Bulletin No. 204 Series C, Systematic Geology and Paleontology, 58

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
CHARLES D. WALCOTT, DIRECTOR

FOSSIL FLORA

OF THE

JOHN DAY BASIN

OREGON

BY

FRANK HALL KNOWLTON



WASHINGTON
GOVERNMENT PRINTING OFFICE
1902

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LETTER OF TRANSMITTAL.

DEPARTMENT OF THE INTERIOR,
UNITED STATES GEOLOGICAL SURVEY,
Washington, D. C., July 15, 1902.

SIR: I have the honor to transmit herewith the manuscript and illustrations of a paper entitled Fossil Flora of the John Day Basin, Oregon, and to request its publication as a bulletin of the Survey.

Very respectfully,

F. H. KNOWLTON,
Paleontologist.

Hon. CHARLES D. WALCOTT,
Director United States Geological Survey.

FOSSIL FLORA OF THE JOHN DAY BASIN, OREGON.

By F. H. KNOWLTON.

INTRODUCTION.

For a number of years I have been gradually accumulating material for a thorough revision of the Tertiary floras of the Pacific slope. Fossil plants are known to occur at numerous points within this area, and their study and identification has already furnished valuable data bearing on the geological history of the region, and when still further exploited it is confidently expected that they will afford more exact data for the use of geologists. This investigation is progressing satisfactorily, and at no distant day it is hoped to have it in form for final publication.

From time to time various members of the United States Geological Survey, as well as others not connected with this organization, have sent in small collections of fossil plants for determination. These have been studied and reported upon as fully as the condition of the problem permitted, so that the determinations could be immediately available to geologists, but with the reservation that none of the questions could be fully settled until all known material had been studied and properly correlated.

The rich fossil plant deposits in the John Day Basin, as set forth more fully in the historical account which follows, have been known for a period of nearly fifty years, but their study has been carried on in a more or less desultory manner. There has also been considerable confusion as to the horizons whence these plants came. As various species of plants described originally from the John Day region were detected in various other localities in Oregon, and in surrounding areas, as central Washington, western Idaho, and northern California, it became more than ever apparent that a thorough study of all material obtainable from this type area would be necessary before any definite or satisfactory conclusions could be reached.

The immediate incentive for this revision was furnished by the receipt of a considerable collection of plants, made by Dr. John C. Merriam in 1900 while he was in charge of an expedition into this region made under the auspices of the University of California.

When these plants were submitted to me for study, it was thought possible to present their description, together with a revision of our knowledge of the previously known forms, within a space sufficiently small to permit the publication of the matter as an appendix to a paper on the general geology of the area, then in preparation by Dr. Merriam. But it soon became apparent that this could not be adequately done within the space available, and a short preliminary report was prepared for and published by Dr. Merriam.[a] The results of a complete restudy of all available fossil plant material from the John Day Basin are now presented.

I wish to record my great indebtedness to Dr. Merriam, who not only accompanied me at a considerable personal sacrifice on a trip through the region in 1901, but placed unreservedly at my disposal all material bearing in any way on the problem then in the paleontological museum of the University of California. To Dr. Arthur Hollick I am indebted for the loan of all material from the John Day region belonging to Columbia University, and now deposited in the New York Botanical Garden at Bronx Park. This material, together with the rich collections belonging to the United States National Museum, represents practically all now known to have come from the John Day Basin.

GEOGRAPHIC LOCATION AND TOPOGRAPHIC FEATURES.

The John Day Basin is situated in the north-central portion of the State of Oregon. It lies mainly in Grant County, but extends also into the northeastern portion of Crook County and the southern portions of Gilliam, Morrow, and Umatilla counties. It is rudely rectangular in outline, and is almost completely surrounded by the Blue Mountains, whose rugged eastern ridges rise to a height of over 6,000 feet, those to the west being lower and made up largely of Tertiary lavas, which form regular and often flat-topped ridges.

John Day River, with its numerous branches and tributaries, draining an area of approximately 10,000 square miles, has a general westward course through the basin, which it leaves on its west side through a gap between the north and south ranges of the Blue Mountains; thence its course is north to the Columbia.

When viewed from an eminence the basin presents a rough and rugged appearance and bears abundant evidence of former volcanic activity in the shape of ridges and plateaus, often several thousand feet in height, made up of volcanic flows of various kinds, as well as vast deposits of ashes, tuffs, and occasionally sands and gravels. Around these ridges and plateaus the water courses have cut deep and often narrow canyons, especially in the soft ashes and tuffs, but occasionally also through the massive basalts, rhyolites, and andesites.

[a] A contribution to the geology of the John Day Basin: Univ. Cal., Bull. Dept. Geol., Vol. II, No. 9, April, 1901, pp. 269-314.

The area of land under cultivation is extremely limited, being confined to the scattered narrow bottoms along the main streams. With the exception of a growth of pines along the higher ridges, the tree growth is confined to a fringe of cottonwoods and willows along the water courses and a few scattered junipers on the lower ridges. The remainder of the country, when not too rugged, is or was formerly covered with a luxuriant growth of grasses, but overstocking has already seriously impaired the value of the ranges for grazing purposes.

HISTORY OF EXPLORATION IN THE JOHN DAY BASIN.

For more than a quarter of a century the John Day Basin has been widely known for its abundant deposits of plant and animal fossils. The first of its fossil riches to be discovered were mammalian remains in the form of teeth and fragments of bones from the Crooked River region, brought back by a company of soldiers who traversed the region in 1861. Some of these fossils fell into the hands of Rev. Thomas Condon, then located in The Dalles. Condon recognized the value of the discovery, and early in the following year he obtained permission to accompany a party of soldiers taking supplies to the military post at Harney Valley. On the way out they passed through the Crooked River region, where Condon obtained fossils, and on the return trip by way of Camp Watson, a post long ago abandoned, he discovered rich plant deposits on Bridge Creek. In 1863 and 1864 Condon spent some weeks in each season in exploring along Bridge Creek and John Day River, in the latter region discovering and naming Turtle Cove, a locality which has afforded a large proportion of the vertebrate remains thus far brought to light in this region.

In the fall of 1871 Prof. O. C. Marsh, of Yale University, in company with a large party of students and others, under the guidance of Condon, made an extended trip through the basin, collecting vertebrate remains, principally from what are now known as the "John Day" and "Mascall" beds. From this date until 1877 parties in the employ of Marsh continued collecting throughout the region, but they appear to have procured only animal remains. As these vertebrate remains were found in such abundance and so well preserved, the region continued to attract students. Thus in 1878 and 1879 collections were made for Prof. E. D. Cope; in 1882 for the United States Geological Survey, under the direction of Professor Marsh, and in 1889 by Prof. W. B. Scott, for Princeton University. In 1899 and 1900 Dr. John C. Merriam, with a large party, collected extensively throughout the region in the interests of the University of California. His attention was mainly devoted to securing vertebrate remains, but he also obtained a small and extremely interesting collection of plants from Cherry

Creek, Clarnos Ferry, Bridge Creek, Van Horn's ranch, and other places. These plants will be noticed later.

As already stated, Professor Condon was the first to discover the rich plant beds on Bridge Creek. His collections from this locality, from Currant Creek, and possibly other places within the basin, were probably made during several years, and were ultimately placed in the hands of the late Dr. J. S. Newberry, of Columbia University, for study. As the partial results of his study Dr. Newberry published, in March, 1883, brief characterizations of fifteen new species of plants.[a] These species, as well as several others, were more fully described and figured in his Later Extinct Floras of North America,[b] a posthumous work issued under the editorship of Dr. Arthur Hollick in 1898. The publication of the latter work, containing as it did the illustrations, made it possible for the first time to be certain of Newberry's species. All, or nearly all, of the material on which Newberry's work was based ultimately became the property of the United States National Museum, where it now is.

Probably about 1870 Mr. C. D. Voy, a well-known collector of San Francisco, California, made a collecting trip through the basin. He obtained plants from Currant Creek, Bridge Creek, and from a new locality known later as Van Horn's ranch or Belshaw's ranch. These specimens, through the munificence of Mr. D. O. Mills, were presented to the University of California, where they now are. This material was all submitted to Prof. Leo Lesquereux for determination. The exact date on which it came into his hands is uncertain, but it must have been in or before 1878, for a part of the species—certain of those from Van Horn's ranch—were, owing to insufficient labeling, included in his Fossil Plants of the Auriferous Gravel Deposits of the Sierra Nevada,[c] published in that year. The remainder, now known to have come from Currant Creek, Bridge Creek, and Van Horn's ranch, though mainly labeled simply "John Day Valley, Oregon," was described by Lesquereux in his Cretaceous and Tertiary Floras.[d] This work bears the date of 1883, and as it contains descriptions and figures of many of the same species that had been submitted to Dr. Newberry, though of course under different names, it becomes a matter of much importance to fix more exactly the actual time of issue. In the case of Newberry's paper the actual date is easily fixed by the date on the final signature as March 21, 1883. From a note in the first page of the Cretaceous and Tertiary Floras it appears that the manuscript was submitted by Professor Lesquereux on September 27, 1882, and was received by the Director of the United States Geological Survey on October 12, 1882.

[a] Proc. U. S. Nat. Mus., Vol. V, 1883, pp. 502-513.
[b] Mon. U. S. Geol. Survey Vol. XXXV.
[c] Mem. Mus. Comp. Zool., Vol. VI, No. 2.
[d] U. S. Geol. and Geog. Surv. Terr., Mon. VIII, 1883, pp. 239-255.

But the letter of transmittal to the then Secretary of the Interior bears date of November 1, 1883, and as this must have preceded by some months the actual issue of the volume, it is clear that Newberry's paper has precedence, and all names of species established by him, when in conflict with those given by Lesquereux, must stand.

By far the largest collection of fossil plants from this region was made in the summer of 1880 by Maj. (then Capt.) Charles E. Bendire, of the United States Army, who made a short tour through the basin with a large party of the Seventh United States Cavalry. He collected at Bridge Creek, Cherry Creek, and Van Horn's ranch, securing mainly plants, but also a few fish and mammal remains, and this entire collection was presented by him to the United States National Museum. The fish remains were described by Cope,[a] and the plants were submitted to Lesquereux, whose report on those from Van Horn's ranch and Cherry Creek was published in 1888.[b] Lesquereux's report on the Bridge Creek material was prepared and submitted at the same time, but on account of the difficulty in securing figures of the supposed new species, was not published. This manuscript has been in my hands for some years awaiting revision, and, so far as possible, has been incorporated in the present work.

As a preliminary to the preparation of this work, I went over very carefully every specimen in the collection of the United States National Museum from Van Horn's ranch and Cherry Creek, as published upon by Lesquereux. In the case of the specimens from Van Horn's ranch the matrix is so distinctive that no difficulty was experienced in making certain that they actually came from this locality, but when the collection from Cherry Creek was taken up, it at once became evident that some mixing of specimens must have occurred. Lesquereux enumerated thirty species in his paper above quoted, but they are preserved on very different kinds of matrix and represent certain well-known species that have never before been reported from the John Day region. Specimens of some of the matrix of the suspected species were sent to Dr. Merriam, of the University of California, for the purpose of ascertaining whether he had noted matrix of this character at Cherry Creek. It proved to be wholly unlike anything observed by him at this locality, thus in a measure confirming my suspicion of a possible mixture. I am uncertain where the doubtful specimens came from, but from the character of the matrix as well as from the species represented, it seems more than possible that they may have come from the Green River beds of Wyoming. As doubt was thus cast on all of the Cherry Creek material in the United States National Museum collection, I visited the locality myself in the summer of 1901, in company with Dr. Merriam, and made as full a collection as possible. This absolutely

[a] Am. Nat. Vol. XXIII, 1889, p. 625. [b] Proc. U. S. Nat. Mus., Vol. XI, pp. 13–24, Pls. V–XIV.

confirmed the theory that Lesquereux had inadvertently confused at least two localities under the name of Cherry Creek. The typical matrix at Cherry Creek is a hard, yellowish-brown sandstone, which fractures very irregularly, making it difficult to obtain perfect impressions. Only the species known to have come from there, or preserved on matrix so similar as to leave no reasonable doubt that it is the same, are included in the following enumeration.

As already stated, Dr. Merriam obtained small collections of fossil plants during the field seasons of 1899 and 1900. These were submitted to me for determination, and a more or less tentative report was incorporated by Dr. Merriam in his report above mentioned on the geology of the John Day Basin.

During the field season of 1901 I visited the John Day Basin under the guidance of Dr. Merriam and made collections of plants at Cherry Creek, Bridge Creek, and Van Horn's or Belshaw's ranch and vicinity. At the close of the field season some weeks were spent in thoroughly going over the type collections of plants in the paleontological museum of the University of California. It was at this time that the fact was developed that a part of the Van Horn's ranch material had been included by Lesquereux in his Flora of the Auriferous Gravels of California. Inasmuch as these species were mainly the ones upon which rested the correlation between the beds in the John Day Basin and the Auriferous gravels, the detection of the error was of the utmost importance.

GEOLOGICAL FEATURES OF THE JOHN DAY BASIN.

HISTORY OF GEOLOGICAL INVESTIGATION IN THE REGION.

Considerable confusion and uncertainty have existed regarding geological events and their sequence within this area, due in large measure to the fact that observations were either hastily made during brief reconnaissance trips through the region, or were confined to the vicinity of the richer fossil deposits. Even at the present time no detailed geological study of this region has been undertaken. By far the most important contribution to the subject that has thus far been made is that by Dr. John C. Merriam, in the paper already referred to.[a] Before passing to an exposition of his own views Dr. Merriam presents the following brief summary of previous work:

> The first mention of the fossiliferous deposits in the John Day Basin which appears in the literature was made by Dr. Joseph Leidy. In October, 1870, Dr. Leidy presented before the Philadelphia Academy of Sciences[b] a short paper, in which he described "A collection of fossils recently received for examination through the Smithsonian Institution, from Rev. Thomas Condon, of Dalles City, Oregon." The

[a] A contribution to the geology of the John Day Basin: Univ. Cal., Bull. Dept. Geol., Vol. II, No. 9, April, 1901, pp. 269-314.

[b] Proc. Phila. Acad. Nat. Sci., Vol. XXII, 1870, pp. 111-112.

collection consisted of "remains of mammalia obtained by Mr. Condon from the valley of Bridge Creek" (and "Big Bottom of John Day"), "a tributary of John Day's River, Oregon." The collection included new forms of *Paracotylops* (*Merycochœrus*), *Rhinoceros*, and *Anchitherium*. New occurrences of *Agriochœrus*, *Leptomeryx*, *Lophiodon* (?), *Elotherum*, and a Dicotyles-like form were also noted. Most of the previously known species, as identified by Leidy, were forms belonging to the White River fauna, and he probably considered the John Day beds as of nearly the same age as the White River.

In 1873 Professor Marsh described[a] several new fossil mammals obtained by his exploring party in the John Day country in 1871. He referred two forms to the Miocene and one to the Pliocene, thus making the first statement regarding the age of the beds.

In his paper on the great lava flood of the West, Prof. Joseph Le Conte[b] makes the first mention of the structural relations of the John Day formations. His statement regarding the relation of the lava to the John Day beds is in part as follows: "The lava of this region is * * * underlaid by the remarkable fossiliferous Miocene lake deposit of the John Day Valley; erosion has cut through the lava cap into the soft strata beneath."

The earliest general discussion of John Day geology which appears in literature is the following statement published by Marsh[c] in 1875:

"The Blue Mountains formed the eastern and southern shores of this lake, but its other limits are difficult to ascertain, as this whole country has since been deeply buried by successive overflows of volcanic rock. It is only when the latter have been washed away that the lake deposits can be examined. The discovery and first explorations in this basin were made by Rev. Thomas Condon, the present State geologist of Oregon. The typical localities of this Miocene basin are along the John Day River, and this name may very properly be used to designate the lake basin. The strata in this basin are more or less inclined and of great thickness. One section near the John Day River, examined by the writer in 1871 and again in 1873, seems to indicate a thickness of not less than 5,000 feet. The upper beds alone of this series correspond to the deposits in the White River Basin. The lower portion also is clearly Miocene, as shown by its vertebrate fauna, which differs in many respects from that above. Beneath these strata are seen, at a few localities, the Eocene beds containing fossil plants mentioned above. They are more highly inclined than the Miocene beds, and some of them show that they have been subjected to heat. The inferior strata elsewhere are Mesozoic and apparently Cretaceous. Above the Miocene strata Pliocene beds are seen in a few places, but basalt covers nearly all."

In this account we find the name "John Day" first used for the principal fossil beds of the basin. The relation of this horizon to the great lava beds is also correctly stated, though it is not quite clear whether he considered the Pliocene as also covered by the basalt flows. The Pliocene referred to is pretty certainly the Mascall beds. It is known that Marsh camped near the typical exposure of this formation and did some collecting in it. To what Marsh referred in his statements concerning Eocene and Cretaceous it is not certain. He has, however, correctly described the stratigraphic sequence.

In 1880 Prof. E. D. Cope[d] published the following statement concerning the geology of the John Day country:

"The regions of the John Day River and Blue Mountains furnish sections of the formations of central Oregon. Above the Loup Fork or Upper Miocene there is a lava outflow which has furnished the materials of a later lacustrine formation, which contains many vegetable remains. The material is coarse and somewhat gravelly and is found on the Columbia River, and I think also in the interior basin. Professor Condon, in his unpublished notes, calls this the Dalles group.

[a] Am. Jour. Sci., 3d ser., Vol. V, 1873, p. 409.
[b] Am. Jour. Sci., 3d ser., Vol. VII, 1874, p. 167.
[c] Am. Jour. Sci., 3d ser., Vol. IX, 1875, p. 52.
[d] Proc. Am. Philos. Soc., Vol. XIX, 1880, p. 61.

It is in turn overlaid by the beds of the second great volcanic outflow. Below the Loup Fork follows the Truckee group, so rich in extinct mammalia, and below this a formation of shales. These are composed of fine material, and vary in color from a white to a pale brown and reddish-brown. They contain vegetable remains in excellent preservation, and indeterminable fishes. The *Taxodium* nearly resembles that from the shales at Osino, Nevada, and on various grounds I suspect that these beds form a part of the Amyzon group (American Naturalist, June, 1880), with the shales of Osino and of the South Park of Colorado. Below these is a system of fine-grained, sometimes shaly, rocks of delicate gray, buff, and greenish colors containing calamites,[a] which Professor Condon calls the *Calamite* beds. Their age is undetermined."

In spite of Cope's assumption that the plant and fish bearing beds mentioned by him were to be correlated with his Amyzon group,[b] Lesquereux[c] referred the collections from Van Horn's ranch to the late Miocene. In a later statement regarding the John Day stratigraphy,[d] Cope speaks of the calamite beds as doubtless belonging to to the Triassic or Jurassic. This horizon was determined by Lesquereux as Eocene.

Following is the geological section of the John Day region as worked out by Dr. Merriam:[e]

River terraces, with undisturbed Quaternary fossils.
Rattlesnake formation. Gravels, ash, tuff, and rhyolitic lava.
Mascall formation. Ashes, tuffs, and possibly gravels.
Columbia [River] lava. Basaltic flows.
John Day series. Ashes, tuffs, and rhyolitic flows. Sands and gravels near the top. Lower, middle, and upper divisions.
Clarno formation. Ashes, tuffs, and andesitic and rhyolitic lavas.
Chico formation. Sandstones and conglomerates.
Knoxville formation. Black shales.
Pre-Cretaceous sedimentaries, serpentines. Granitic masses of unknown age.

PRE-CRETACEOUS ROCKS.

Although the oldest fossiliferous strata which have thus far been found in the John Day Basin north of the southern portion of the Blue Mountains belong to the Cretaceous, there are formations exposed at a number of points that present the appearance, according to Merriam, of being much older. Thus, on the Middle Fork of the John Day, about 5 miles above Ritter, there are certain sedimentary rocks bordering an area of quartz-diorite which are much more indurated and deformed than any known Cretaceous within the basin.

At Spanish Gulch, 12 miles southwest of Dayville, the Chico Cretaceous is seen resting upon serpentine, which has the appearance of being intruded into it. At the head of the gulch the serpentine is separated from what was taken to be the Chico conglomerate by a zone of schist and quartzite. Not far from this locality there is associated with the serpentine a considerable thickness of quartzite with quartz veins, which have produced some gold. Limestones quite different from any seen in the Chico are also exposed here. From the same neighborhood the writer obtained a specimen of a granitic rock, said to form one wall of a tunnel.

Although no direct proof can be presented, it seems probable that some of the rocks associated with the serpentine at Spanish Gulch are older than the Cretaceous.[f]

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[a] This is apparently *Equisetum oregonense* Newberry, q. v.
[b] Cope, Am. Nat. 1879, p. 332, Late Eocene or Early Miocene, Nevada.
[c] Proc. U. S. Nat. Mus., Vol. XI, 1888, p. 13.
[d] Mon. U. S. Geol. and Geogr. Surv. Terr., Vol. III, 1884, p. 16.
[e] Merriam, op. cit., p. 278
[f] Ibid, p. 280.

At a point 6 miles south of Clarnos Ferry, near the junction of Muddy and Currant creeks, there are several hundred feet of black slates. No fossils have been found in these slates, which seem older than the Knoxville shales.

KNOXVILLE AND CHICO BEDS.

No fossiliferous Knoxville beds have been found within the basin, and the presence of this formation is based on purely lithological grounds. At Mitchell there is exposed a section, thought by Merriam to be hardly less than 3,000 or 4,000 feet in thickness, which is made up of sandstone, conglomerate, and shale. The lower portion of this section is composed mainly of shale which, from its resemblance to the Knoxville so usually developed in California and south-central Oregon, is assumed to be of this age.

The Chico is exposed at Mitchell and Spanish Gulch. Only a single fossil has thus far been afforded by the Mitchell locality. Fossil invertebrates have, however, been obtained at two localities near Spanish Gulch. These were submitted to Dr. T. W. Stanton, who reports that they indicate a "horizon at or very near the base of the Chico formation."

CLARNO FORMATION.

The name Clarno formation has been given by Merriam to a series of beds some 400 feet in thickness which rests on the Chico or Knoxville, and which consists almost entirely of eruptive materials in the form of rhyolite and andesite flows and ash and tuff beds. It is found in typical exposures at Clarnos Ferry, near the town of Fossil, on Cherry Creek, and near Burnt ranch.

Where the Clarno has been found in contact with the John Day there is no apparent angular unconformity of the strata. The difference in induration and weathering is, however, very noticeable. The sedimentary parts of the Clarno show a much greater degree of induration than the John Day beds immediately above, and tend at all localities to form steep bluffs, ornamented frequently with balanced rocks or grotesque figures.[a]

Thus far neither vertebrate nor invertebrate remains have been found in the Clarno, but at most of the localities where carefully exploited fossil plants have been found, often in abundance. The celebrated Bridge Creek locality falls within this formation, occurring at the base of the superimposed John Day beds. I visited this locality in 1901 and obtained a small collection. The plants occur abundantly in a reddish shale, which weathers whitish. The other plant localities in the Clarno will be listed later.

[a] Merriam, op. cit., p. 286.

JOHN DAY SERIES.

Resting directly upon and apparently conformable with the Clarno formation is a thick series of regularly stratified sediments now widely known as the John Day beds. This series of beds is found quite generally throughout the basin, and represents what was called by Marsh the deposits of the John Day Lake. The beds are made up almost entirely of ashy or tufaceous materials, with occasionally, toward the top, some 100 or 200 feet of a harder, blocky tuff.

The erosion forms and coloration of the John Day strata are quite characteristic when compared with those of other formations in the basin. In general the beds are colored various shades of red, green, blue, or yellow. In some cases they are white or gray. As will be shown later, the coloration is an important character in distinguishing the subdivisions of the system. The beds are usually quite soft and disintegrate very rapidly, forming a layer of mud several inches thick over a large part of the exposed surface. A moderately heavy rain starts the mud almost in streams.[a]

The thickness of the John Day series north of the southern portion of the Blue Mountains is placed by Dr. Merriam between 1,500 and 2,000 feet, while to the south, in the vicinity of Logan Butte, it is estimated to be between 3,000 and 4,000 feet.

The John Day series is divided by Dr. Merriam into a lower, middle, and upper division. The lower division, having an estimated thickness of 250 or 300 feet, consists of—

highly colored shale which breaks down readily, forming characteristic mud-covered domes. These beds are in the main a deep red, with occasional alternating strata of buff or white ash. At Bridge Creek alternating beds of red, white, and green, occurring in a group of typical hills of this division, form a striking feature of the landscape, the colored strata making sharply-defined rings about the hills.[b]

The middle division, having a thickness of from 500 to possibly 800 or 1,000 feet—

consists of drab to bluish-green beds, sometimes forming rounded hills, but more frequently exposed as steep, pinnacled, and ribbed bluffs.[c]

The uppermost beds, showing a thickness of 300 or 400 feet, or in some cases of somewhat more, are—

buff, tufaceous, or ashy deposits, sometimes with sand and gravels near the top. . . . . They are usually harder and are generally exposed as steeper bluffs than the strata of the lower divisions.[d]

The lower division of the John Day series is practically barren of fossils of all kinds, while the middle and upper divisions have furnished a very extensive fauna. The only plant remains, with possibly a single exception, are found in the upper division, and even here they consist of only four or five species. The locality is 3½ miles south of Lone Rock.

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[a] Merriam, op. cit., p. 292. [b] Idem, p. 293. [c] Idem, p. 294. [d] Idem, p. 295.

COLUMBIA RIVER LAVA.

So far as can now be made out the great Columbia River lava once covered practically the entire John Day country, with few, if any, points projecting above it. It consists of a large number of basalt flows which are sometimes separated by beds of tuff, and it is estimated by Dr. Merriam to be not less than 1,000 feet in thickness, and in many cases it seems to be still thicker. This lava sheet has been comparatively little disturbed, remaining practically flat over the entire region, being rarely inclined more than 5° or 10°.

MASCALL FORMATION.

At several points within the basin there is a series of sediments resting upon the Columbia River lava to which Dr. Merriam has given the name Mascall formation. This series, or portions of it, has been variously known in literature as the Cottonwood beds, Loup Fork beds, the Ticholeptus beds, the Amyzon beds in part, and finally the Protolabis beds. For one reason or another these various terms are inapplicable. Thus "Cottonwood" is preoccupied by its use for a Carboniferous formation in Kansas; its correlation with the Loup Fork, the Amyzon beds, and the Ticholeptus beds is open to doubt, leaving only Wortman's term, Protolabis beds, which, in Dr. Merriam's opinion, will cover only a portion of the section. The name Mascall formation was suggested by the occurrence of the typical section near the Mascall ranch, 4 miles below Dayville.

At Rattlesnake Creek, near Cottonwood, the Mascall is not less than 800 to 1,000 feet thick. The beds are made up largely of ash and tuff, and are generally light colored, though there are some brownish and reddish strata. Coarse, detrital materials are generally absent from the typical section.[a]

The Mascall formation has afforded a large and varied fauna, consisting of mammals, testudinates, and fish, and a large and interesting flora. The Van Horn's or Belshaw's ranch locality is in this formation, occurring near the base of the section. The plants are preserved in a soft, white, fine-grained ash or tuff, which is often 10 feet in thickness, though usually less. This material is so light when dry that it readily floats for some time on water.

RATTLESNAKE FORMATION.

Dr. Merriam has given the name Rattlesnake formation to a series of coarse gravels, tuffs, and rhyolite flows that rest unconformably upon the Mascall formation. These beds are very slightly inclined, showing a dip of only about 5°.

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[a] Merriam, op. cit., p. 307.

. . . . At one locality on Birch Creek, where a section of the Rattlesnake was carefully examined, it was found to comprise 30 to 40 feet of coarse basal gravels, above this about 25 feet of soft brown tuff, and capping this about 30 feet of rhyolite. At other localities more than 100 feet of gravel have been seen upon the rhyolite. The basal gravel beds show a thickness of 200 feet or more in other localities. They are frequently very coarse and contain many pebbles, evidently derived from the Columbia [River] lava.[a]

The Rattlesnake formation has therefore not yielded fossil plants, but contains a considerable vertebrate fauna.

RIVER TERRACES.

At many places along the John Day and its tributaries "one or more terraces are to be found not far above the existing floor of the valley." In several localities they have been found to contain undisturbed remains of *Elephas primigenius*.

LOCALITIES FOR FOSSIL PLANTS IN THE JOHN DAY BASIN.

1. BRIDGE CREEK, about 6 miles southeast of Burnt ranch and 2½ miles southwest of The Dalles military road at Allen's ranch. Collections at this place have been made by Condon, Voy, Bendire, Merriam, Osmont, and Knowlton.

2. ROAD CROSSING AT CHERRY CREEK, about 10 miles northwest of Burnt ranch. Collections made by Merriam's party in 1900 and by Knowlton and Merriam in 1901. The original locality which afforded the specimens studied by Lesquereux and Newberry is said to be about 2 miles up Cherry Creek from the point where the military road first crosses it.

3. CURRANT CREEK, CROOK COUNTY. Several species were described by Newberry from collections made by Condon at this locality. Only one of these species has been since obtained in this area and then not at the original place, but at Cherry Creek. The type locality is unknown.

4. ONE AND ONE-HALF MILES EAST OF CLARNOS FERRY. Collection made by Merriam's party in 1900.

5. THREE MILES ABOVE CLARNOS FERRY. Collection made by Merriam's party in 1900.

6. ONE-HALF MILE NORTHEAST OF FOSSIL. Collection made by Merriam's party in 1900.

7. THREE AND ONE-HALF MILES SOUTH OF LONE ROCK. Collection made by Merriam's party in 1900.

8. VAN HORN'S RANCH (now Belshaw's ranch), about halfway between Canyon and Dayville, on East Fork of John Day River. Original locality south side of military road and near bed of stream. Collections made by Condon, Voy, Bendire, Merriam, and Knowlton and Merriam.

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[a] Merriam, op. cit., p. 310.

9. BELSHAW'S RANCH, at white hill about one-half mile northeast of original locality and on north side of military road. Collections made probably by Bendire and by Knowlton and Merriam.

10. BELSHAW'S RANCH, in gulch 1 mile northeast of Belshaw's house and about 2 miles east of original locality. Collection made by Knowlton and Merriam.

11. OFFICER'S RANCH, one-fourth mile from John Day River, lower end of Butler Basin (Butler Basin = upper end of Turtle Cove). Collection made by Merriam, July 22, 1901.

12. FOUR MILES EAST OF DAYVILLE, south side of East Fork Valley. Collection made by Merriam's party in 1900.

SYSTEMATIC DESCRIPTION OF SPECIES.

Family SCHIZÆACEÆ.

LYGODIUM KAULFUSII Heer.

LYGODIUM KAULFUSII Heer. Newberry, Later Extinct Floras, p. 1, Pl. LXII, figs. 1–4, 1898.

Lygodium neuropteroides Lesq., Tert. Fl., p. 61, Pl. V, figs. 4–7; Pl. VI, fig. 1, 1878; Proc. U. S. Nat. Mus., Vol. XI, p. 24, 1888.

As it now seems pretty generally agreed that Lesquereux's *Lygodium neuropteroides* is the same as *L. Kaulfusii* of Heer, all the Oregon material has been so referred.

The material from Cherry Creek collected by Major Bendire embraces some forty more or less perfect examples.[a] The expedition of the University of California of 1900 obtained four examples of this species at Cherry Creek in a matrix corresponding to that first mentioned above, and a number of additional specimens were obtained by Dr. Merriam and myself at the same place in 1901.

Locality.—Cherry Creek, Crook County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 2505), by Merriam's party in 1900 (Mus. Univ. Cal., Nos. 176, 177, 183, 224), and by Knowlton and Merriam in 1901 (U. S. Nat. Mus., Nos. 9059–9066).

Family POLYPODIACEÆ.

ASPLENIUM SUBSIMPLEX (Lesq.) Knowlton.

ASPLENIUM SUBSIMPLEX (Lesq.) Knowlton, Cat. Cret. and Tert. Pl. N. A., p. 45, 1898.
Pteris subsimplex Lesq., Proc. U. S. Nat. Mus., Vol. XI, p. 24, 1888.

There are fragments of several fronds in the collection that should probably be referred to this species, yet they do not quite agree in all particulars. Thus the example secured by Bendire (U. S. Nat. Mus.,

[a] As already pointed out (ante p. 13) the material in the United States National Museum under this number appears to consist of two very distinct lots. Only those known to have come from Cherry Creek are here referred to.

No. 2634) has the frond from 4.5 cm. to nearly 5 cm. in width, while a specimen obtained by the University of California (No. 170, counterpart 171) is only 2.5 cm. in width. These measurements are larger and smaller respectively than the usual examples of *A. subsimplex* from Colorado, and the nervation arises at a less angle in the Oregon specimen, but these differences are slight and probably not sufficient to exclude them from this species.

Locality.—Cherry Creek, Crook County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 2634), by Merriam's party in 1900 (Mus. Univ. Cal., Nos. 170, 174), and by Knowlton and Merriam, 1901 (U. S. Nat. Mus., Nos. 9068–9074).

Pteris pseudo-pinnæformis? Lesq.

Pteris pseudo-pinnæformis Lesq., Tert. Fl., p. 52, Pl. IV, figs. 3, 4, 1878.
Pteris pinnæformis Heer. Newberry, Later Extinct Floras, p. 7, Pl. XLVIII, fig. 5, 1898.

This species appears to have been found but once. The specimen is now in the United States National Museum and is preserved in matrix which closely resembles that at Cherry Creek.

Locality.—Currant Creek, Oregon. Collected by Rev. Thomas Condon (U. S. Nat. Mus., No. 8098).

Lastrea (Goniopteris) Fischeri? Heer.

Lastrea (Goniopteris) Fischeri Heer, Fl. Tert. Helv., Vol. I, p. 34; Pl. IX, figs. 3a–3e, 1855; Newberry, Later Extinct Floras, p. 10, Pl. XLVIII, fig. 6, 1898.
Lastrea Knightiana Newb., Proc. U. S. Nat. Mus., Vol. V, p. 503, 1883.

The specimen upon which this determination was based is in the United States National Museum, and so far as known no others have since been obtained.

Locality.—Currant Creek, Oregon. Collected by Rev. Thomas Condon (U. S. Nat. Mus., No. 7097).

Family EQUISETACEÆ.

Equisetum oregonense Newb.

Equisetum oregonense Newb., Proc. U. S. Nat. Mus., Vol. V, p. 503, 1883; Later Extinct Floras, p. 14, Pl. LXV, fig. 7, 1898.
Equisetum Hornii Lesq., Proc. U. S. Nat. Mus., Vol. XI, p. 23, 1888.

After a careful examination of the forty or more specimens of Lesquereux's *E. Hornii* I am convinced that they are the same as Newberry's *E. oregonense.* They are better preserved than Newberry's material, many of them not being compressed in the least. Two or three flat specimens have a width of fully 3 cm., and the non-compressed examples range from 1.25 cm. to over 1.5 cm. in diameter. Several of the diaphragms are preserved without distortion. They are from 1.25 to 2 cm. in diameter and evidently several millimeters

in thickness. The sheaths are short and provided with short, obtuse dentations. The teeth are nearly obsolete. The number of striations, as nearly as can be made out, is between forty and fifty.

Localities.—Currant Creek, Oregon. Collected by Rev. Thomas Condon (type of *E. oregonense*, which is in Mus. Columbia Univ., N. Y.). Cherry Creek, Crook County, Oregon. Collected by Maj. Charles E. Bendire (type of *E. Hornii*, U. S. Nat. Mus., No. 2464, 41 specimens); by Merriam's party in 1900 (Mus. Univ. Cal., Nos. 184, 185, 922), and by Knowlton and Merriam in 1901 (U. S. Nat. Mus., No. 9067). Also 3 miles above Clarnos Ferry. Collected by Merriam's expedition of 1900 (Mus. Univ. Cal., Nos. 184, 185, 910, 922).

EQUISETUM sp.

Pl. I, fig. 1.

The collection contains a small fragment that appears to represent a short portion of the stem and a single sheath of an Equisetum. The stem is about 0.5 cm in diameter, while the sheath is about 8 mm. long and 4 mm. broad at the upper extremity. It is not well enough preserved to show the full character of the sheath, but as nearly as can be made out it was provided with about 16 ribs and presumably an equal number of sharp teeth.

Locality.—Gulch 1 mile northeast of Belshaw's ranch, Grant County, Oregon. Collected by Knowlton and Merriam, July, 1901 (U. S. Nat. Mus., No. 8503).

Family GINKGOACEÆ.

GINKGO sp.

Pl. I, fig. 5.

The collection contains a fragment of what appears to be a leaf of Ginkgo, but it is too much broken to make out any of the essential characters. The most that can be said is that it must have been a large leaf as compared with the living species.

Locality.—Mascall beds, Van Horn's ranch, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by John C. Merriam, July, 1901 (U. S. Nat. Mus., No. 8536).

Family PINACEÆ.

SEQUOIA HEERII Lesq.

SEQUOIA HEERII Lesq., Tert. Fl., p. 77, Pl. VII, figs. 11–13, 1878; Newberry, Later Extinct Floras, p. 20, Pl. XLVII, fig. 7, 1898.

In the Later Extinct Floras there is a fine figure of this species, but according to the note by the editor, Dr. Hollick, there was no clew to the locality whence the specimen came. The original is not now in

the collection of the United States National Museum, so it is impossible to compare the matrix with that from Bridge Creek, but in the material from this locality obtained by Major Bendire there is a fine specimen that is absolutely the same as Lesquereux's type (U. S. Nat. Mus., No. 60) from Sage Creek, Montana. It is also identical with the figure given by Newberry, and as this species has never before been found outside of the type locality it is more than probable that Newberry's specimen was from Bridge Creek.

Locality.—Bridge Creek, Grant County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 9220).

SEQUOIA ANGUSTIFOLIA Lesq.

SEQUOIA ANGUSTIFOLIA Lesq., Cret. and Tert. Fl., p. 240, Pl. L, fig. 5, 1883.
Sequoia Nordenskiöldii Heer. Lesquereux, Proc. U. S. Nat. Mus., Vol. XI, p. 19, 1888.

The Mascall beds at Van Horn's ranch contain a large number of specimens that are undoubtedly the same as Lesquereux's *Sequoia angustifolia* from Corral Hollow, San Joaquin County, California. Whether the California material is identical with the original material[a] from Elko, Nevada, I am not prepared to say, as the types are not at hand for comparison, but a large number of specimens obtained during the past season at Elko by Prof. George C. Lawson, of the University of California, are absolutely indistinguishable from the specimens as figured by Lesquereux. Such of this material as passed through Lesquereux's hands was referred by him to *Glyptostrobus Ungeri* with the exception of a single undoubtedly similar example, which was placed under *Sequoia Nordenskiöldii* as set forth in the above synonymy. This can not be properly referred to American specimens of *Glyptostrobus Ungeri*, although, as I have stated on several occasions,[b] the status of this form is at present unsatisfactory.

In seeking for affinities for these Oregon specimens I have compared most of the figures of conifers given by Heer in his Flora Fossilis Arctica and other publications, and I am forced to the conclusion that there has been more or less confusion in dealing with these forms. Thus I am not able to distinguish what is called by Heer *Glyptostrobus europæus* from the Baltic Miocene[c] from the Van Horn's ranch specimens, and what seems to be the same species or something very close to it is called *Taxodium Tinajorum* Heer[d] from the Miocene of Spitzbergen. The whole subject of the Tertiary conifers, especially of northern and arctic lands, is much in need of revision, and pending this the form under discussion may be referred to Lesquereux's *Sequoia angustifolia* as typified from Corral Hollow, California.

In the original description *S. angustifolia* is characterized as follows: "Leaves short, narrow, linear pointed, erect or slightly

[a] See Tert. Fl., p. 77, Pl. VII, figs. 6–10, 1878.
[b] Cf. Cat. Cret. and Tert. Pl. N. A., p. 113.
[c] Mioc. Balt. Fl., Pl. III, figs. 8, 9.
[d] Fl. Foss. Arc., Vol. II, Abth. 3, Pl. IV, figs. 6, 29, etc.

appressed all around the branches, decurring at base." This in the Tertiary Flora is amended to read: "Branchlets short, slender; leaves at unequal distances, sometimes very close, two or three together, or very distant, often dimorphous, linear lanceolate, taper pointed, open or curved backward, decurrent; middle nerve indistinct." In the discussion in the latter book Lesquereux emphasizes the fact that the leaves are "decurrent but not narrowed at base."

All things considered this description agrees well with the specimens from Oregon, but the material from Elko, obtained during the summer of 1901 and presumably at or near the type locality, shows a slight narrowing of the leaves at the base and a tendency to be less acute at the apex.

Locality.—Mascall beds, Van Horn's ranch and vicinity, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 2610), and by Knowlton and Merriam, July, 1901 (U. S. Nat. Mus., Nos. 9029–9033).

Sequoia Langsdorfii (Brgt.) Heer.

Sequoia Langsdorfii (Brgt.) Heer. Lesquereux, Proc. U.S. Nat. Mus., Vol. XI, p. 19, 1888.

Taxodium distichum miocenum Heer. Newberry, Later Extinct Floras, p. 22, Pl. XLVII, fig. 6, 1898.

The collections contain a number of examples that undoubtedly belong to this species, although some of them do not agree in all particulars with certain of the published figures. The branchlets are rather small, with small leaves, but the latter are distinctly decurrent, after the manner of *S. Langsdorfii.*

The Bridge Creek material, which passed through the hands of Newberry, was identified by him as *Taxodium distichum miocenum*, but absolutely similar material was referred by Lesquereux to *Sequoia Langsdorfii*, and I believe correctly so.

This species, although not especially abundant at any locality in the John Day Basin, is widely distributed, as may be seen from the following list of localities:

Localities.—Bridge Creek. Collected by Rev. Thomas Condon (U. S. Nat. Mus., No. 7086), by Maj. Charles E. Bendire (U. S. Nat. Mus., Nos. 9236, 9281, 9285, 9303, 9314, 9330, 9376), and by Knowlton and Merriam. One and one-half miles east of Clarnos Ferry. Collected by Merriam's expedition of 1900 (Mus. Univ. Cal., Nos. 896, 907, 914.) One and one-half miles northeast of Fossil. Collected by Merriam's expedition of 1900 (Mus. Univ. Cal., Nos. 925, 927, 929). Three and one-half miles south of Lone Rock. Collected by Merriam's expedition of 1900 (Mus. Univ. Cal., No. 1339). Mascall beds, Van Horn's ranch and vicinity. Collected by Major Bendire (U. S. Nat. Mus., No. 2607), and by Knowlton and Merriam, July, 1901 (U. S. Nat. Mus., Nos. 8958–8960).

SEQUOIA sp. (Cone).

Pl. I, fig. 2.

The original collection contains a large cone that was referred by Lesquereux to *Sequoia Langsdorfii*, but it does not appear to agree in size with the cones usually assigned to that species. This cone is a little more than 2.5 cm. in length and nearly 2 cm. thick, and stands on a thick peduncle 7 mm. long and nearly 3 mm. thick. It has been much crushed, and the shape of the scales can not be made out with certainty. In general appearance, however, it seems to belong to Sequoia, but the species must remain uncertain.

Locality.—Van Horn's ranch, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 8510).

THUITES sp.

Pl. I, fig. 3.

Branchlets slender, alternate, leaves thickish, 4-ranked, imbricated, the lateral ones broad-deltoid, rather obtuse pointed, others apparently broader and more obtuse, obscurely carinate on the back.

The little fragment figured is all that has been thus far found in the collections. The branchlets appear to be alternate and slender. As nearly as can be made out, the leaves are 4-ranked and very thick, with obtuse apices.

This form does not differ greatly from *T. Ehrenswærdi* Heer,[a] from the Miocene of Sachalin, and Spitzbergen.

This has slender, alternate branchlets and thick 4-ranked leaves. They are more strongly carinate on the back than ours, but otherwise there is no marked difference. As the branchlets from Oregon are so small and not very well preserved, I have hesitated to identify them with Heer's species, although they may all be the same.

Locality.—Van Horn's ranch, 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Merriam's expedition of 1900 (Mus. Univ. Cal., No. 879).

GLYPTOSTROBUS UNGERI Heer.

GLYPTOSTROBUS UNGERI Heer. Lesquereux, Proc. U. S. Nat. Mus., Vol. XI, p. 19, 1888.

Sequoia Nordenskiöldii Heer. Lesquereux, op. cit., p. 19.

The collection contains numerous specimens that are referred to this species. As I have pointed out on several occasions, there is more or less confusion regarding the proper fixing of the limits of this species. It is apparent that there is or has been a mixing of this with what has

[a] Fl. Foss. Arct., Vol. II, p. 36, Pl. II, figs. 25, 26, 1870; idem, Vol. V, Abth. 4, p. 23, Pl. I, figs. 12–14, 1878.

been called *G. europæus*, *Sequoia Couttsiæ*, etc., but we have not a sufficient amount of authentic material to enable us to settle the question.

The single specimen with its counterpart (U. S. Nat. Mus., No. 2610), referred by Lesquereux to *Sequoia Nordenskiöldii*, is undoubtedly the same as what is here called *Glyptostrobus Ungeri*.

Locality.—Van Horn's ranch, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., Nos. 2480, 2610) and by Merriam's expedition of 1900 (Mus. Univ. Cal., Nos. 863, 872–882).

Taxodium distichum miocenum Heer.

The collections embrace a dozen or more branchlets that I am constrained to refer to this form. They do not agree perfectly with certain figures of this species, but the differences are slight, and they had best be placed here. Unless material is very perfectly preserved it is difficult to determine the exact manner of the insertion of the leaves, and such is the case with these specimens.

Locality.—Mascall beds, Van Horn's ranch, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 2614) and by Merriam's expedition of 1900 (Mus. Univ. Cal., No. 878a).

Taxodium, male aments of.

Pl. I, figs. 4, 6.

In the material from the Mascall beds are two specimens, both of which are here figured, that appear to represent the male aments of Taxodium. They are long, slender, and clustered, with the aments on short lateral spurs. They are hardly to be distinguished from the aments of the living *Taxodium distichum*, and in all probability belonged to *T. distichum miocenum*, which is not uncommon in these beds.

Locality.—Mascall beds, Van Horn's ranch, Oregon. Larger specimen (fig. 4) collected by Merriam's expedition of 1900 (type in Mus. Univ. Cal., No. 889). Other example (fig. 6) collected by Knowlton and Merriam, July, 1901 (U. S. Nat. Mus., No. 8551).

Family GRAMINEÆ.

Phragmites œningensis Al. Br.

Phragmites œningensis Al. Br. Lesquereux, Proc. U. S. Nat. Mus., Vol. XI, p. 19, 1888.

Locality.—Van Horn's ranch, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 2530).

Family CYPERACEÆ.

CYPERACITES sp.

Pl. I, fig. 9.

The collection contains a single specimen that appears to be the leaf of a large cyperaceous plant. It is about 1 cm. in width and has about 10 ribs or striæ through it, but there is hardly enough to afford any characters of importance, and it is included simply to show that this type of vegetation was present.

Locality.—Mascall beds, Van Horn's ranch, 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Knowlton and Merriam, July, 1901 (U. S. Nat. Mus., No. 8542).

Family SMILACEÆ.

SMILAX WARDII Lesq.

SMILAX WARDII Lesq., Proc. U. S. Nat. Mus., Vol. XI, p. 19, Pl. XIII, fig. 1, 1888.

The type specimen, with its counterpart, is all that has ever been obtained.

Locality.—Van Horn's ranch, South Fork of John Day River, 12 miles west of Mount Vernon, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 2613).

MONOCOTYLEDONOUS PLANT.

Pl. I, figs. 7, 8.

Among the collections lately obtained by the University of California I found two examples of what are undoubtedly monocotyledonous plants, the nature of which I am at present unable to satisfactorily describe. They are shown as well as possible in the accompanying figures.

The one shown in fig. 7 is about 6.5 cm. in length, as now preserved, and 1.5 cm. in width. It is bifurcate at apex into two nearly equal, acute lobes. It is provided with some 8 or 9 longitudinal ribs, separated by rather deep channels.

The other, shown in fig. 8, is rather elliptical-lanceolate in shape and is apparently acuminate at apex, but the extreme point and the base are not preserved. It is the same length as the other, but is a little wider, being 1.75 cm. It is likewise provided with 8 or 9 ribs, between which are numerous finer striæ or veins. The basal end is truncated, as though it was a sheathing organ of some kind.

In general appearance these specimens, and especially the one last mentioned, are at least suggestive of what Lesquereux[a] has described

[a] Tert. Fl., p. 28, Pl. I, figs. 10, 11, 1878.

as *Podozamites oblongus*, from the Dakota group of Kansas, but this is without the prominent ribs seen in our specimens. This resemblance can hardly be more than superficial, and we must await future material before the status of these specimens can be definitely settled.

Locality.—Bridge Creek, Oregon. Collected by Merriam's party of 1900 (types in Mus. Univ. Cal., Nos. 2500, 2501).

Family SALICACEÆ.

POPULUS LINDGRENI Knowlton.

Pl. II, fig. 1.

POPULUS LINDGRENI Knowlton, Eighteenth Ann. Rept. U. S. Geol. Surv., Pt. III, p. 725, Pl. C, fig. 3, 1898.

The collections from near Van Horn's ranch, made during the season of 1901 by Dr. Merriam and myself, contain a single very perfectly preserved leaf that must be referred to this species. It differs slightly from the type in being more nearly circular in shape, but in matter of size, marginal teeth, and nervation the two specimens are identical.

Locality.—White hill one-half mile east of original Van Horn's ranch locality, Grant County, Oregon. Collected by Knowlton and Merriam, July, 1901 (U. S. Nat. Mus., No. 8512). Type specimen from 2 miles southeast of Marsh post-office, Boise County, Idaho (U. S. Nat. Mus., No. 8292).

SALIX SCHIMPERI Lesq.

SALIX SCHIMPERI Lesq., Proc. U. S. Nat. Mus., Vol. XI, p. 21, Pl. XIII, fig. 5, 1888.

Locality.—Cherry Creek, Crook County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 2595).

SALIX ENGELHARDTI Lesq.

SALIX ENGELHARDTI Lesq., Proc. U. S. Nat. Mus., Vol. XI, p. 17, Pl. VIII, fig. 2, 1888. *Cassia phaseolites?* Ung. Lesquereux, idem., p. 16.

It seems doubtful if this is correctly referred to Salix, but as no new material except a specimen to be mentioned below has come to light, it may be best to retain it as left by its author.

It was observed that the single example referred by Lesquereux to *Cassia phaseolites?* Ung. had a serrate margin, which would exclude it from this genus, and a further comparison convinces me that it is another leaf of *Salix Engelhardti*. It is a small leaf, not quite so broad relatively in the upper part, but it has a base of the same shape, the same serrate margin, and the same nervation as this species, and is therefore referred to it. It becomes then the second known specimen of *S. Engelhardti*.

Locality.—Van Horn's ranch, South Fork of John Day River, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., Nos. 2455, 2589.)

SALIX RÆANA? Heer.

SALIX RÆANA? Heer. Lesquereux, Proc. U. S. Nat. Mus., Vol. XI, p. 17, 1888.

It is extremely doubtful if this is correctly identified, as the specimen upon which it is based is very poor, but as no other example has been found it may remain as above. Little weight should be attached to it, however.

Locality.—Van Horn's ranch, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 2594).

SALIX VARIANS Göppert.

SALIX VARIANS Göppert. Lesquereux, Proc. U. S. Nat. Mus., Vol. XI, p. 17, 1888.

I regard this identification as more or less doubtful. It is smaller than the usual form of this species, although similar in size and appearance to a leaf so determined by Heer[a] from Alaska. It is the only example found.

Locality.—Van Horn's ranch, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 2596).

SALIX ANGUSTA Al. Br.

SALIX ANGUSTA Al. Br. Lesquereux, Cret. and Tert. Fl., p. 247, Pl. LV, fig. 6, 1883.

These are two narrow leaves that agree closely with the smaller figures given by Lesquereux as above quoted. The locality is stated to be "Oldfield claim, Oregon," but I have been unable to further identify the place. The type specimen is preserved in the paleontological collection of the University of California (No. 1963), and the leaves under consideration appear to be the same as the leaves from this unknown locality in Oregon. It does not follow, however, that they should be regarded as identical with all leaves that have been referred to this species from other localities.

Locality.—Van Horn's ranch, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Merriam's expedition of 1900 (Mus. Univ. Cal., Nos. 85, 87.)

SALIX AMYGDALÆFOLIA Lesq.

SALIX AMYGDÆFOLIA Lesq., Cret. and Tert. Fl., p. 156, Pl. XXXI, figs. 1, 2, 1883. Proc. U. S. Nat. Mus., Vol. XI, p. 17, 1888.

Locality.—Van Horn's ranch, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 2587).

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[a] Fl. Foss. Alask., p. 27, Pl. II, fig. 8, 1869.

SALIX PSEUDO-ARGENTEA n. sp.

Pl. II, figs. 2-4.

Sapindus angustifolius Lesq., Proc. U. S. Nat. Mus., Vol. XI, p. 15, 1888.

Leaves of firm texture, lanceolate or narrowly ovate-lanceolate in shape, narrowed about equally to both base and apex; margin perfectly entire; petiole short, rather slender; midrib rather strong; secondaries numerous, some 12 or 15 pairs, at an acute angle, thin and nearly concealed in the substance of the leaf, camptodrome; finer nervation not preserved.

I refer a large number of specimens to this form, among them one that was identified by Lesquereux as *Sapindus angustifolius*. They are mainly small, narrow leaves from 4 to 6 cm. in length and from 1 to 1.5 cm. in width. The petiole is 5 mm. long, and, as stated above, slender for the size of the leaf. This form has a close resemblance to the living *Salix argentea*.

Locality.—Mascall beds, Van Horn's ranch, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Knowlton and Merriam, July, 1901 (U. S. Nat. Mus., Nos. 8527, 8528, 8529).

SALIX DAYANA n. sp.

Pl. II, figs. 9, 10.

Leaves of firm texture, ovate-lanceolate or elliptical-lanceolate, truncate or slightly heart-shaped at base, acuminate at apex; margin perfectly entire; petiole very short, stout; midrib thick; secondaries, 10 or 12 pairs, at an angle of about 40°, thin and obscure, camptodrome, arching and joining well inside the margin; finer nervation not retained.

I refer three examples to this form, two of which are here figured. The smaller is 4.5 cm. long and 1.5 cm. wide, the larger 5.5 cm. long and nearly 2 cm. wide. The petiole is about 2 mm. long.

Locality—Mascall beds, Van Horn's ranch, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Knowlton and Merriam, July, 1901 (U. S. Nat. Mus., Nos. 8530, 8531).

SALIX PERPLEXA n. sp.

Pl. II, figs. 5-8.

Leaves of firm texture, obovate-lanceolate to elliptical-lanceolate in shape, narrowed, often abruptly, to the petiole, rather obtuse at apex; margin entire; petiole short; midrib strong below, becoming very thin above; secondaries numerous, 12 or 15 pairs, alternate, at a low angle, parallel, effaced near the margin, but apparently camptodrome; finer nervation obscure, but apparently producing very fine areolæ.

This form is represented by a dozen or more examples, among which there is a considerable range in size. The smallest leaves are only 2.25 cm. in length and 13 mm. in width, while the larger are nearly 5 cm. in length and 1.75 cm. in width. The average size is about 3.5 cm. in length and 1.75 cm. in width. The petiole is 5 or 6 mm. long.

This species is certainly similar in general appearance to certain forms of *Salix Bebbiana*, a species now widely distributed throughout the Rocky Mountain area.

Locality.—Mascall beds, Van Horn's ranch and vicinity, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Knowlton and Merriam, July, 1901 (U. S. Nat. Mus., Nos. 8521, 8522, 8523, 8524).

SALIX MIXTA n. sp.

Pl. II, figs. 11, 12.

Leaves coriaceous in texture, ovate-lanceolate or ovate-elliptical in shape, slightly unequal-sided, subcordate or abruptly rounded at base; margin finely and evenly serrate; midrib thick; secondaries numerous, rather close, parallel, emerging at a low, almost right, angle, curving upward near the margin, strongly camptodrome, or occasionally with a secondary passing to the margin; when camptodrome arching well inside the margin with fine nervilles passing to the teeth; nervilles numerous, mainly broken, at an oblique angle; finer nervation forming a very regular fine mesh.

This form is represented by about a dozen examples, many of which are quite perfect. The longest appear to have been about 8 cm. in length and the smallest about 4 cm. The width is about 2 cm. The petiole is not preserved in any case. The margin is uniformly serrate. The secondaries are numerous, emerging nearly at a right angle on one side of the leaf and an angle of 20° or 30° on the other, all passing in the upper portion to an angle of about 45°. They are mainly camptodrome, but occasionally one passes directly to the margin.

These leaves undoubtedly belong to Salix and are so close to certain described forms that it is difficult to determine whether or not they should be regarded as new.

Locality.—Mascall beds, Van Horn's ranch and vicinity, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Knowlton and Merriam, July, 1901 (U. S. Nat. Mus., Nos. 8525, 8526).

SALIX sp. ? Knowlton.

Pl. III, fig. 1.

SALIX sp., Knowlton in Merriam, Univ. Cal., Bull. Dept. Geol., Vol. II, No. 9, p. 303. 1901.

A fragment that appears to belong to Salix. It is not sufficient to settle its identity.

Locality.—Three and one-half miles south of Lone Rock. Collected by Merriam's expedition of 1900 (Mus. Univ. Cal., No. 1343).

Family MYRICACEÆ.

MYRICA OREGONIANA n. sp.

Pl. III, fig. 4.

Leaf coriaceous, ovate-lanceolate, very unequal-sided at base, acuminate at apex; margin coarsely toothed, the teeth upward pointing, rather obtuse; petiole short, very strong; midrib strong, perfectly straight; secondaries, some 10 or 12 pairs, thin, arising at an angle of about 45°, straight, ending in the teeth; finer nervation obscure.

The very perfect example figured, with its counterpart, is all thus far detected of this form. It is rather broadly ovate-lanceolate in shape, cordate on one side at base and very oblique on the other side. The apex is acuminate. The length is 3.5 cm. exclusive of the petiole, which is 3 mm. long, and the width is 1.4 cm. The margin is very coarsely toothed.

This species is nearest to *Myrica callicomæfolia* Lesq.,[a] found abundantly at Elko station, Nevada, and Florissant, Colorado. It differs, however, in being relatively much shorter and broader, and in having much larger teeth, which are obtuse rather than flat and acute. The petiole is also relatively shorter and thicker.

Locality.—White hill, one-half mile east of original Van Horn's ranch locality. Collected by Knowlton and Merriam, July, 1901 (U. S. Nat. Mus., No. 8532).

MYRICA? PERSONATA n. sp.

Pl. III, fig. 2.

MYRICA n. sp., Knowlton in Merriam, Univ. Cal., Bull. Dept. Geol., Vol. II, No. 9, p. 290, 1901.

Leaf membranaceous, narrowly lanceolate in shape, wedge-shaped at base and apparently acuminate at apex; margin coarsely and sharply serrate; midrib very thick, straight; secondaries numerous, about 16 or 18 pairs, alternate, emerging at a low to nearly an angle of 45° in the upper portion of the blade, somewhat curving upward and ending in the teeth, occasionally forking before passing to the teeth; nervilles strong, percurrent, at right angles to the secondaries; finer nervation producing rectangular areas.

The example figured unfortunately lacks portions of both base and apex, but it is the only fragment thus far obtained. It was apparently about 8 or 9 cm. long and is exactly 2 cm. wide. It appears wholly unlike anything previously described from this area.

Locality.—One-half mile northeast of Fossil, Gilliam County, Oregon. Collected by Merriam's party of 1900 (type No. 924 in Mus. Univ. Cal.).

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[a] Cret. and Tert. Fl., p. 146, Pl. XXVI, figs. 5-14.

Family JUGLANDACEÆ.

JUGLANS RUGOSA Lesq.

JUGLANS RUGOSA Lesq., Proc. U. S. Nat. Mus., Vol. XI, p. 22, 1888.

Represented by two fragments that are more or less obscure and doubtful. There is also a single fragment obtained by the expedition of the University of California of 1900.

Locality.—Cherry Creek, Crook County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 2489) and by Merriam's party of 1900 (Mus. Univ. Cal., No. 188).

JUGLANS? BENDIREI n. sp.

Pl. III, fig. 3.

Ilex? longifolia Heer. Lesquereux, Proc. U. S. Nat. Mus., Vol. XI, p. 21, 1888.

Leaflet coriaceous in texture, lanceolate, apparently wedge-shaped at base and acuminate at apex; margin irregularly and rather obscurely toothed; midrib very thick, straight; secondaries numerous, rather close, about 20 pairs, alternate, at an angle of about 45°, somewhat arching upward, camptodrome, arching near the margin and each joining the one next above by a thin branch, with their nervilles on the outside passing to the marginal teeth; nervilles numerous, percurrent, at right angles to the secondaries; finer nervation producing a close areolation.

This particular specimen, as noted above, was referred to *Ilex longifolia* Heer, a species from the Miocene of Piedmont, but a comparison with the figure given by Heer shows that it is undoubtedly different. The original seems to have been a much shorter leaf, and while the Oregon specimen resembles it in a general way, there are important differences. The teeth are different, the secondaries more numerous, and the finer nervation is of a totally different character.

The question of the proper generic reference of this leaf or leaflet is an open one. It is not greatly unlike things that have been variously referred to Ilex, Quercus, and Juglans, but on the whole seems to have closest relationship with the latter. It will, however, need more and better material to settle the matter definitely.

Locality.—Cherry Creek, Crook County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 8545, on same stone with 2424).

JUGLANS SCHIMPERI? Lesq.

JUGLANS SCHIMPERI Lesq., Tert. Fl., p. 287, Pl. LVI, figs. 5–10, 1878.

A single example that seems to be identical with this species, yet as the specimen is broken and is the only one, I have preferred to question it.

Locality.—Bridge Creek, Grant County, Oregon. Collected by Merriam's expedition of 1900 (Mus. Univ. Cal., No. 196).

JUGLANS ACUMINATA? Al. Br.

Pl. III, fig. 5.

JUGLANS ACUMINATA? Al. Br., Neues Jahrb., 1845, p. 170.

The Bendire collection contains a single example that was referred by Lesquereux to this species. It does resemble this, but may not be the same.

Locality.—Bridge Creek, Grant County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 3006).

JUGLANS CRYPTATA n. sp.

Pl. VI, figs. 4, 5.

Leaflets membranaceous, broadly lanceolate, narrowed and unequal-sided at base, apparantly acuminate at apex; margin denticulate throughout, the teeth short, rather blunt; midrib very thick; secondaries numerous, 15 or more pairs, thin, alternate, close below, more remote above, mostly camptodrome and sending fine branches from the outside to the teeth; nervilles mainly percurrent and at right angles to the secondaries.

This form is represented by three leaflets, none of which is quite perfect. The largest, which is not figured, was probably about 14 cm. long and is 5 cm. wide at a point evidently some distance above the middle. The one next in size, shown in fig. 4, was 13.5 cm. long and is 3.5 cm. wide. The smallest one, shown in fig. 5, is about 10 cm. long and a little more than 2.5 cm. in width. Neither base nor apex is preserved in any case.

This species appears to find its greatest affinity with *Juglans Crossii* Knowlton,[a] from Green River, Wyoming, and other localities. The leaflets, however, are smaller, relatively narrower, less unequal-sided, and are toothed on both sides.

Locality.—Bridge Creek, Oregon. Collected by Merriam's expedition in 1900. Types in Mus. Univ. Cal., Nos. 2502, 2503.

JUGLANS, nut of.

This is clearly a nut of Juglans, but the specimen is not well enough preserved to permit of specific determination. Lesquereux, through whose hands this specimen once passed, was inclined to identify it doubtfully with *J. troglodytarum* Heer,[b] but it seems best not to venture giving it a name at present.

Locality.—Bridge Creek, Grant County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 8492).

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[a] Cat. Cret. and Tert. Pl. N. A., p. 122, 1888.

[b] Fl. Tert. Helv., Vol. III, p. 92, Pl. CXXVII, fig. 45, 1859.

JUGLANS CRASSIFOLIA n. sp.

Pl. IV, fig. 3.

Juglans n. sp., Knowlton in Merriam, Univ. Cal., Bull. Dept. Geol., Vol. II, No. 9, p. 303, 1901.

Leaflets thick in texture, lanceolate-acuminate in shape, rather abruptly narrowed at base; margin perfectly entire; midrib thick, rather strong; secondaries 9 to 12 pairs, strong, mainly alternate, at an angle of about 45°, much curving upward, camptodrome, passing near the margin and often joining the one next above; finer nervation nearly or quite obsolete.

This species is represented by a large number of leaflets, all more or less broken, preserved in a tangled mass on two or three pieces of matrix. The length is from 9 to 11 cm. and the width about 2.5 cm., with occasionally one somewhat smaller.

The affinity of this species is undoubtedly with certain of the forms of *J. Schimperi* Lesq.,[a] of the Green River group, being of the same size and shape as the figures quoted above, but different in having a less number of secondaries and a distinct finer nervation. These species are closely related and a larger series might show them to be identical.

Locality.—Three and one-half miles south of Lone Rock, Gilliam County, Oregon. Collected by Merriam's expedition of 1900 (Mus. Univ. Cal., Nos. 1326–1331).

JUGLANS OREGONIANA Lesq.

JUGLANS OREGONIANA Lesq., Foss. Pl. Aurif. Gravel, p. 35, Pl. IX, fig. 10, 1878.

Rhus Bendirei Lesq., Proc. U. S. Nat. Mus., Vol. XI, p. 15, 1888. (The small leaflet described.)

Juglans hesperia Knowlton, Eighteenth Ann. Rept. U. S. Geol. Survey, Pt. III, p. 723, Pl. XCIX, fig. 8, 1898.

This species was described by Lesquereux in his Flora of the Auriferous Gravels. As to the locality whence the type specimen came he says: "On soft laminated clay with *Aralia Whitneyi*, evidently of the same age as the Chalk Bluffs of California, without definite locality but Oregon." From these remarks it has been assumed that the specimen actually was from the Auriferous gravels, and that the label on it was wrong. Fortunately this type is preserved in the paleontological collection of the University of California (No. 1798), where I recently had opportunity of seeing it. It was at once seen that it was on the characteristic matrix of the Van Horn's ranch locality, and indeed the obscure labeling on the back of the specimen so indicates.

In both the older and more recent collections from Van Horn's ranch and vicinity I find a number of specimens, which I refer with

[a] Tert. Fl., p. 287, Pl. LVI, fig. 6, 1878.

little hesitation to *Juglans oregoniana*. Most of them are smaller than the type, being often only 7 cm. long and 2.5 cm. wide, although occasionally there is one that approaches it in size. In shape, marginal teeth, and nervation they are practically identical.

In 1888 Lesquereux[a] established his *Rhus Bendirei* on two specimens, one of which is figured and is to be taken as the type of the species. Regarding the other he says: "To these I refer a small oblong-lanceolate leaflet, rounded in narrowing rapidly to the point of attachment, very short petioled, with small teeth and areolation identical." This specimen (U. S. Nat. Mus., No. 2582) is identical with certain of the smaller leaflets of *Juglans oregoniana*, and is referred to it.

In my paper on the plants of the Payette formation of Idaho I ventured to describe,[b] under the name of *Juglans hesperia*, a fine, large leaflet. Attention was called at the time to the fact that it was very close to, if not identical with, *Juglans oregoniana*. Since that time I have again gone over the Payette material and have decided that the differences are not sufficient to warrant keeping them separate.

Locality.—Van Horn's ranch, about 12 miles west of Mount Vernon, Grant County, Oregon. Type in Mus. Univ. Cal. collected by C. D. Voy. Obtained by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 2582), Merriam's expedition of 1900 (Mus. Univ. Cal., No. 891), and by Knowlton and Merriam, July, 1901 (U. S. Nat. Mus., Nos. 9049, 9050, 9054). One mile northeast of Belshaw's ranch. Collected by Knowlton and Merriam, July, 1901 (U. S. Nat. Mus., Nos. 9043–9048). Two miles southeast of Marsh post-office, Boise County, Idaho (U. S. Nat. Mus., No. 8290).

HICORIA? OREGONIANA n. sp.

Pl. V, figs. 3, 4.

HICORIA n. sp., Knowlton in Merriam, Univ. Cal., Bull. Dept. Geol., Vol. II, No. 9, p. 289, 1901.

Leaflets subcoriaceous in texture, ovate-lanceolate, obtusely wedge-shaped and slightly unequal-sided at base, acuminate at apex; margin finely serrate, the teeth short, sharp; midrib thin, straight; secondaries numerous, about fifteen pairs, alternate and at somewhat irregular distances, thin, arising at various angles (45°±) and considerably arching upward, craspedodrome, ending in the marginal teeth; nervilles numerous, thin, percurrent, about at right angles to the secondaries; finer nervation perfect, forming a fine, irregular network.

This is represented at present by two examples. One is 13 cm. long and 6 cm. wide, and the other is 12 cm. long and 5 cm. wide.

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[a] Proc. U. S. Nat. Mus., Vol. XI, p. 15, Pl. IX, fig. 2.

[b] Eighteenth Ann. Rept. U. S. Geol. Survey, Pt. III, p. 723, Pl. XCIX, fig. 8, 1898.

Locality.—Cherry Creek, Crook County, Oregon, collected by Merriam's expedition in 1900 (type in Mus. Univ. Cal., No. 172. Additional specimen, No. 190).

HICORIA sp?

Pl. V, fig. 2.

The single fragment figured is all that was found of this form. Lesquereux would call it *Hicoria* (*Carya*) *elænoides* (Ung.) Knowlton, but it seems too small a fragment on which to base a specific determination.

Locality.—Bridge Creek, Grant County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 2978).

HICORIA ELÆNOIDES (Unger) Knowlton.

HICORIA ELÆNOIDES (Unger) Knowlton, Cat. Cret. and Tert. Pl. N. A., p. 117, 1898.
Carya elænoides (Unger) Heer. Lesquereux, Proc. U. S. Nat. Mus., Vol. XI, p. 18, 1888.

A single example that may be this species. It is oblong in shape, 2.25 cm. in long, and 1.5 cm. in short, diameter.

Locality.—Van Horn's ranch, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 2446).

Family BETULACEÆ.

CARPINUS BETULOIDES Unger.

CARPINUS BETULOIDES Unger.

Locality.—Bridge Creek, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 8487).

CARPINUS GRANDIS? Unger.

CARPINUS GRANDIS Unger. Lesquereux, Proc. U. S. Nat. Mus., Vol. XI, p. 18, 1888.
Carpinus pyramidalis (Göpp.) Heer. Lesquereux, idem, p. 18, 1888.

The collection contains two specimens that are referred as above by Lesquereux, but they are rather obscure, one being without margin, and I have hesitated to recognize these species. They agree fairly well with *C. grandis* and may stand under this species until further material can be obtained.

Locality.—Mascall beds, Van Horn's ranch, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., Nos. 2439, 2440).

CORYLUS MACQUARRII (Forbes) Heer.

CORYLUS MACQUARRII (Forbes) Heer, Urwelt d. Schweitz, p. 321, 1865; Fl. Foss. Alask., Pl. IV, figs. 1–8, 1869; Newberry, Later Extinct Floras, Pl. XLVIII, fig. 4, 1898.

Among the large amount of material from Bridge Creek, I have seen but two imperfect examples that should be referred to this species.

One of these was figured by Newberry in his Later Extinct Floras (Pl. XLVIII, fig. 4) and the original is preserved in the United States National Museum (No. 7076), but no mention is made of the fact in the body of that work, although this information is given on the back of the specimen itself.

The other example was detected among the recent collections made by the University of California and is in its museum. Both of these specimens agree perfectly with the figures of this species given by Heer in his Flora Fossilis Alaskana (Pl. IV). There can be no question of their identity.

Locality.—Bridge Creek, Oregon. Collected by Rev. Thomas Condon (U. S. Nat. Mus., No. 7076) and by V. C. Osmont (Mus. Univ. Cal., No. 2504).

BETULA HETEROMORPHA n. sp.

Pl. III, figs. 6, 7; Pl. V, fig. 1.

Populus polymorpha Newb., in part, Proc. U. S. Nat. Mus., Vol. V, p. 506, 1883; Later Extinct Floras, p. 50, Pl. XLVI, fig, 3; Pl. XLVII, figs. 4, 8; Pl. XLIX, fig. 4, 1898 (not other figures).

Leaves of firm or subcoriaceous texture, ovate, elliptical, or very slightly elliptical-obovate in general outline, from very obtusely wedge-shaped to truncate or obscurely heart-shaped, and often unequal-sided base, obtusely acuminate at apex; petiole usually strong, one-half or less the length of the blade; margin usually coarsely and unequally dentate or sometimes doubly dentate, the teeth mainly obtuse, occasionally acute; midrib rather thick, especially in the lower part of the blade; secondaries 7 to 9 pairs, usually strong, the two or three lower pairs close together and at a lower angle than the others; upper ones at an angle of about 45°, often spreading and slightly curved downward, all craspedodrome and ending in the large teeth, and often with several branches on the lower side which pass to smaller teeth; nervilles numerous and strong, both percurrent and broken, approximately at right angles to the secondaries; finer nervation producing an irregular areolation.

This form is the most abundant one in the collections and is represented by hundreds of examples. They are in general small leaves, ranging in length from 4.5 to 7 cm., and average length being about 5 cm. In width they range from 2.5 to 5 cm., the average being perhaps a little more than 3 cm. Only occasionally is one noted that is a little smaller than the above dimensions (cf. Newberry, Later Extinct Floras, Pl. XLIX, fig. 4). The variation in shape, margin, etc., is well shown in the figures quoted and in the examples here figured.

It is with much hesitation that I venture to found this species; not, indeed, from lack of sufficient material, but rather from embarrassment of riches. Lesquereux, through whose hands much of this material has passed, would separate them not only into many species

but into several genera (Quercus, Alnus, Betula, Carpinus, etc.), while Newberry, judging from what he actually did, would combine them all under his *Populus polymorpha*. I can not believe that they belong to Populus. The only living species with which it is reasonable to compare them is *Populus alba*, which has, it is true, very variable leaves, but they seem of a different type and generically unlike the ones under consideration. I have, therefore, broken up Newberry's *Populus polymorpha*, placing certain of them under this form. If Newberry's elastic species was maintained it would be polymorphous enough to include them all, but I do not think it will adequately represent the facts to do so.

In regard to Lesquereux's point of view, it may be said that if extreme examples were selected it might seem logical to call them species, but when the whole are grouped together it is found absolutely impossible to draw any satisfactory line between them. Take, for example, the question of shape. The narrowest possible form may be unlike the broadest form, yet every step between them can be found. So, also, from the specimens with a wedge-shaped base to those with a a truncate base, and still farther to those with a markedly inæquilateral base, there are gradual steps. In the matter of nervation, however, there are only comparativelyslight differences, yet even here the variations are all connected.

The form most nearly related to this is *B. heterodonta* Newb., from which it is sometimes almost impossible to separate it. In general, the latter species has much larger leaves, with coarser toothed margins and a more markedly inaequilateral base. Yet these differences come so near breaking down that it is sometimes difficult to say where a particular specimen shall go.

Locality.—Bridge Creek, Oregon. Found abundantly in all collections (U. S. Nat. Mus., Nos. 8481, 8482).

BETULA HETERODONTA Newb.

BETULA HETERODONTA Newb., Proc. U. S. Nat. Mus., Vol. V, p. 508, 1883; Later Extinct Floras, p. 64, Pl. XLVI, figs. 1–4; Pl. XLV, figs. 1, 6, 1898.

As stated under the preceding species, it is almost impossible to distinguish certain of the forms of this species from that.

Locality.—Bridge Creek, Oregon. Collected by Rev. Thomas Condon (U. S. Nat. Mus., No. 7071) and Maj. Charles E. Bendire (U. S. Nat. Mus., No. 8483).

BETULA BENDIREI n. sp.

Pl. IV, fig. 2.

Leaf membranaceous in texture, nearly circular in outline, abruptly rounded below to a nearly truncate base, rounded similarly above to

a very short obtusely acuminate apex; margin rather coarsely toothed, most of the teeth, but especially those on the lower half of the blade, with several smaller teeth; midrib rather thick, straight; secondaries about 9 pairs, opposite below, becoming subopposite above, the two lower pairs emerging at an angle of about 20°, others about 45°, all craspedodrome and ending in the large teeth, often with one or two branches on the lower side, which pass to smaller teeth; nervilles thin, mainly percurrent and oblique to the secondaries; finer nervation producing a minute network.

I have ventured to describe this species on the single example figured. It is a little more than 4.5 cm. in length and is 4 cm. in width. As may be seen, it is a very perfect and symmetrical leaf, nearly circular in outline, with rather coarsely, doubly dentate margins.

Among living forms this is perhaps closest to *Betula occidentalis* Hooker, which is now found in the same general region. It has the same shape and nervation, but differs slightly in the marginal dentation. It is also quite similar, except as regards the margin, to certain forms of *B. papyrifera* Marshall.

Among fossil forms it has a number of evident affinities. From *B. heteromorpha* it differs in being nearly circular in shape, with an equal base and regularly spaced secondaries.

Locality.—Bridge Creek, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 8485).

BETULA ANGUSTIFOLIA Newb.

BETULA ANGUSTIFOLIA Newb., Proc. U. S. Nat. Mus., Vol. V, p. 508; Later Extinct Floras, p. 63, Pl. XLVI, fig. 5; Pl. XLVII, fig. 5, 1898.

A large number of leaves of this species are present in every collection from this locality.

Locality.—Bridge Creek, Oregon. Collected by Rev. Thomas Condon (Types, U. S. Nat. Mus., Nos. 7074, 7075).

BETULA? DAYANA, n. sp.

Pl. IV, fig. 4.

Leaf small, membranaceous, ovate-cordate, obtuse at apex; margin very coarsely toothed; midrib thin; secondaries thin and obscure, about four pairs, alternate, ending in the larger teeth; finer nervation producing a very fine network.

A single leaf only. The length is 2 cm. and the width 1.5 cm.

Locality.—Mascall beds, Van Horn's ranch, Oregon, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Knowlton and Merriam, July, 1901 (U. S. Nat. Mus., No. 8535).

ALNUS CARPINOIDES Lesq.

ALNUS CARPINOIDES Lesq., Cret. and Tert. Fl., p. 243, Pl. L, fig. 11; Pl. LI, figs. 4, 4ª, 5, 1883.

All collections from Bridge Creek contain a large number of leaves of this species, which has been well described and figured by Lesquereux.

Locality.—Bridge Creek (types in Mus. Univ. Cal., No. 1759, figs. 4, 4ª; 1764, fig. 5). One and one-half miles east of Clarnos Ferry. Collected by Merriam's expedition of 1900 (Mus. Univ. Cal., Nos. 931.) One-half mile northeast of Fossil. Collected by Merriam's expedition of 1900 (Mus. Univ. Cal., Nos. 923, 928).

ALNUS SERRULATA FOSSILIS Newb.

ALNUS SERRULATA FOSSILIS Newb., Later Extinct Floras, p. 66, Pl. XLVI, fig. 6, 1898.

The example figured by Newberry as the type is the only one that has thus far been found, with the exception of a single somewhat doubtful example obtained by the University of California.

Locality.—Bridge Creek, Grant County, Oregon. Collected by Rev. Thomas Condon (U. S. Nat. Mus., No. 7091).

ALNUS MACRODONTA, n. sp.

Pl. IV, fig. 1.

Leaf of firm texture, ovate-cordate in shape, abruptly rounded below to a heart-shaped base and narrowed above to an apparently obtusely acuminate apex; margin coarsely and irregularly dentate, the teeth all obtuse; midrib thick, especially in the lower half of the blade; secondaries about 9 pairs, the two lower pairs sub-opposite and at a right angle, other secondaries at varying angles and distances, all more or less curving upward, craspedodrome and often with several branches in the lower side, which pass to marginal teeth; nervilles numerous and prominent, usually percurrent and rather oblique to the secondaries; finer nervation producing a copious, irregularly quadrangular network.

This species is based on the single example figured. It lacks, as may be seen, a considerable portion of one side and all of the apex. It is broadly ovate, with abruptly truncate, heart-shaped base and coarsely dentate margin. The length was about 7 cm. and the width about 5.5 cm.

Locality.—Bridge Creek, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 8551).

ALNUS sp?, fruit of, Newb.

ALNUS sp?, fruit of, Newb., Later Extinct Floras, p. 67, Pl. XLVI, fig. 7, 1898.

Locality.—Bridge Creek, Grant County, Oregon. Collected by Rev. Thomas Condon (U. S. Nat. Mus., No. 7093).

ALNUS KEFERSTEINII? (Göpp.) Unger.

ALNUS KEFERSTEINII (Göpp.) Unger. Lesquereux, Proc. U. S. Nat. Mus., Vol. XI, p. 18, 1888.

A single example having no portion of the margin preserved. It is referred with hesitation to this species.

Locality.—Van Horn's ranch, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 2419).

Family FAGACEÆ.

FAGUS? sp.

FAGUS CASTANEÆFOLIA Unger. Lesquereux, Proc. U. S. Nat. Mus., Vol. XI, p. 18, 1888.

This determination was based on a single fragment of the lower portion of a leaf. It is doubtful even whether it belongs to Fagus, and can have no value in fixing the age of or affording a stratigraphic mark for these beds.

Locality.—Van Horn's ranch, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 2466).

QUERCUS FURCINERVIS AMERICANA Knowlton.

QUERCUS FURCINERVIS AMERICANA Knowlton, Cat. Cret. and Tert. Pl. N. A., p. 192, 1898.

Quercus furcinervis (Rossm.) Ung. Lesquereux, Proc. U. S. Nat. Mus., Vol. XI, p. 22, 1888.

This is not the European form, and is best indicated by the varietal name given above. This determination is based solely on a part of the middle portion of a single leaf, which is very similar indeed to *Castanea pulchella* Knowlton[a] from Lower Miocene beds in the Yellowstone National Park.

Locality.—Cherry Creek, Crook County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 2554).

QUERCUS? sp.

Pl. VIII, fig. 4.

Leaf very thick, narrowly obovate, obtusely wedge-shaped at base (apex destroyed); margin entire below, probably toothed above; midrib very thick, especially below, secondaries also strong, 6 or 7 pairs, alternate at an angle of about 45°, a pair near the middle of the blade largest, with strong outside branches, probably ending in lobes or teeth; nervilles very strong and deeply impressed, both broken and percurrent; finer venation producing large areas.

[a] Mon U. S. Geol. Survey, Vol. XXXII, Pt. II, p. 702, Pl. LXXXVII, fig. 1.

A single broken specimen is all that I now refer to this form. It was clearly a large thick leaf, with prominent deeply impressed nervation. It is entire in the lower portion, but from the size and disposition of the secondaries in the middle of the blade it was apparently lobed or toothed above. Its length was about 12 cm. and the width about 6.5 cm. It is doubtfully referred to Quercus.

Locality.—Cherry Creek, Crook County, Oregon. Collected by Knowlton and Merriam, July, 1901 (U. S. Nat. Mus., No. 8555).

QUERCUS PAUCIDENTATA Newb.

QUERCUS PAUCIDENTATA Newb., Proc. U. S. Nat. Mus., Vol. V, p. 505, 1883; Later Extinct Floras, p. 76, Pl. XLIII, fig. 1, 1898.

It is with some misgiving that this species is permitted to stand. It is based, as Newberry says, on a single example, the only one ever found. It is in all probability a large leaf of *Q. affinis*, but rather than complicate matters by combining forms without sufficient material I have preferred to keep it distinct.

Locality.—Bridge Creek, Grant County, Oregon. Collected by Rev. Thomas Condon (U. S. Nat. Mus., No. 7059).

QUERCUS DRYMEJA Unger.

QUERCUS DRYMEJA Unger. Lesquereux, Cret. and Tert. Fl., p. 245. Pl. LIV, fig. 4, 1883.

Lesquereux has figured a single leaf of this form, and the Bendire collection contains another example. Neither of these is perfectly preserved, but they seem to differ from other allied forms. It may be, however, that they are very large leaves of *Q. consimilis* Newb.

Locality.—Bridge Creek, Grant County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., Nos. 9231, 9328).

QUERCUS SIMPLEX Newb.

QUERCUS SIMPLEX Newb., Proc. U. S. Nat. Mus., Vol. V., p. 505, 1883; Later Extinct Floras, p. 78, Pl. XLIII, fig. 6, 1898.

As stated by Newberry the collections from Bridge Creek always contain a large number of leaves of this species. They are of the same size and shape as leaves of *Q. consimilis*, and only differ in being entire margined, and Newberry questioned as to whether they might not be only a varietal form of that species. As none of the specimens that have passed under my observation show any such gradation, it may be taken as established that they are distinct.

Locality.—Bridge Creek, Grant County, Oregon, collected by Rev. Thomas Condon (U. S. Nat. Mus., No. 7058a) and Maj. Charles E. Bendire (U. S. Nat. Mus., Nos. 9219, 9227, 9238, 9249, 9252, 9264, 9283, 9289, 9295, 9300, 9302, 9312, 9316, 9332, 9336, 9369, 9380, 9383). Officer's ranch, lower end of Butler Basin. Collected by Dr. John C. Merriam, July 22, 1901 (U. S. Nat. Mus., No. 9210).

QUERCUS AFFINIS (Newb.) n. comb.

Fraxinus affinis Newb., Proc. U. S. Nat. Mus., Vol. V, p. 510, 1883; Later Extinct Floras, p. 127, Vol. XLIX, fig. 5, 1898 (1899).

Quercus furcinervis Rossm. Lesquereux, Cret. and Tert. Fl., p. 244, Pl. LIII, figs. 10–12, 1883.

Quercus Breweri Lesq., idem, p. 246, Pl. LIV, fig. 9 (not other figures described as *Q. Breweri*) 1883.

This species came first into the hands of Dr. Newberry and was called by him *Fraxinus affinis*. He appears to have noticed only a single example, namely, the one made the type, yet there is a larger leaf on the same piece of matrix. A little later a number of similar leaves from the same locality were studied by Lesquereux and by him identified with *Quercus furcinervis* of Rossmassler, and his own *Q. Breweri* (See synonymy above).

As Newberry well states, there is a strong resemblance between his leaf and the living *Fraxinus americana*, yet in placing it by the side of the figures given by Lesquereux there can be no doubt that only one species is represented, and moreover that this is much more like Quercus than Fraxinus. This view is further strengthened by the finding of additional leaves in later collections. It is therefore clear to my mind that they are oak leaves, and I have placed them under Quercus.

It now remains to explain the selection of the specific name for these leaves. Newberry's *Fraxinus affinis* was published March 21, 1883, whereas Lesquereux's volume, as pointed out on page 12, could not have been issued until late in 1883 or more probably not until sometime in 1884. Newberry, therefore, clearly has priority. Now, if either of Lesquereux's references of these leaves to species of Quercus was valid, it would simply be necessary to transfer *Fraxinus affinis* to the one selected, but in my opinion they are not. I do not think that the leaves referred to *Quercus furcinervis*[a] are the same as Rossmassler's species, and, obviously, the leaf called *Quercus Breweri*[b] is not the same as the others with which it is associated, and is identical with the one on the preceding plate. On these grounds I have retained Newberry's specific name because it is the oldest, and I have placed them under Quercus because I consider them to be oak leaves.

Locality.—Bridge Creek, Grant County, Oregon. Collected by Rev. Thomas Condon (U. S. Nat. Mus. No. 7125). Type of fig. 9, op. cit., is in Mus. Univ. Cal., No. 1774.

QUERCUS CONSIMILIS Newb.

QUERCUS CONSIMILIS Newb., Proc. U. S. Nat. Mus., Vol. V, p. 505, 1883; Later Extinct Floras, p. 71, Pl. XLIII, figs. 2–5, 7–10, 1898.

This species is very abundant in the collections from Bridge Creek, and is well characterized and figured by Newberry. It is closely allied

[a] Lesquereux, Cret. and Tert. Fl., Pl. LIII, figs. 10–12.
[b] Idem, Pl. LIV, fig. 9.

to *Q. Breweri* Lesq., but can be readily distinguished by being shorter and relatively much broader.

A single broken leaf was found by Merriam at Officer's ranch, in the lower end of Butler Basin.

Locality.—Bridge Creek, Grant County, Oregon. Collected by Rev. Thomas Condon (U. S. Nat. Mus., Nos. 7048, 7050, 7057, 7063, 7070) and Maj. Charles E. Bendire (U. S. Nat. Mus., Nos. 9230, 9235, 9239, 9247, 9251, 9259, 9261, 9271, 9276, 9280, 9282, 9287, 9305, 9311, 9321, 9329, 9333, 9337, 9342, 9344, 9347, 9351, 9362). Officer's ranch, lower end of Butler Basin. Collected by Merriam, July 22, 1901 (U. S. Nat. Mus., No. 9209).

Quercus Breweri Lesq.

Quercus Breweri Lesq., Cret. and Tert. Fl., p. 246, Pl. LIV, figs. 5–8 (non fig. 9), 1883.

Some years ago, when preparing the manuscript for my Catalogue of the Cretaceous and Tertiary Plants of North America, I was led from a casual examination of the figures to refer this species to *Q. consimilis* Newb. and *Q. paucidentata* Newb. Since that time I have found the long narrow leaves of *Q. Breweri* in the vicinity of Ashland, Oregon, and I have also gone carefully over the abundant material from Bridge Creek, which contains a number of finely preserved leaves, and I am now inclined to regard them as distinct from *Q. consimilis*. They are undoubtedly close to this species, yet differ in being much longer and narrower. They can be readily distinguished. I have seen and examined the types of this species in the University of California, and I am the more convinced that it is distinct.

Locality.—Bridge Creek, Grant County, Oregon. Collected by Rev. Thomas Condon (U. S. Nat. Mus., No. 9345), by Maj. Charles E. Bendire (U. S. Nat. Mus., Nos. 9218, 9224, 9277, 9294, 9322, 9331, 9345, 9352), and by F. H. Knowlton. Types in Mus. Univ. Cal., Nos. 1761, 1762, 1763.

Quercus pseudo-alnus Ettingshausen.

Quercus pseudo-alnus Ettingshausen. Lesquereux, Cret. and Tert. Fl., p. 244, Pl. LIII, figs. 1–7, 1883.

Populus polymorpha Newb., in part. Later Extinct Floras, p. 50, Pl. XLIX, fig. 7, 1898.

Under the above name Lesquereux has figured a number of leaves from Bridge Creek. They differ considerably among themselves, yet may well belong to a single polymorphous species. Nearly all the forms are abundant in any collection from this locality.

The leaf figured by Newberry as *Populus polymorpha* (loc. cit., fig. 4) is certainly the same as fig. 6 of Pl. LIII in the Cretaceous and Tertiary Flora, and I have placed it under this species as determined by Lesquereux. It is one of the most abundant forms in all collections.

Locality.—Bridge Creek, Oregon. Collected by Rev. Thomas Condon (U. S. Nat. Mus., No. 7051) and Maj. Charles E. Bendire (U. S. Nat. Mus., Nos. 9229, 9250, 9253, 9266, 9274, 9292, 9307, 9309, 9317, 9319, 9326, 9334, 9343, 9355, 9358, 9365, 9368, 9372, 9374). Types of original American figured specimens in Mus. Univ. Cal., fig. 1, No. 1767; fig. 2, No. 1768; fig. 3, No. 1769; fig. 4, No. 1770; fig. 5, No. 1771; fig. 6, No. 1772; fig. 7, No. 1773. Officer's ranch, lower end of Butler Basin. Collected by Dr. John C. Merriam, July 22, 1901 (U. S. Nat. Mus., No. 9204).

QUERCUS OREGONIANA, n. sp.

Pl. VI, figs. 2, 3; Pl. VII, fig. 1.

QUERCUS, n. sp., Knowlton in Merriam, Univ. Cal., Bull. Dept. Geol., Vol. II, No. 9, p. 288, 1901.

Populus polymorpha Newb., in part. Proc. U. S. Nat. Mus., Vol. V, p. 506; Later Extinct Floras, p. 50, Pl. XLVI, fig. 4 (not the other figures of *P. polymorpha*).

Leaf membranaceous in texture, elliptical-ovate or slightly elliptical-obovate in shape, rather abruptly rounded at base, obtusely acuminate at apex; margin coarsely and irregularly toothed, the teeth rounded or somewhat acute (petiole not preserved); midrib rather slender, perfectly straight; secondaries 8 or 9 pairs, alternate, arising at an angle of 45° or 50°, nearly straight, ending in the larger marginal teeth, often with one or two branches on the lower side, which also pass to the marginal teeth; the secondaries in the lower part of the blade closer than those above and at a less angle; nervilles numerous, percurrent or broken, approximately at right angles to the secondaries; finer nervation producing a close, irregularly quadrangular network.

This species is based on two examples, one of which (Pl. VI, fig. 2) is the original of one of Newberry's types of *Populus polymorpha*, and the other (Pl. VII, fig. 1) a smaller specimen that was identified by Lesquereux as *Carpinus betuloides* Unger. The leaves are about 6 cm. in length and 4 cm. in width. The first-mentioned example is nearly perfect, lacking only the petiole, while the other lacks all of the basal portion. The drawing given in Newberry's Later Extinct Floras is not quite correct as regards the form, the teeth being uniformly rounded, and the nervation is only partially shown. The other example has never before been figured.

I am moved to take this leaf from Newberry's polymorphic aggregation for two reasons: First, because it differs from the other forms included under *P. polymorpha;* and, second, because I can not believe that it belongs with the genus Populus. It has much more the appearance and general facies of a Quercus, and for these reasons has been removed.

Locality.—Bridge Creek, Oregon. Collected by Rev. Thomas Condon (U. S. Nat. Mus., No. 7049) and Maj. Charles E. Bendire (U. S. Nat. Mus., No. 8484).

QUERCUS PSEUDO-LYRATA Lesq.

QUERCUS PSEUDO-LYRATA Lesq., Foss. Pl. Aurif. Gravel, p. 8, Pl. II, figs. 1, 2, 1878; Proc. U. S. Nat. Mus. Vol. XI, p. 17, Pl. X, fig. 1, 1888; Knowlton, Univ. Cal., Bull. Dept. Geol., Vol. II, No. 9, p. 308, 1901.

Quercus pseudo-lyrata acutiloba Lesq., Proc. U. S. Nat. Mus., Vol. XI, p. 17, Pl. XI, fig. 1, 1878.

Quercus pseudo-lyrata brevifolia Lesq., idem, p. 18, Pl. X, fig. 2.

Quercus pseudo-lyrata latifolia Lesq., idem, p. 18, Pl. XII, fig. 1.

Quercus pseudo-lyrata obtusiloba Lesq., idem, p. 18, Pl. X, fig. 3.

This species was originally described and figured by Lesquereux in his Fossil Plants of the Auriferous Gravel (p. 8, Pl. II, figs. 1, 2). After the description he has the following to say regarding the locality:

> The locality is unknown, or at least not marked in the catalogue of the labels. The matrix of the specimens is a white, soft clay like that of the Chalk Bluffs of Nevada County, California, and no other species is preserved upon them except a fragment of a leaf apparently referable to *Castanea intermedia* Lesq. These specimens are evidently from the same formation and age as those of the Chalk Bluffs.

Both of the type specimens on which Lesquereux based his description and the above statement are preserved in the Paleontological Collection of the University of California (Nos. 1796 and 1796a), where I recently had the opportunity of examining them. A glance at the matrix was sufficient to show that they came from Van Horn's ranch, John Day Valley, Oregon. They form a part of the original Voy collection, made about thirty years ago, which fact is recorded on the back of each speciman. The matrix, mistaken by Lesquereux for a white, soft clay, is made up of very fine spicules of glass of volcanic origin, and is unmistakably that of the Van Horn's ranch locality. From this it appears that *Quercus pseudo-lyrata* was not originally, and, so far as now known, has never been found in California, or indeed outside of the John Day Basin. These facts are of great importance, since this characteristic species was relied upon to establish the correlation between the Auriferous gravels and the Van Horn's ranch deposits.

I have before me all of the type and duplicate material, belonging to the United States National Museum, on which Lesquereux based the above enumerated varieties of this species, as well as the material obtained by Dr. John C. Merriam in 1900 for the University of California, and by myself in 1901. This comprises fully one hundred more or less perfect examples. There are, it is true, slight differences between the various forms, but I am now quite convinced that they are only individual variations, such as may be noted in the leaves of many species of living oaks. I have placed all these leaves in a single series and have found it quite impossible to draw any satisfactory line between them. They have consequently been referred to the single original form.

Locality.—Van Horn's ranch and vicinity, on South Fork of John Day River, 12 miles west of Mount Vernon, Grant County, Oregon. Collected originally by C. D. Voy (Univ. Cal., Nos. 1796, 1796a). Since collected by Maj. Charles E. Bendire (U. S. Nat. Mus., Nos. 2565, 2566, 2568, 2569, 2570), Dr. John C. Merriam in 1900 (Mus. Univ. Cal., Nos. 838, 839, 841, 842, 843, 844, 847a, 849, 852, 859, 865, 872), and by F. H. Knowlton, in July, 1901 (U. S. Nat. Mus., Nos. 8999–9015).

QUERCUS MERRIAMI n. sp.

Pl. VI, figs. 6, 7; Pl. VII, figs. 4, 5.

QUERCUS n. sp., Knowlton in Merriam, Univ. Cal., Bull. Dept. Geol., Vol. II, No. 9, p. 308, 1901.

Quercus pseudo-lyrata angustiloba Lesq., Proc. U. S. Nat. Mus., Vol. XI, p. 17, Pl. XI, fig. 2, 1888.

Leaves coriaceous in texture, narrowly lanceolate in outline, wedge-shaped at base, slenderly acuminate at apex; provided with 4 or 5 pairs of alternate or subopposite lobes, which are deltoid or deltoid-lanceolate in shape, usually sharp-pointed, but occasionally with the basal ones obtuse and rounded; petiole very long and slender; midrib moderately strong; secondaries usually at an acute angle, as many as the lobes and ending in their apices; intermediate secondaries few, apparently craspedodrome; finer nervation not well retained.

This species is now represented by more than twenty-five more or less perfect examples. The one shown in Pl. VII, fig. 4, was figured by Lesquereux under the name of *Quercus pseudo-lyrata angustiloba.*[a] As shown in Lesquereux's figure, it appears to lack the basal portion with the petiole, but this was covered by matrix, which has now been removed, exposing the long, slender petiole. The other specimens figured, as well as all but one or two of those now known, were obtained in 1901.

The first-mentioned example (Pl. VI, fig. 6) is about 14 cm. long, including the petiole, which is fully 4 cm. long. At the widest point between the lobes it is only a little over 3 cm., while at the narrowest point, which is near the middle of the blade, it is considerably less than 1 cm. The still larger example, shown in fig. 6, must have been 15 or 16 cm. long and 6 cm. broad between the points of the lobes. At the narrowest point it is about 2 cm. One of the smallest leaves is shown in Pl. VI, fig. 6. It is 9.5 cm. long, including the petiole of about 1.5 cm. in length. The broadest portion between the lobes is 2 cm., and the narrowest only 7 mm. in width.

The specimens representing this species are intimately associated with the numerous leaves of typical *Q. pseudo-lyrata*, and it is hardly

[a] This varietal name can not be retained, as it is preoccupied by *Quercus angustiloba* Al. Br., in Ludgw. Palæontogr., Vol. VIII, p. 103, Pl. XXXVI, fig. 3, 1861.

to be wondered that Lesquereux, with only a single example before him, should regard it as an extremely narrow form of that species. But with the fine series now at hand it is clear that it is very distinct.

Among living species this form is certainly suggestive of *Quercus heterophylla* Michx. f., the so-called Bartram oak, which is supposed to be a hybrid between *Q. phellos* and *Q. rubra*. This resemblance may be only superficial, but it is nevertheless plain.

I take pleasure in naming this species in honor of Dr. John C. Merriam, of the Univerity of California.

Locality.—Van Horn's ranch and the two other near-by localities, 12 miles west of Mount Vernon, Grant County, Oregon. Type of fig. 4 collected by Major Bendire (U. S. Nat. Mus., No. 8505). Types of other figures collected by Knowlton and Merriam, July, 1901 (U. S. Nat. Mus., Nos. 8506, 8507). Type of fig. 7 collected by Merriam's expedition of 1900 (Mus. Univ. Cal., No. 846).

QUERCUS DURIUSCULA n. sp.

Pl. VIII, fig. 2.

Leaf coriaceous in texture, broadly obovate in general outline, deeply lyrate-pinnatifid into about five lobes, of which the basal are very small, triangular, and obtuse, the other broad, rounded, with deeply undulate or toothed lobes; midrib strong; secondaries three pairs, alternate, ending in the principal lobes, the upper ones with strong branches passing to the smaller lobes; finer nervation not well retained.

Unfortunately only one example of this form was found, and even this lacks a small portion of the base and has the upper lobes somewhat injured, evidently before fossilization. The length was about 5.5 cm. and the greatest width about 5 cm. The two basal lobes are less than 1 cm. in length. The outline and such details of nervation as are preserved are well shown in the figure.

This leaf clearly belongs to the white-oak group, and apparently finds its greatest affinity with *Quercus minor* (Marsh.) Sargent, the well-known post, or iron, oak, a species now common over much of the region east of the Rocky Mountains south of Massachusetts. It is so close to this species, in fact, that it can hardly be distinguished from many of the smaller leaves. It would therefore seem beyond question that the living *Q. minor* is a direct descendant of this fossil form, if, indeed, it has not remained practically unchanged from the time the Mascall beds were laid down to the present day.

Locality.—White hill one-half mile east of original Van Horn's ranch locality, 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Knowlton and Merriam, July, 1901 (U. S. Nat. Mus., No. 8508).

QUERCUS URSINA n. sp.

Pl. VII, figs. 2, 3.

QUERCUS n. sp., Knowlton in Merriam, Univ. Cal., Bull. Dept. Geol., Vol. II, No. 9, p. 308, 1901.

Leaves coriaceous in texture, roughly obovate in general outline, 5 to 7 lobed, the lobes triangular or triangular-ovate in shape, very acute and apparently bristle-tipped; petiole long, relatively strong; nervation consisting of a strong midrib and as many alternate, rather thin secondaries as there are lobes; finer nervation not fully preserved.

This species is represented by several very well-preserved leaves. They are small leaves, about 4.5 cm. long, exclusive of the petiole, and about 4.5 cm. broad. The petiole is fully 1.5 cm. in length. The lobes, usually about 6 in number, are mainly triangular in shape, and are entire or occasionally with a single small sharp tooth, as shown in Pl. VII, fig. 2.

This species, so far as I am able to determine, finds its closest affinity among living species with *Quercus nana* (Marsh.) Sargent, the bear or scrub oak of the Eastern United States. The fossil form has a longer petiole, but otherwise the shape is very similar to certain of the smaller leaves of this species.

It is barely possible that these leaves may be only small forms of the polymorphous *Quercus pseudo-lyrata*, but I do not at present think so, for out of more than a hundred examples of the latter species there are no forms that can well be regarded as intermediate.

Locality.—Van Horn's ranch, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Merriam's expedition of 1900 (type of fig. 2, in Mus. Univ. Cal., No. 841). White hill one-half mile east of above-mentioned locality. Collected by Knowlton and Merriam, July, 1901 (type of fig. 3, U. S. Nat. Mus., No. 8509).

QUERCUS DAYANA n. sp.

Pl. VI, fig. 1.

Leaf coriaceous, broadly elliptical-lanceolate, about equally obtusely acuminate at both base and apex; margin undulate, perhaps reflexed, otherwise entire; petiole very short and thick; midrib also very thick; secondaries thin and obscure, apparently about 12 pairs, alternate, emerging at a low angle, apparently ending in or very near the margin; finer nervation not retained.

The leaf figured—the only one thus far found—is 3.5 cm. long and 9 mm. broad and has the petiole only 3 mm. long. The outline and scant nervation are well shown in the figure.

This little leaf has such a familiar appearance that it would seem to be a known species, and, indeed, it does resemble more or less closely

a number of forms, but after careful comparison I am forced to regard it as hitherto undescribed. It is clearly an oak leaf of the well known *sempervirens* type, and is allied to a number of fossil forms of this kind. It differs, for instance, from *Quercus simplex* Newb.,[a] in being much shorter, relatively broader, with shorter petiole and closer, lower angled secondaries. It somewhat resembles *Q. convexa* Lesq.,[b] of the Auriferous gravels of California, but differs in nervation, petiole, and other details. It is not greatly unlike the smallest leaves of *Q. simulata* Knowlton,[c] from the Payette formation of Idaho, but is sharper at both ends and has an undulate margin and a much shorter, thicker petiole.

Locality.—White hill one-half mile east of original Van Horn's ranch locality. Collected by Knowlton and Merriam, July, 1901 (U. S. Nat. Mus., No. 8546).

QUERCUS HORNIANA Lesq.

Pl. VIII, fig. 1.

QUERCUS HORNIANA Lesq., Proc. U. S. Nat. Mus., Vol. XI, p. 17, 1888 (the figure given on Pl. V, fig. 6, is not a figure of this specimen, being a figure of a specimen of *Ulmus californica*).

Castanea atavia Unger. Lesquereux, Cret. and Tert. Fl., p. 247, Pl. LII, fig. 2, 1884.

The type specimen of Lesquereux's *Quercus horniana* has not previously been figured, the figure supposed to represent it being that of a specimen of *Ulmus californica* from the same beds. It is here figured for the first time, and it needs but a glance to show that it is identical with the leaf identified by Lesquereux as *Castanea atavia* Unger, a fact apparently overlooked by Lesquereux when he established *Q. horniana*. I have not been able to see any European material of *Castanea atavia*, but a study of the type figures,[d] as well as others, leads me to the conclusion that Lesquereux was in error in identifying the John Day leaf with this species. In the European species the teeth are smaller and lower, the secondaries opposite and only about ten pairs instead of fifteen or more pairs, and the finer nervation is much more open. In the John Day form the margin is entire for a considerable distance above the base while the upper portion is provided with very large, sharp teeth.

While there can be no doubt that this leaf is the same as that figured by Lesquereux as *Castanea atavia*, there may be some as to its being referred to Quercus. The size and shape of the leaf, however, are very suggestive of an oak, and for the present it may remain in this genus. It is very well marked and one not likely to be easily mistaken for anything thus far discovered in these beds.

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[a] Later Extinct Floras, p. 78, Pl. XLIII, fig. 6.
[b] Foss. Pl. Aurif. Gravel, p. 4, Pl. I, figs. 13–17, 1878.
[c] Eighteenth Ann. Rept. U. S. Geol. Surv., Pt. III, p. 728, Pl. CI, fig. 3.
[d] Foss. Fl. v. Sotzka, p. 34 (164), Pl. X (XXXI), figs. 5–7, 1850.

Locality.—Van Horn's ranch, South Fork of John Day River, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 8504).

QUERCUS? sp. Knowlton.

Pl. VIII, fig. 3.

QUERCUS? sp., Knowlton in Merriam, Univ. Cal., Bull. Dept. Geol., Vol. II, No. 9, p. 308, 1901.

The collection made by the University of California contains a single leaf—the one figured—which appears to belong to Quercus. Only the basal portion is preserved together with a very short, thick petiole. The texture seems to have been coriaceous; the shape is lanceolate, wedge-shaped at base, and entire margined. The midrib is very thick and the secondaries—several pairs—subopposite. None of the finer nervation is retained.

This may possibly be a fragment of *Quercus simplex* Newb., which is so abundant at Bridge Creek, but it is only a fragment and the nervation is not well preserved, so I have hesitated to so regard it.

Locality.—Van Horn's ranch, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Merriam's expedition of 1900. (Mus. Univ. Cal., No. 860.)

Family ULMACEÆ.

ULMUS SPECIOSA Newb.

ULMUS SPECIOSA Newb., Proc. U. S. Nat. Mus., Vol. V, p. 507, 1883; Later Extinct Floras, p. 80, Pl. XLV, figs. 2–4, 7 (non figs. 5 and 8), 1898.
Ulmus pseudo-americana Lesq., Cret. and Tert. Fl., p. 249, Pl. LIV, fig. 10, 1883.

The leaf made the type of Lesquereux's *Ulmus pseudo-americana* is preserved in the paleontological collection of the University of California (No. 1758), and as it is clearly the same as the large leaves figured as the types of Newberry's *U. speciosa* and is referred to it, as the latter has priority.

As Newberry states, the collections from Bridge Creek contain a number of elm leaves of the character and size shown in fig. 8 of his plate; that is, they are very much smaller and have less coarsely cut margins than those shown in figs. 2–4, and 7. He decides, however, that these differences are not sufficient to warrant separating them as a distinct species. If these extremes of size and shape were connected by intermediate forms it would be unwarranted to separate them, but among a considerable number this is not found to be the case. It is possible to determine from even a relatively small fragment the form in hand. It therefore seems justifiable to separate them, and I have accordingly done so, retaining the name *speciosa* for the larger leaves and giving to the smaller ones the name of *Ulmus Newberryi*.

Ulmus speciosa, as here emended, may be described as follows: Leaves 10 to 13 cm. in length, 5.5 to 6 cm. in width, petioled, long ovoid or elliptical in outline, very unequal sided at base, narrow pointed at apex; margins coarsely and doubly serrate; nervation strong, very regular, with a strong midrib and some 15 to 20 pairs of thin, close, parallel secondaries; nervilles numerous, close, mainly percurrent and at right angles to the secondaries.

The fruit probably of this species is figured and described by Newberry.

Locality.—Bridge Creek, Grant County, Oregon. Collected by Rev. Thomas Condon (U. S. Nat. Mus., Nos. 7065, 7066, 7067, 7068) and Maj. Charles E. Bendire (U. S. Nat. Mus., Nos. 9217, 9367).

ULMUS NEWBERRYI n. sp.

Pl. IX, fig. 4.

ULMUS n. sp., Knowlton in Merriam, Univ. Cal., Bull. Dept. Geol., Vol. II, No. 9, p. 288, 1901.

Ulmus speciosa Newb., Later Extinct Floras, p. 80, Pl. XLV, figs. 5 and 8 (now figs. 2–4 and 7), 1898 (1899).

Leaves membranaceous in texture, lanceolate in outline, narrowed, and very unequal sided at base, long and slender pointed at apex; margin coarsely and irregularly doubly serrate, the primary teeth large, of quite regular size, the other teeth smaller and quite irregular; midrib rather thin, perfectly straight; secondaries about 12 or 15 pairs, parallel, at an acute angle and ending in the larger teeth; nervilles numerous, fine, mainly broken, producing a large block network between the secondaries.

This species is founded on a considerable number of leaves besides the ones figured by Newberry under *U. speciosa*. One of the most perfect has been figured here. This is very narrowly lanceolate, 10 cm. in length and only a little over 3 cm. in width. The petiole is about 5 mm. long. Other examples are only about 6 cm. long and 2.5 cm. wide, and this is the usual size.

As pointed out under *U. speciosa*, this species may be distinguished by its much smaller size, much narrower shape, and more oblique base. In fact, it approaches closer to *U. californica*[a] in size and shape than to *U. speciosa*. It differs from *U. californica* in having larger, doubly dentate teeth, those of the former species being small and only simply dentate.

Locality.—Bridge Creek, Grant County, Oregon. Collected by Rev. Thomas Condon (U. S. Nat. Mus., No. 7064) and Maj. Charles E. Bendire (U. S. Nat. Mus., No. 8493).

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[a] Mem. Mus. Comp. Zool., Vol. VI, No. 2, p. 15, Pl. IV, fig. 2, 1878.

ULMUS PLURINERVIA Unger.

ULMUS PLURINERVIA Unger. Lesquereux, Proc. U. S. Nat. Mus., Vol. XI, p. 18, 1888.

A single specimen with its counterpart is all that has been found of this form. It is a little larger than the figure given by Heer[a] of the Alaskan form, but is otherwise the same.

Locality.—Van Horn's ranch, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 2620).

ULMUS CALIFORNICA? Lesq.

ULMUS CALIFORNICA Lesq., Foss. Pl. Aurif. Gravel, p. 15, Pl. IV, fig. 2, 1878; Proc. U. S. Nat. Mus., Vol. XI, p. 18, Pl. V. fig. 6 (there wrongly stated to be a figure of *Quercus horniana*), 1888.

The collections contain several examples, one of which was referred by Lesquereux to his *Ulmus californica*. The others are similar to this and should properly go with it. The question as to whether they are properly referred to this species is a rather difficult one to settle. None of the leaves are nearly perfect nor do they agree in all particulars with the types. The secondaries incline to arch slightly outward instead of strongly upward. The character of the teeth can not be made out satisfactorily. In view of these statements, it seems best to question their reference to this species, and await future material to settle the matter definitely.

Locality.—Mascall beds, Van Horn's ranch, 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 2621) and by Knowlton and Merriam, July, 1901 (U. S. Nat. Mus., Nos. 8983–8985).

PLANERA UNGERI Ettingshausen.

PLANERA UNGERI Ettingshausen. Lesquereux, Proc. U. S. Nat. Mus., Vol. XI, p. 19, 1888.

This species is represented by a single example and its counterpart, and although not perfectly preserved may well belong to this form.

Locality.—Mascall beds, Van Horn's ranch, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 2534.)

Family MORACEÆ.

FICUS TENUINERVIS Lesq.

FICUS TENUINERVIS Lesq., Cret. and Tert. Fl., p. 164, Pl. XLIV, fig. 4, 1883; Proc. U. S. Nat. Mus., Vol. XI, p. 23, 1888.

The single broken leaf upon which Lesquereux based its presence at Cherry Creek remains unique. It is described and discussed at length in the paper above quoted.

Locality.—Cherry Creek, Crook County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 2479).

[a] Fl. Foss. Alaska, p. 34, Pl. V, fig. 1, 1869.

FICUS PLANICOSTATA? Lesq.

FICUS PLANICOSTATA? Lesq., Newberry, Later Extinct Floras, p. 88, Pl. XLVI, fig. 1, 1898 (1899).

Locality.—Bridge Creek, Grant County, Oregon. Collected by Rev. Thomas Condon (U. S. Nat. Mus., No. 7084).

FICUS? OREGONIANA Lesq.

Pl. X, fig. 3.

FICUS? OREGONIANA Lesq., Proc. U. S. Nat. Mus., Vol. XI, p. 18, Pl. IX, fig 3, 1888.

As the original figure of this species is so poorly and even incorrectly drawn, I give another of the type specimen. As may be seen, Lesquereux's figure shows a curious prolongation on one side, but this has been greatly exaggerated. The specimen is a little broader on one side, but not to such an extent as might be inferred from the figure. The recent collections from the same locality contain a fine, nearly perfect example of this species, which shows it to be nearly equilateral.

Locality.—Van Horn's ranch, South Fork of John Day River, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., Nos. 2475, 8543) and Dr. John C. Merriam (Mus. Univ. Cal., No. 884).

ARTOCARPUS CALIFORNICA? Knowlton.

ARTOCARPUS CALIFORNICA Knowlton, Science, Vol. XXI, p. 24, Jan. 13, 1893.
Aralia pungens Lesq., Proc. U. S. Nat. Mus., Vol. XI, p. 16, 1888.
Myrica (*Aralia*) *Lessigii?* Lesq., idem., p. 16, 1888.

The collections made by Bendire contained three specimens that were referred by Lesquereux as above indicated. They are all very fragmentary and can not be made out with satisfaction, yet it is reasonably certain that only one species is represented, and in all probability they are the same as my *Artocarpus californica.* It was hoped that late collections from these beds might contain specimens that would clear up this question, but unfortunately they do not, and it must remain open to revision.

Artocarpus californica differs from *A. Lessigiana* (Lesq.), Knowlton, in its smaller size, thinner texture, and shorter, more acute lobes.

Locality.—Van Horn's ranch, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., Nos. 2428, 2522.)

Family BERBERIDACEÆ.

BERBERIS SIMPLEX Newb.

BERBERIS SIMPLEX Newb., Proc. U. S. Nat. Mus., Vol. V, p. 514,1883; Later Extinct Floras, p. 97, Pl. LVI, fig. 2, 1898 (1899).

The type of this very distinct species still remains unique.

Locality.—Bridge Creek, Grant County, Oregon. Collected by Rev. Thomas Condon (U. S. Nat. Mus., No. 7046).

BERBERIS? GIGANTEA n. sp.

Pl. XI, fig. 1.

Leaf of large size, very thick and leathery in texture, palmately deeply three-lobed, lobes lanceolate, provided with numerous, large, triangular or triangular-lanceolate, sharp-pointed lobes; lobes provided with very thick, fleshy midrib, and an apparently continuous intramarginal vein; secondary branches very thin, arising from the midrib and passing directly or with a slight curve to the apices of the lateral lobes; finer nervation very thin, anastomosing, producing large, irregular areas.

The single magnificent specimen upon which this opinion is based remains absolutely unique. It was clearly a thick, leathery leaf, and palmately deeply three-lobed. There is no means of knowing the full length and width, as both base and apex are absent. Of the middle lobe only about 6 cm. is preserved; of the lateral lobes 8 to 11 cm. is preserved. The widest part between the lobes as now preserved measures about 13 cm. When perfect it was probably at least 15 cm. long and spread probably 18 cm. The petiole is, of course, not preserved. The nervation, as set forth in the diagnosis, is strongly marked. There is a thin intramarginal vein running around the entire margin, this being especially prominent in the interval between the lateral lobes. Each lobe is provided with a very thick, fleshy midrib, from which arise, at irregular intervals, the thin secondaries which pass to the sharp points of the lateral lobes. The other nervation produces large anastomosing areas.

I am somewhat uncertain as to the proper generic reference for this fine leaf. The late Dr. Newberry, to whom the specimen was sent and who had prepared a drawing of it, placed it provisionally in the genus Cnicus, or Carduus, as it is now called. The peculiar sharp lobes, as well as the fleshy midribs, are suggestive of the large spiny leaves of thistles, but no species of this genus, so far as I know, has palmate leaves. The individual lobes resemble the whole leaf of many species of Carduus, but the palmate character effectively excludes it.

The only genus with which I have been able to satisfactorily compare this leaf is Berberis, and the nearest species is *B. trifoliolata* Moric. This species, now found in southern Texas and Mexico, has ordinarily small trifoliolate leaves, but occasionally one is found in which two and sometimes all three leaflets are united for a greater or less distance at the base, thus producing a leaf of exactly the same character as the fossil under discussion. The individual leaflets of this living species are rarely more than 4 cm. in length, whereas the lobes of this fossil form must have been 10 or 12 cm. long. In the matter of lobation, nervation, and general appearance, even to the intramarginal vein, the agreement between them is perfect. For this reason I have placed this fossil under Berberis and denoted the doubt by a question mark.

Locality.—Mascall beds, Van Horn's ranch, about 12 miles west of Mount Vernon, Oregon. Collected by Rev. Thomas Condon. The type and only specimen is the property of Columbia University, New York, and is under the care of the New York Botanical Garden.

Family MAGNOLIACEÆ.

MAGNOLIA LANCEOLATA Lesq.

MAGNOLIA LANCEOLATA Lesq., Proc. U. S. Nat. Mus., Vol. XI, p. 20, 1888.

Locality.—Cherry Creek, Crook County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 2515).

MAGNOLIA CULVERI Knowlton.

MAGNOLIA CULVERI Knowlton, Mon. U. S. Geol. Surv. Vol. XXXII, Pt. II, p. 720, Pl. XCII, fig. 5, 1899.

Populus monodon Lesq., Proc. U. S. Nat. Mus., Vol. XI, p. 21, 1888.

This material is not very well preserved, but it agrees absolutely with this species and is so referred.

Locality.—Cherry Creek, Crook County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 2546) and by Knowlton and Merriam in 1901 (U. S. Nat. Mus., No. 9058).

MAGNOLIA INGLEFIELDI Heer.

MAGNOLIA INGLEFIELDI Heer, Fl. Foss. Arc., Vol. I, p. 120, Pl. III, fig. 5c; Pl. XVI, figs. 5, 6, 8b; Pl. XVIII, figs, 1–3, 1868; Lesquereux, Proc. U. S. Nat. Mus., Vol. XI, p. 13, 1888.

This is certainly different from the last and may well be Heer's species. It is not contained in recent collections.

Locality.—Van Horn's ranch, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 2513).

Family LAURACEÆ.

LAURUS OREGONIANA n. sp.

Pl. IX, figs. 2, 3.

Laurus n. sp., Knowlton in Merriam, Univ. Cal., Bull. Dept. Geol., Vol. II, No. 9, p. 309, 1901.

Leaves coriaceous in texture, narrowly lanceolate in shape, narrowed from apparently above the middle to a long narrowly wedge-shaped base (upper portion not preserved, but apparently long and narrowly acuminate); midrib thick below, becoming very slender in the upper portion; secondaries about 6 pairs, thin, alternate, arising at an acute angle, passing high up near the margin, where they join,

by a series of broad loops, the one next above; nervilles prominent, oblique to the midrib and mainly broken, producing large, irregular areas; finer nervilles numerous, very thin, oblique to the stronger ones; ultimate nervation made up of very minute but regular reticulations.

This species is represented thus far by only two specimens, the one figured and another much less perfect. The one shown in the plate was about 18 cm. long (13.5 cm. in length is now preserved), and 3.5 cm. wide at a point probably a little above the middle. It is impossible to estimate the length of the other specimens, but it is wider, being fully 4.5 cm. wide. The nervation differs slightly, also, the secondaries arise at a less acute angle, but otherwise there is no appreciable difference.

The affinity of the unfigured example seems to be with some forms of *Laurus californica* Lesq., but it differs in having the secondaries at a more acute angle of divergence and undoubtedly belongs with the leaf figured. It may also be compared with *Persea punctulata* Lesq.[a]

Locality.—Van Horn's ranch, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Merriam's expedition of 1900 (Mus. Univ. Cal., No. 868).

CINNAMOMUM DILLERI Knowlton.

CINNAMOMUM DILLERI Knowlton, Twentieth Ann. Rept. U. S. Geol. Surv., Pt. III, p. 47, Pl. IV, fig. 1, 1900.

The material from Cherry Creek obtained in 1901 contains one nearly perfect example and several fragmentary specimens that must belong to this species. The most perfect specimen is slightly larger than the type, but otherwise there is no appreciable difference.

The type was described from Comstock, Douglas County, Oregon, in beds supposed to be Miocene in age, but associated with it were shells of *Cardita planicostata* and other characteristic Eocene fossils. As the beds at Cherry Creek are certainly Eocene it would seem to sus tain the contention that the beds at Comstock are also of this age.

Locality.—Cherry Creek, Crook County, Oregon. Collected by Knowlton and Merriam, July, 1901 (U. S. Nat. Mus., Nos. 9055, 9056).

CINNAMOMUM BENDIREI n. sp.

Pl. X, fig. 4.

Leaf membranaceous in texture, oblong-lanceolate in shape, long wedge-shaped at base, apparently rather obtusely pointed at apex; margin entire; petiole long and slender; midrib thick below, becoming very thin above, with two or three pairs of thin secondaries in the upper part which are at a low angle; lower pair of strong secondaries

[a] Proc. U. S. Nat. Mus., Vol. XI, p. 26, Pl. XIV, fig. 1, 1888.

arising at a point well above the base of the blade, passing up at an acute angle to near the upper part of the leaf, and here they become thin and join with the equally thin secondaries from the upper part of the midrib; each of the large secondaries with several thin loops on the outer side; nervilles numerous, thin, crossing between the midrib and strong secondaries, mainly percurrent though irregular; finer nervation producing rather large blocks.

The example figured is the only one found in the collections. It lacks only the extreme upper portion. The length was about 6.5 cm., exclusive of the petiole, which is 1.5 cm. in length. The width of the blade is 2.5 cm. at the broadest point, which is slightly above the middle.

This species is wholly unlike anything before reported from the beds at Bridge Creek. It is perhaps nearest to certain forms of *C. Scheuchzeri* of Heer, being, for example, hardly to be separated from a leaf figured by Ludwig[a] in his Fossile Pflanzen aus der ältesten Abtheilung der Rheinisch-Wetterauer Tertiär-Formation. This, however, is not the typical form of *C. Scheuchzeri*, and I prefer to describe it as new rather than unite it with an anomalous leaf that has been referred to an established species.

Locality.—Bridge Creek, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 8490).

Family HYDRANGEACEÆ.

HYDRANGEA BENDIREI (Ward) Knowlton.

Pl. IX, figs. 6, 7.

HYDRANGEA BENDIREI (Ward) Knowlton in Merriam, Univ. Cal., Bull. Dept. Geol., Vol. II, No. 9, p. 309, 1901.

Marsilea Bendirei Ward, Fifth Ann. Rept. U. S. Geol. Surv., p. 446, 1885.

Porana Bendirei (Ward) Lesquereux, Proc. U. S. Nat. Mus., Vol. XI, p. 16, Pl. VIII, fig. 4, 1888.

Sterile flowers of large size; calyx lobes of firm texture, broadly obovate, oval, or nearly circular in shape, considerably overlapping, obtuse and rounded at apex, truncate or slightly narrowed at the sessile base; nervation strong, consisting of some six or eight nerves of equal strength, the central one passing apparently to the tip of the calyx lobes and having two or three branches at various distances which anastomose with it some distance below the apex; other nerves diverging and joining by broad loops with several series of smaller loops outside; nervilles producing quite large irregularly quadrangular areas in which there are often free veins.

[a] Palæontographica, Vol. VIII, Pl. XLI, fig. 8.

Four more or less perfect examples of this exceedingly interesting species have been found. The original specimen is nearly 4 cm. by 3 cm. in size, the large sepals being 2 cm. long and 1.5 cm. broad. The next discovered specimen was obtained by Dr. John C. Merriam in 1900. It is not quite perfect, but has the nervation very well preserved. The sepals are about 2 cm. long and nearly as broad. The two remaining examples were obtained by myself in 1901.

The original specimen, as may be noted under the synonymy, was first tentatively referred to Marsilea, and was later placed under Porana by Lesquereux, who correctly recognized its nature. Lesquerex, however, was in error in supposing that the sepals were "connate to above the middle." They are undoubtedly free and overlapping, as shown by the present drawing. (See Pl. IX, fig. 6.) The example secured by Dr. Merriam is, as already stated, not perfectly preserved, but as nearly as can be made out, it consists of only three sepals, although the fourth may be present, concealed under the others. They are clearly free, however.

The fossil forms referred to Porana consist of the more or less leathery sepals and are usually five in number. Two species have been described from the United States by Lesquereux, both coming from Florissant, Colorado. *Porana Speirii*[a] is a five-lobed connate species, while *P. tenuis*[b] has never been figured, but is described as having the sepals separate to the base. The first is very distinct from the form under consideration, while the latter can not be well compared.

On first examining these specimens, especially the one collected by Dr. Merriam (Pl. IX, fig. 7), they seem to be referable to a Cornus of the type of *C. florida* or *C. Nuttallii* Aud., but the absence of any marked indication of the flowers in the center apparently precludes their reference to this genus.

At the suggestion of Mr. Charles Louis Pollard, of the United States National Herbarium, these fossils were compared with various species of the genus Hydrangea, and the resemblance between them and the sterile flowers so characteristic of this genus was so striking that they have been referred to Hydrangea.

Eight fossil species of Hydrangea have been described from the European Tertiary, but none of them approach closely to our form.

Locality.—Van Horn's ranch, South Fork of John Day River, 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 8515), and by Dr. John C. Merriam (Pal. Col. Univ. Cal., No. 854). Also obtained from a gulch half a mile northwest of the Belshaw ranch, the next ranch east of Van Horn's, by F. H. Knowlton, July, 1901 (U. S. Nat. Mus., Nos. 8994, 8995).

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[a] Cret. and Tert. Fl., p. 172, Pl. XXVIII, fig. 15, 1883. [b] Idem, p. 173.

Family HAMAMELIDACEÆ.

LIQUIDAMBAR EUROPÆUM Al. Br.

LIQUIDAMBAR EUROPÆUM Al. Br. Newberry, Later Extinct Floras, p. 100, Pl. XLVII, figs. 1–3, 1898 (1899).

As Newberry well says (op. cit. p. 101), this species is hardly to be distinguished from large leaves of Lesquereux's *Liquidambar californicum*, from the Auriferous gravel of California. But it appears that the large form is rare among the Auriferous gravel examples, most of them being much smaller and only three lobed. It therefore seems best to keep them apart for the present, although they are undoubtedly close. Its identity with the European form is also a matter for future settlement.

Locality.—Bridge Creek, Grant County, Oregon. Collected by Rev. Thomas Condon (U. S. Nat. Mus., Nos. 7094, 7095, 7096).

LIQUIDAMBAR EUROPÆUM PATULUM, n. var.

Pl. X, fig. 5.

Liquidambar europæum Al. Br. Lesquereux, Proc. U. S. Nat. Mus., Vol. XI, p, 14, 1888.

This specimen, the only one thus far found at this locality, was referred by Lesquereux, without comment, to *L. europæum*. It is a well-known fact that this is a very variable species, which more than likely covers several distinct forms, but the leaf under consideration differs markedly from any that I have seen figured in European books. It is distinctly different from the large five- to seven-lobed leaves found at Bridge Creek, nor is it the same as Lesquereux's *L. californicum*, from the Auriferous gravels. I have therefore ventured to give it subspecific rank under the name of *L. europæum patulum*. It may be described as follows: Leaf coriaceous in texture, three-lobed and much broader than long; central lobe obtusely elliptical; lateral lobes lanceolate-acuminate, nearly at right angles to the central lobe; margin finely and sharply serrate throughout.

The width of this leaf is about 14 cm. and the length only about 8 cm. The central lobe is about 4 cm. broad and the same in length, while the lateral lobes are but little more than 2.5 cm. broad.

Locality.—Van Horn's ranch, South Fork of John Day River, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 8544).

LIQUIDAMBAR PROTENSUM ? Unger.

LIQUIDAMBAR PROTENSUM ? Unger. Lesquereux, Proc. U. S. Nat. Mus., Vol. XI, p. 13, Pl. VIII, fig. 3, 1888.

I regard this identification as extremely doubtful. The specimen lacks practically all of the margin, and other of its characters have

been distorted. As Lesquereux suggests (op. cit., p. 13), this leaf has a striking resemblance to his *Acer dimorphum*, but the specimen is not sufficiently perfect to warrant the assertion that it represents a leaf of that species.

Locality.—Van Horn's ranch, South Fork of John Day River, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 2504).

LIQUIDAMBAR PACHYPHYLLUM, n. sp.

Pl. IX, fig. 1.

Leaf of small size, very thick in texture, five-lobed, the lobes short, ovate, or ovate-lanceolate, acute; margin serrate throughout, the teeth rather large, upward pointing; ribs arising just inside the lower margin of the blade, very strong, passing to the apices of the lobes; secondary branches numerous, alternate, often irregular, camptodrome, arching near the margin; nervilles very irregular, producing a coarse, heavy network.

The single broken example figured is all that was found in the collections. It was clearly five-lobed, but only the two lower and a part of one middle lobe is preserved. The total length appears to have been between 5 and 6 cm., or possibly a little more. The width between the two lower lobes is 5.5 cm.

This species had evidently a very thick, pulpy leaf, and the nervation is especially strong, particularly the ribs and nervilles.

Leaves of this genus appear to be rare in the Mascall beds, and the leaf under consideration is wholly unlike any before detected. The leaves referred to *L. europæum patulum* and *L. protensum* are thin, being like the living species in texture, whereas ours is clearly a thick leaf with a strong nervation. It is also unlike *L. californicum*, from the Auriferous gravels.

Locality.—Mascall beds, Van Horn's ranch, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Knowlton and Merriam, July, 1901 (U. S. Nat. Mus., No. 8534).

LIQUIDAMBAR sp.?

Pl. XII, fig. 4.

The collection contains one leaf that apparently belongs to Liquidamber, but it is much broken, and does not show all the characters. This example, shown in Pl. XII, fig. 4, is a large leaf, five or possibly seven lobed, the lower lobes being at right angles with the midrib, producing a novel truncate base. The width between these two lobes is nearly 14 cm. The margin of the lobes is provided with numerous fine teeth. The nervation is well marked, consisting of about five strong ribs, which radiate from the top of the petiole and presumably end

in the tips of the lobes. Each is provided with numerous secondary branches, and from the larger size of some it is presumed that they supplied lateral lobes. The finer nervation is that of Liquidambar.

Locality.—White hill one-half mile east of original Van Horn's ranch locality. Collected by Knowlton and Merriam, July, 1901 (U. S. Nat. Mus., No. 8545).

Family PLATANACEÆ.

PLATANUS ASPERA Newb.

PLATANUS ASPERA Newb., Proc. U. S. Nat. Mus., Vol. V, p. 509, 1883; Later Extinct Floras, p. 102, Pl. XLII, figs. 1-3; Pl. XLIV, fig. 5; Pl. LIX, fig. 3, 1898.

The types of this species are before me, together with a number of more or less fragmentary examples collected later. They exhibit nothing to modify the views originally expressed by Newberry.

Locality.—Bridge Creek, Grant County, Oregon. Collected by Rev. Thomas Condon (U. S. Nat. Mus., Nos. 7079, 7081, 7082, 7083) and Maj. Charles E. Bendire (U. S. Nat. Mus., No. 3010).

PLATANUS CONDONI (Newb.) Knowlton.

PLATANUS CONDONI (Newb.) Knowlton in Merriam, Univ. Cal., Bull. Dept. Geol., Vol. II, No. 9, p. 289, 1901.

Ficus? Condoni Newb., Proc. U. S. Nat. Mus., Vol. V, p. 512, 1883; Later Extinct Floras, p. 85, Vol. LVI, fig. 1; Pl. LVIII, fig. 1, 1898.

The following conclusions are based on all of the original types of Newberry, together with a considerable number more recently collected, which have passed through Lesquereux's hands. Newberry, as evidenced by the question mark placed after the genus as well as the discussion in the Later Extinct Floras, was in doubt as to the reference of these fine leaves to the genus Ficus, and Lesquereux referred them without hesitation to *Platanus basilobata*. That it should be placed in the genus Platanus is certain, but that it should be referred to Professor Ward's species is not quite so clear. After a careful examination of the types of *Platanus basilobata* and consultation with their author, I can but conclude that, although close, there are sufficient differences to warrant keeping them apart, at least for the present. The basal lobes in *P. basilobata* are uniformly larger, and in most cases several times the size of those in the form under discussion, and, moreover, they appear to be always deeply lobed in the former and entire in the latter. Assuming that the evolutional tendency is to get rid of these large stipular organs, as suggested in the living *P. occidentalis*, the Bridge Creek form would represent a more recent and higher developed stage than *P. basilobata*, a supposition

borne out by the relative ages of the beds in which they are found. In size of blade, configuration of margin, and in nervation the two forms are practically identical.

Localities.—Bridge Creek, Grant County, Oregon. Collected by Rev. Thomas Condon (Newberry's types, U. S. Nat. Mus., Nos. 7079, 7085) and Maj. Charles E. Bendire (U. S. Nat. Mus., Nos. 2892, 2898). Officer's ranch, lower end of Butler Basin. Collected by Dr. John C. Merriam, July 22, 1901 (U. S. Nat. Mus., No. 9206–9208).

Platanus nobilis? Newb.

Platanus nobilis? Newb. Lesquereux, Proc. U. S. Nat. Mus., Vol. XI, p. 19, 1888.

The material from Van Horn's ranch contains a single very large leaf which Lesquereux identified with this species. This particular specimen lacks most of the margin, but as nearly as can be made out it was five-lobed and entire, or at most only undulate on the margin. In size it must have been more than 25 cm. long and 23 cm. or more broad. The petiole is preserved entire and is 8 cm. long and 7 mm. thick at the point of attachment to the branch and 4 mm. thick in the middle. The nervation of the leaf is strong. The margin not having been preserved it is hard to be positive of this determination, yet, all things considered, it is possibly correct, although the petiole is stronger than I remember to have seen in this species. Additional material must be awaited for satisfactory settlement.

Locality.—Van Horn's ranch, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 2538).

Platanus aceroides? (Göppert) Heer.

Platanus aceroides (Göppert) Heer. Lesquereux, Proc. U. S. Nat. Mus., Vol. XI, p. 19, Pl. V, fig. 7, 1888.

The two examples identified by Lesquereux as this species are very unlike in size, the smaller—the one figured—being 4 cm. long and a little more than 3.5 cm. broad, while the larger one is 11 or 12 cm. long and 13 cm. or more broad. I am uncertain as to the correctness of this identification. They do have somewhat the appearance of various leaves that have been referred to this species, but they also differ. There is not a sufficient amount of material, however, to warrant attempting to properly characterize them as new. I have therefore retained them as above, with the mark of interrogation after the specific name.

Locality.—Van Horn's ranch, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 2535).

PLATANUS sp.

Platanus Raynoldsii Newberry. Lesquereux, Proc. U. S. Nat. Mus., Vol. XI, p. 19, 1888.

This identification rests on two fragments of very large leaves that are not in my opinion well enough preserved to warrant specific determination. They can hardly belong to *P. Raynoldsii*, as Lesquereux has stated, nor do they seem to be parts of either *P. nobilis* or *P. aceroides*. Just what they are I am unable to say at present.

Locality.—Van Horn's ranch, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 2539).

Family ROSACEÆ.

CRATÆGUS FLAVESCENS Newb.

Pl. X, fig. 1.

CRATÆGUS FLAVESCENS Newb., Proc. U. S. Nat. Mus., Vol. V, p. 507, 1883; Later Extinct Floras, p. 112, Pl. XLVIII, fig. 1, 1898.

Myrica diversifolia Lesq., Cret. and Tert. Fl., p. 241, Pl. L, fig. 10, 1883.

I have before me as I write the type of Newberry's *Cratægus flavescens* (U. S. Nat. Mus., No. 7088) and a part of Lesquereux's types of his *Myrica diversifolia* as described first from Florissant, Colorado. The type of the Bridge Creek example referred by Lesquereux to *M. diversifolia* (op. cit., Pl. L, fig. 10) is in the paleontological collection of the University of California, where I have seen it, and there can be no doubt of its absolute identity with Newberry's *Cratægus flavescens* of prior date, and I have so referred it. In regard to the status of the Florissant specimens[a] I am somewhat in doubt. The National Museum collection does not appear to contain all of the figured examples and, judging from the figures alone, it would seem that they represent more than one species. Figs. 7, 8, 11, 12, and 14 are seemingly identical with the Bridge Creek species, yet they show a tendency to have sharply toothed lobes, a condition not often present in the former species. In the absence of a sufficient amount of material (these leaves appear to be rare in the Bridge Creek collections) it has seemed best to leave it for future settlement.

Locality.—Bridge Creek, Grant County, Oregon. Collected by Rev. Thomas Condon and Maj. Charles E. Bendire (U. S. Nat. Mus., No. 8489). Type of Lesquereux's fig. 10, op. cit., in Mus. Univ. Cal., No. 1757.

CRATÆGUS IMPARILIS n. sp.

Pl. X, fig. 2.

Leaf semicoriaceous, roughly ovate in outline, very obtusely wedge-shaped at base, palmately three-ribbed, primarily three-lobed, but

[a] Cret. and Tert. Fl., p. 148, Pl. XXV, figs. 6–15.

ultimately seven-lobed; lateral lobes of same size, separated from central lobe by sharp, deep sinuses, rather obtuse at apex, each with a single, small, obtuse lateral lobe; central lobe much the larger, lanceolate, three-lobed at apex, secondary lobes short acute; margin of lobes undulate or obscurely dentate; the three ribs of about the same size, the central or midrib with about six pairs of alternate, thin secondaries, two of which enter the lateral lobes; lateral ribs with several pairs of thin, irregular secondaries, two of which are slightly larger and enter the side lobes; finer nervation producing a regular, deeply impressed network.

The leaf figured, the only one found, is 3 cm. long and about 2 cm. wide. It is seven-lobed, but only three-ribbed, the lower lobes each have a small side lobe, and the main central lobe a small lobe on each side. The length of the lower lobes from the sinus is about 1 cm. that of the middle lobe from the sinus is 1.75 cm. The configuration of the margin and the nervation are well shown in the figure.

This species appears to find its closest affinity with *Cratægus flavescens* Newb.,[a] or *Myrica diversifolia*, as it was later called by Lesquereux.[b] The leaf from Bridge Creek, referred by Lesquereux to his *Myrica diversifolia*, is certainly the same as Newberry's *Cratægus flavescens*, and certain of the Florissant leaves appear to be the same, but I am under the impression that at least two species are represented in the latter material.

The leaf under consideration differs in a number of particulars from the Bridge Creek specimens. Thus it is deeply three-lobed with each lateral lobe provided with a small lobe, whereas the Bridge Creek specimens are usually rather evenly lobed throughout. The ribs in the new form are three in number and arise at the top of the petiole. In the other species the leaf is not palmately ribbed, but is provided with secondaries, even the lowest pair of which arise from the midrib well above the base and pass to the lobes. The margin of these latter specimens inclines to be more crenulate. One specimen is perhaps closer in shape to one of the Florissant leaves,[c] but it differs in the nervation in the same manner as do the other examples.

Locality.—White hill half-mile east of original Van Horn's ranch locality. Collected by Knowlton and Merriam, July, 1901 (U. S. Nat. Mus., No. 8513.)

Prunus? Merriami n. sp.

Pl. XI, figs. 2, 3, 6, 7.

Prunus n. sp., Knowlton in Merriam, Univ. Cal., Bull. Dept. Geol., Vol. II, No. 9, p. 309, 1901.

Leaves coriaceous, ovate in shape, apparently abruptly rounded and truncate at base, obtusely acuminate at apex; margin finely serrate,

[a] Later Extinct Floras, p. 112, Pl. XLVIII, fig. 1.

[b] Cret. and Tert. Fl., p. 241, Pl. L, fig. 10. This species was also described and figured from Florissant, Colorado, idem, p. 148, Pl. XXV, figs. 6–15.

[c] Idem, Pl. XXV, fig. 11.

the teeth of nearly equal size, obtusely pointed; midrib very thick, especially below; secondaries about ten pairs, mostly strong, alternate or a few opposite, arising nearly at a right angle on one side and at an angle of about 20° or 25° on the other, strongly camptodrome, arching far below the margin and joining the secondary next above by a broad loop, with a series of loops on the outside from which nervilles enter the teeth; nervilles numerous, strong, irregular, often broken, producing large areas which are filled by a very regular fine network.

The type of this species is nearly 4 cm. in length and is a little more than 2.5 cm. in width. It appears to have been a rather thick leaf, ovate in shape, with a finely serrate margin, a thick midrib, and about ten pairs of strong, camptodrome secondaries, which divide and arch far inside the margin.

While I am not absolutely certain that this leaf should properly be referred to Prunus, it agrees so closely in a general way with various living species of this genus that it has been tentatively placed under it. It is, for instance, very similar to certain forms of *P. virginiana*, *P. demissa*, etc. It is also quite like some species of Cydonia, as *C. japonica*, the flowering quince, but it is hardly likely that this genus was natural to this country. In any case the species is a well marked one and can readily be identified as a stratigraphic mark.

This species is named in honor of Dr. John C. Merriam, of the University of California.

Locality.—Van Horn's ranch, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Merriam's expedition of 1900 (Mus. Univ. Cal., Nos. 886, 887) and by Knowlton and Merriam, 1901 (U. S. Nat. Mus., No. 8514).

PRUNUS? TUFACEA n. sp.

Pl. XI, fig. 4.

Prunus n. sp., Knowlton in Merriam, Univ. Cal., Bull. Dept. Geol., Vol. II, No. 9, p. 309, 1901.

Leaves semicoriaceous in texture, elliptical or elliptical-obovate, slightly unequal sided, rather abruptly wedge shaped at base, and similarly narrowed at apex; margin finely, sharply, and evenly serrate throughout; petiole thick and strong; midrib rather thick, especially below; secondaries about eight or nine pairs, opposite in the lower portions, alternate above, arising at an angle of about 30° or less and camptodrome, forking well below the margin and joining the one next above by a broad loop, and apparently with thin nervilles passing to the teeth; nervilles strong, mainly broken; finer nervation producing minute areolæ.

These leaves are about 3.5 cm. long and 2 cm. broad. The thick petiole is over 1 cm. long. The marginal teeth are fine, regular, and sharp pointed.

These leaves may belong to the preceding species, but as they differ in a number of minor particulars it has seemed best to keep them separate. They are elliptical or slightly elliptical-obovate instead of ovate, the teeth are finer, more regular, and evidently sharper pointed, and the secondaries are at a stronger angle of divergence.

Locality.—Van Horn's ranch, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Merriam's expedition of 1900. (Type in Mus. Univ. Cal., No. 885.)

Family MIMOSACEÆ.

ACACIA OREGONIANA Lesq.

ACACIA OREGONIANA Lesq., Proc. U. S. Nat. Mus., Vol. XI, p. 14, Pl. V, fig. 4, 1888.

The type specimen with its counterpart still remains unique.

Locality.—Van Horn's ranch, South Fork of John Day River, 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 2412).

Family CÆSALPINACEÆ ?

CASSIA ? sp. Newb.

CASSIA? sp., Newb., Later Extinct Floras, p. 113, Pl. XLVI, fig. 10, 1898.

The type of this form is before me and it requires but a glance to see that the drawing does not correspond accurately with the specimen. Judging from the drawing alone it would seem to represent a small leguminous pod with faint depressions corresponding to the places occupied by the seeds. The outer surface is represented as uniform and unmarked. The specimen itself does not show any evidence of the presence of seeds, and the outer surface is strongly marked with close parallel lines which are oblique to the long direction and which completely cross it from side to side. I do not understand this structure, and while it may represent a small pod it is hardly probable that it is a Cassia.

Locality.—Bridge Creek, Grant County, Oregon. Collected by Rev. Thomas Condon (U. S. Nat. Mus., No. 7093).

Family SIMARUBACEÆ.

AILANTHUS OVATA Lesq.

AILANTHUS OVATA Lesq., Cret. and Tert. Fl., p. 254, Pl. LI, figs. 7, 8, 1883.

The type specimens only are known. I have examined these specimens, both being preserved on the same piece of matrix. The figure of the branch shows the buds much clearer than they appear on the specimen, but it is perhaps correctly referred. The samaras are

described by Lesquereux as being rounded at one end and acute at the other. An examination shows that the bluntness described is due to the ends of one or two being broken or covered by matrix, while in one well preserved both ends are similar and acute.

Locality.—Bridge Creek, Grant County, Oregon. Collected by C. D. Voy. (Types in Mus. Univ. Cal., Nos. 1765, 1766.)

Family ANACARDIACEÆ.

RHUS BENDIREI Lesq.

RHUS BENDIREI Lesq., Proc. U. S. Nat. Mus., Vol. XI, p. 15, Pl. IX, fig. 2, 1888.

The type material consisted of the example figured and another specimen with its counterpart. The figured specimen, it will be noted, is oblanceolate in shape, about 10.5 cm. in length, 3.5 cm. in width at the broadest point, and is narrowly wedge-shaped below and acuminate above. Lesquereux regarded this as the terminal leaflet and decided that the other specimen represented a lateral leaflet of the same species. Of this latter he says: "To this I refer a small, oblong-lanceolate leaflet, rounded in narrowing rapidly to the point of attachment, very short-petioled, and areolation identical." This is much smaller, being only 6 cm. in length and 2.5 cm. in greatest width, and while it looks at first quite different, may belong to it. The collection made by Dr. John C. Merriam in 1900 contains two specimens like the smaller leaflet.

Locality.—Van Horn's ranch, South Fork of John Day River, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 2582).

RHUS ? sp. Lesq.

Pl. XIV, fig. 6.

The original collection by Bendire contains a fragment of the base of a leaf or leaflet that was referred by Lesquereux to Rhus, but was not included in his published list of species. It is impossible to make out the whole outline, but it seems to have been obovate with a broadly wedge-shaped, unequal-sided base. The margin appears to have been provided with small, sharp teeth. The nervation consists of a comparatively thick midrib and quite a number of thin secondaries, those on the broader side of the blade being at a right angle and those on the narrower side at an angle of about 40°. They are apparently camptodrome.

It is clearly unsafe to attempt comparisons between this specimen and other known species.

Locality.—Van Horn's ranch, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 8550).

Family CELASTRACEÆ.

CELASTRUS DIGNATUS n. sp.

Pl. XI, fig. 5.

Leaves membranaceous, elliptical, or slightly obovate-elliptical in shape, truncate, or very obtuse and somewhat unequal-sided at base, truncate at apex; margin coarsely toothed, the teeth obtuse, upward pointing; petiole short and thick; midrib thick; secondaries about 10 pairs, alternate, at a low angle, craspedodrome, passing to the marginal teeth; nervilles numerous, mainly unbroken, at right angles to the secondaries; finer nervation, producing numerous small, irregularly quadrangular meshes.

Several specimens represent this species, all being of about the same size. They are in general elliptical-obovate, very obtusely wedge-shaped or truncate at base and rounded at apex. They are 4 cm. in length and 3 to 3.5 cm. in width. The petiole, preserved in only one example, is 5 mm. long and 2 mm. thick at the point of attachment. The toothed margin and characteristic nervation are well shown in the figures.

This species seems to have some affinity with *Celastrus inæqualis* Knowlton[a] from the Fort Union beds in the Yellowstone National Park. This differs, however, in being a much larger leaf, toothed only above the lower third of the blade, the teeth being also more obtuse. The general appearance of the two species, however, is strikingly similar.

Locality.—Mascall beds, Van Horn's ranch, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Knowlton and Merriam, July, 1901 (U. S. Nat. Mus., No. 8539).

CELASTRUS CONFLUENS, n. sp.

Pl. II, figs. 1–3.

Leaves membranaceous, elliptical in shape, wedge-shaped and slightly unequal-sided at base, obtuse but not truncate at apex; margin toothed, the teeth quite large, sharp pointed; midrib strong; secondaries, about twelve pairs, mainly alternate, at an angle of about 45° on one side of the blade and nearly a right angle on the other, camptodrome, arching very near the margin or forking and sending branches to the teeth; nervilles and finer nervation as in the last species.

This form is represented by several quite perfect leaves, which may possibly belong to the last species, but they are much larger and are unaccompanied by examples of intermediate size, so that it has seemed best to give them tentatively a new name. The best preserved example, which is also the largest, is 9 cm. long and 5 cm. wide. The

[a] Mon. U. S. Geol. Surv., Pl. XCVIII, fig. 3.

smallest example was apparently about 8 cm. long and is a little over 4 cm. wide.

Locality.—Mascall beds, Van Horn's ranch, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Merriam and Knowlton, July, 1901 (U. S. Nat. Mus., No. 8578).

Family ACERACEÆ.

ACER OSMONTI n. sp.

Pl. XIII, fig. 3.

Leaf membranaceous, five-lobed from the top of the petiole, lower pair of lobes small, at right angles to the midrib, other pair large, at an angle of 45° with the midrib; central lobe evidently largest of all (mainly destroyed); all lobes irregularly toothed and lobed, the lobes sharp pointed; petiole very long and strong; nervation palmately five-ribbed, the ribs ending in the main lobes, each with several pairs of alternate secondaries which emerge at an acute angle and terminate in the teeth of small lateral lobes; nervilles numerous, rather thin, mainly percurrent and crossing approximately at right angles to the secondaries; finer nervation producing rather large areolæ.

The genus Acer seems to be quite rare in the Bridge Creek beds, although abundantly represented in the Mascall beds at Van Horn's ranch and vicinity. All that I have thus far seen is the leaf here described, a fragment of another, and less than half a dozen fruits. The one under consideration lacks the major portion of the central lobe and the terminal portion of one of the large lateral lobes. It spreads about 8 cm. between the points of the lower lobes and about 11 cm. between the points of the larger lobes. The length of the leaf can not be determined, but it can hardly have been less than 9 or 10 cm. The petiole, very thick and stout for the size of the blade, has 4 cm. of its length retained and was evidently somewhat longer.

This leaf has a very modern appearance, much more so, in fact, than the forms found in the Mascall beds. It suggests at once the sugar maple (*Acer saccharum* Marshall) of the East and is not greatly unlike small leaves of *A. macrophyllum* Pursh, the common maple of the west coast.

This species is named in honor of Mr. V. C. Osmont, of the University of California, who collected it.

Locality.—Bridge Creek, Oregon. Collected by Merriam's party in 1900. (Type in Mus. Univ. Cal., No. 2505.) The fragmentary leaf above described is No. 8488 in the U. S. Nat. Mus. It was collected by Condon.

ACER sp., Knowlton.

Pl. XIII, figs. 1, 2.

ACER sp., Knowlton, in Merriam, Univ. Cal., Bull. Dept. Geol., Vol. II, No. 9, p. 289, 1901.

A fragment of a small, three-lobed leaf showing a portion of the base, one lateral lobe, and a part of the central lobe. The length appears to have been about 5 cm. and the width between the lobes about 5.5 cm. It is coarsely toothed.

Another fragment from the same locality has the base with a short portion of the petiole preserved. It appears to be the same as the other.

Locality—One and one-half miles east of Clarnos Ferry. Collected by Merriam's expedition of 1900. Types in Mus. Univ. Cal. Nos. 900, 932.

ACER BENDIREI Lesq.

ACER BENDIREI Lesq., Proc. U. S. Nat. Mus., Vol. XI, p. 14, Pl. V, fig. 5; Pl. VI, fig. 1; Pl. VII, fig. 1; Pl. VIII, fig. 1, 1888.

Acer trilobatum productum (Al. Br.) Heer. Lesquereux, Cret. and Tert. Fl., p. 253, Pl. LIX, figs. 1, 2, 4 (non fig. 3, which is *Platanus dissecta* Lesq.).

This species, as may be seen from the above synonymy, was first regarded by Lesquereux as referable to the European *A. trilobatum productum*, but later was raised to full specific rank. This name was also applied to several leaves from Carbon, Wyoming,[a] but they are clearly not the same as those under consideration. In the Cretaceous and Tertiary Floras (p. 253), Lesquereux records the specimens under discussion as coming from "Currant Creek, John Day Valley, Oregon." This is in error, as the types are preserved in the paleontological collection of the University of California (Nos. 1797, 1797a, 1797b), and are seen at once to have come from Van Horn's ranch. They are in the characteristic white volcanic tuff, and not the hard, brownish matrix of the Current Creek deposits.[b]

Locality.—Van Horn's ranch, South Fork of John Day River, 12 miles west of Mount Vernon, Grant County, Oregon. Original material collected by C. D. Voy about 1870 (Mus. Univ. Cal., Nos. 1797, 1797a, 1797b); since collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 2413), Dr. John C. Merriam (Mus. Univ. Cal., Nos. 850, 851), and F. H. Knowlton (U. S. Nat. Mus., Nos. 8940–8948).

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[a] Tert. Fl., p. 261, Pl. XLVIII, figs. 2, 3a, 1878.

[b] On Pl. LIX of the Cretaceous and Tertiary Floras, Lesquereux gives four figures which he refers to *Acer trilobatum productum* (now *A. Bendirei*), and all the specimens are said to be from the same locality, namely, "Currant Creek, Oregon." This is in error in regard to fig. 3, the original of which is preserved with the others in the Paleontological Collection of the University of California (No. 1835). This fragment was found to fit into and form a part of the same individual that is figured in the Auriferous gravel flora (Pl. V, fig. 3) under the name of *Aralia Zaddachi?* Heer. And further it was found that when so fitted together they produce a leaf that must be referred to *Platanus dissecta*. The locality, plainly marked on the back of each fragment, is Table Mountain, California.

ACER DIMORPHUM Lesq.

ACER DIMORPHUM Lesq., Proc. U. S. Nat. Mus., Vol. XI, p. 15, Pl. IX, fig. 1, 1888.

Locality.—Van Horn's ranch, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 2415).

ACER MERRIAMI n. sp.

Pl. XIV, fig. 7.

ACER n. sp., Knowlton in Merriam, Univ. Cal., Bull. Dept. Geol., Vol. II, No. 9, p. 309, 1901.

Leaf coriaceous in texture, palmately deeply three lobed, the lobes broad, roughly ovate in shape, of approximately the same size, lateral lobes at a low angle with the central lobe; all margin coarsely and irregularly toothed, being provided with low, irregular, mostly sharp-pointed teeth; petiole long, very thick; midrib thick, with six or more pairs of alternate, strong secondaries which end in the large teeth of the central lobe, and have smaller branches which pass to other marginal teeth; lateral ribs nearly as strong as the midrib, at a low angle, each with about seven pairs of alternate secondaries passing to the large teeth, and those on the lower side especially with short branches, which end in marginal teeth; nervilles numerous, thin, mainly percurrent and at right angles to the secondaries; finer nervation forming a rather coarse, irregularly quadrangular network.

The example figured is the only one that has thus far been found. It is a large, deeply three-lobed leaf about 12 cm. long, exclusive of the petiole (of which 2.5 cm. in length is preserved), and about 14 cm. broad. All three lobes are of approximately the same size, and all are irregularly toothed, the margin being provided with low, sharp-pointed teeth. The nervation is beautifully preserved.

Maples are abundant in these beds, and many leaves, fruits, and branches have been obtained. The leaf under consideration is markedly different from *Acer Bendirei*, which is perhaps the most abundant species present, but may possibly be a very broad, coarsely toothed form of *A. dimorphum*. The latter species is described by its author as being prolonged at base into two small lobes which open like wings on each side of the midrib. The lateral ribs, therefore, arise at some distance above the top of the petiole in the broad, basal portion of the blade. In the leaf before me there is no indication of the basal lobes that are so conspicuous in *A. dimorphum*, and the ribs appear to arise at the top of the petiole and at the very base of the blade. Further, the lobes are doubly dentate—that is, have large, irregular teeth or lobes, the margins of which are provided with low teeth. Therefore it seems most logical to regard them as distinct, at least for the present.

This species is not greatly unlike some forms of *Acer trilobatum tricuspidatum* Heer[a] of the Swiss Miocene.

I take great pleasure in naming this species in honor of Dr. John C. Merriam, who has done so much for the paleontology of this region.

Locality.—Van Horn's ranch, South Fork of John Day River, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Merriam's expedition of 1900. (Type in Mus. Univ. Cal., No. 869.)

ACER, branches of?

ACER, branches of? Lesquereux, Proc. U. S. Nat. Mus., Vol. XI, p. 15, 1888.

A number of branches supposed to belong to some species of Acer, but it is quite impossible to determine which one.

Locality.—Van Horn's ranch, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 2418).

ACER OREGONIANUM n. sp.

Pl. XIII, fig. 5–8.

Acer, fruits of, Lesquereux, Proc. U. S. Nat. Mus., Vol. XI, p. 15, Pl. VI, figs 2, 3, 1888.

Fruits long and broad-winged, the wing being evidently very thick and provided with numerous strong veins; nucleus large, round, showing broad truncation where attached to the sister fruit.

This form is so very abundant in all collections from these beds and admits so readily of separation that I have ventured to give it a name. It of course represents the fruit of one of the species founded on leaves that are also abundant in all collections, but thus far no fruit has been found attached to or even approximate to a leaf, and until so found it is more convenient to be able to refer to the fruits independently.

These fruits are, with the exception of that of *Acer gigas* (supra, p. 76), the largest ones found in these beds. They range in length from 3.5 to 4.5 cm. The wing is unusually broad, being not infrequently 1.75 cm. wide. It is filled with numerous strong veins, which are given off from the axis of the fruit in groups or bundles.

As Lesquereux has well suggested, these fruits most closely resemble those of the living *Acer macrophyllum* Pursh, the large-leaved maple so common on the Pacific coast; in fact, they are hardly to be distinguished.

Locality.—Abundant in Mascall beds at Van Horn's ranch and vicinity. All collectors have obtained it. Types of Lesquereux's figures in U. S. Nat. Mus., No. 2417. Types of figures in this paper collected by Knowlton and Merriam, July, 1901, in U. S. Nat. Mus., Nos. 8494–8497.

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[a] Fl. Tert. Helv., Vol. III, Pl. CXII, fig. 3.

ACER MEDIANUM n. sp.

Pl. XIV, figs. 4, 5.

Fruit large, lanceolate in shape; wing relatively narrow, filled with thin veins; nucleus round or oblong, the scar of attachment to its sister fruit very oblique.

This provisional species is represented by the two examples figured. The smaller is 4.25 cm. long and has the wing 1 cm. wide; the other is 4.75 cm. long and has a wing 1.25 cm. wide.

It is possible that there are merely very large fruits of the following species, as they are of approximately the same shape, but there are no intermediate specimens, and I have preferred to keep them separate for the present.

Locality.—Figure 4, the smaller, is from the original Van Horn's ranch locality; the other is from the white hill, one-half mile east of the first locality. Collected by Knowlton and Merriam, July, 1901 (U. S. Nat. Mus., Nos. 8498, 8499).

ACER MINOR n. sp.

Pl. XIV, figs. 2, 3.

Acer, fruits of, Lesquereux, Proc. U. S. Nat. Mus., Vol. XI, p. 15, Pl. VII, fig. 2, 1888.

Fruits of small size, similar in shape to the preceding species; length, 2.5 cm., width of wing, 8 mm.

As already stated, this may be the same as the preceding form, but the specimens are so much smaller, and moreover, as there are no intermediate specimens, it has seemed best to regard them as distinct.

Inasmuch as three species have been differentiated in these beds, based on leaves, it is natural to suppose that the fruits might also show differences, In any case it would seem easy to recognize the three forms of fruits here described.

Locality.—White hill one-half mile east of original Van Horn's ranch locality, Grant County, Oregon. Collected by Knowlton and Merriam, July, 1901 (U. S. Nat. Mus., Nos. 8500, 8501).

ACER GIGAS n. sp.

Pl. XIV, fig. 1.

Fruit of enormous size, very narrow; wing of nearly similar width throughout, filled with numerous but rather fine veins; nucleus very large, elliptical in shape.

This fine species is represented thus far by the single example figured, with its counterpart. It is a very long, narrow fruit, 9.5 cm. in length and only about 1.5 cm. in width. The nucleus or seed proper is large, being 2 cm. in long, and nearly 1 cm. in short, diameter.

The scar where it was attached to its sister fruit is oblique and very long.

I know nothing either living or fossil to which this fruit can be compared.

Locality.—Gulch 1 mile northeast of Belshaw's ranch, Grant County, Oregon. Collected by Knowlton and Merriam, July, 1901 (U. S. Nat. Mus., No. 8502).

RULAC CRATÆGIFOLIUM n. sp.

Pl. XVI, fig. 7.

Leaf coriaceous, trifoliolate or very deeply three-lobed, lateral leaflet (or lobe) roughly ovate-lanceolate in shape, irregularly, deeply cut into toothed lobes or large teeth near the apex, wedge-shaped at base, acuminate at apex; middle leaflet (or lobe) much smaller than the lateral ones, narrowly ovate-lanceolate, long, wedge-shaped below, very acuminate at apex, margin coarsely toothed; nervation of leaflets (or lobes) consisting of a strong midrib and several pairs of alternate rather thin secondaries which end in the lobes or teeth; finer nervation not preserved.

This species is represented only by the specimen figured, and this unfortunately is not sufficiently well preserved fully to reveal its character. It is presumably trifoliolate, but may be only deeply three-lobed. The larger leaflet is assumed from its position to be a lateral one, the middle one being much smaller. This lateral leaflet is 5.5 cm. in length, and 2.75 cm. in width between the larger lobes. The central leaflet is 4 cm. long and 1.25 cm. in width. Both are sessile.

Owing to the poor state of preservation it is not possible to fix the position of this leaf with certainty. In most trifoliolate leaves, if the leaflets differ in size, the middle one is usually the larger. In this case the larger leaflet of our specimen is the lateral one, and it is assumed to be lateral because it curves away from the smaller one and has a curved midrib, whereas the smaller one is erect and has a straight midrib.

With the limitations set by the imperfections of the specimen it is perhaps unwise to attempt comparisons between it and described forms, yet a few of these may be suggested. Thus the larger leaflet is not greatly unlike *Cratægus acerifolia* Lesq.,[a] from Florissant, Colorado, which itself is probably the same as a part at least of the leaves described as *Myrica diversifolia* Lesq.,[b] from the same locality. These are all long petioled, showing them to be leaves and not leaflets, whereas ours is sessile, showing that it is probably a leaflet.

[a] Cret. and Tert. Fl., p. 198, Pl. XXXVI, fig. 10. [b] Idem, p. 146, Pl. XXV, figs. 6–15.

If we assume the larger leaflet to be the central one of a trifoliolate leaf, it certainly suggests one of the specimens described by Lesquereux as *Rhus Hilliæ*,[a] also from Florissant. However, the other specimens classed with this one make it extremely improbable that ours is the same. I have, therefore, assumed that it belongs to Rulac (formerly Negundo), the well-known box elder, but it must remain for future collections to settle the question.

Locality.—Van Horn's ranch, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Knowlton and Merriam, July, 1901 (U. S. Nat. Mus., No. 8533).

Family HIPPOCASTANACEÆ.

ÆSCULUS SIMULATA n. sp.

Pl. XV, figs. 1, 2.

Leaflets rather membranaceous in texture, broadly obovate-lanceolate in shape, somewhat unequal-sided, long, wedge-shaped at base, rather abruptly rounded above to an apparently accuminate apex; margin minutely and regularly serrate throughout except for a short distance just above the base; midrib very thick; secondaries numerous, about 15 pairs, alternate, close, mainly parallel, forking or breaking up into two or three branches near the margin and ending in the teeth, occasionally camptodrome, with fine branches on the outside which enter the teeth; nervilles numerous, thin, mainly percurrent, oblique to the secondaries; finer nervation producing minute irregular areolæ.

This fine species is represented by several examples, two of the best being figured. As all are separate leaflets, it is impossible to determine their arrangement. They are short-petioled if not quite sessile. The smaller of the figured specimens has 6 cm. of its length preserved and was probably between 8 and 9 cm. long when perfect. It is 4 cm. wide. The larger specimen has above 9 cm. of its length preserved and is 6 cm. wide. The entire length was probably about 15 cm.

This species seems very close, indeed, to both *Æsculus octandra* and *Æ. glabra*, well-known living species of the eastern United States.

Locality.—White hill one-half mile east of original Van Horn's ranch locality. Collected by Knowlton and Merriam, July, 1901 (U. S. Nat. Mus., Nos. 8519, 8520).

Family SAPINDACEÆ.

SAPINDUS Merriami n. sp.

Pl. IX, fig. 5.

Coriaceous in texture, leaflets ovate in shape, obtusely wedge-shaped at base, obtuse at apex, alternate on the rachis; margin entire; midrib

[a] Cret. and Tert. Fl., p. 194, Pl. XLI., fig. 14 only.

thin, straight; secondaries few, thin, alternate; finer nervation not preserved.

The single example figured is all that can with certainty be referred to this form. It consists of a portion of the upper part of a rachis with two leaflets, neither of which is the terminal one. The lateral ones are alternate and obtusely ovate in shape.

This species resembles certain of the smaller examples referred to *S. obtusifolius* Lesq.,[a] and may possibly be this, but it is smaller and has a thinner secondary nervation.

Locality.—Bridge Creek, Oregon. Collected for the University of California. Type in Mus. Univ. Cal., No. 2506.

Sapindus obtusifolius Lesq.

Sapindus obtusifolius Lesq., Tert. Fl., p. 266, Pl. XLIX, figs. 10, 11, 1878; Cret. and Tert. Fl., p. 235, Pl. XLVIII, figs. 5–7, 1883.

A single example that seems to belong to this somewhat variable species. It is more like the examples figured from the Green River group, having the narrow shape, thick midrib, and very short petiole of those.

Locality.—Van Horn's ranch, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Merriam's expedition of 1900 (Mus. Univ. Cal., No. 892).

Sapindus angustifolius? Lesq.

Sapindus angustifolius Lesq., Proc. U. S. Nat. Mus., Vol. XI, p. 15, 1888.

The single example referred by Lesquereux to this species remains unique. I should incline to place it in Salix, yet, as it is obscurely preserved, I have permitted it to remain as above, but have questioned the correctness of the reference.

Locality.—Van Horn's ranch, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 2598).

Sapindus oregonianus n. sp.

Pl. XV, fig. 3.

Leaflet coriaceous in texture, elliptical or elliptical-obovate, very unequal-sided at base, apex destroyed; margin perfectly entire; petiole short, thick; midrib very thick; secondaries thin, about twelve pairs, emerging at a low angle, parallel, camptodrome, each arching and joining the one next above; nervilles very irregular, producing large areas between the secondaries, which are filled by the very fine ultimate nervation.

[a] Tert. Fl., p. 266, Pl. XLIX, figs. 8–11, 1878.

The only specimen referred to this species lacks the upper portion. It appears to have been about 5 cm. in length and nearly 3 cm. in width, with a petiole 4 mm. long. The nervation is well shown in the figure.

I at first inclined to refer this to *Sapindus obtusifolius* Lesq.,[a] which has been found southeast of Green River station, Wyoming, in beds supposed to be "Washakie" in age, and also in the Fort Union beds of Montana and North Dakota. It has about the same size and shape, although perhaps rather elliptical than ovate. The principal difference is in the secondaries, these being more numerous at a lower angle of divergence and less curved upward. The disposition of the nervilles is much the same in both. However, these two species are close, and possibly a series of specimens would show them to be identical.

Locality.—Mascall beds, Van Horn's ranch, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Knowlton and Merriam, July, 1901 (U. S. Nat. Mus., No. 8538).

Family RHAMNACEÆ.

RHAMNUS CLEBURNI? Lesq.

RHAMNUS CLEBURNI Lesq., Tert. Fl., p. 280, Pl. LIII, figs. 1–3, 1878.

The collections made by Merriam's expedition contain a single broken specimen that may belong to this species, but it is only the upper portion of the blade, and it is impossible to identify this specimen with certainty in the absence of the basal portion. It seems to be this species, however.

Locality.—Cherry Creek, Cook County, Oregon. Collected by Merriam's expedition in 1900 (Mus. Univ. Cal., No. 180).

RHAMNUS ERIDANI Unger.

RHAMNUS ERIDANI Unger. Newberry, Later Extinct Floras, p. 118, Pl. XLVIII, fig. 7, 1898.

Locality.—Bridge Creek, Grant County, Oregon. Collected by Rev. Thomas Condon (U. S. Nat. Mus., No. 9103).

Family TILIACEÆ.

GREWIA CRENATA (Unger) Heer.

GREWIA CRENATA (Unger) Heer, Fl. Tert. Helv., Vol. III, p. 42, Pl. CIX, figs. 12–21; Pl. CX, figs. 1–11, 1859; Ward, Types of the Laramie Flora, p. 85, Pl. XXXIX, fig. 1, 1887; Newberry, Later Extinct Floras, p. 120, Pl. XLVI, fig. 2; Pl. XLVII, figs. 2, 3, 1898 (1899).

Paliurus colombi Heer. Lesquereux, Proc. U. S. Nat. Mus., Vol. XI, p. 16, 1888.

Grewia crenata was first found in this area at Bridge Creek, and the specimens figured by Newberry, as well as a number of others

[a] Tert. Fl., p. 266, Pl. XLIX, figs. 8–11, 1878.

since obtained, are before me. They not only agree among themselves but quite closely, indeed, with the figures of this species given by Heer. There can be no reasonable doubt as to their identity.

A number of specimens have been found in the Mascall beds at Van Horn's ranch and vicinity that must also be referred to *Grewia crenata*. The single example referred by Lesquereux to *Paliurus colombi* probably belongs here, although it is very much like certain forms of *Populus Zaddachi* from the Auriferous gravels of California. The leaves, three in number, from the Mascall beds are a little narrower than those from Bridge Creek, and are somewhat more deeply cordate or auriculate at base, but the differences are not sufficient to warrant separating them.

Locality.—Bridge Creek, Oregon. Collected by Rev. Thomas Condon (U. S. Nat. Mus., Nos. 7077, 7078, 7079) and Maj. Charles E. Bendire (U. S. Nat. Mus., No. 9532). Mascall beds, Van Horn's ranch and vicinity. Collected by Major Bendire (U. S. Nat. Mus., No. 2542) and by Knowlton and Merriam July, 1901 (U. S. Nat. Mus., Nos. 8990, 8991).

GREWIA AURICULATA Lesq.

GREWIA AURICULATA Lesq., Cret. and Tert. Fl., p. 252, Pl. LV, fig. 1, 1883.

This species appears to rest on the single example figured as the type. None of the recent collections contain it, although there are a number of specimens of *G. crenata*.

The type of *G. auriculata* should be in the University of California, but it can not now be found. If it has been correctly figured it seems to be very different from the other leaves of Grewia found in the same beds, although it may be only an abnormal form of that species.

Locality.—Bridge Creek, Grant County, Oregon. Collected by Rev. Thomas Condon.

Family ARALIACEÆ.

ARALIA DIGITATA Ward.

ARALIA DIGITATA Ward. Lesquereux, Proc. U. S. Nat. Mus., Vol. XI, p. 20, Pl. XI, fig. 4, 1888.

Locality.—Cherry Creek, Crook County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 2424).

ARALIA sp. ?

Aralia notata Lesq., Proc. U. S. Nat. Mus., Vol. XI, p. 20, 1888.

The collection contains the example referred to *Aralia notata* by Lesquereux and a fragment of the base of another. There is hardly

sufficient data to warrant placing them in this species, and until further material can be obtained it seems best to leave them as above indicated.

Locality.—Cherry Creek, Crook County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., Nos. 2426, 2430).

ARALIA ? sp. Knowlton.

Pl. XVI, fig. 8.

ARALIA ? sp., Knowlton in Merriam, Univ. Cal., Bull. Dept. Geol., Vol. II, No. 9, p. 289, 1901.

A fragment of what appears to be the upper part of a lobe of an Aralia. It has an entire margin and alternate, much curved, rather thin secondaries.

This may be the upper portion of a single leaf like Juglans, but on the slab appears more like Aralia If this latter view be true, its form can only be conjectured.

Locality.—Three miles above Clarnos Ferry. Collected by Merriam's expedition of 1900 (Mus. Univ. Cal., No. 912).

ARALIA sp., Knowlton.

Plate XV, fig. 4.

ARALIA sp., Knowlton in Merriam, Univ. Cal., Bull. Dept. Geol., Vol. II, No. 9, p. 289, 1901.

The fragmentary upper portion of a large leaf, showing portions of three lobes. The lobes are some 5 or 6 cm. in length and about 3 cm. in width. They appear to be without teeth.

It is impossible to tell from this fragment what it is. It may be the upper portion of a moderate sized leaf of *Aralia Whitneyi* Lesq.

Locality.—Three miles above Clarnos Ferry. Collected by Merriam's expedition of 1900 (Mus. Univ. Cal., No. 913).

ARALIA WHITNEYI? Lesq.

ARALIA WHITNEYI Lesq., Foss. Pl. Aurif. Gravel, p. 20, Pl. V, fig. 1, 1878; Proc. U. S. Nat. Mus., Vol. XI, p. 16, 1888.

The early collection from Van Horn's ranch contained a single example that Lesquereux referred with some doubt to this species, and the later collection also contains a single specimen which I assume to belong here. It is a smaller leaf than the figured type, which is itself much smaller than the normal-sized leaves, and naturally has shorter lobes, but it can hardly be anything else.

Locality.—Van Horn's ranch, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 2429). Smaller specimen obtained by Merriam's expedition in 1900 (Mus. Univ. Cal., No. 845).

Family CORNACEÆ.

CORNUS FEROX? Unger.

CORNUS FEROX Unger. Lesquereux, Proc. U. S. Nat. Mus., Vol. XI, p. 21, 1888.

A single much-broken example is all that was found. Its identification is extremely doubtful, and is permitted to stand simply for the purpose of calling attention to the fact that there is present in these beds a large leaf that, while resembling *Cornus ferox*, is of practically unknown affinity. For purposes of correlation it is obviously of no value.

Locality.—Cherry Creek, Crook County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 2452).

Family ERICACEÆ.

ANDROMEDA CRASSA Lesq.

Pl. XVI, fig. 3.

ANDROMEDA CRASSA Lesq., Proc. U. S. Nat. Mus., Vol. XI, p. 16, 1888.

This species has not before been figured. It still rests on the type specimen.

Locality.—Van Horn's ranch, South Fork of John Day River, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 8511).

Family EBENACEÆ.

DIOSPYROS ALASKANA Schimper.

DIOSPYROS ALASKANA Schimper, Pal. Vég., Vol. II, p. 949, 1872.
Diospyros lancifolia Lesq., Proc. U. S. Nat. Mus., Vol. XI, p. 21, 1888.

Represented by the upper portions of two leaves only; probably correctly identified.

Locality.—Cherry Creek, Crook County, Oregon. Collected by Maj. Charles E. Bendire. (U. S. Nat. Mus., No. 2461.)

DIOSPYROS ELLIPTICA n. sp.

Pl. XVI, fig. 5.

Leaf coriaceous in texture, elliptical in shape, rounded at base to the short petiole, very obtuse at apex; midrib very thick; secondaries four or five pairs, thin, alternate, at an angle of about 45°, camptodrome arching and joining well inside the margin with a fine mesh outside; intermediate secondaries occasional; finer nervation producing an irregular network.

Of this species I have only seen the leaf figured. It is elliptical in outline, very obtuse at apex, and rounded at base. It is 3.25 cm. in length to the petiole, which is less than 3 mm. long and 2 cm. in width. The nervation consists of a very thick midrib and some four or five pairs of alternate thin secondaries which arch and join some distance from the margin.

This species has the nervation of living American species of Diospyros, but is more obtuse at apex than is usual in these leaves.

Locality.—Van Horn's ranch, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Knowlton and Merriam, July, 1901, (U. S. Nat. Mus., No. 8556).

Family OLEACEÆ.

FRAXINUS INTEGRIFOLIA Newb.

FRAXINUS INTEGRIFOLIA Newb., Proc. U. S. Nat. Mus., Vol. V, p. 509. 1883; Later Extinct Floras, p. 128, Pl. XLIX, figs. 1-3, 1898.

This species is represented in all the collections from Bridge Creek by a large number of examples which agree exactly with Newberry's types. When the lower surface of the leaves is exposed the nervation shows clearly, but when the upper surface is the one exposed it is impossible to detect a trace of the nervation. This shows conclusively that the leaves were very thick and coriaceous. The upper surface is also minutely wrinkled, as would be the case with a thick, leathery leaf. From these considerations I am inclined to doubt the correctness of referring them to Fraxinus, but for the present they may be so retained.

Locality.—Bridge Creek, Grant County, Oregon. Collected by Rev. Thomas Condon (U. S. Nat. Mus., Nos. 7062, 7090) and Maj. Charles E. Bendire (U. S. Mus., Nos. 7062, 7090).

FRAXINUS DENTICULATA Heer?

FRAXINUS DENTICULATA Heer? Newberry, Later Extinct Floras, p. 128, Pl. XLIX, fig. 6, 1898.

More or less doubt still attaches to this form.

Locality.—Bridge Creek, Grant County, Oregon. Collected by Rev. Thomas Condon.

INCERTÆ SEDES.

PHYLLITES WASCOENSIS Lesq.

PHYLLITES WASCOENSIS Lesq., Proc. U. S. Nat Mus., Vol. XI, p. 22, Pl. XIV, fig. 3, 1888.

Locality.—Cherry Creek, Crook County, Oregon. Collected by Maj. Charles E. Bendire (U. S. Nat. Mus., No. 2633).

PHYLLITES sp.

Pl. XVII.

The recent material from Cherry Creek contains the single fragment figured, which is just sufficient to show that a leaf of immense size was present in these beds. It is a segment, evidently from near the middle of the blade, showing a width of at least 22 cm. Apparently little or none of the margin is retained.

So little of this leaf is preserved that it is impossible to conjecture as to its affinity.

Locality.—Cherry Creek, Crook County, Oregon. Collected by Knowlton and Merriam, July, 1901.

PHYLLITES OREGONIANUS n. sp.

Pl. XVI, fig. 1.

Phyllites n. sp., Knowlton in Merriam, Univ. Cal., Bull. Dept. Geol., Vol. II, No. 9, p. 303, 1901.

Leaf of firm texture, lanceolate, narrowly wedge-shaped at base, acuminate at apex; margin perfectly entire; midrib very thin; secondaries very thin, about eight pairs, alternate, arising at an acute angle and much curving upward, camptodrome; nervilles few, obscure; finer nervation not preserved.

The example figured is about 6.5 cm. long and about 1.5 cm. wide. Another much-broken example was apparently about the same length, but was nearly 3 cm. broad. It has the same kind of secondaries and has the nervilles better preserved, these being usually broken.

I am uncertain as to the affinities of this little leaf, although in some respects it suggests Cornus.

Locality.—Three and one-half miles south of Lone Rock, Gilliam County, Oregon. Collected by Merriam's expedition of 1900 (Mus. Univ. Cal., No. 1334).

PHYLLITES BIFURCIES n. sp.

Pl. XVI, fig. 2.

Leaf coriaceous, ovate or ovate-elliptical in shape, abruptly rounded at base (apex destroyed), with a single triangular-lanceolate, acuminate basal lobe; margin otherwise coarsely toothed, the teeth sharp, pointing upward; petiole short, strong; midrib very strong below, becoming very thin above; secondaries numerous, thin, somewhat irregular, ending in the lobe and marginal teeth; finer nervation not retained.

The curious leaf figured is apparently all that is represented of this form. It was apparently between 7 and 8 cm. in length, exclusive of the petiole, nearly 1 cm. long, and is 4.5 cm. broad between the tip of

the long lobe and the opposite of the blade. The major part of the blade is only 3 cm. broad. The single basal lobe is 2 cm. long.

This leaf presents a very curious appearance with the long, sharp-pointed lobe on one side, and it is quite possible that it is an abnormal example perhaps of some well-known form. If it is the normal form, it is certainly one that will be readily recognizable in future. Its affinity is obviously in doubt. If it were not for the presence of the single basal lobe it might perhaps be referred to Betula, but I do not know any species, either living or fossil, with which it can be satisfactorily compared.

Locality.—White hill one-half mile east of original Van Horn's ranch locality, 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Knowlton and Merriam, July, 1901 (U. S. Nat. Mus., No. 8537).

PHYLLITES INEXPECTANS n. sp.

Pl. XVI, fig. 6.

Leaf evidently coriaceous, obovate-lanceolate in shape, narrowed below, obtuse and rounded at apex; margin perfectly entire; petiole long, very strong for the size of the leaf; midrib also very strong; other nervation obscure.

This form is represented by the example figured. It is narrowly obovate-lanceolate in outline, 3.25 cm. long and 9 mm. wide at the broadest part, which is near the upper extremity. The petiole is 6 mm. long. Unfortunately nothing of the nervation except the thick midrib is preserved.

This leaf resembles quite closely certain of the leaves referred to *Quercus convexa* Lesq.,[a] from the Auriferous gravels of California. These leaves are uniformly thick and coriaceous, yet the nervation shows distinctly in all cases. Our leaf is apparently no thicker, yet has no trace of the nervation beyond the midrib. The petiole in *Q. convexa* is uniformly short, whereas in the leaf under discussion it is several times longer, being about one-fourth the length of the blade.

On the whole, this leaf is perhaps closest to *Phyllites obscurus* Knowlton,[b] from the Payette formation of Idaho. This latter species, however, is elliptical-lanceolate or slightly ovate-lanceolate, while ours is distinctly obovate-lanceolate. The petiole and midrib are similar, and both also lack details of nervation. Perhaps a larger series might show them to grade together.

Locality.—Van Horn's ranch, about 12 miles west of Mount Vernon, Grant County, Oregon. Collected by Knowlton and Merriam, July, 1901 (U. S. Nat. Mus., No. 8547).

[a] Foss. Pl. Aurif. Gravel, p. 4, Pl. I, figs. 13-17; Cret. and Tert. Fl., p. 265, Pl. XLV, figs. 5, 6.
[b] Eighteenth Ann. Rept. U. S. Geol. Surv., Pt. III, p. 735, Pl. XCIX, figs. 10, 11, 1898.

PHYLLITES PERSONATUS n. sp.

Plate XVI, fig. 4.

Leaf evidently thick and leathery in texture, narrowly obovate-lanceolate in shape, long, wedge-shaped at base, acuminate at apex; margin perfectly entire; midrib very thin, almost disappearing above; secondaries three or four pairs, very thin and obscure, the two lower pairs close together near the base of the blade, at an acute angle, passing up for a long distance, camptodrome and apparently joining the one next above; nervilles obscure, apparently arising at an acute angle from the secondaries and soon lost; finer nervation not satisfactorily discernible.

The single specimen figured is all I have seen of this form. It is a small leaf, about 4.5 cm. long and 1.5 cm. wide, being slightly obovate-lanceolate in shape. From the faint impression of the nervation as well as the wrinkled appearance it is inferred that the leaf was of thick and leathery texture.

Locality.—Cherry Creek, Crook County, Oregon. Collected by Knowlton and Merriam, July, 1901 (U. S. Nat. Mus., No. 8554).

SPECIES EXCLUDED FROM THIS WORK.

A number of species that are not now recognized have, at one time or another, been referred to the various beds within the John Day Basin. The reasons for excluding each are set forth in the following list:

Alnus corrallina Lesq., Cret. and Tert. Fl., p. 243, Pl. LI, figs. 1–3, 1883. The original of fig. 1 is said by Lesquereux to be from "John Day Valley, Oregon." This specimen is No. 1944 of the paleontological collection of the University of California, and is from south of Mount Diablo, California, agreeing with others from the same place, and being so marked on the back.

Betula elliptica Saporta. Lesq., Cret. and Tert. Fl., p. 242, Pl. LI, fig. 6, 1883. Said by Lesquereux to be from "John Day Valley, Oregon." It is No. 1760 of the paleontological collection of the University of California, and is from south of Mount Diablo, California.

Betula parce-dentata Lesq., Cret. and Tert. Fl., p. 242, Pl. L, fig. 12, 1883. Said by Lesquereux to be from "John Day Valley, Oregon." It is from south of Mount Diablo, California, and is No. 1955 of the paleontological collection of the University of California.

Berchemia multinervis (Al. Br.) Heer. Lesquereux, Proc. U. S. Nat. Mus., Vol. XI, p. 16, 1888. Not found in the collection of the United States National Museum. Omitted for lack of evidence.

Populus glandulifera Heer. Lesquereux, Proc. U. S. Nat. Mus., Vol. XI, p. 18, 1888. A single broken example that it is impossible to identify.

Quercus lonchitis Unger. Lesquereux, Proc. U. S. Nat. Mus., Vol. XI, p. 22, 1888. Much broken and impossible of identification.

Quercus fraxinifolia Lesq., op. cit., p. 22. Discarded for same reasons as the last.

Quercus Olafseni Heer. Lesquereux, op. cit., p. 22. Rejected for the same reason as the last two.

Juglans Lecontcana Lesq., op. cit., p. 22. Same as the last.

Juglans denticulata Heer. Lesquereux, op. cit., p. 22. Could not be found in the collection of the United States National Museum.

Pteris elegans Newb., Proc. U. S. Nat. Mus., Vol. V, p. 503, 1883. Not recognized by its author in his Later Extinct Floras and specimens now lost, so far as known.

LIST OF SYNONYMS.

As a considerable number of changes in the names and disposition of species have been made in the present paper, the following list of changes is presented for the convenience of users of previous literature:

Acer, fruit of, Lesq., Proc. U. S. Nat. Mus., Vol. XI, p. 15=*Acer oregonianum*, n. sp.

Acer trilobatum productum (Al. Br.) Heer. Lesq., Cret. and Tert. Fl., Pl. LIX, figs. 1, 2, 4 = *Acer Bendirei* Lesq.; fig. 3=*Platanus dissecta* Lesq.

Aralia pungens Lesq., Proc. U. S. Nat. Mus., Vol. XI, p. 16 = *Artocarpus californica?* Knowlton.

Carpinus pyramidalis (Göpp.) Heer. Lesq., Proc. U. S. Nat. Mus., Vol. XI, p. 18 = *Carpinus grandis?* Unger.

Carpinus, involucre of = *Betula heteromorpha.*

Carya elænoides (Ung.) Heer. Lesq., Proc. U. S. Nat. Mus., Vol. XI, p. 18 = *Hicoria elænoides* (Ung.) Knowlton.

Cassia phaseolites? Unger. Lesq., Proc. U. S. Nat. Mus., Vol. XI, p. 16 = *Salix Engelhardti* Lesq.

Castanea atavia Unger. Lesq., Cret. and Tert. Fl., p. 247, Pl. LII, fig. 2 = *Quercus horniana* Lesq.

Diospyros lancifolia Lesq. = *D. alaskana* Schimp.

Equisetum Hornii Lesq. = *E. oregonense* Newb.

Fagus castaneæfolia Unger. Lesq., Proc. U. S. Nat. Mus., Vol. XI, p. 18 = *Fagus?* sp.

Ficus? Condoni Newb. = *Platanus Condoni* (Newb.) Knowlton.

Fraxinus affinis Newb. = *Quercus affinis* (Newb.) Knowlton.

Ilex longifolia Heer. Lesq., Proc. U. S. Nat. Mus., Vol. XI, p. 21 = *Juglans? Bendirei* Knowlton.

Juglans hesperia Knowlton = *J. oregoniana* Lesq.

Lastrea Knightiana Newb. = *Lastrea Fischeri* Heer.

Liquidambar europæum Al. Br. Lesq., Proc. U. S. Nat. Mus., Vol. XI, p. 14 = *L. europæum patulum*, n. var.

Lygodium neuropteroides Lesq. = *L. Kaulfusii* Heer.

Marsilea Bendirei Ward = *Hydrangea Bendirei* (Ward) Knowlton.

Myrica diversifolia Lesq., Cret. and Tert. Fl., Pl. L., fig. 10 = *Cratægus flavescens* Newb.

Myrica Lessigii? Lesq., Proc. U. S. Nat. Mus., Vol. XI, p. 16 = *Artocarpus californica?* Knowlton.

Paliurus colombi Heer. Lesq., Proc. U. S. Nat. Mus., Vol. XI, p. 16 = *Grewia crenata* (Unger.) Heer.

Platanus Raynoldsii Newb. Lesq., Proc. U. S. Nat. Mus., Vol. XI, p. 19 = *Platanus* sp.

Populus monodon Lesq., Proc. U. S. Nat. Mus., Vol. XI, p. 21 = *Magnolia Culveri* Knowlton.

Populus polymorpha Newb., in part = *Betula heterodonta* Knowlton, *Quercus pseudoalnus* Ett., and *Quercus oregoniana* Knowlton.

Porana Bendirei (Ward) Lesq. = *Hydrangea Bendirei* (Ward) Knowlton.

Pteris pinnæformis Heer. = *P. pseudo-pinnæformis* Lesq.

Pteris subsimplex Lesq. = *Asplenium subsimplex* (Lesq.) Knowlton.

Quercus Breweri Lesq., Cret. and Tert. Fl., Pl. LIV, fig. 9 = *Q. affinis* (Newb.) Knowlton.

Quercus furcinervis (Rossm.) Unger. Lesq., Proc. U. S. Nat. Mus., Vol. XI, p. 22 = *Q. furcinervis americana* Knowlton.

Quercus pseudo-lyrata acutiloba Lesq., Proc. U. S. Nat. Mus., Vol. XI, p. 17 = *Q. pseudo-lyrata* Lesq.

Quercus pseudo-lyrata angustiloba Lesq., op. cit., p. 17 = *Q. Merriami* Knowlton

Quercus pseudo-lyrata brevifolia Lesq., op. cit., p. 18 = *Q. pseudo-lyrata* Lesq.

Quercus pseudo-lyrata latifolia Lesq., op. cit., p. 18 = *Q. pseudo-lyrata* Lesq.

Quercus pseudo-lyrata obtusiloba Lesq., op. cit., p. 18 = *Q. pseudo-lyrata* Lesq.

Rhus Bendirei Lesq., Proc. U. S. Nat. Mus., Vol. XI, p. 15 (the small leaflet described) = *Juglans oregoniana* Lesq.

Sequoia Nordenskiöldii Heer. Lesq., Proc. U. S. Nat. Mus., Vol. XI, p. 19 = *S. angustifolia* Lesq.

Taxodium distichum miocenum Heer. Newberry, Later Extinct Floras, Pl. XLVII, fig. 6 = *Sequoia Langsdorfii* (Brgt.) Heer.

Ulmus pseudo-americana Lesq. = *U. speciosa* Newb.

Ulmus speciosa Newb., Later Extinct Floras, Pl. XLV, figs. 5, 8 = *Ulmus Newberryi* Knowlton.

DISCUSSION OF THE FLORA

STATISTICAL VIEW.

The fossil flora of the John Day Basin, as set forth in the preceding pages, is seen to be a rich and interesting one. Although the present enumeration comprises all that is now known regarding the fossil plants, it is probably still far from complete, as every collection contains a good proportion of new forms. But as it is in a measure a type locality, it has seemed proper to present a summary of existing knowledge, in order that the information may be made available for use in contiguous and obviously related areas.

The following table has been prepared for the purpose of bringing out the local distribution and the stratigraphic relationships of the plants:

Table showing distribution of species in the John Day Basin, Oregon.

Page of this work.	Species.	Currant Creek.	Cherry Creek.	Bridge Creek.	1½ miles E. of Clarnos Ferry.	3 miles above Clarnos Ferry.	¼ mile NE. of Fossil.	3½ miles S. of Lone Rock.	Van Horn's ranch and vicinity.	Officer's ranch.
		1	2	3	4	5	6	7	8	9
21	Lygodium Kaulfusii Heer	....	×	....	....	....	....	....	....	....
21	Asplenium subsimplex (Lesq.) Kn.	....	×	....	....	....	....	....	....	....
22	Pteris pseudo-pinnæformis? Lesq.	×	....	....	....	....	....	....	....	....
22	Lastrea Fischeri? Heer	×	....	....	....	....	....	....	....	....
22	Equisetum oregonense Newb.	×	×	....	....	....	....	....	....	....
23	sp.	....	....	....	....	....	....	....	×	....
23	Ginkgo sp.	....	....	....	....	....	....	....	×	....
23	Sequoia Heerii Lesq.	....	....	×	....	....	....	....	....	....
24	angustifolia Lesq.	....	....	....	....	....	....	....	×	....

Table showing distribution of species in the John Day Basin, Oregon—Continued.

Page of this work.	Species.	Currant Creek.	Cherry Creek.	Bridge Creek.	1½ miles E. of Clarnos Ferry.	3 miles above Clarnos Ferry.	½ mile NE. of Fossil.	3½ miles S. of Lone Rock.	Van Horn's ranch and vicinity.	Officer's ranch.
		1	2	3	4	5	6	7	8	9
25	Sequoia Langsdorfii (Brgt.) Heer			×	×		×	×	×	
26	sp								×	
26	Thuites sp								×	
26	Glyptostrobus Ungeri Heer								×	
27	Taxodium dist. miocenum Heer								×	
27	male aments of								×	
27	Phragmites œningensis Al. Br								×	
28	Cyperacites sp								×	
28	Smilax Wardii Lesq								×	
28	Monocotyledonous plant			×						
29	Populus Lindgreni Kn								×	
29	Salix Schimperi Lesq		×							
29	Engelhardti Lesq								×	
30	Ræana? Heer								×	
30	varians Göppert								×	
30	angusta Al. Br								×	
30	amygdalæfolia Lesq								×	
31	pseudo-argentea n. sp								×	
31	dayana n. sp								×	
31	perplexa n. sp								×	
32	mixta n. sp								×	
32	sp.? Knowlton							×		
33	Myrica oregoniana n. sp								×	
33	? personata n. sp						×			
34	Juglans rugosa Lesq		×							
34	? Bendirei n. sp		×							
34	Schimperi? Lesq			×						
35	acuminata? Al. Br			×						
35	cryptata n. sp			×						
36	crassifolia n. sp							×		
36	oregoniana Lesq								×	
37	Hicoria? oregoniana n. sp		×							
38	sp?			×						
38	elænoides (Ung.) Kn								×	
38	Carpinus betuloides Unger			×						
38	grandis? Unger								×	
38	Corylus MacQuarrii (Forbes) Heer			×						
39	Betula heteromorpha n. sp			×						
40	heterodonta Newb			×						
40	Bendirei n. sp			×						
41	angustifolia Newb			×						
41	? dayana n. sp								×	
42	Alnus carpinoides Lesq			×	×		×			
42	serrulata fossilis Newb			×						
42	macrodonta n. sp			×						
42	sp.? fruit of, Newb			×						
43	Kefersteinii? (Göpp.) Unger								×	
43	Fagus? sp								×	
43	Quercus furcinervis Americana Kn		×							
43	? sp		×							

Table showing distribution of species in the John Day Basin, Oregon—Continued.

Page of this work.	Species.	Currant Creek.	Cherry Creek.	Bridge Creek.	1½ miles E. of Clarnos Ferry.	3 miles above Clarnos Ferry.	½ mile NE. of Fossil.	3½ miles S. of Lone Rock.	Van Horn's ranch and vicinity.	Officer's ranch.
		1	2	3	4	5	6	7	8	9
44	Quercus paucidentata Newb			×						
44	drymeja Unger			×						
44	simplex Newb			×						×
45	affinis (Newb.) Kn			×						
45	consimilis Newb			×						×
46	Breweri Lesq			×						
46	pseudo-alnus Ett			×						
47	oregoniana n. sp			×						
48	pseudo-lyrata Lesq									
49	Merriami n. sp								×	
50	duriuscula n. sp								×	
51	ursina n. sp								×	
51	dayana n. sp								×	
52	horniana Lesq								×	
53	? sp. Knowlton								×	
53	Ulmus speciosa Newb			×					×	
54	Newberryi n. sp			×						
55	plurinervia Unger								×	
55	californica? Lesq								×	
55	Planera Ungeri Ett								×	
55	Ficus tenuinervis Lesq		×							
56	planicostata? Lesq			×						
56	? oregoniana Lesq								×	
56	Artocarpus californica? Kn								×	
56	Berberis simplex Newb			×						
57	gigantea n. sp								×	
58	Magnolia lanceolata Lesq		×?						×	
58	Culveri Kn		×							
58	Inglefieldi Heer								×	
58	Laurus oregoniana n. sp								×	
59	Cinnamomum Dilleri Kn		×							
59	Bendirei n. sp			×						
60	Hydrangea Bendirei (Ward) Kn								×	
62	Liquidambar europæum Al. Br			×						
62	europæum n. var								×	
62	protensum? Unger								×	
63	pachyphyllum n. sp								×	
63	sp.?								×	
64	Platanus aspera Newb			×						
64	Condoni (Newb.) Kn			×						×
65	nobilis? Newb								×	
65	aceroides? (Göpp.) Heer								×	
66	sp								×	
66	Cratægus flavescens Newb			×						×
66	imparilis n. sp								×	
67	Prunus ? Merriami n. sp								×	
68	tufacea n. sp								×	
69	Acacia oregoniana Lesq								×	
69	Cassia ? sp. Newb			×						
69	Ailanthus ovata Lesq			×						

Table showing distribution of species in the John Day Basin, Oregon—Continued.

Page of this work.	Species.	Currant Creek.	Cherry Creek.	Bridge Creek.	1½ miles E. of Clarnos Ferry.	3 miles above Clarnos Ferry.	½ mile NE. of Fossil.	3½ miles S. of Lone Rock.	Van Horn's ranch and vicinity.	Officer's ranch.
		1	2	3	4	5	6	7	8	9
70	Rhus Bendirei Lesq	----	----	----	----	----	----	----	×	----
70	? sp. Lesq	----	----	----	----	----	----	----	×	----
71	Celastrus dignatus n. sp	----	----	----	----	----	----	----	×	----
71	confluens n. sp	----	----	----	----	----	----	----	×	----
72	Acer Osmonti n. sp	----	----	×	----	----	----	----	----	----
73	sp	----	----	----	×	----	----	----	----	----
73	Bendirei Lesq	----	----	----	----	----	----	----	×	----
74	dimorphum Lesq	----	----	----	----	----	----	----	×	----
74	Merriami n. sp	----	----	----	----	----	----	----	×	----
75	branches of	----	----	----	----	----	----	----	×	----
75	oregonianum n. sp	----	----	----	----	----	----	----	×	----
76	medianum n. sp	----	----	----	----	----	----	----	×	----
76	minor n. sp	----	----	----	----	----	----	----	×	----
76	gigas n. sp	----	----	----	----	----	----	----	×	----
77	Rulac cratægifolium n. sp	----	----	----	----	----	----	----	×	----
78	Æsculus simulata n. sp	----	----	----	----	----	----	----	×	----
78	Sapindus Merriami n. sp	----	----	×	----	----	----	----	----	----
79	obtusifolius Lesq	----	----	----	----	----	----	----	×	----
79	angustifolius ? Lesq	----	----	----	----	----	----	----	×	----
79	oregonianus n. sp	----	----	----	----	----	----	----	×	----
80	Rhamnus Cleburni? Lesq	----	×	----	----	----	----	----	----	----
80	Eridani Unger	----	----	×	----	----	----	----	----	----
80	Grewia crenata (Ung.) Heer	----	----	×	----	----	----	----	×	----
81	auriculata Lesq	----	----	×	----	----	----	----	----	----
81	Aralia digitata Ward	----	×	----	----	----	----	----	----	----
81	sp.?	----	×	----	----	----	----	----	----	----
82	? sp. Knowlton	----	----	----	----	×	----	----	----	----
82	sp. Knowlton	----	----	----	----	×	----	----	----	----
82	Whitneyi? Lesq	----	----	----	----	----	----	----	----	----
83	Cornus ferox? Unger	----	×	----	----	----	----	----	----	----
83	Andromeda crassa Lesq	----	----	----	----	----	----	----	×	----
83	Diospyros alaskana Schimp	----	×	----	----	----	----	----	----	----
83	elliptica n. sp	----	----	----	----	----	----	----	×	----
84	Fraxinus integrifolia Newb	----	----	×	----	----	----	----	----	----
84	denticulata? Heer	----	----	×	----	----	----	----	----	----
84	Phyllites wascoensis Lesq	----	×	----	----	----	----	----	----	----
85	sp	----	×	----	----	----	----	----	----	----
85	oregonianus n. sp	----	----	----	----	----	----	×	----	----
85	bifurcies n. sp	----	----	----	----	----	----	----	×	----
86	inexpectans n. sp	----	----	----	----	----	----	----	×	----
87	personatus n. sp	----	----	----	----	----	----	----	×	----

An examination of the table shows that the flora as at present understood comprises 150 forms, of which number 44 species and 1 variety are described as new to science. Of the remaining number 24 are forms not specifically named, thus leaving 81 species, or about 53 per cent, of previously known species.

The following table shows at a glance the number of forms found at each of the localities:

Table showing the number of forms at each locality.

Currant Creek	3
Cherry Creek	20
Bridge Creek	46
One and one-half miles east of Clarnos Ferry	3
Three miles above Clarnos Ferry	2
One and one-half miles northeast of Fossil	3
Three and one-half miles south of Lone Rock	4
Van Horn's ranch and vicinity	80
Officer's ranch	3

From this it appears that three localities—namely, Cherry Creek, Bridge Creek, and Van Horn's ranch and vicinity—afford over 90 per cent of the entire flora.

BIOLOGICAL CONSIDERATIONS.

As already pointed out, the present woody flora of the John Day Basin is inconsiderable, consisting of pines along the higher ridges, occasional junipers along the lower ridges, and a scant fringe of cottonwoods and willows along the streams. At best not more than three families are represented. The fossil flora, on the other hand, is a relatively rich one, and shows especially a great variety of woody plants. Following is a complete list of families represented:

Schizæaceæ.	Ulmaceæ.	Celastraceæ.
Polypodiaceæ.	Moraceæ.	Aceraceæ.
Equisetaceæ.	Berberidaceæ.	Hippocastanaceæ.
Ginkgoaceæ.	Magnoliaceæ.	Sapindaceæ.
Pinaceæ.	Lauraceæ.	Rhamnaceæ.
Gramineæ.	Hydrangeaceæ.	Tiliaceæ.
Cyperaceæ.	Hamamelidaceæ.	Araliaceæ.
Smilaceæ.	Platanaceæ.	Cornaceæ.
Salicaceæ.	Rosaceæ.	Ericaceæ.
Myricaceæ.	Mimosaceæ.	Ebenaceæ.
Juglandaceæ.	Cæsalpinaceæ?	Oleaceæ.
Betulaceæ.	Simarubaceæ.	
Fagaceæ.	Anacardiaceæ.	

The ferns, judging from the remains, must have played a very inconspicuous rôle in the Tertiary flora of this region. Two families and only four species are represented, and these are confined to a single horizon. They are also few in individuals, Lygodium being the most abundant.

Associated in the same beds with the ferns are a large number of individuals of an Equisetum, all of which have been referred to a single species (*E. oregonense* Newb.). The confused character of the matrix gives no indication of the height to which this species grew, but it must have been conspicuous, for it is not uncommon to find

stems nearly 3 cm. in diameter; the m y of them, however, are considerably smaller. The only other Equisetum is a small, more or less doubtful fragment from the Mascall beds, not enough of it being preserved to convey a satisfactory idea of its size and appearance.

Ginkgo is represented in the highest plant-bearing beds (Mascall) by a few fragments that are so poorly preserved as to give very little idea of it beyond the fact that it appears to have been larger leaved than the ordinary leaves of the living species.

The Pinaceæ, although represented by four genera and six or seven species, could hardly have been a very conspicuous element in the Tertiary flora of the basin. The most abundant species was the widely distributed *Sequoia Langsdorfii*, which occurs at five of the localities. Associated in the beds at Bridge Creek are a few cones of what Lesquereux has called *Sequoia Heerii*, that may possibly belong to what has been identified as *S. Langsdorfii*, but if this be so, the latter identification can hardly be correct.

The remaining conifers are all confined to the Mascall beds. Of these, *Sequoia angustifolia*, *Taxodium distichum miocenum*, and what has been called *Glyptostrobus Ungeri* are the most abundant. Taxodium is also represented by what, with little question, are male aments. It is more than probable that they belong to *T. distichum miocenum*. *Thuites* is represented by a mere fragment. The Gramineæ and Cyperaceæ are each represented by a single form, both of which are more or less doubtful.

To the Smilaceæ is referred the single species *Smilax Wardii*. It is very rare, as only one leaf has ever been discovered.

We come now to the deciduous-leaved types of vegetation, and it requires but a glance at the list of families to show that they predominate to a marked degree. They are represented not only by numerous genera and species, but in the case of some forms by a great wealth of individuals. The deposits at Bridge Creek, many feet in thickness, are filled with thousands of leaves of Betula, Alnus, Quercus, etc., and the Mascall beds at Van Horn's ranch contain great numbers of leaves of oaks, willows, and maples. We therefore seem warranted in concluding that the Tertiary flora of the basin was distinctly a hard-wood flora, not unlike in general appearance that which characterizes much of the area east of the Mississippi River at the present time. This fact is still further emphasized by the evident close relationship between certain of the species found fossil in the John Day Basin and those now living in the Eastern States. This will be brought out more fully under the discussion of each family.

The Salicaceæ are represented by both Populus and Salix, but of the former genus only one species (*P. Lindgreni*), represented by a single leaf, has thus far been found. This species was first characterized from the Payette formation of Boise County, Idaho. As I have

already said, "Among living species this appears to approach most closely to *P. balsamifera candicans*. It differs in being much more obtuse, in having a more marked serrate border, and in the stronger nervation. The relationship is, however, quite marked, the two leaves being of the same type, but with strong specific differences."[a]

The genus Salix is represented by eleven forms, all but one of which (*S. Schimperi*) are confined to the upper beds. Several of the species included are represented by single and often more or less doubtful specimens, while others are represented by numerous individuals. Thus *S. pseudo-argentea* is very abundant. It closely resembles the living *S. argentea*, whence its name. *Salix perplexa*, to which is referred a dozen or more specimens, is very similar in general appearance to certain forms of *S. Bebbiana*, a species now widely distributed throughout the Rocky Mountain region. The Myricaceæ are represented by two species, both of which are described as new. Of these, *M. oregoniana* is very closely related to *M. callicomæfolia* Lesq., a species very abundant at Elko station, Nevada, and Florissant, Colorado. The other species, *Myrica? personata*, is wholly unlike anything previously described from the John Day region, and may not belong to this genus.

The Juglandaceæ are richly represented, both Juglans and Hicoria being present, the former with eight forms and the latter with three. The species are rather widely distributed, occurring in the older, middle, and younger plant-bearing beds of the region. Perhaps the most interesting form is Lesquereux's *Juglans oregoniana*, which has long been supposed to have come from the Auriferous gravels of California, but which is now known to have come from the Mascall beds at Van Horn's ranch. Quite a number of additional specimens have been found recently, and, with the exception of being slightly smaller, they agree well with the type form. One of the specimens described by Lesquereux as *Rhus Bendirei* has been referred to this, as also my *J. hesperia*, from the Payette formation of Idaho.

Judging from the remains, Hicoria was rather rare, for only a few specimens have been found.

The family Betulaceæ, so far at least as regards individual leaves, is the dominant family of the flora. It is represented by Carpinus, Corylus, Betula, and Alnus, each, except Corylus, with several well-marked species.

The Clarno formation, or the beds at Bridge Creek and allied localities, seems to have witnessed the culmination of the Betulaceæ in the region, for, with the exception of two or three doubtful forms, all the species are confined to it.

Carpinus is represented by numerous leaves, which are referred to *C. betuloides* at Bridge Creek, while two more or less questionable

[a] Eighteenth Ann. Rept. U. S. Geol. Survey, Pt. III, p. 725.

leaves from the Mascall beds are referred to the well-known Miocene *C. grandis*.

Out of the vast number of leaves from Bridge Creek only two have thus far been found which clearly belong to *Corylus MacQuarrii*, and these are not to be distinguished from leaves of this species figured by Heer from Alaska. There can be no doubt as to the correctness of this identification.

Betula, as already pointed out, is the most abundantly represented of any genus in the flora. *B. heteromorpha* and *B. heterodonta* are by far the most abundant species. The first mentioned was in part described by Newberry, under the name of *Populus polymorpha*, from the resemblance to certain of the leaves of the living *P. alba*, but with the great number of individuals at my disposal I can not believe that they should be referred to Populus, although they do somewhat resemble *P. alba*. Hardly to be separated from this is Newberry's *B. heterodonta*, but in general it has much larger leaves, with coarser-toothed margins, and a more markedly inequilateral base. Many of the leaves of both species show evidence of having been attacked by fungi, producing spots and punctures so characteristic of numerous spot-producing fungi. As none of the essential features of these fungi are preserved, no attempt has been made to describe them.

Under the name of *Betula Bendirei* I have ventured to describe a single leaf that, while evidently allied to *B. heteromorpha*, differs in being nearly circular in shape, with an equal base and regularly spaced secondaries.

Almost equally abundant was the species of Alnus described by Lesquereux as *A. carpinoides*. It is contained in all the collections from Bridge Creek, and has also been detected at several other localities within the basin. From a fragment of a single large leaf I have characterized a new species under the name of *A. macrodonta*. It is broadly ovate, with abruptly truncate and heart-shaped base and coarsely dentate margin.

To the Fagaceæ are referred a single very doubtful leaf of Fagus and no less than 17 species or forms of Quercus. The oaks, although not quite so abundant in individuals as certain of the species of Betula, Alnus, etc., above mentioned, are much more abundant in species and in a few cases are nearly as numerous in individuals. The oaks are divided sharply into two groups corresponding to the horizons in which they occur. Thus 8 species are confined to the beds at Bridge Creek and 7 species to the Mascall beds at Van Horn's ranch and vicinity, and very few from either locality have been found beyond the confines of the John Day Basin.

The oaks from Bridge Creek are small, nonlobed forms, with entire or serrate margins. They are also in the main thick, coriaceous-leaved

species, evidently evergreen, and quite like the *Q. virens* type. Those from Van Horn's ranch, on the other hand, are all or nearly all lobed forms, some of them being very profoundly lobed. They are evidently thinner in texture than the Bridge Creek species.

The most abundant form in the Mascall beds is *Q. pseudo-lyrata* of Lesquereux. It is present in abundance in all collections and is hardly to be distinguished from the living *Q. lyrata*. It was divided up by Lesquereux into 5 varieties, but an examination of more than 100 examples convinces me that, with one exception, no satisfactory line can be drawn between them, and they have been reduced to the typical form. The exception above noted is that of Lesquereux's *Q. pseudo-lyrata angustiloba*. After examining more than 25 more or less perfect examples, it became clear that this was entitled to specific rank, and it has been called *Q. Merriami*, the varietal name *angustiloba* being preoccupied by A. Braun's *Q. angustiloba*. It is a very narrowly lanceolate form, quite suggestive of certain leaves of *Q. heterophylla*, the so-called Bartram oak.

A small but very perfectly preserved leaf from the same beds has been called *Q. duriuscula*. This specimen is very close indeed to *Q. minor* (Marsh.) Sargent, the well-known post or iron oak of the Eastern United States.

Another distinctly modern type, represented by several examples, is *Q. ursina*, which is undoubtedly related to *Q. nana* (Marsh.) Sargent, the bear or scrub oak of the Eastern States.

The only entire-leaved oak in the Mascall beds is *Q. dayana*, a very small-leaved species of the *virens* type. It resembles various species, such, for example, as *Q. simplex* Newb., *Q. convexa* Lesq., and *Q. simulata* Knowlton, but appears to differ from them all.

The family Ulmaceæ is represented by four species of Ulmus, evenly divided between Bridge Creek and Van Horn's ranch, and a single one of Planera. Of the two from Bridge Creek, *U. speciosa* Newb., is the largest and finest, being from 10 to 13 cm. in length. It is very suggestive of the living *U. americana*, and was called *U. pseudo-americana* by Lesquereux, but his name is antedated by that of Newberry. The other species, which I have called *U. Newberryi*, has a much smaller and narrower leaf, ranging from 6 to 10 cm. in length, and less than 3 cm. in width. It was referred to *U. speciosa* by Newberry, but seems distinct. Associated with these leaves, but especially with *U. speciosa*, are a number of very perfect examples of the winged fruits. They were placed with *speciosa* by Newberry.

The two species from the Mascall beds are *U. plurinervia* Unger, represented by a single leaf, and *U. californica* Lesq., to which several small leaves are doubtfully referred. It is clear that elms were not abundant in these beds.

Planera (*P. Ungeri* Ett.) is also represented by a single example.

The Moraceæ were not abundant, being represented by three species of Ficus and one of Artocarpus. The figs are all small leaves, and are represented by few specimens, and they evidently played an unimportant part in this flora. Artocarpus is unfortunately represented by only two or three fragments, which were referred by Lesquereux to *Aralia pungens* Lesq. and *Myrica* (*Aralia*) *Lessigii* Lesq. As nearly as can be made out, they are the same as my *A. californica* from the Auriferous gravels of California.

The Berberidaceæ are represented by the very distinct and still unique *Berberis simplex* of Newberry. It is undoubtedly closely related to the living *B. aquifolia*, which is so abundant in the region.

The Magnoliaceæ are represented by three species, two of which (*M. Culveri* and *M. lanceolata*) are found in the lowest beds of the region, and one (*M. Inglefieldi*) in the Mascall beds.

The Lauraceæ are represented by three species—one of Laurus, in the Mascall beds, and two of Cinnamomum, one of which (*C. Dilleri* Kn.) is found at Cherry Creek and the other (*C. Bendirei*) in the Bridge Creek beds.

After much consideration it has seemed probable that the family Hydrangeaceæ is represented by the curious sterile flowers which were first called *Marsilea Bendirei* by Ward and transferred to Porana by Lesquereux. The evidence on which it is changed to Hydrangea is fully set forth in the discussion of this species (ante, p. 60).

Liquidambar, representing the Hamamelidaceæ, was evidently an important group in this flora. Five forms have been detected, several of which are represented by a considerable number of specimens. They all come from the middle and upper plant-bearing beds of the region. The large leaves from Bridge Creek are referred to *L. europæum*, although they approach quite closely in certain specimens to *L. californicum* of Lesquereux. Under the name of *L. europæum patulum* I have characterized a form from the Mascall beds with very broad three-lobed leaves. The identification of Unger's *L. protensum* by Lesquereux is open to doubt. It rests upon a single broken example, and may belong to *Acer dimorphum* Lesq. A very peculiar thick-leaved form has been named *L. pachyphyllum*. It is wholly unlike any of the other forms found in the region.

The Platanaceæ formed an important family, represented by five forms and a large number of examples. Of these *P. aspera* Newb., is peculiar to the Bridge Creek beds, being a medium-sized species with sharp upward-pointing lobes. The largest and most abundant form is *P. Condoni*, originally described by Newberry as a questionable Ficus. This is undoubtedly very closely allied to Ward's *P. basilobata*, if, indeed, it is not actually identical with that species. The main difference lies in the basal lobes. In *P. basilobata* these are several times the size of those in *P. Condoni*, and appear to be always deeply lobed,

whereas they are entire in the latter. Assuming that the evolutional tendency is to get rid of these large stipular organs, as suggested in the living *P. occidentalis*, the Bridge Creek form would represent a more recent and highly developed stage than *P. basilobata*, a supposition borne out by the relative ages of the beds in which they are found.

Another interesting form, unfortunately represented by only a single example, was identified by Lesquereux as *P. nobilis?* Newb. It is a leaf more than 25 cm. long and 23 cm. broad, with a petiole 8 cm. long and some 7 mm. in thickness. The margin is not well preserved. This may well be the *P. nobilis* of Newberry, but additional material will be necessary to definitely establish the fact. The well-known *P. aceroides* of Europe and this country was also determined by Lesquereux from the Mascall beds, but it rests on two examples, neither of which agrees entirely with the ordinary figures of this species. Additional material is needed to settle the status of this species also.

The Rosaceæ are represented by two species of Cratægus and two of Prunus, one of the latter being more or less open to question. *Cratægus flavescens* Newberry, from Bridge Creek, is a well-marked species. It is undoubtedly similar to what was called *C. flava* Ait., but which has now been segregated into several closely allied forms. Lesquereux's *Myrica diversifolia* is clearly the same as *C. flavescens* and has been united with it. A form quite similar to *flavescens*, but undoubtedly distinct, I have called *C. imparilis*. It is a small seven-lobed leaf.

The form that I have named *Prunus? Merriami* is a small ovate leaf with finely serrate margins, and in appearance quite like some forms of the living *P. virginiana*, *P. demissa*, etc. It also resembles some species of Cydonia, as *C. japonica*.

Closely related to *P. Merriami*, and possibly identical with it, is what I have called *P. tufacea*. It is from the same beds, but differs in a number of minor particulars, being elliptical or slightly elliptical-obovate instead of ovate, and has finer, more regular, and evidently sharper-pointed teeth.

The family Mimosaceæ is represented by a single pod, which was named *Acacia oregoniana* by Lesquereux.

The presence of the Cæsalpinaceæ in this flora is open to doubt, as it depends solely on the problematical form referred to Cassia by Newberry. Judging from the drawing alone, it would be concluded at once that it represented a small pod, but a careful study of the type specimen shows that this is not a fair interpretation. It may be a small pod, but this is extremely doubtful, and even granting this, the reference of it to Cassia is open to the gravest question.

The presence of the Simarubaceæ rests on what Lesquereux has identified as a species of Ailanthus. This consists of a branch and a number of samaras, all preserved in the same piece of matrix. In the first place, they have not been correctly described and figured by

Lesquereux, and beyond this remains the further question of the correctness of their reference to Ailanthus.

The Anacardiaceæ were but poorly represented, there being only one species and a doubtful form referred to Rhus.

The Celastraceæ are represented by two species of Celastrus, both from the Mascall beds.

Next to the Betulaceæ and Fagaceæ the Aceraceæ appear to have been the most important family in this flora. It is represented by two genera, Acer, with eleven nominal forms, and Rulac (Negundo), with one.

The maples appear to have been absent at the time the lowest of the plant-bearing beds of the region were deposited; at least no remains of them have been discovered. In the Clarno formation maples are rare, a single species (*A. Osmonti*) having been found at Bridge Creek and doubtful forms at the same place and near Clarnos Ferry. *Acer Osmonti* is a fine species, very modern in appearance, suggesting at once the living *A. saccharum* and small leaves of *A. macrophyllum*, the common maple of the coast.

Maples were undoubtedly abundant at the time the Mascall beds were laid down, for numerous leaves, fruits, and branches are present. The most abundant of the species founded on the leaves is Lesqureuex's *A. Bendirei*, which was for a time supposed to be the same as the European *A. trilobatum productum* (Al. Br.) Heer. They are large, deeply lobed and toothed leaves. *A. dimorphum* Lesq. is different entirely from the last, and its status is possibly still open to more or less question. What I have called *A. Merriami* is wholly unlike *A. Bendirei*, but may be a very broad, coarsely toothed form of *A. dimorphum*. It is, however, without the basal lobes so conspicuous in *dimorphum*.

Associated throughout the beds with the leaves are numerous specimens of maple fruits. It is not possible to characterize these fruits with entire satisfaction, but largely on the basis of size, as well as other minute characters, I have ventured to give names to these species: *A. oregonianum*, *A. medianum*, and *A. minor*. It is possible that only two species of fruits are represented, but the differences in size would seem to be greater than are found in any one living species. In the same beds was found a single specimen of a maple fruit which I have named *Acer gigas*. It is a long, narrow fruit, 9.5 cm. in length, and, so far as I know, is the largest fruit of the kind thus far described.

Under the name of *Rulac cratægifolium* I have described a compound leaf that is certainly very suggestive of the living box elder. It is unfortunately not quite perfect, and its form and other characters are made out with difficulty.

The Hippocastanaceæ are represented by a single but undoubted species of Æsculus, which, from its close approach to certain living

forms, I have called *Æ. simulata*. It is clearly related to *Æ. octandra* and *Æ. glabra*, both well-known species of the Eastern United States.

The Sapindaceæ are represented by four species of Sapindus, but by a relatively small number of specimens. Under the name of *S. Merriami* I have characterized a small species from Bridge Creek. It seems closest to some of the smaller leaflets of *S. obtusifolius* Lesq., but has smaller and thinner secondaries. The other species are all found in the Mascall beds, and are each represented by single specimens. This family was clearly not of great importance.

The Rhamnaceæ, although represented by two species, are few in numbers and evidently played an unimporant rôle.

To the Tiliaceæ are referred two species of Grewia, one of which, *G. crenata*, is a well-known European Miocene species. It is most abundant in the beds at Bridge Creek, but a few examples have also been found in the Mascall beds at Van Horn's ranch. The other form, *G. auriculata* Lesq., rests on the single type specimen, no others having been obtained. It is possible that it is only an abnormal leaf of *G. crenata*.

The family Araliaceæ is represented by two named forms, and a number so poorly preserved as to render specific identification unsafe. Thus *A. digitata* Ward is found in the lowest or Cherry Creek locality. In the same beds is another broken specimen that was referred to *Aralia notata* by Lesquereux, but it is too fragmentary to permit of a satisfactory specific determination. The locality 3 miles above Clarnos Ferry has afforded two fragments, evidently representing quite distinct species of Aralia, but they are too poor to warrant specific naming. The Mascall beds afford a single specimen that is referred with some doubt to *A. Whitneyi*. It is a smaller leaf than is usual in this species.

The families Cornaceæ and Ericaceæ are represented by a single species each, the first by *Cornus ferox*? Unger and the latter by *Andromeda crassa* Lesq.

The Ebenaceæ are represented by two species of Diospyros, *D. alaskana* Schimper, in the Cherry Creek deposits, and *D. elliptica*, a new form from the Mascall beds. The latter has the nervation of living American species, but is more obtuse at apex than is usual in these leaves.

The Oleaceæ, although represented by only two species of Fraxinus, both from Bridge Creek, was of considerable prominence, judging from the number of individuals present. *Fraxinus integrifolia* Newb., is a very thick, coriaceous-leaved species.

Under the name of Phyllites there are a number of peculiar forms. Some of these are well preserved and may later be referred to more distinctive places; others are mere fragments too small for adequate determination.

GEOLOGICAL CONSIDERATIONS.

We now come to a consideration of the bearing of the fossil flora on the age of the beds involved. I took occasion to say in my report on the plants obtained by the expeditions of the University of California, under the charge of Dr. Merriam: "In attempting to work out the bearing of the plants above enumerated on the question of the age of the beds it should not be overlooked that any conclusions drawn might be quite different from what they would be were the whole flora of each of the localities to be considered."[a] I added, however, that the conclusions then expressed were "not likely to be greatly modified by subsequent work." The truth of this prediction has been satisfactorily confirmed, for after a full consideration of every known species or form, from every known locality, no evidence was forthcoming to modify the conclusions then expressed. In the following pages the evidence on which these conclusions rest will be set forth more fully than the space then at my disposal would permit.

A reference to the table given on pages 89–92 shows that the bulk of the flora of the John Day Basin has come from Cherry Creek, Bridge Creek, and Van Horn's ranch and vicinity. Very few species are common to two or more of these localities. The species found at the several other scattered localities, as will be shown later, naturally fall under one or another of these three.

LOWER CLARNO BEDS.

CHERRY CREEK.

The flora of Cherry Creek, to which may be added that from Currant Creek, which is clearly the same horizon and only a short distance away, comprises 22 forms, as follows:

Lygodium Kaulfusii Heer.
Asplenium subsimplex (Lesq.) Kn.
Pteris pseudo-pinnæformis Lesq.
*Lastrea Fischeri? Heer.
*Equisetum oregonense Newb.
*Salix Schimperi Lesq.
Juglans rugosa Lesq.
Juglans? Bendirei n. sp.
Hicoria? oregoniana n. sp.
Quercus furcinervis americana Kn.
Quercus sp.
Ficus tenuinervis Lesq.
Magnolia lanceolata? Lesq.
Magnolia Culveri Kn.
Cinnamomum Dilleri Kn.
*Rhamnus Cleburni var Lesq.
Aralia digitata Ward.
Aralia sp.
*Cornus ferox? Unger.
Diospyros alaskana Schimp.
*Phyllites wascoensis Lesq.
Phyllites sp.

Of the forms above listed 2 are new to science, 3 are not named specifically, while 6 (those marked with an asterisk) have not been reported outside these beds, leaving 11 species, or exactly 50 per cent,

[a] Univ. Cal., Bull. Dept. Geol., Vol. II, No. 9, p. 290.

enjoying a distribution beyond the limits of the John Day Basin. Their distribution is shown in the following table:

Table showing the extralimital distribution of the fossil plants from the Cherry Creek locality.

Species.	Laramie.	Denver.	Eocene in general.	Fort Union.	Green River.	Miocene.	Remarks.
Lygodium Kaulfusii	----	----	×	----	----	----	
Asplenium subsimplex	----	×	----	----	----	----	
Pteris pseudo-pinnæformis	----	×	----	----	----	----	
Juglans rugosa	×	×	×?	×	----	----	
Ficus tenuinervis	----	----	----	----	×	----	
Quercus furcinervis americana	----	----	----	----	----	×?	Plumas County, Cal.
Magnolia lanceolata?	----	----	----	----	----	×	
Magnolia Culveri	----	----	----	----	----	×	Lamar flora.
Cinnamomum Dilleri	----	----	×	----	----	----	
Aralia digitata	----	----	----	×	----	----	
Diospyros alaskana	×?	----	×?	----	----	----	

A study of this table brings out the fact that only four of the eleven species have been found above the Fort Union beds. Of these four, *Quercus furcinervis americana* is doubtfully reported from the supposed Miocene of Plumas County, California, and *Magnolia lanceolata* is doubtfully identified in the Cherry Creek beds. *Ficus tenuinervis* was described originally from the Green River beds of Wyoming, and *Magnolia Culveri* from the Lamar beds of the Yellowstone National Park. The remainder have been found in the Laramie, Denver, Fort Union, and the Eocene in general.

Of the species previously known but not found outside the Cherry Creek beds, *Rhamnus Cleburni* var. is closely allied to *R. Cleburni* of the Denver beds, and *Cornus ferox* is allied to an Eocene species.

From these considerations it appears that the plants of the Cherry Creek locality point to the lower Eocene age of the beds.

UPPER CLARNO BEDS.

BRIDGE CREEK.

The flora of Bridge Creek comprises 45 forms, as follows:

Sequoia Heerii Lesq.
Sequoia Langsdorfii (Brgt.) Heer.
Monocotyledonous plant.
Juglans Schimperi? Lesq.
Juglans acuminata? Al. Br.
Juglans cryptata n. sp.
Juglans, nut of.
Hicoria? sp.
Carpinus betuloides Unger.
Corylus MacQuarrii (Forbes) Heer.
Betula heteromorpha n. sp.
Betula heterodonta Newb.

Betula Bendirei n. sp.
Betula angustifolia Newb.
Alnus carpinoides Lesq.
Alnus serrulata fossilis Newb.
Alnus macrodonta n. sp.
Alnus sp., fruit of.
Alnus Kefersteinii (Göpp.) Unger.
Quercus paucidentata Newb.
Quercus drymeja Unger.
Quercus simplex Newb.
Quercus affinis (Newb.).
Quercus consimilis Newb.
Quercus Breweri Lesq.
Quercus oregoniana n. sp.
Ulmus speciosa Newb.
Ulmus Newberryi n. sp.
Ficus planicostata Lesq.
Berberis simplex Newb.
Cinnamomum Bendirei n. sp.
Liquidambar europæum Al. Br.
Platanus aspera Newb.
Platanus Condoni (Newb.).
Cratægus flavescens Newb.
Cassia? sp. Newb.
Ailanthus ovata Lesq.
Acer Osmonti n. sp.
Acer sp.
Sapindus Merriami n. sp.
Rhamnus Eridani Unger.
Grewia crenata (Ung.) Heer.
Grewia auriculata Lesq.
Fraxinus integrifolia Newb.
Fraxinus denticulata? Heer.

Of the 45 forms here enumerated, 6 have not been specifically named and 9 are new, leaving 30 previously known, of which 16 have not been found outside of these beds. It thus appears that about 30 per cent of the entire flora, or 14 species, has an outside distribution. None of these are found in the Cherry Creek beds and only 2 in the Mascall beds. The distribution of these 14 species is shown in the following table:

Table showing extralimital distribution of fossil plants from Bridge Creek locality.

Species.	Upper Cretaceous.	Laramie.	Denver.	Livingston.	Fort Union.	Eocene in general.	Eocene of Alaska.	Green River.	Miocene.	Remarks.
Sequoia Heerii							×	×?		Payette formation.
Sequoia Langsdorfii	×?				×	×	×	×	×	
Juglans Schimperi			×		×			×		
Juglans acuminata							×			
Betula angustifolia										
Carpinus betuloides										
Alnus Kefersteinii							×			
Quercus drymeja								×		
Quercus Breweri									×?	
Ficus planicostata		×	×							
Liquidambar europæum							×	×		
Rhamnus Eridani						×				
Grewia crenata					×?					
Fraxinus denticulata?		×?		×						

This table brings out the fact that the plants of Bridge Creek, when found outside, belong to a higher horizon. One—*Sequoia Langsdorfii*—has been reported from the Upper Cretaceous at Nanaimo, British

Columbia, but it is doubtful if it has been correctly determined. Otherwise, this species is found from the Fort Union to the Miocene. *Ficus planicostata* is of rather doubtful occurrence at Bridge Creek. It is a Laramie and Denver species. *Fraxinus denticulata* is also a doubtful form at Bridge Creek; it has been reported from Evanston, Wyoming, in beds supposed to be of Laramie age, and in the Livingston beds of Montana. *Juglans Schimperi* is found in the Denver beds at Golden, Colorado. The remaining species are all found in or above the Fort Union beds. Two are found in the Eocene in general, 5 in the so-called Eocene of Alaska, 5 in the Green River beds of Wyoming, and 2 (one of which is doubtful) in the Miocene.

The conclusion reached in my preliminary paper—that these beds should be regarded as Upper Eocene in age—appears to have been justified. The fact of this higher distribution than the plants of Cherry Creek is further emphasized by a review of the species related to the forms indigenous to these beds. Thus, the species described as *Juglans cryptata* is closely related to *J. denticulata* Lesq., from the Green River, Wyoming, and other localities. *Quercus consimilis* is related to *Q. drymeja*, reported in this country from the Green River. *Quercus simplex* is related to *Q. consimilis*, differing merely by the entire margin, while *Q. Breweri* is similarly closely related, differing in being much longer and narrower. *Ulmus speciosa* is suggestive of *U. Braunii*, found in this country in the Green River beds at Florissant, Colorado. The species I have described as *U. Newberryi* is close to *U. speciosa*, being smaller and narrower. *Platanus Condoni* is clearly related to *P. basilobata* of the Fort Union beds of Montana, being evidently a more highly developed form than that species. *Cratægus flavescens*, which, as already pointed out, is the same as Lesquereux's *Myrica diversifolia* as identified by him at Bridge Creek, is certainly very similar to the originals of this from Florissant, Colorado. This list could be further extended if necessary.

OTHER LOCALITIES.

There are a number of other localities discovered by Dr. Merriam that are evidently the same age as Bridge Creek. None of them have afforded a flora of more than three or four species. They are as follows:

ONE AND ONE-HALF MILES EAST OF CLARNOS FERRY.

From this locality the following species have been obtained:

Sequoia Langsdorfii (Brgt.) Heer.
Alnus carpinoides Lesq.
Acer sp.

ONE-HALF MILE NORTHEAST OF FOSSIL.

This locality has yielded the following:

Sequoia Langsdorfii (Brgt.) Heer.
Myrica? personata n. sp.
Alnus carpinoides Lesq.

OFFICER'S RANCH, BUTLER BASIN.

The following species are found:

Quercus simplex Newb.
Quercus consimilis Newb.
Platanus Condoni (Newb.) Kn.

These species, wherever previously known, are identical with those from Bridge Creek, and the beds are referred to the same age.

MASCALL BEDS.

VAN HORN'S RANCH AND VICINITY.

This flora is by far the richest thus far found in the John Day Basin. Following is a list of the forms identified:

Equisetum sp.
Ginkgo sp.
Sequoia Langsdorfii (Brgt.) Heer.
Sequoia angustifolia Lesq.
Sequoia sp.
Thuites sp.
Glyptostrobus Ungeri Heer.
Taxodium distichum miocenum Heer.
Taxodium, male aments of.
Phragmites œningensis Al. Br.
Cyperacites sp.
*Smilax Wardii Lesq.
Populus Lindgreni Kn.
*Salix Engelhardti Lesq.
Salix Rœana? Heer.
Salix varians Göpp.
Salix angusta Al. Br.
Salix amygdalæfolia Lesq.
Salix pseudo-argentea n. sp.
Salix dayana n. sp.
Salix perplexa n. sp.
Salix mixta n. sp.
Myrica oregoniana n. sp.
Juglans oregoniana Lesq.
*Hicoria elænoides (Ung.) Kn.
Carpinus grandis? Ung.
Betula? dayana n. sp.
Alnus Kefersteinii? (Göpp.) Unger.
Fagus? sp.
*Quercus pseudo-lyrata Lesq.
Quercus Merriami n. sp.
Quercus duriuscula n. sp.
Quercus ursina n. sp.
Quercus dayana n. sp.
*Quercus horniana Lesq.
Quercus? sp. Kn.
Ulmus plurinervia Ung.
Ulmus californica? Lesq.
Planera Ungeri Ett.
*Ficus? oregoniana Lesq.
Artocarpus californica? Kn
Magnolia lanceolata Lesq.
Magnolia Inglefieldi Heer.
Berberis? gigantea n. sp.
Laurus oregoniana n. sp.
*Hydrangea Bendirei (Ward) Kn.
Liquidambar europæum patulum n. var.
*Liquidambar protensum? Ung.
Liquidambar pachyphyllum n. sp.
Liquidambar sp.
Platanus nobilis? Newb.
Platanus aceroides? (Göpp.) Heer.
Platanus sp.
Cratægus imparilis n. sp.
Prunus? Merriami n. sp.
Prunus tufacea n. sp.
*Acacia oregoniana Lesq.
*Rhus Bendirei Lesq.
Rhus? sp. Lesq.
Celastrus dignatus n. sp.
Celastrus confluens n. sp.
Acer Bendirei Lesq.
*Acer dimorphum Lesq.
Acer Merriami n. sp.
Acer, branches of.
Acer oregonianum n. sp.
Acer medianum n. sp.
Acer minor n. sp.
Acer gigas n. sp.
Rulac cratægifolium n. sp.
Æsculus simulata n. sp.
Sapindus obtusifolius Lesq.
Sapindus angustifolius? Lesq.
Sapindus oregonianus n. sp.
Grewia crenata (Ung.) Heer.
*Andromeda crassa Lesq.
Diospyros elliptica n. sp.
Phyllites bifurcies n. sp.
Phyllites inexpectans n. sp.
Phyllites personatus n. sp.

The total number of forms represented is 80, of which number 11 have not been specifically named, and 30 species and 1 variety are described as new to science. The remainder, or 37 species, are those previously known from these beds. Of these 37 species, 12 (those marked with an asterisk in the preceding list) have not been found beyond the limits of these beds, leaving 25 species which have an outside distribution. This distribution is shown in the following table:

Table showing extralimital distribution of fossil plants from Van Horn's ranch and vicinity.

Species.	Fort Union.	Eocene in general.	Green River.	Eocene of Alaska.	Miocene.	Remarks.
Sequoia Lansgdorfii	×	×	×	×	×	Upper Cretaceous.
Sequoia angustifolia			×?	×	×	
Glyptostrobus Ungeri			×	×?	×	
Taxodium distichum miocenum	×	×			×	
Phragmites œningensis						Laramie to Pliocene.
Populus Lindgreni					×	
Salix Rœana?				×	×	
Salix varians				×		
Salix angusta						Whole Tertiary.
Salix amygdalæfolia			×		×	
Juglans oregoniana					×	
Carpinus grandis?		×	×		×	
Alnus Kefersteinii?				×	×	
Ulmus plurinervia				×		
Ulmus californica?					×	
Artocarpus californica?					×	
Magnolia lanceolata					×	
Magnolia Inglefieldi			×?			Lassen County, Cal.
Platanus nobilis?	×	×?				
Platanus aceroides?						Laramie to Miocene.
Acer Bendirei					×	
Sapindus obtusifolius	×					
Sapindus angustifolius?		×	×		×	
Grewia crenata	×?	×				Bridge Creek.

In my report on the collection of plants from Van Horn's ranch[a] and vicinity obtained by Dr. Merriam I made the following statement: "The flora of the Van Horn ranch finds its greatest affinity with that of the Auriferous gravels and with allied floras of California, and is to be regarded as upper Miocene in age." Since writing this I have brought out the fact, already set forth, that certain of the species most relied upon in making this correlation, such as *Quercus pseudo-*

[a] Univ. Cal., Bull. Dept. Geol., Vol. II, No. 9, p. 309.

lyrata, *Juglans oregoniana*, etc., that were supposed to have come from the Auriferous gravels, are in reality confined to the Van Horn's ranch locality. This correlation therefore fails, and the age of the Van Horn's ranch material must be fixed in other ways.

The table on the preceding page shows at a glance that the geologic horizons of those species found outside these beds are decidedly higher than those of either of the floras previously considered. Thus, 17 species out of 25 are found in the Miocene. The oldest beds represented, at least by species having any particular value for fixing the age, is the Fort Union, which contains 5 or 6 of the species listed. *Sequoia Langsdorfii* extends throughout the entire Tertiary, and possibly even into the Upper Cretaceous. *Phragmites œningensis* extends from the Laramie to the Pliocene, but it is at best a doubtful organism, hard to identify satisfactorily. *Salix angusta* is another species ranging throughout the Tertiary, but it is simply a narrow-leaved willow that may or may not be the same form at all points where it has been reported. Seven of the species enumerated, 2 of which are doubtful, are found in the Green River beds, and 6, one of which is open to question, have been found in the Eocene in general. Seven species are found in the so-called Eocene of Alaska, which was, until recently, regarded as of Lower Miocene age.

If dependence were placed exclusively on the distribution of the above-mentioned forms in fixing the age of these beds, the tendency would be to regard them as not younger than Lower Miocene, or even possibly as old as the Upper Eocene, but when we take into account the affinities and relationships of the forty or more named species that are confined to these beds, the preponderance of evidence would seem to relegate them to an age as young as Upper Miocene. Thus the species of Salix are closely allied to various living species, such as *S. argentea*, etc. The species of Quercus are distinctly modern. *Quercus pseudo-lyrata* is hardly to be distinguished from *Q. lyrata; Q. Merriami* is also near *Q. lyrata; Q. duriuscula* is very close to *Q. minor*, and *Q. ursina* to the living *Q. nana*. The form referred to *Artocarpus californica*, if correctly identified, is close to the living *A. incisa; Hydrangea Bendirei* is closely related to several living species; and the species of Liquidambar are not far from *L. Styraciflua*. The two species referred to Prunus are close to the living *P. demissa*, *P. virginiana*, etc. The maples are very modern in appearance, being related to *A. saccharum*, *A. macrophyllum*, etc., and the box elder is not far from the living species. The species described as *Æsculus simulata* is similar to *Æ. octandra* and *Æ. glabra*.

Taking all lines of evidence into account, it seems warranted to refer these beds to the Upper Miocene.

THE FLORA OF THE JOHN DAY BASIN IN OTHER LOCALITIES.

Before leaving this subject it may be of interest to give a short account of this flora as it has been recorded at several localities beyond the limits of the John Day Basin. This is especially desirable since we now have for the first time a definite knowledge of the geological sequence of the plant-bearing beds in the basin. Up to the date of the publication of Dr. Merriam's paper on the geology of the basin our knowledge of the interrelations of the plant beds has been in a much confused state. This confusion is in large measure due to the fact that no definite localities were given by Lesquereux, they being simply recorded as "John Day Valley, Oregon," and so it came to be supposed that all species from this area were of the same age. This confusion was helped along by Newberry, who placed Cherry Creek, Currant Creek, and Bridge Creek in the same horizon, which he referred to the Miocene. In his latest publication on the subject (Proc. U. S. Nat. Mus., Vol. XI. pp. 13–24) Lesquereux referred the beds at Cherry Creek to the Laramie and the Van Horn's ranch deposits to the Miocene, but he made no attempt to give more definite localities for the forms mentioned in his earlier reports. It was possible to settle the exact locality of these species only by a careful study of the types, which are the property of the University of California. This investigation, as already set forth, has been made, and the results are incorporated in the foregoing pages. But the confused condition of our knowledge of this flora has made its impress on determinations of the plants whenever they have been found beyond the limits of the John Day Basin. These outside floras will be passed in review and the attempt will be made to adjust them to accord with our present fuller knowledge of the type section.

So far as I now know, the first recognition of the flora of the John Day Basin beyond the original limits was made by myself in a "Report on fossil plants from near Ellensburg, Washington," which was published in 1893 as an appendix to Bulletin 108 of the United States Geological Survey, by Prof I. C. Russell, entitled "A Geological Reconnoissance in Central Washington." Ten species were enumerated in this collection as follows:

Salix varians Göpp.
Populus glandulifera Heer.
Populus Russelli Kn.
Alnus? sp.
Ulmus californica Lesq.
Ulmus pseudo-fulva Lesq.
Platanus dissecta Lesq.
Platanus aceroides? (Göpp.) Heer.
Paliurus colombi Heer.
Magnolia lanceolata Lesq.

Some of these forms were recognized by Lesquereux as occurring at Van Horn's ranch, although they have not all been admitted in the present paper. *Populus glandulifera* was based on a single example,

which I have considered as too indefinite to be entitled to recognition, and *Paliurus colombi* has been referred to *Grewia crenata*. The examples representing these species at Ellensburg are more numerous and better preserved, and are probably correctly determined. *Salix varians*, which is represented at Van Horn's ranch by a very few examples, is extremely abundant at Ellensburg, and I have also recognized in this material one of the new species of Salix (*S. pseudo-argentea*) from the Mascall beds. A number of the Ellensburg species are also common to the Auriferous gravels of California.

As I pointed out in the report on the Ellensburg material, there can be no doubt that it is of the same age as that at Van Horn's ranch, a condition further emphasized by the similarity in the matrix, that from both localities being a white, soft, fine-grained volcanic ash.

In 1892 Mr. J. S. Diller made a small collection of fossil plants at a point 6 miles southeast of Ellensburg, Washington, that contains, among other species, some well-preserved examples of *Platanus dissecta*. The matrix is also similar to that at Ellensburg and Van Horn's ranch, and the age of the beds is undoubtedly the same.

In 1898 I published a report[a] on the Fossil Plants of the Payette Formation. The name Payette formation was given by Mr. Waldemar Lindgren to a series of lake beds along the Snake River, in western Idaho. The flora here enumerated embraced 32 forms, of which number 17 were described as new and 5 were not specifically named, leaving, as then known, only 10 species having an outside distribution. On page 736 of this report I gave a table showing the extralimital distribution of these 10 species. On referring to this table it will be seen that 5 of these species are found only in the beds at Bridge Creek, and to this list I am now able to add another species (*Sequoia angustifolia*), thus making 6 of the 10 species common to these two localities. A number of forms that I described as new are undoubtedly related to Bridge Creek species. Thus *Quercus simulata* is related to *Q. simplex*, and *Q. idahoensis* and *Q. payettensis* are both more or less closely related to *Q. consimilis*. Two species (*Juglans hesperia*, which I have now referred to *J. oregoniana* Lesq., and *Populus Lindgreni*), described as new in the Payette formation, have been detected in the Mascall beds at Van Horn's ranch.

In this report the Payette formation was referred to the Upper Miocene, but I was misled by the knowledge then current regarding the position of the Bridge Creek beds, as I have already pointed out, and it is now necessary to change that reference. The flora of the Payette formation undoubtedly finds its greatest affinity with that at Bridge Creek, a fact recognized all along, and, like it, is now referred

[a] Eighteenth Ann. Rept. U. S. Geol. Survey, Pt. III, pp. 721-744; Pls. XCIX-CII.

to the Upper Eocene. It may be noted, though the fact is perhaps not of great importance, that the matrix in which the plants of the Payette formation are preserved is similar to that at Bridge Creek.

In 1900 I published a short paper on the Fossil Plants associated with the Lavas of the Cascade Range,[a] which accompanied a paper by Mr. J. S. Diller, on The Bohemia Mining Region of Western Oregon, with notes on the Blue River Mining Region and on the Structure and Age of the Cascade Range. It was with the latter portion of Mr. Diller's paper that my own had especial connection. This paper was based on small collections that had been made by Mr. Diller and others. Six localities were represented, as follows: (1) Left bank of the Columbia River, near the mouth of Moffats Creek; (2) Comstock, Douglas County; (3) 1 mile east of Murphys Springs, southeast of Ashland; (4) Coal Creek, Lane County; (5) 5 miles directly north of Ashland; and (6) 3 miles southeast of Ashland. The entire flora comprised only 28 forms, of which 10 were described as new to science and 7 were not named specifically, leaving but 11 species with previously known distribution. No locality was represented by more than 10 forms and most of them by from 2 to 5 forms.

The species composing this flora were compared with those from the John Day Basin and the Auriferous gravels of California, and were referred to the Miocene. In the light of our present knowledge of the type section in the John Day Basin, certain modifications of this reference seem necessary. I hesitate, however, to make radical changes in my former determination without additional material. When taken as a unit this flora is undoubtedly similar to that of the John Day Basin, considered as a whole, but when an attempt is made to relegate the species from individual localities to one of the three horizons now recognized in the basin, the meagerness of the material becomes very apparent. With the exception of the first of the localities to be mentioned, the following tentative classification may be made: The locality on the Columbia River near the mouth of Moffats Creek contains *Acer Bendirei* and a doubtful leaf of *Populus Zaddachi*. The first of these species is so characteristic that I have little or no hesitation in referring it to the same age as the Van Horn's ranch material, namely, Upper Miocene. The localities 5 miles north of Ashland and 3 miles southeast of Ashland seem to be more closely allied to Bridge Creek and are probably to be regarded as Upper Eocene in age. Murphys Springs is also probably the same in age as Bridge Creek, while Coal Creek, in Lane County, and Comstock, in Douglas County, seem likely to be older Eocene than the Bridge Creek beds. But I wish to emphasize the fact that these are purely tentative views, and we must depend upon fuller collections to settle the points at issue.

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[a] Twentieth Ann. Rept., U. S. Geol. Survey, Pt. III, pp. 37-64, pls. 1-5.

THE DALLES, OREGON.

By the kindness of Dr. Arthur Hollick I have been enabled to examine a number of unpublished plates of fossil plants by the late Dr. Newberry, on which are depicted several species from the so-called Dalles group, at the Dalles of the Columbia. The matrix, I am informed by Dr. Hollick, is a whitish, very coarse-grained volcanic ash, identical in appearance with that bearing fossil plants at Kelly Hollow, Wenas Valley, near Ellensburg, Washington. These plates were not published by Dr. Newberry and simply bear provisional names penciled on the margins of the plates. These species are represented as follows:

Acacia, or *Cassia* sp.—A small, even-pinnate compound leaf of numerous small oblong leaflets. Nothing similar has been thus far found in the John Day Basin.

"*Myrica diversifolia* Lesq."—Two figures of this form are shown. They appear to be the same as *Cratægus flavescens* Newb., from Bridge Creek.

"*Ulmus* sp."—Two small, coarsely toothed leaves with well-marked secondaries ending in the marginal teeth. Judging from the drawings alone I should incline to refer these leaves to a small form of *Carpinus grandis* Unger, very similar to some forms found at Bridge Creek, and not to Ulmus. They are wholly unlike the common elm leaves that are abundant at this latter locality.

With only these data available I should incline to regard the locality affording them as referable to the same age as the Bridge Creek beds, viz, Upper Clarno.

From the facts here adduced it seems beyond dispute that the conditions which prevailed in the John Day Basin during Tertiary times were much more far reaching than the mere local limits of the basin; in other words, that the formations there recognized extended as far north as central Washington, east into northwestern Idaho, and westward over much of western Oregon.

SUMMARY.

(1) The John Day Basin lies between the north and south ranges of the Blue Mountains, in north-central Oregon. It covers an area of approximately 10,000 square miles and is drained by John Day River and its tributaries. It has been the scene of great volcanic activity, its rock masses being made up of numerous volcanic flows, with alternations of ashes, tufas, sands, and gravels.

(2) No detailed geological study has been made of the region, but contributions to this subject have been made by Le Conte, Condon, Marsh, Cope, Wortman, Matthew, and Merriam, the most important and comprehensive being by the latter author.

(3) Its fossil riches, in the shape of mammalian teeth, were first brought to scientific attention in 1861. Since that time an extensive vertebrate fauna has been described by Leidy, Cope, Marsh, Wortman, Merriam, and others.

(4) The first fossil plants were found at Bridge Creek in 1862, by Prof. Thomas Condon. Since that date collections of plants have been made by Condon, Voy, Bendire, Merriam, Osmont, and Knowlton. The plants have been studied and described by Newberry, Lesquereux, and Knowlton.

(5) The fossil flora of the John Day Basin, as set forth in the present paper, comprises 150 forms, distributed among 37 natural families and the anomalous group of Phyllites. Of the 150 forms enumerated, 24 have not been named specifically, and 44 species and 1 variety are described as new to science. The previously known species number 81.

(6) The known fossil floras of the John Day Basin are all of Tertiary age. The oldest, represented by the localities of Cherry Creek, Currant Creek, and 3 miles above Clarnos Ferry, is referred to the Lower Eocene. It is in the lower part of Merriam's Clarno formation. The next younger in age, exposed at Bridge Creek, 1½ miles east of Clarnos Ferry, one-half mile northeast of Fossil, and Officer's ranch in the Butler Basin, occupies the upper part of the Clarno formation and is Upper Eocene in age. The youngest plant-bearing beds of the region, found at Van Horn's ranch and vicinity, are in the basal portion of the Mascall formation. The age is regarded as Upper Miocene.

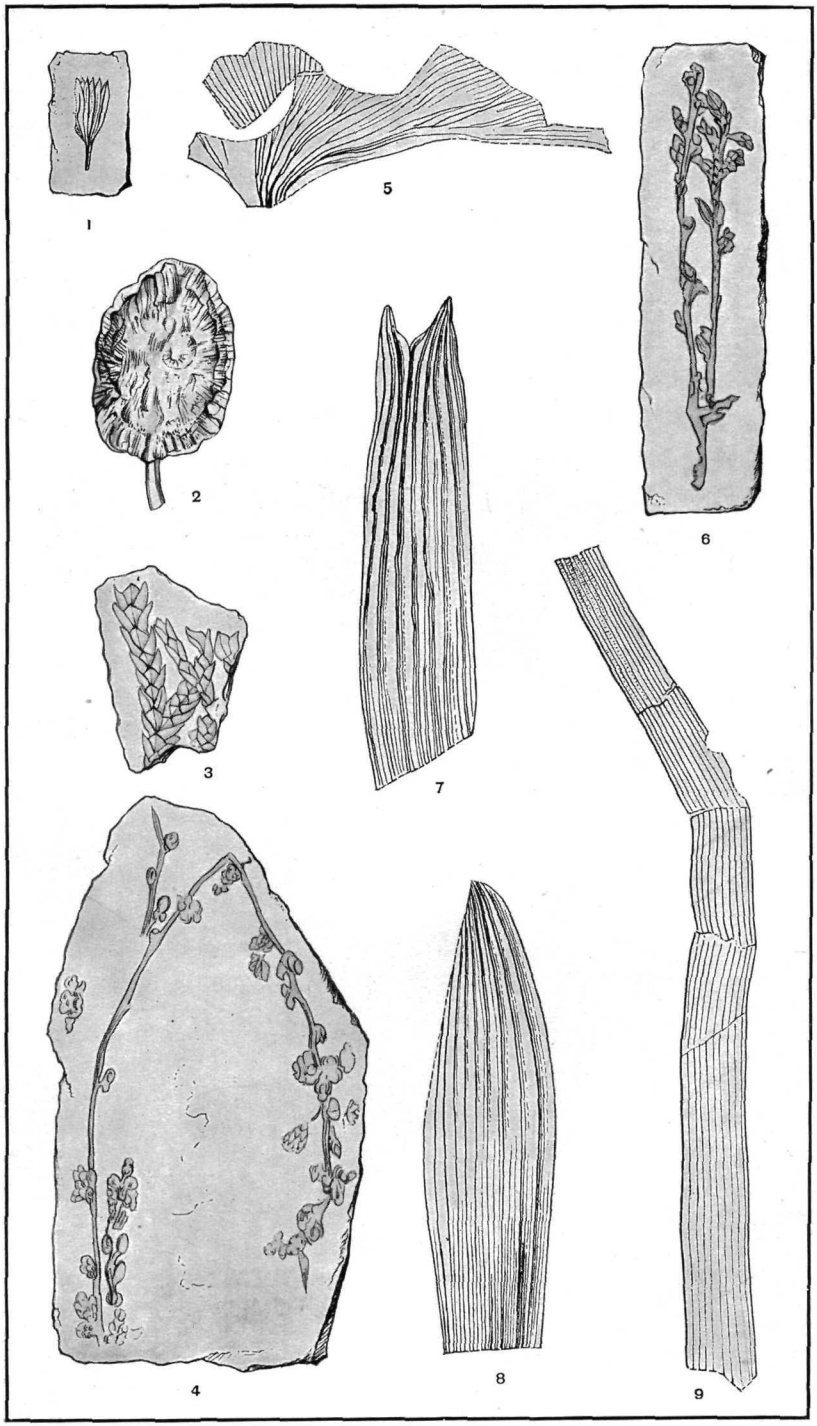
(7) From the facts adduced in this bulletin it is concluded that the conditions which prevailed in the John Day Basin during Tertiary times extended also into central Washington, northwestern Idaho, and western Oregon.

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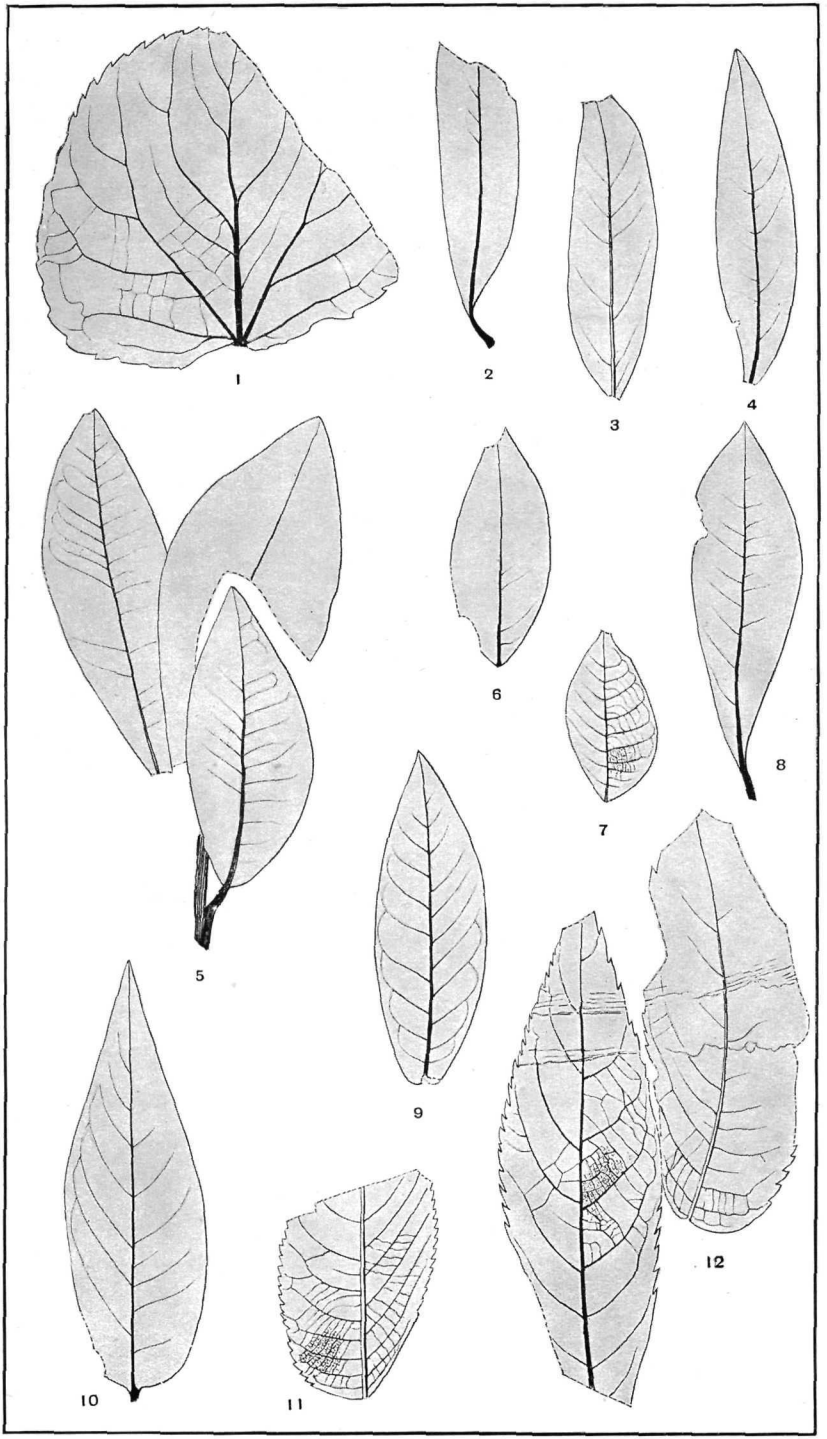


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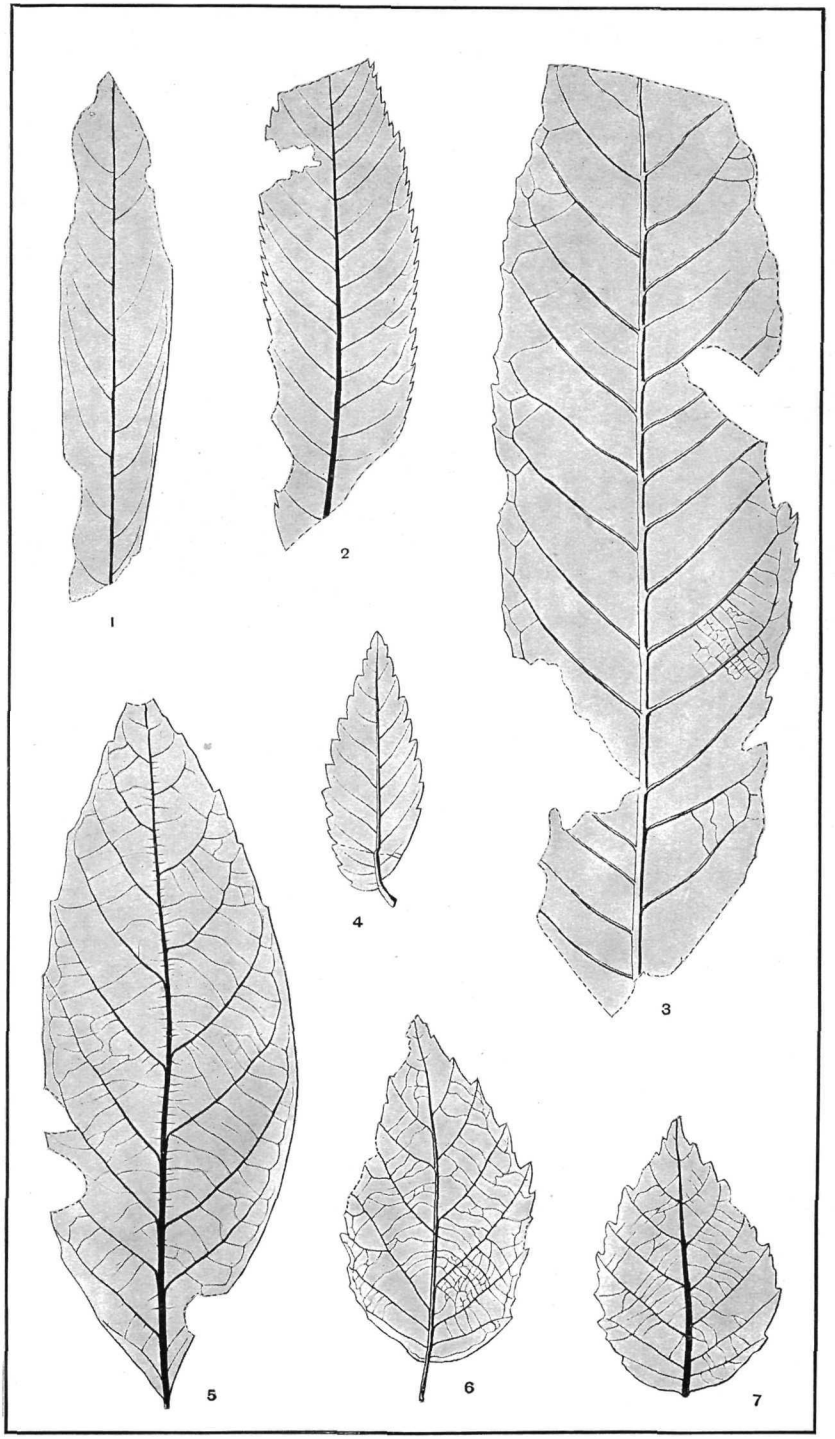


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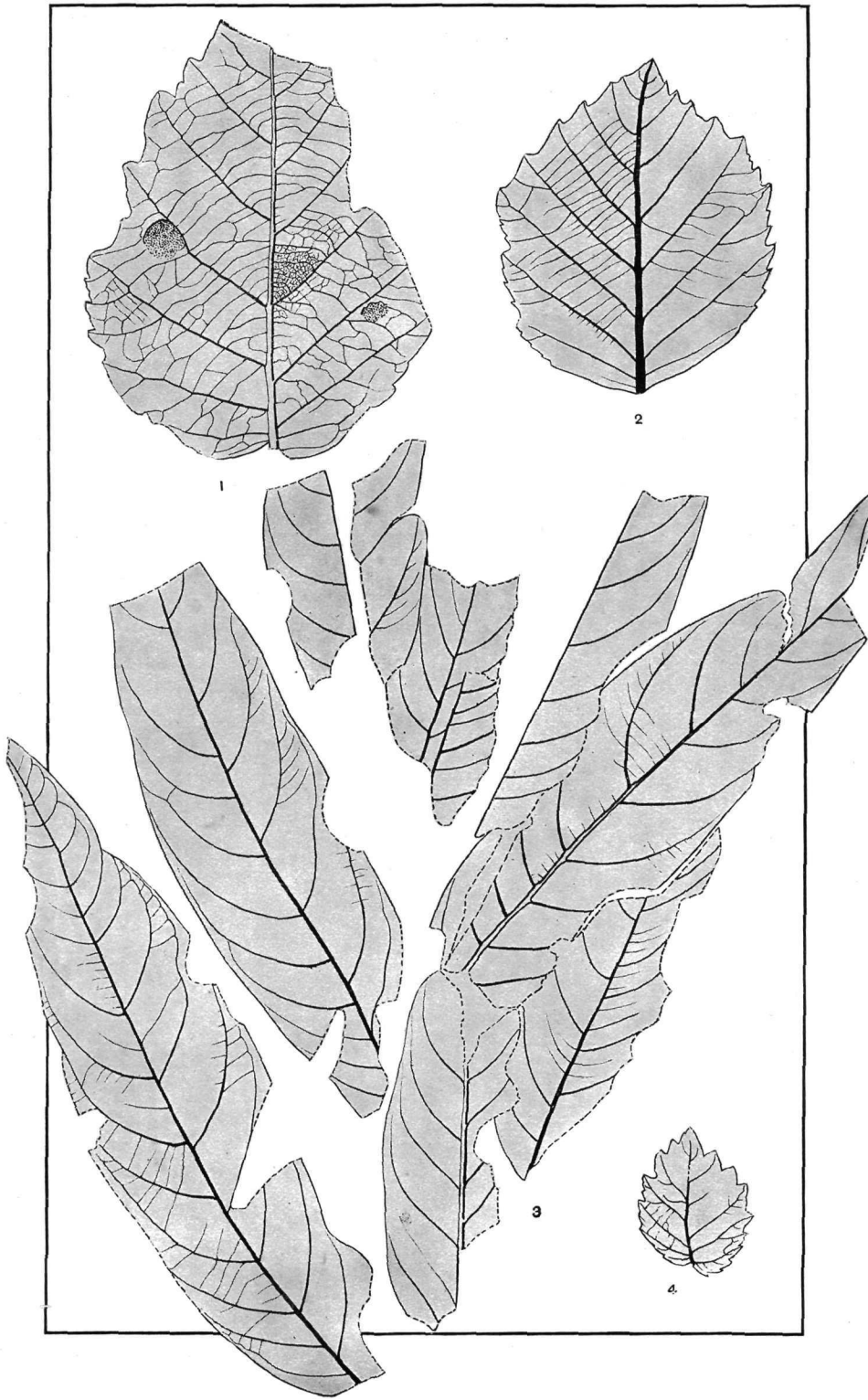
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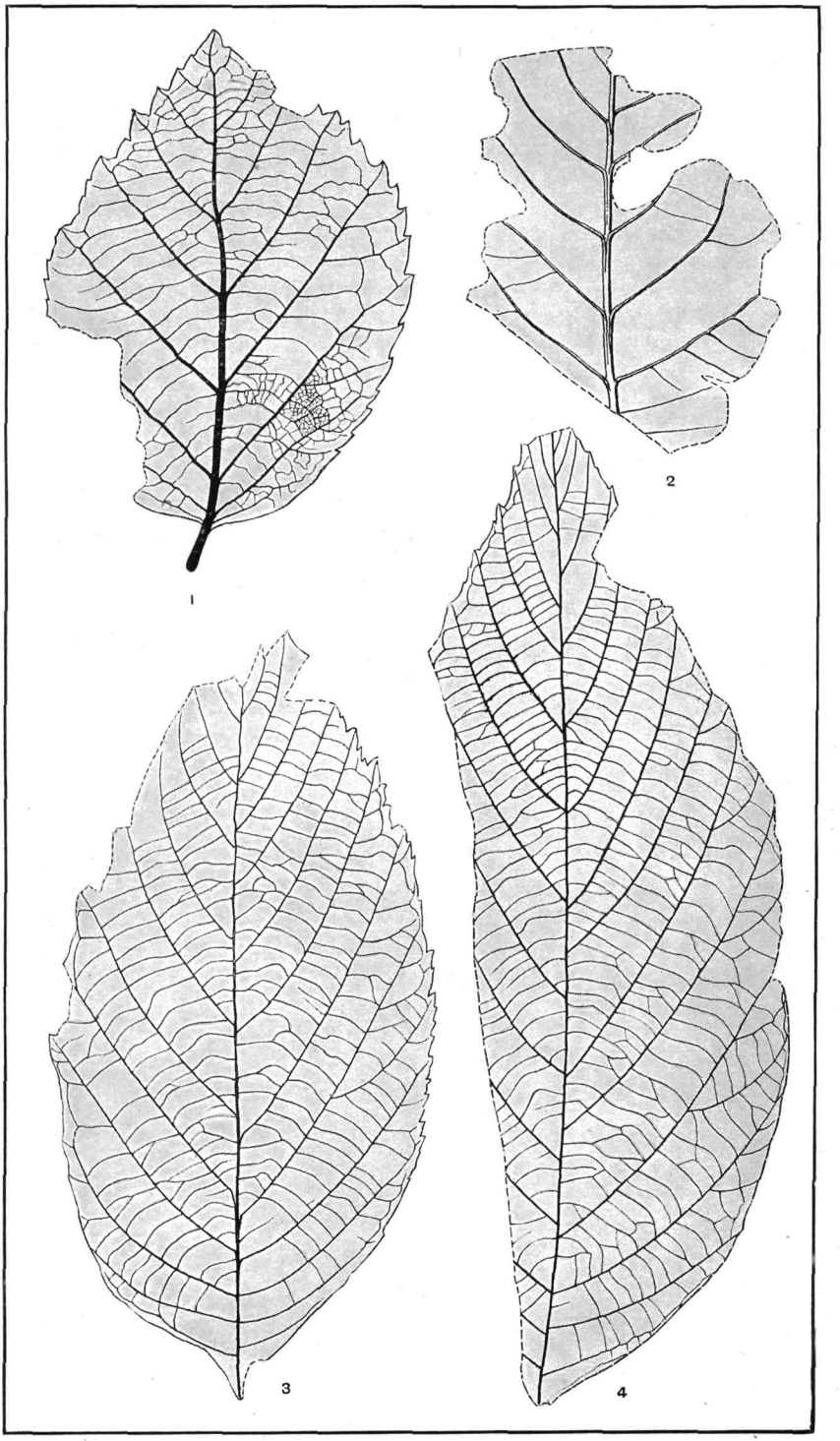
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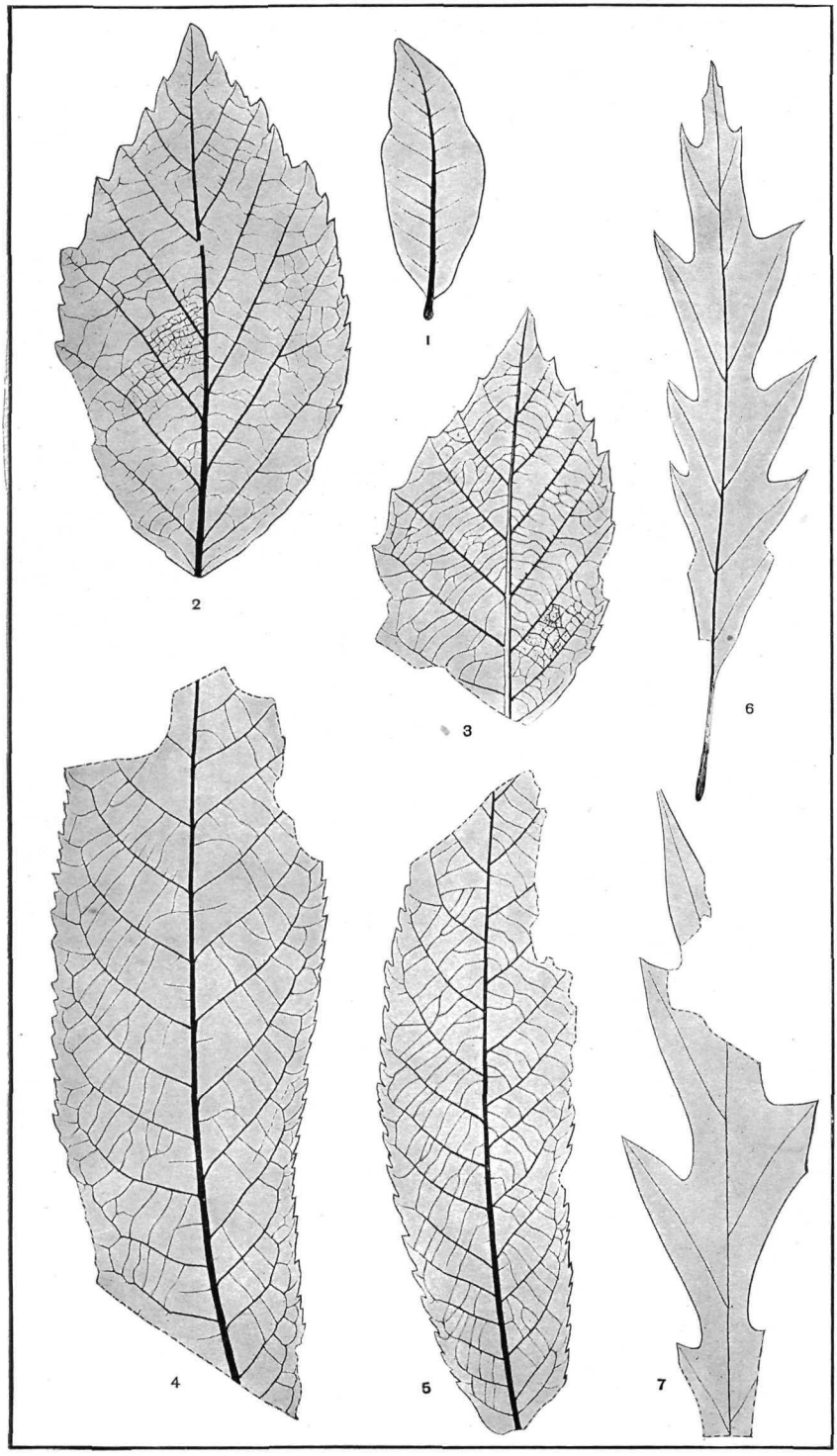
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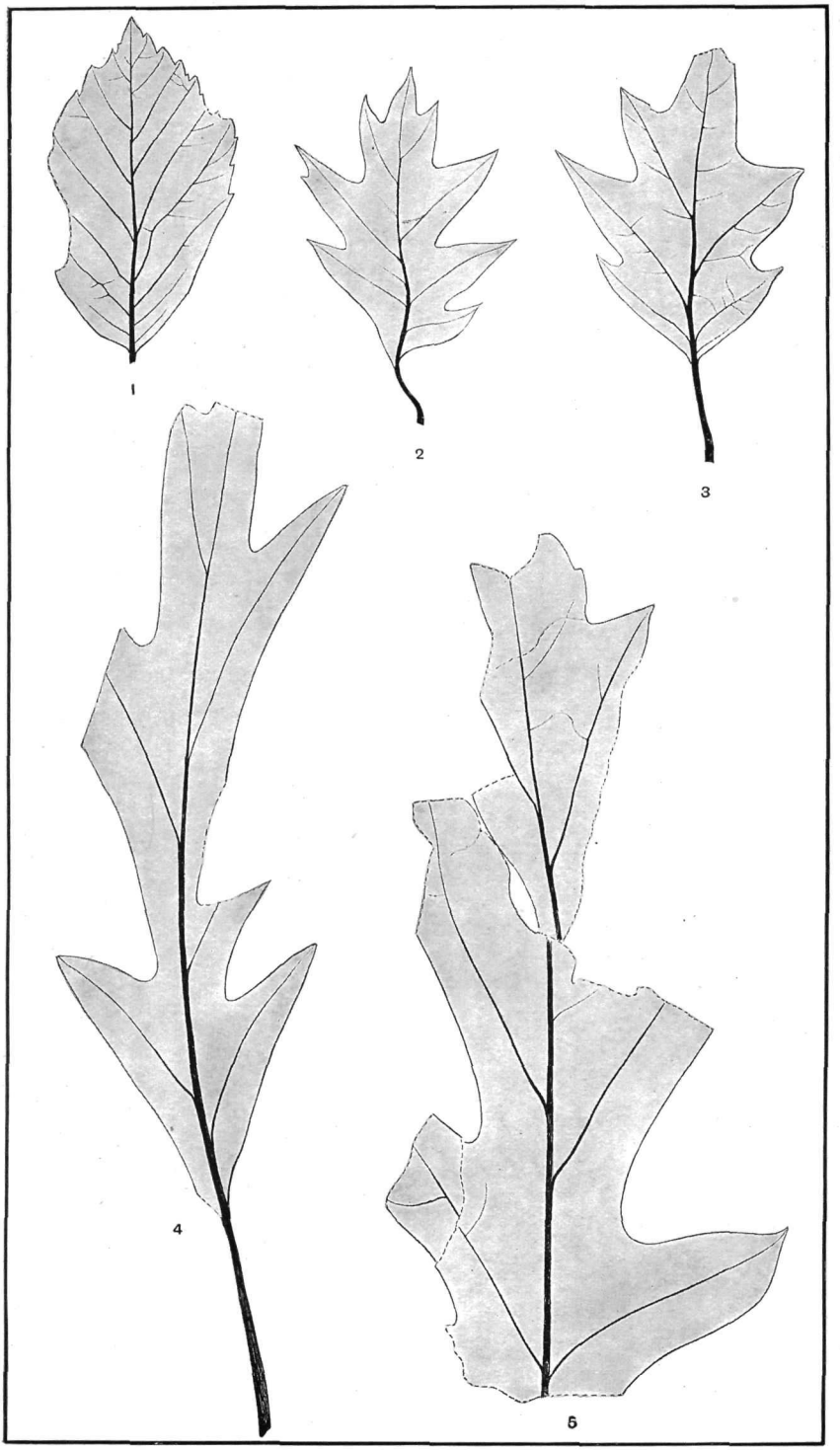


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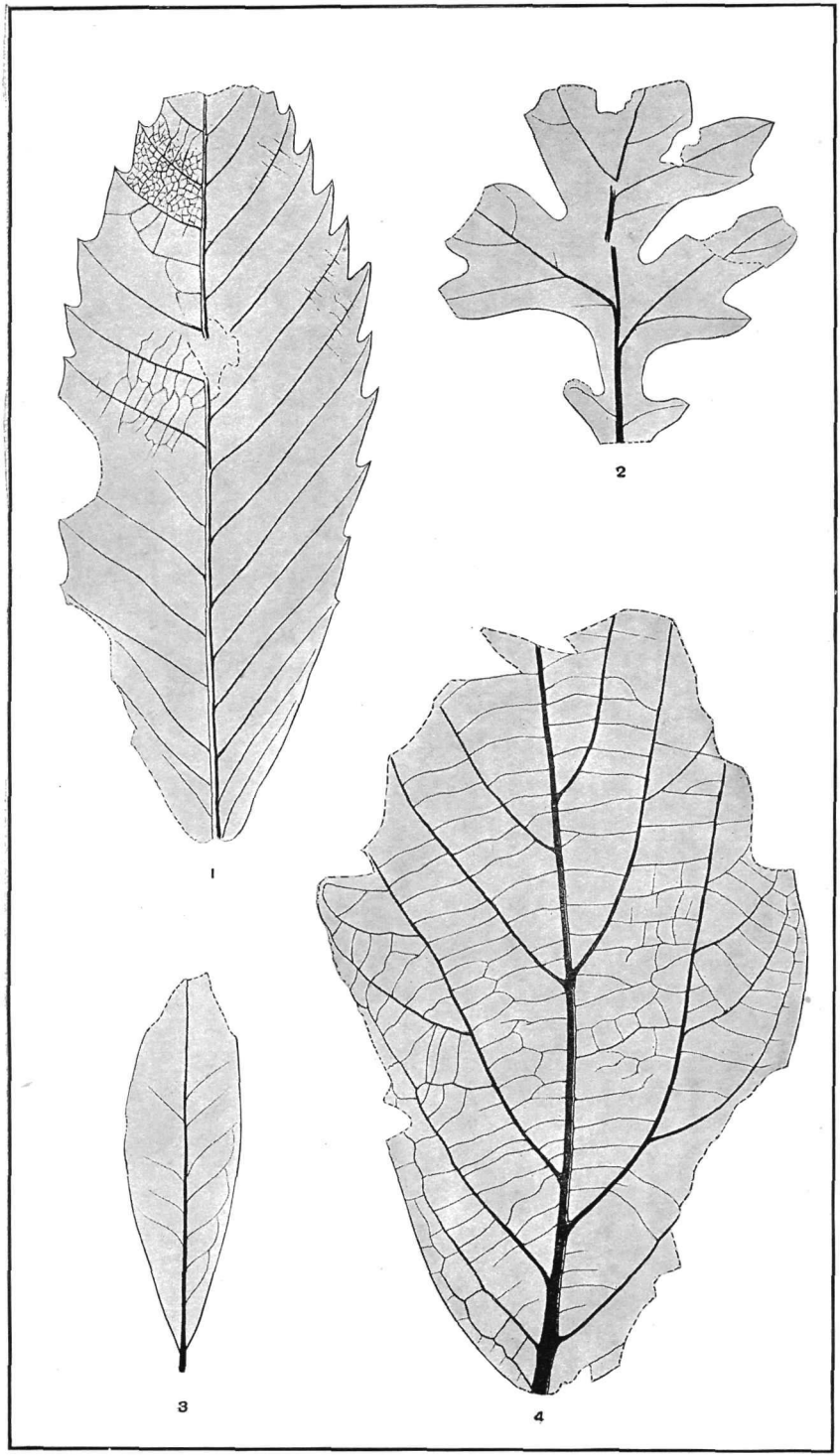


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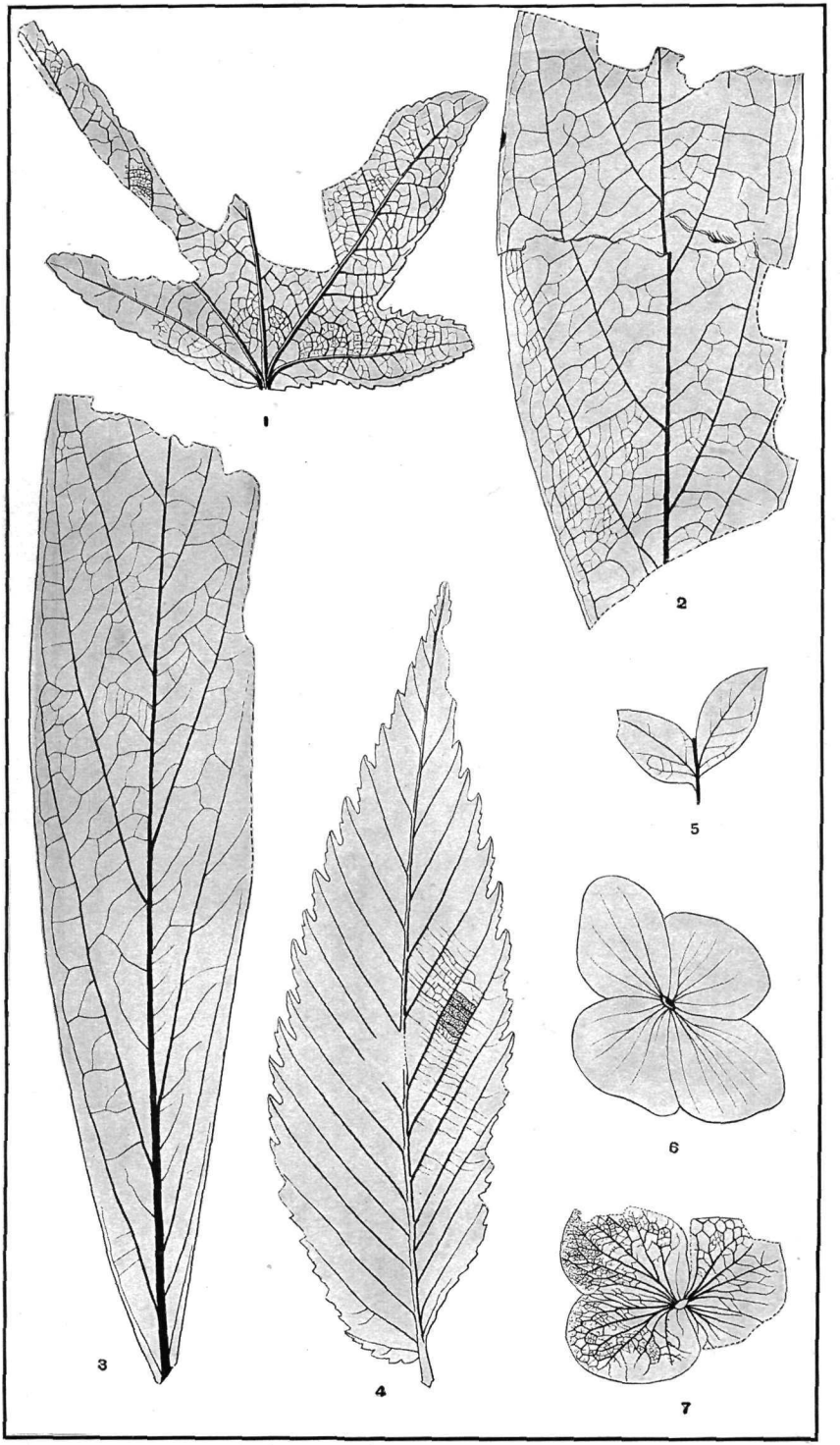


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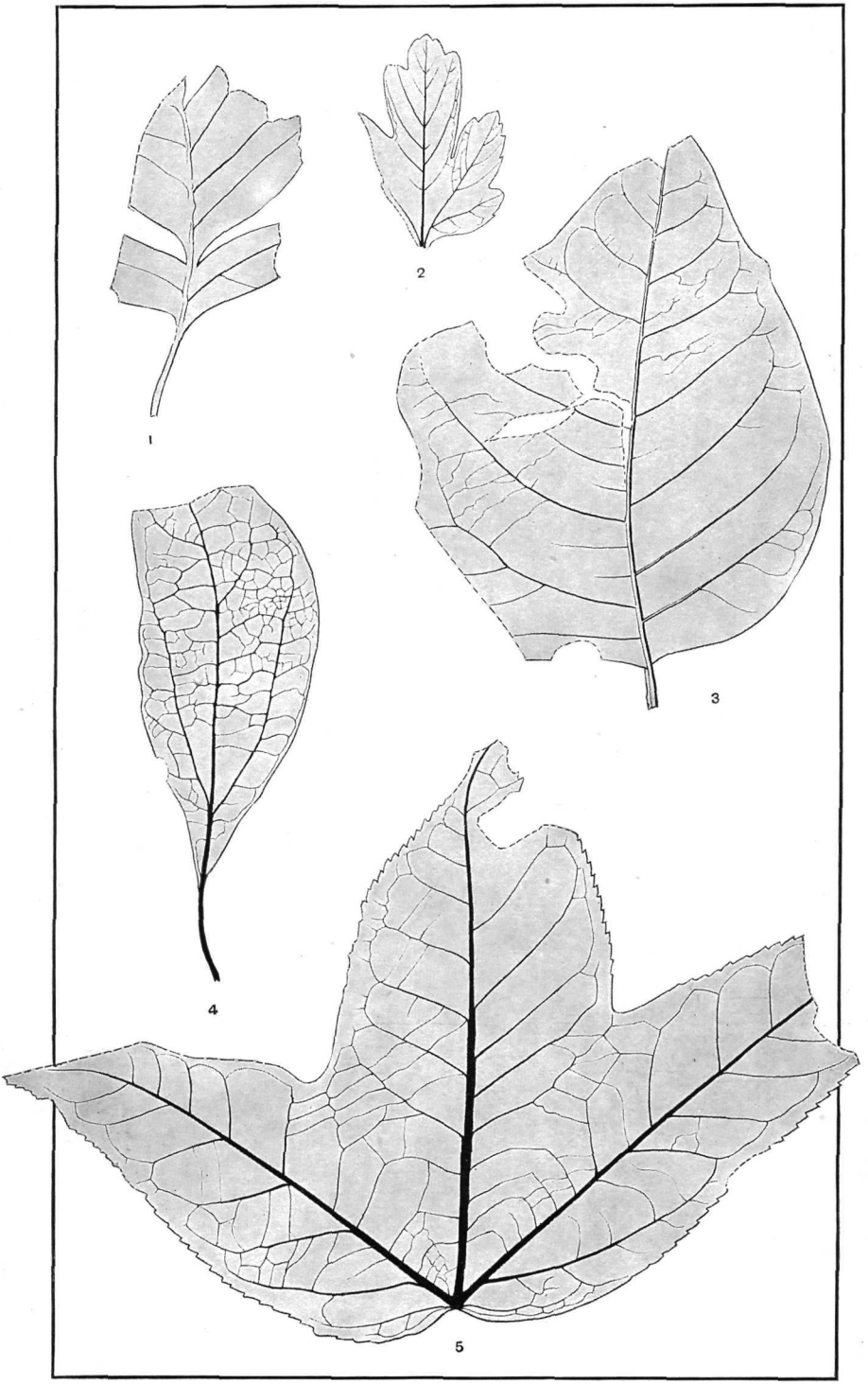
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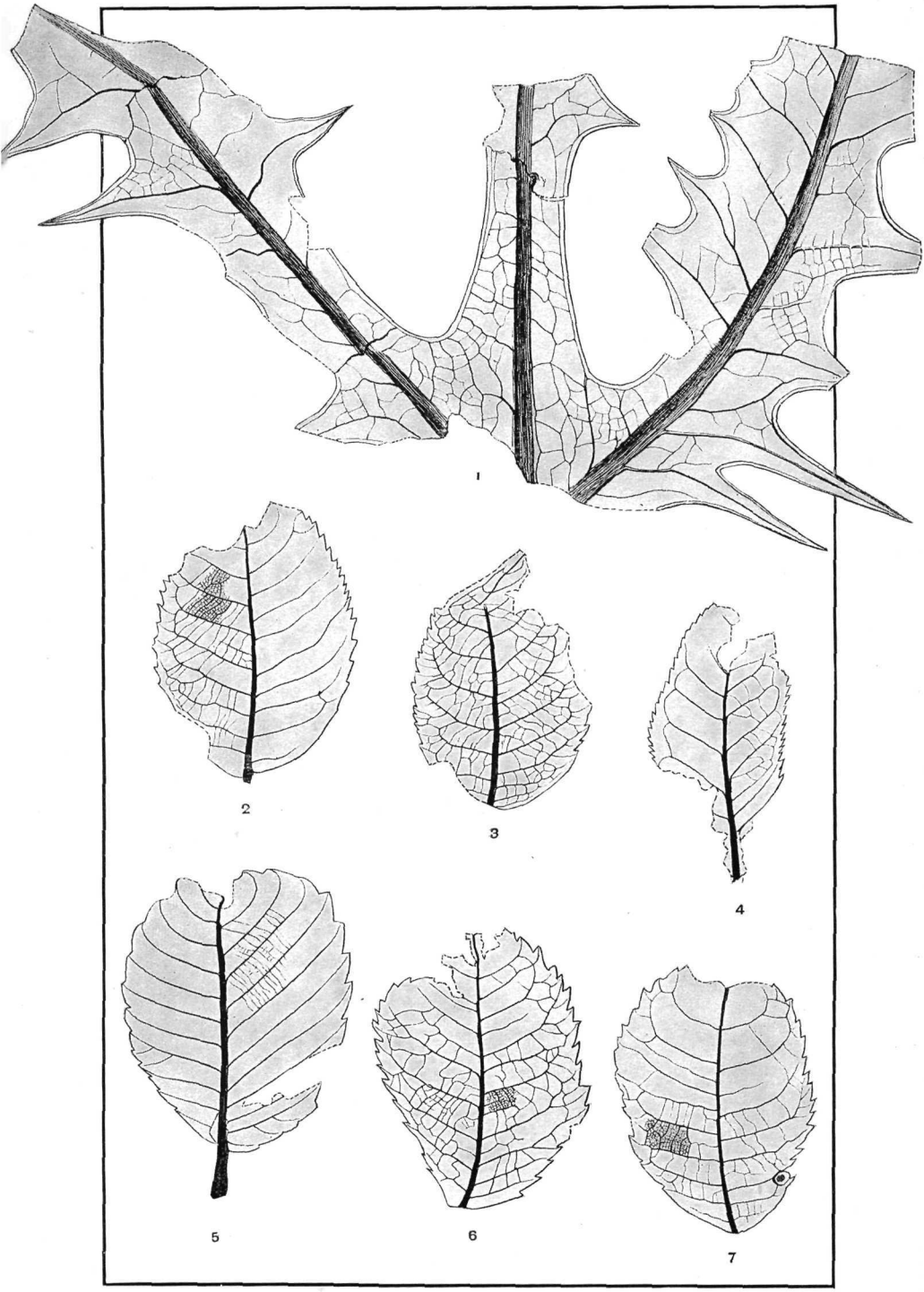


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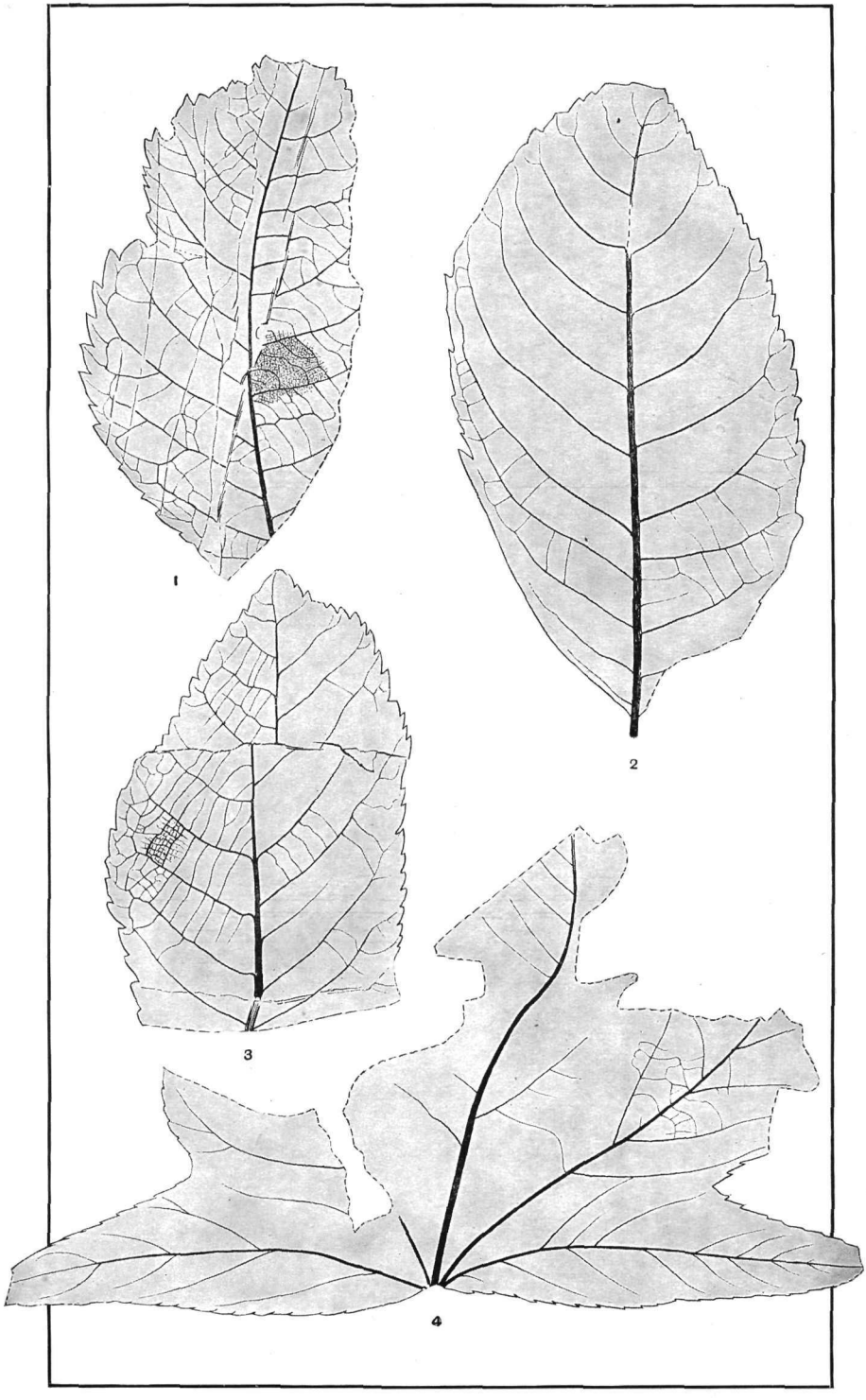
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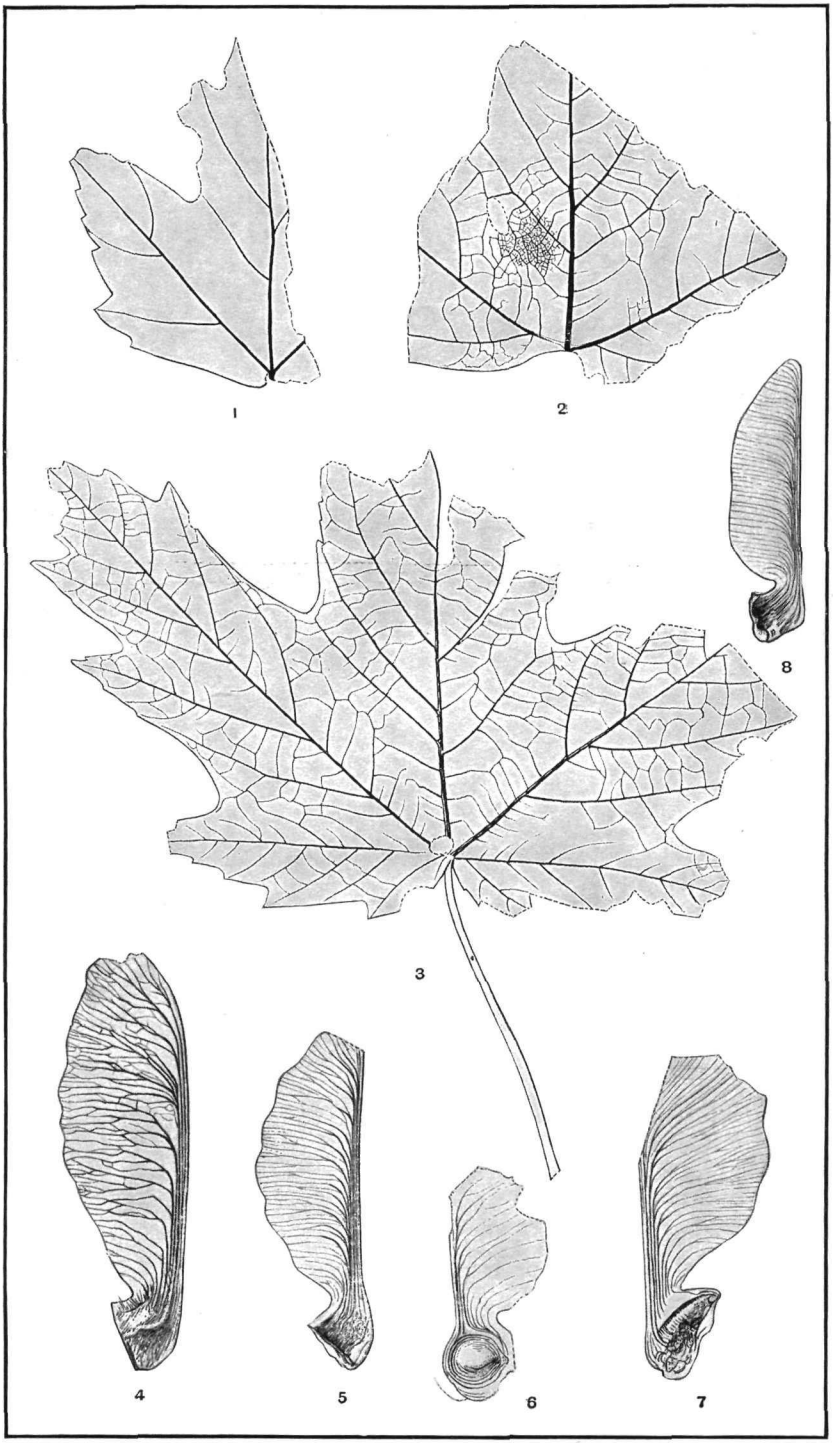


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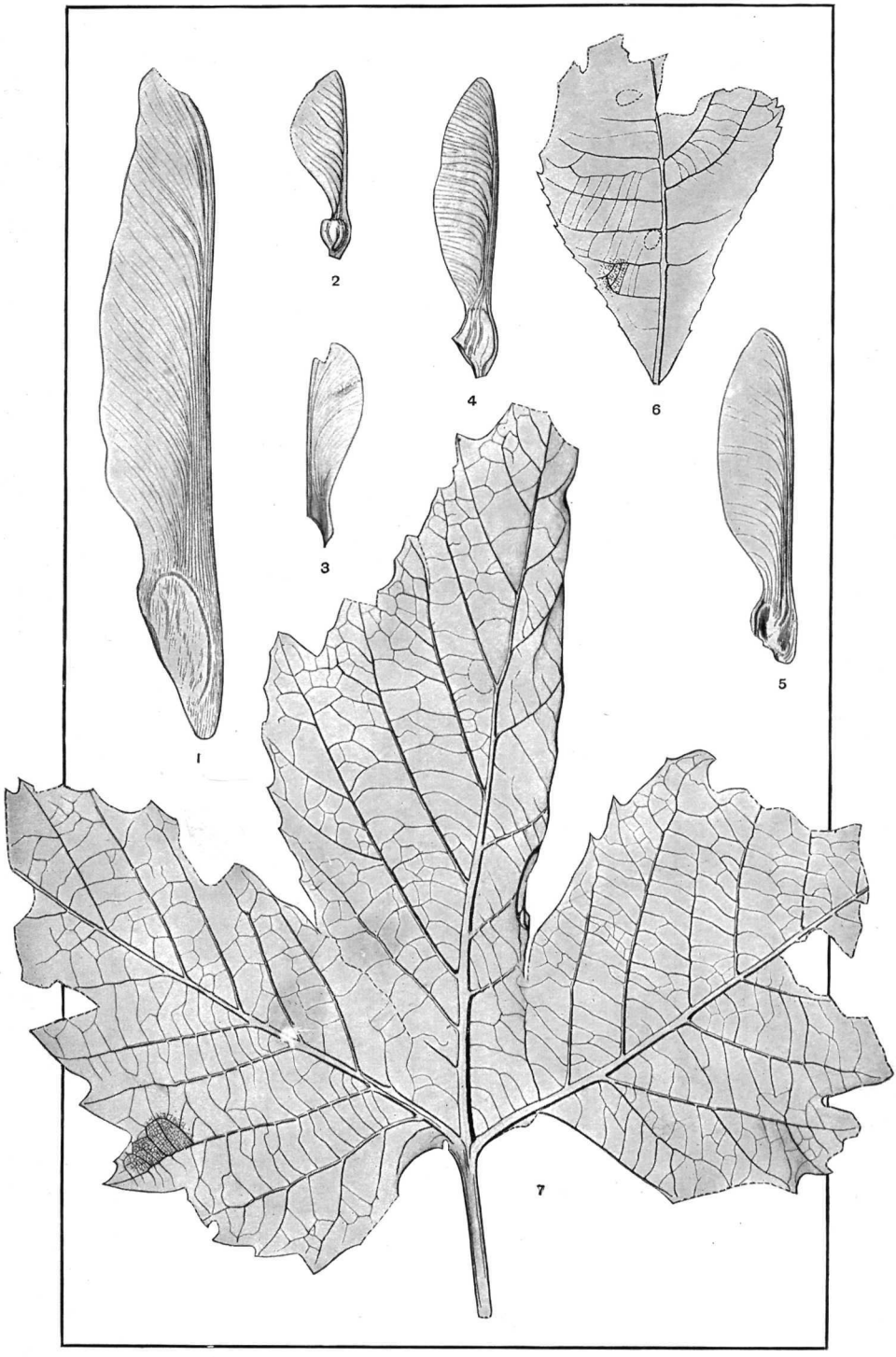


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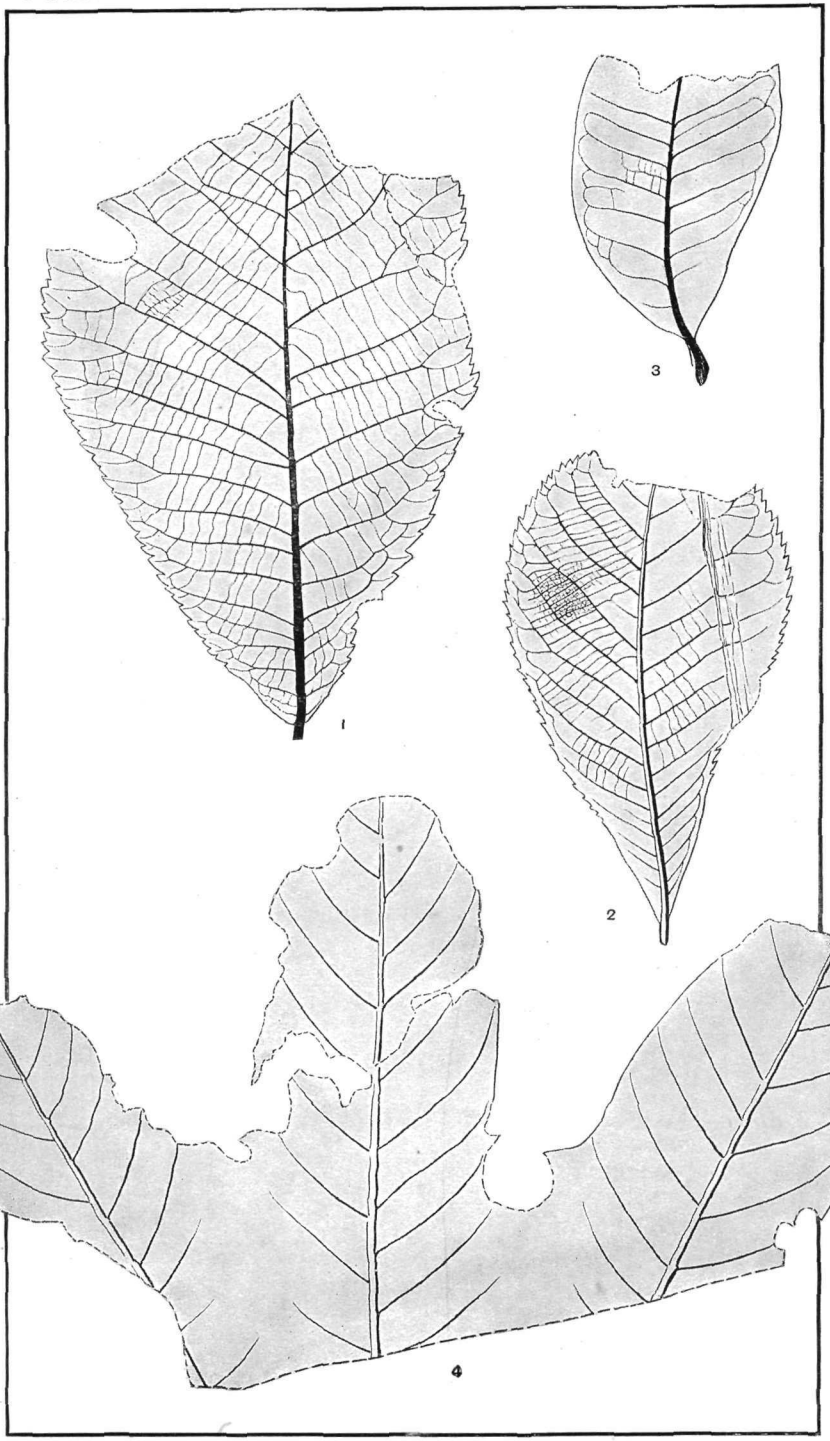


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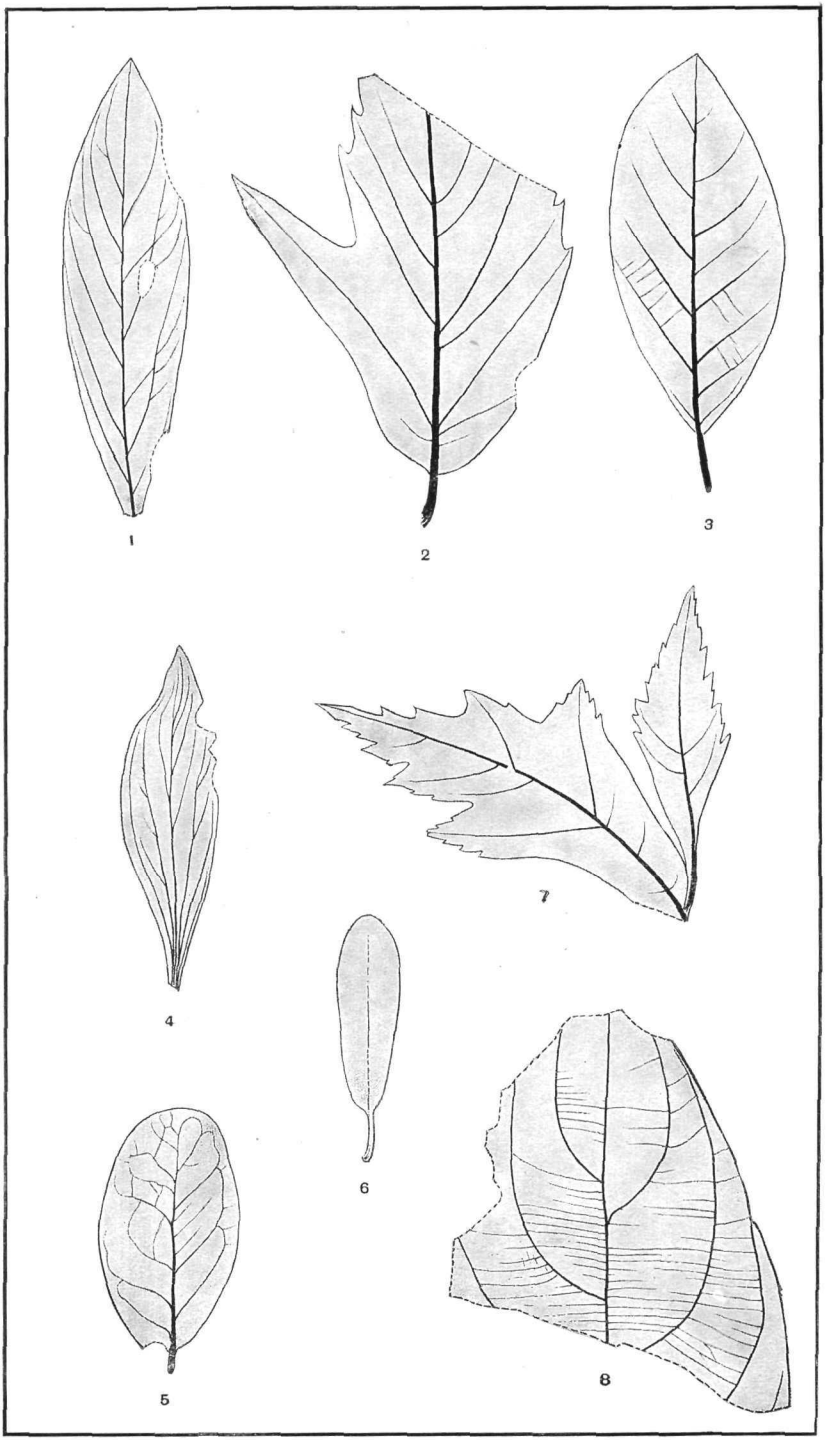


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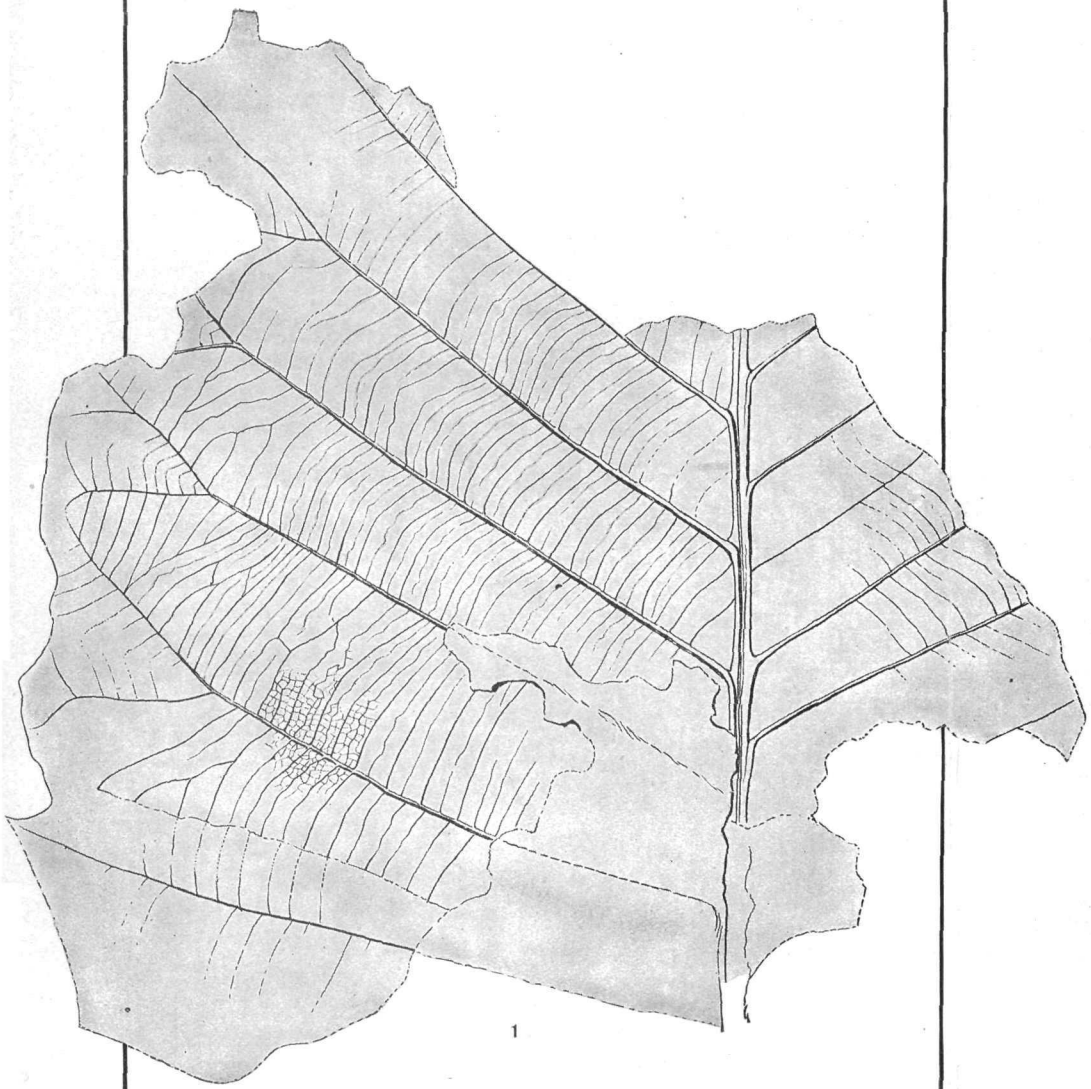
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[Bulletin No. 204.]

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