

Some Miocene Plants From North Central Idaho*

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In Miocene time northern Idaho and northeastern Washington were covered with a vegetation much different from that of the present time. It had an aspect which more closely resembled our present eastern deciduous forests. One of the earlier studies on the Miocene floras of the northwest was that of F. H. Knowlton⁵ in 1925. The floristic study of Knowlton accompanied a geological study of the Spokane region by Pardee and Bryan⁷. These latter authors proposed the name **Latah formation** "for a series of beds, consisting mostly of clay and shale and of fresh water origin that are found near Spokane, Wash., and that contain an abundant middle or lower Miocene flora". These rocks are often overlaid by basalt flows which are also probably Miocene in age.

Pardee and Bryan state that the rock which composed their Latah formation seems to have been derived from volcanic ash, much of which seemed to have been of an andesite type that fell in showers on the region during the period of sedimentation and apparently was deposited in a fresh water lake. Data derived by Upson⁸ point to the same conclusions in regard to the nature of the sediments in which the fossils here discussed are found.

A theory of origin of the Latah sediments is described by Kirkham and Johnson⁴ as follows:

Westward-flowing drainage in mature valleys would be obstructed and ponded by lava flows advancing toward the mountains from a generally westerly direction along an irregular north-south front. Sediments brought down from adjacent mountains would be deposited in front of the flows at first, and as the ephemeral lakes rose in level and were filled up by deposition, the lakes would extend gradually to the west. The sediments would also thin to the west. Successive lava flows would result in a succession of similar phenomena,

and consequently more than one sedimentary series would occur in the section. The final result should be a succession of lava flows alternating with sedimentary beds which lie partly in front of them, and partly interbedded with them. Thickness and area of the part which lay in front of the lava flows would vary greatly from place to place, but the thickness and extent of that part which became interbedded would be more likely to show some uniformity. At all of the Idaho localities, where the relationships are clear, the evidence bears out the postulate.

Kirkham and Johnson state that field evidence in the Idaho localities has persuaded them to stand by this time-honored theory of origin although it was rejected by Pardee and Bryan for the Spokane area.

The original Latah flora as described by Knowlton contained 42 genera and 95 species of which 51 were regarded as new to science. All specimens examined were from the vicinity of Spokane, Washington and Coeur d'Alene, Idaho. In 1928 Berry² revised the flora of the Latah formation and added 57 species and 33 genera. In this latter paper fossils from an additional locality, Stanley Hill, two miles northeast of Coeur d'Alene, were studied.

In the last ten years investigators have reported other localities from which fossils assumed to belong to the Latah formation can be obtained. Kirkham and Johnson⁴ list forty such localities within an area approximately 175 miles long and 75 miles wide. Although they include no descriptions of species, they do enumerate species that had not been reported from the Spokane localities. In 1932 Ashlee¹ published the results of his studies on some of the Latah formation in Idaho, and in this several species were added to those already listed by Berry, Knowlton, and Kirk-

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ham and Johnson. Olson⁶ has enumerated several fossil localities in north central Idaho in Latah, Nez Perce, Clearwater, and Idaho counties. Most of these he infers are Latah in age and the majority of these are the same as listed previously by Kirkham and Johnson.

In 1936 Brown⁷ published in the United States Geological Survey "Additions to some fossil floras of the western United States". This paper represents a partial revision of the floras represented in the collections of the United States Geological Survey and the United States National Museum. He has proposed many changes in the nomenclature of Knowlton, Berry, and others in the belief that these changes "express a more accurate taxonomic disposition of the species involved". Although Brown's study represents mainly a revision of nomenclature as far as the Latah of Spokane is concerned, seven new species from this region have been described. Several new genera have been added as the result of these synonymy studies.

The materials used in this study were obtained from road cuts along the highway between Juliaetta and Arrow Junction in Nez Perce County, Idaho. One locality (Kirkham and Johnson's sta-

tion 27(?)) is approximately five miles south of Juliaetta, and a second is five miles farther on toward Arrow Junction (Figure 1). Both localities are on the right side of the highway.

Thus far in this work 35 genera, 42 species in 22 families of Spermatophyta have been recognized from these localities. Some specimens of Bryophyta and club mosses also have been found, but these have not been placed in any genus. Of the seed plants, none of the following genera was mentioned by Knowlton, Berry, Kirkham and Johnson, and Ashlee: *Abies*, *Picea*, *Thuites*, *Carya*, *Cedrela*, *Maytenus*(?), *Fraxinus*, *Vitis*, *Zelkova*, and *Philadelphus*. (Some of these are the result of Brown's changes of the nomenclature of Knowlton and others.) In addition to the above genera, the following species are new to the Latah flora: *Amelanchier dignatus* (Knowlton) Brown, *Acer septilobatum* Oliver, *Umbellularia oregonensis* Chaney, and undetermined species of *Sophora* and *Nyssa*. Besides these there are several leaves which as yet are unidentified with any available descriptions of western Miocene plants. Some of these doubtless will prove to be new genera for this area. In addition it has been impossible to identify numerous twigs, seeds, and fruits.



Figure 1. Second locality, 10 miles south of Juliaetta, Idaho. Sediments here are tilted.

The flora may be divided into three eastern Asiatic element, (2) an eastern groups on the basis of distribution of North American element, and (3) a the living equivalents, namely: (1) An western North American element.

THE ASIATIC ELEMENT:

Fossil Species.	Living Equivalents.	Distribution.
<i>Alnus relatus</i>	<i>Alnus japonica</i>	Japan
<i>Betula fairii</i>	<i>Betula luminifera</i>	China
<i>Zelkova oregoniana</i>	<i>Zelkova ulmoides</i>	Southwestern Asia
	<i>Zelkova serrata</i>	Japan
<i>Hydrangea bendirei</i>	<i>Hydrangea strigosa</i>	China
<i>Sapindus oregonianus</i>	<i>Sapindus mukorossi</i>	Eastern Asia
<i>Viburnum lantanafolium</i>	<i>Viburnum dilatatum</i>	Japan
	<i>Viburnum erubescens</i>	China
	<i>Viburnum lantana</i>	Southeastern Asia and Europe

THE EASTERN AMERICAN ELEMENT:

<i>Taxodium dubium</i>	<i>Taxodium sp.</i>	Southeastern U. S. and Mexico
<i>Carya egregia</i>	<i>Carya ovata</i>	Eastern N. A.
<i>Ostrya oregoniana</i>	<i>Ostrya virginiana</i>	Central and eastern U. S.
<i>Magnolia dayana</i>	<i>Magnolia acuminata</i>	Eastern N. A.
<i>Liquidambar californicum</i>	<i>Liquidambar styraciflora</i>	Eastern U. S.
<i>Nyssa knowltoni</i>	<i>Nyssa aquatica</i>	Southeastern U. S.

THE WESTERN AMERICAN ELEMENT:

<i>Torreya bonseri</i>	<i>Torreya californica</i>	West coast
<i>Sequoia langsdorfii</i>	<i>Sequoia sempervirens</i>	West coast
<i>Alnus carpinoides</i>	<i>Alnus tenuifolia</i>	Western states
<i>Philadelphus pardeeii</i>	<i>Philadelphus lewisii</i>	Northwestern states
<i>Acer septilobatum</i>	<i>Acer circinatum</i>	West coast
<i>Fraxinus denticulata</i>	<i>Fraxinus oregona</i>	West coast

In addition to these there are some species whose living equivalents are fairly widespread, at least in the North Temperate zone.

THE COMPOSITION OF THE FLORA**Taxaceae**

Torreya bonseri

Pinaceae

Abies sp.

Picea sp.

Pinus spp. (seeds and cone scales)

Sequoia langsdorfii (Brongniart) Heer

Taxodium dubium (Sternberg) Heer

Thuites sp.

Typhaceae

Typha (?) sp.

Salicaceae

Populus heteromorpha Knowlton

Populus fairii Knowlton

Juglandaceae

Carya egregia (Lesquereux) LaMotte

Betulaceae

Alnus corallina Lesquereux

Alnus carpinoides Lesquereux

Alnus relatus (Knowlton) Brown

Betula fairii Knowlton

Ostrya oregoniana Chaney

Fagaceae

Castanea orientalis Chaney

Fagus sp.

Quercus simulata Knowlton

Quercus payettensis Knowlton

Ulmaceae

Zelkova oregoniana (Knowlton) Brown

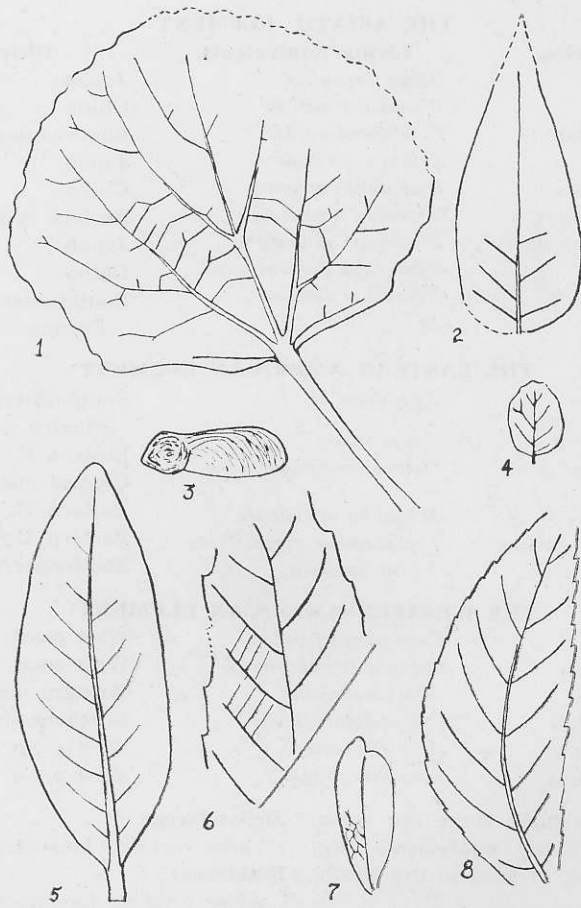
Ulmus sp. fruit.

Lauraceae

Umbellularia oregonensis Chaney

Magnoliaceae

Magnolia dayana Cockerell



(Drawings reduced about $\frac{1}{3}$ in diameter from originals.)

PLATE I.

- Fig. 1—*Vitis washingtonensis* (Knowlton) Brown.
U. I. Botany collection No. 100.
- Fig. 2—*Fraxinus denticulata* Heer. U. I. collection No. 101.
- Fig. 3—*Acer septilobatum* Oliver. U. I. Botany collection No. 102.
- Fig. 4—*Philadelphus pardeci* (Knowlton) Brown.
U. I. Botany collection No. 103.
- Fig. 5—*Umbellularia oregonensis* Chaney. U. I. Botany collection No. 104.
- Fig. 6—*Zelkova oregoniana* (Knowlton) Brown.
U. I. Botany collection No. 105.
- Fig. 7—*Maytenus* (?) sp. cf. *M. phyllanthoides* Benth.
U. I. Botany collection No. 106.
- Fig. 8—*Carya egregia* (Lesquereux) LaMotte. U. I. Botany collection No. 107.

Saxifragaceae

- Hydrangea bendirei* (Ward) Knowlton
Philadelphus pardeeii (Knowlton) Brown

Hamamelidaceae

- Liquidambar pachyphyllum* Knowlton
Liquidambar californicum Lesquereux
 (fruit)

Rosaceae

- Amelanchier dignatus* (Knowlton)
 Brown

Leguminosae

- Cercis spokaneensis* Knowlton
Sophora spokaneensis Knowlton

Meliaceae

- Cedrela pteriformis* (Berry) Brown

Celastraceae

- Maytenus* (?) cf. *phyllanthoides* Bentham

Aceraceae

- Acer septilobatum* Oliver (fruit)
Acer sp. (leaf)

Sapindaceae

- Sapindus oregonianus* Knowlton

Vitaceae

- Vitis washingtonensis* (Knowlton)
 Brown

Cornaceae

- Nyssa knowltoni* Berry

Oleaceae

- Fraxinus denticulata* Heer

Caprifoliaceae

- Viburnum lantanifolium* Berry

Incertae Sedis

- Carpites boraginoides* Knowlton

CONCLUSIONS

The plants listed above from the two localities in north central Idaho indicate Miocene age and probably Latah. Whether these are older or younger than the Latah of Spokane, the writer is not prepared to state at the present time.

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Abstract**Pegmatite Minerals at the Kettle Falls of the Columbia**

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A granitic pegmatite sill in the quartzites forming Kettle Falls swells to over ten feet in thickness, and pinches out to zero, the variations being irregular. Its minerals, in decreasing order of abundance, are orthoclase, quartz, albite, muscovite, tourmaline, garnet and beryl. The larger orthoclase crystals are six-inch ovoids, locally perthitic. These and the smaller crystals are coated with creamy albite which has turned crumbly with weathering. Gray vitreous quartz forms small irregular masses, and a later generation cuts all other minerals. Muscovite books up to

two inches across are imbedded in the feldspars. Small black prisms of tourmaline are clustered locally; many are cracked and then healed with late quartz. Red trapezohedral garnets occur in most places; and in one nest near the east end of the lower falls, crystals over an inch in diameter were found. A few small pale-blue beryl crystals occur in a north-facing wall upstream from the large garnets. Only the late quartz, in fragile veinlets, is thought to be of later date than the deformation which strained, cracked and granulated the other minerals.