful fruit, divided into lobes at top, and supposed to be allied to Tiliaceae. These fruits occur in Greenland and Spitzbergen, and have been discovered by Mr. McConnell for the first time in Canada. It is by some referred to the genus *Cistus* or to *Diospyros.*

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[1] Fossil Plants of Laramie, Trans. R. S. C., 1886. [2] *Ibid.*

In connection with the reference of this fruit to Tiliaceae, it is worthy of note that Saporta inclines to the belief that the previous species may belong not to a hazel but to a *Tilia* or linden.

Carpolithes.—Oval, flattened bodies, probably seeds or fruits, about one centimetre in length, and without distinct markings. They may be seeds possibly of Taxites, but their affinities for the present must remain uncertain, and I do not give them a specific name, in hope of additional facts being discovered.

Pyritized and Ferruginous Wood.—The collection contains several branches and portions of stems evidently of Exogenous trees, but in a state of preservation which does not admit of distinct determination. Schroeter, as already stated, has described fossil wood from these beds, one species of which, his *Sequoia Canadensis*, may be the wood of *Sequoia Langsdorffii*, another is not improbably that of *Platanus Ungeri*. Another of his species of fossil wood is referred to the genus *Ginkgo*, but it may have belonged to *Taxites Olriki*.

Leguminosites (?) borealis, *S. N.* (Pl. X, Fig. 7).—Pods of unequally obovate form, apparently arranged on the sides of a stem. They are grooved or ribbed longitudinally, and resemble *L. arachioides*, Lesq., except in their smaller size and broader form. One shows what seems to be the remains of a sheath or calyx.

Callistemophyllum latum, *S. N.* (Pl. X, Fig. 8).—Leaf entire, obovate, without petiole. Midrib distinct, secondary veins obsolete; indications of delicate reticulation. This is probably a Myrtaceous leaf and may, provisionally at least, be placed in the genus above named. It seems quite different from the other described species.

II.

Mr. Weston's Collections from the Laramie of Bow River.

With the above specimens from Mackenzie River, there have been placed in my hands some interesting leaves collected by Mr. Weston in the Upper Laramie sandstones, near Calgary. They belong to two species, *Populus Richardsonii* and *Quercus platania* of Heer, (Pl. XI, Fig. 7). The leaves of the former species are chiefly remarkable for their large size, but in other respects are similar to those of Mackenzie River. The latter species is represented by leaves of great size. One of them must, when perfect, have been at least ten inches in length without the petiole. This species has not yet been found at Mackenzie River, but is one of those common to the United States Laramie and that of Canada, and found also in Greenland. As the species seems to be variable, and Heer had only fragments in his collections, I figure a small, but perfect, specimen in Mr. Weston's collection. Schimper regards the place of this species in the genus *Quercus* as "fort contestable", and it is quite possible that when its fruit shall be known, it may be found to have different affinities. It was evidently one of the most magnificent of the Laramie species in point of foliage. Its leaves are in some points not unlike those borne on vigorous, young shoots of *Tilia Americana*, though narrower in proportion to their breadth.

III.

General Remarks.

The general conclusion indicated by the above facts is the strong resemblance of the flora of the Mackenzie River beds with that of the Laramie of other parts of Canada and of the United States, and also with the Tertiary of Greenland, Spitzbergen, Alaska and the Hebrides. They thus confirm the inferences as to this similarity, and as to the Lower Eocene age of the Upper Laramie, stated by the author in "The Report on the 49th parallel" in 1875, in subsequent 'Reports of the Geological Survey,' and in previous volumes of these Transactions.

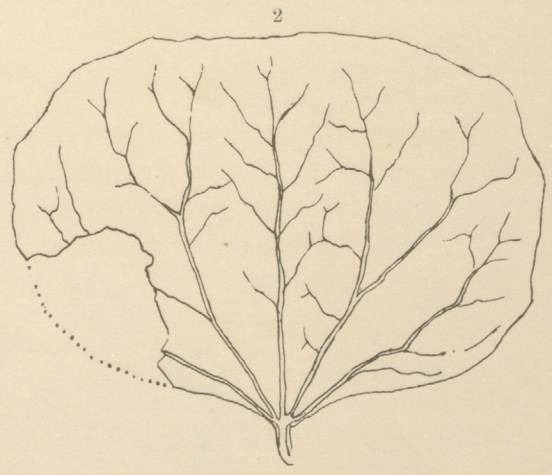
It is to be observed, in connection with this, that recent observations in the western parts of the United States by Mr. Whitman Cross and others, lead to the conclusion that, locally, plants of Middle Tertiary age have been inadvertently mixed with those of the true Laramie, and that this has tended to mislead palæobotanists. Farther, it seems probable that due attention has not been paid to the distinction of the Lower Laramie and the Upper, or to the separation of the former from the Belly River series of the Upper Cretaceous, which has a very similar flora. It is also quite possible that the line between the Eocene and the Upper Cretaceous may ultimately be drawn, as I have suggested in a previous paper, between the Upper and Lower Laramie. The intervention, in the Northwest Territories of Canada, of a thick series of barren beds of red clay, and the affinities of the Lower Laramie flora with that of the Upper Cretaceous, certainly tend to this conclusion. In the mean time there can scarcely be any doubt that the flora of the Upper Laramie, of the Atanekerdluk series in Greenland, and of the Spitzbergen and Alaskan Tertiaries, corresponds with that of the Eocene in Europe, and is also identical with the Fort Union flora of the Missouri region, formerly regarded as Miocene. On these points and as to the evidence of the stratigraphical position of the Laramie between the Cretaceous and the Lower Miocene, I would refer to previous papers in these Transactions.

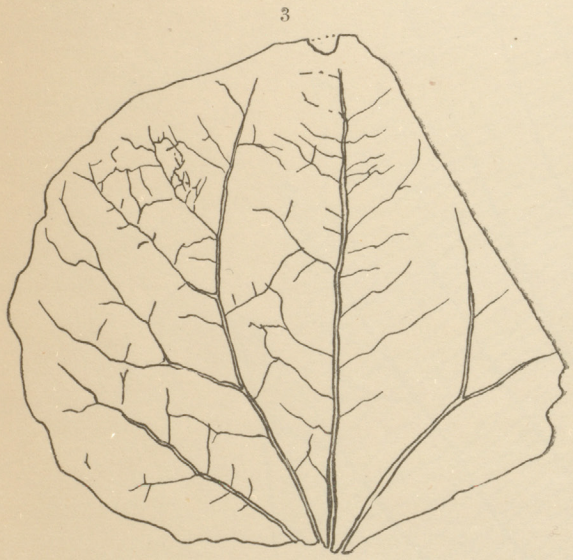
Lastly, it is worthy of note that while the Greenland flora of this age is temperate, that of the temperate regions of America is of the same character and closely allied to that now extant, showing that the conditions of temperature were those of great uniformity over a wide range of latitude rather than of excessive heat in the north. This leads to the inference that the causes of the mild Arctic temperature were geographical rather than astronomical, a conclusion which I have elsewhere stated and maintained.

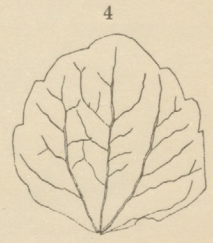
NOTE.

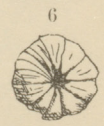
While the above paper was in the press, I received the memoirs of Nathorst on the Tertiary Flora of Japan, and of Ettingshausen on that of New South Wales. These suggest some very interesting comparisons. The early Tertiary Flora of Japan coincides in many species with the Upper Laramie Flora of the Hebrides, Greenland, Northern Canada, Alaska and Saghalien, indicating the prevalence in later Cretaceous and early Eocene times of a similar flora throughout the Northern

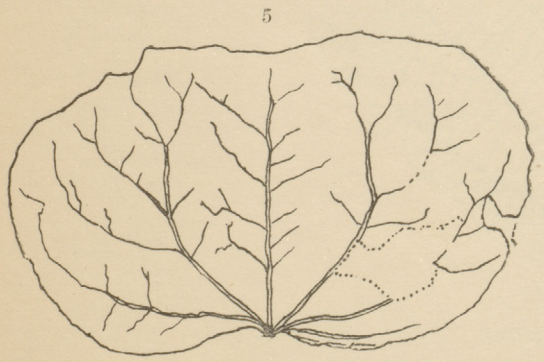
Hemisphere. Even in Australia the early Tertiary flora includes many types now foreign to that country, but resembling those of Upper Cretaceous age in the North, and thus indicating a much greater uniformity in those times than at present, or perhaps that a flora originating in the North had already in the Eocene spread into the Southern Hemisphere. In generalizing on these subjects, Ettingshausen regards them too much from the point of view of local evolution rather than of migration, and does not sufficiently recognize the great antiquity of modern types in the Northern Hemisphere, and the certainty that, in the vicissitudes of climate in geological time, there have been many great transportations of floras from north to south, and from south to north. The time is rapidly approaching when these great questions will meet with adequate answers; but the accumulation of facts is scarcely as yet sufficient. Ettingshausen's specimens were unfortunately somewhat fragmentary, but I have received from Baron von Mueller a small collection of fossil fruits which show some curious American affinities in the Tertiary period.











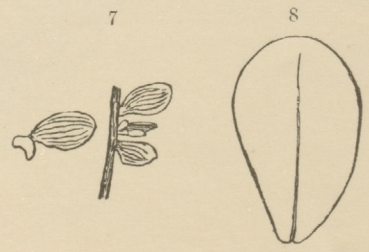


Fig. 1.—*Pteris Sitkensis*, Heer. 2, 3, 4.—*Populus arctica*, Heer. 5.—*P. Hookeri*, Heer. 6.—*Nordenskioldia borealis*, Heer. 7.—*Callistemophyllum latum*, Dn. 8.—*Leguminosites borealis*, Sch.

To illustrate Sir William Dawson's Paper on New Fossil Plants from the Northwest.

Quercus platania, Heer.

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