ADDITIONS TO SOME FOSSIL FLORAS OF THE WESTERN UNITED STATES

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ABSTRACT

This paper summarizes a study of selected species of fossil plants in the collections of the United States Geological Survey and the United States National Museum from several localities in the western United States. It is not a complete revision of any one flora, but many new combinations are proposed in the belief that they express a more accurate taxonomic disposition of the species involved. Seven new species are described from the Latah formation at Spokane, Wash., and one from the Creede formation at Creede, Colo.

INTRODUCTION

In the course of identifying new collections the writer, while handling the Cenozoic plants in the United States National Museum, discovered many discrepancies in the identification of types and other specimens. The notations then made are now concentrated in this paper, but they must not be regarded as a complete study or revision of any of the fossil floras involved, for, in one sense, such studies will never be complete, because new species are constantly being found that either invalidate or modify previous conclusions.

LOCALITIES

The localities supplying the fossils under consideration are as follows:

1. *Spokane, Wash.*—The Latah formation in Washington and deposits regarded as its equivalents in Idaho have been described in several papers, of which the principal ones are United States Geological Survey Professional Papers 140–A, 154–H, 170–C, and 185–E. This formation has yielded an abundance of fossil plants, especially in the vicinity of Spokane, chiefly through the efforts of E. E. Alexander, C. O. Fernquist, and the late T. A. Bonser, many of whose specimens are here figured. This flora is rich in genera and species and consists of mosses, club mosses, horsetails, ferns, ginkgo, incense cedar, redwood, swamp cypress, keteleeria, pines, cattail, arum, smilax, hickory, walnut, sweet fern, willows, poplar, birches, alders, hornbeam, chestnut, beech, oaks, elm, zelkova, sycamore, tulip tree, magnolias, sweet gum, hydrangea, mock orange, service berry, mountain mahogany, redbud, sophora, euonymus, maples, buckthorn, linden, gordonia, laurels, cedrela, umbellularia, dogwood, black gum, grape, persimmon, huckleberries, and viburnums. This is a flora that is comparable in many respects to that in parts of the eastern United States and eastern Asia but is in strong contrast to that now living in the region about Spokane. The decrease in annual precipitation and a probable changed distribution of the rainfall throughout the year are held to be the chief causes for the disappearance of many species from the region, for species similar to the fossils and presumably with the same climatic requirements flourish in the parks of Spokane, where they are watered.

New species are constantly being added to the Latah flora. The following, described in this paper, came from the Latah formation at Spokane:

Equisetum alexanderi.
Betula vera.
Machilus americana.
Machilus asiminoides.
Euonymus pacificus.
Dilodendron boreale.
Tetracera spokanensis.

Of these species, *Machilus americana* and *Machilus asiminoides* are similar to species now living in Asia; *Equisetum alexanderi*, *Betula vera*, and *Euonymus pacificus* resemble species in the eastern United States; and *Dilodendron boreale* and *Tetracera spokanensis* are most like species now living in Central America and the West Indies.

The age of the Latah flora is regarded as middle Miocene.

2. *Republic, Wash.*—The fossil plants from this locality occur in the light-colored dense tuffaceous shale exposed on the east side of the road at the south end of the town. These deposits rest upon or are intercalated with andesite flows and underlie Tertiary basalt. In United States Geological Survey Professional Paper 154–H, Berry merged this flora with the Latah flora from Spokane. A complete list of the material studied by Berry and of that collected by the writer on a short visit to Republic in 1934 is as follows:

Ginkgo adiantoides (Unger) Heer.
Sequoia langsdorfii (Brongniart) Heer.
Taxodium dubium (Sternberg) Heer.
Thuites sp.
Comptonia hesperia Berry.
Cercidiphyllum crenatum (Unger) Brown.
Pinus latahensis Berry.
Pinus monticolensis Berry.
Pinus tetrafolia Berry.
Pinus macrophylla Berry.
Fagus washoensis LaMotte.
Alnus elliptica Berry.
Alnus corallina Lesquereux.
Zelkova oregoniana (Knowlton) Brown, n. comb.

Acer glabroides Brown, n. name.
Acer negundoides MacGinitie.
Dipteronia americana Brown.
Cornus acuminata Berry.
Sassafras hesperia Berry.
Aralia republicensis Brown, n. name.
Liquidambar californicum Lesquereux.
Porana speirii Lesquereux.

The presence of a few species such as *Dipteronia americana*, *Aralia republicensis*, and *Porana speirii*, which are represented by the same or closely related species in fossil floras regarded as older than the Latah flora, together with the fact that the flora occurs in deposits lying beneath Tertiary basalt that may be equivalent to the Columbia River basalt at Spokane, suggests that the flora at Republic may be somewhat older than the Latah flora—that is, probably lower Miocene.

3. *John Day Basin, Oreg.*—This is the type region of the Mascall and Bridge Creek floras. The present paper deals only with a few misidentified types from these floras. The Mascall flora is regarded as being middle or upper Miocene, and the flora from Bridge Creek as lower Miocene.

4. *Tipton, Oreg.*—The fossil flora of this locality is found in diatomaceous deposits exposed in a railroad cut 1 mile south of Tipton, in sec. 4, T. 11 S., R. 35½ E., in the Sumpter quadrangle, Oreg. An account of the geology of this region was given by Pardee and Hewett,[1] and the flora was studied by Oliver,[2] who reported 32 species of higher plants and a large number of diatoms. To these the following species, collected by the writer in 1930, are now added:

Abies chaneyi Mason.
Torreya bonseri (Knowlton) LaMotte.
Castanopsis convexa (Lesquereux) Brooks.
Quercus simulata Knowlton.
Sassafras hesperia Berry.
Mahonia reticulata (MacGinitie) Brown, n. comb.
Cedrela pteraformis (Berry) Brown.

This flora compares so well with that from the Mascall formation in the John Day Basin, 45 miles to the southwest, that it is regarded as being contemporaneous—that is, of middle or perhaps upper Miocene age.

5. *Sucker Creek, Oreg.*—This region is in the eastern part of Malheur County. Because the stratigraphy has not yet been fully resolved, the relationships of the Payette formation are somewhat in doubt, and in consequence the positions of the fossil floras found at several localities are not clear. It is probable that the age of the floras that have been assigned to the Payette formation may cover a range from lower Miocene to Pliocene.

[1] Pardee, J. T., and Hewett, D. F., Geology and mineral resources of the Sumpter quadrangle, Oreg.: Mineral Resources of Oregon, vol. 1, no. 6, pp. 3–128, Oregon Bur. Mines, 1914.

[2] Oliver, Elizabeth, A Miocene flora from the Blue Mountains, Oregon: Carnegie Inst. Washington Pub. 455, pt. 1, pp. 1–27, 5 pls., 1934.

6. *White Bird, Idaho.*—An especially rich fossil locality in reddish shale occurs along the highway 2.5 miles east of White Bird. The relation of this outcrop, which is in the foothills, to the light-colored sedimentary rocks interbedded with Columbia River basalt in the surrounding mountains, is not clear, because there has been considerable faulting and land-slipping in that area. The fossil flora, however, is so similar to the Latah flora at Spokane that they are considered to be practically contemporaneous—that is, of middle Miocene age.

7. *Idaho City, Idaho.*—In 1934 the writer revisited the locality near Idaho City from which Knowlton described part of the Payette flora. A study of the collection then made has added nothing new but suggests that the flora is similar to that from Bridge Creek, Oreg., and may be of lower Miocene age.

8. *Salmon, Idaho.*—The fossil flora here is found in lake beds exposed on both sides of the Salmon River and in escarpments farther back in the valley. C. P. Ross classes the sedimentary rocks with the Challis volcanics. The outcrop furnishing the best and most abundant plants to Ross and the writer in 1930 was at the G. W. Oliver coal mine, about 3 miles west of Salmon up Jesse Creek. The complete flora as identified is as follows:

Fern spp.
Pinus sp.
Sequoia langsdorfii (Brongniart) Heer.
Typha lesquereuxi Cockerell.
Alnus carpinoides Lesquereux.
Alnus corallina Lesquereux.
Alnus relatus (Knowlton) Brown, n. comb.
Umbellularia dayana (Knowlton) Berry.
Amelanchier dignatus (Knowlton) Brown.
Chamaebatia prefoliolosa Brown.
Malus idahoensis Brown.
Potentilla salmonensis Brown.
Sassafras hesperia Berry.
Acer bendirei Lesquereux.
Acer glabroides Brown, n. name.
Ceanothus idahoensis Brown.
Rhamnus idahoensis Brown.
Arctostaphylos cuneata Brown.
Symphoricarpos salmonensis Brown.

In addition to these plants there are well-preserved grasshoppers and beetles, which, according to a personal communication from T. D. A. Cockerell, are very similar to species described from Florissant, Colo. This flora with *Umbellularia* and *Chamaebatia* suggests an ecologic situation much like that found in the Yosemite Valley, Calif., today. It may be of lower Miocene age.

9. *Thunder Mountain, Idaho.*—The fossil plants at this locality are derived from silicified auriferous sedimentary rocks that crop out particularly at the Dewey gold mine and vicinity, the geology of which is described by P. J. Shenon and C. P. Ross.[2a] The fossils

[2a] Shenon, P. J., and Ross, C. P., Geology and ore deposits near Edwardsburg and Thunder Mountain, Idaho: Idaho Bur. Mines and Geol. Pamph. 44, 45 pp., 19 pls., 1936.

are few and in general not well enough preserved to show details. They include ferns, pines, firs, alders, sweet fern, dogwood, and huckleberry—a flora that may indicate an upland ecology in lower Miocene time.

10. *Florissant, Colo.*—The age of the lake beds in which the fossils are found at this classic locality for fossil plants and insects continues to be a subject of discussion among paleontologists. To the writer the flora has a distinctly old aspect and seems to be of upper Oligocene or lower Miocene age. Correlations of the Latah and Florissant floras have been published on the basis of an alleged community of numerous identical species, but a careful comparison of the type specimens of these species does not substantiate such correlations. This flora needs thorough revision.

11. *Creede, Colo.*—The flora from the Miocene lake deposits in the vicinity of Creede, Colo., was described by Knowlton.[2b] Two undescribed specimens in the original collections are now referred to *Chamaebatiaria creedensis* Brown, n. sp.

12. *Fossil, Wyo.*—This is a notable locality in the Green River formation where the fossil fishes have claimed most interest among paleontologists. Nevertheless, the few plants found are unusually well preserved and often of great beauty—brown or black against a white or cream-colored background. Those figured here are published to supplement the illustrations of types. The Green River formation is middle Eocene.

CHANGES OF NAME AND NEW COMBINATIONS

Before satisfactory correlations between fossil floras can be drawn it is necessary to be reasonably certain that the species correlated are identical. In the past too many species have been named without thorough investigation of already published species, thus cluttering up the record and making further study difficult because of the inevitable expanding and compounding of those errors. As a result of examining the type specimens of species considered in this paper the writer has deemed the following changes of name and new combinations necessary. The reasons for these changes will be found in the systematic description of the several items. Unless otherwise stated all the types and figured specimens are to be found in the United States National Museum.

Acalypha myricina Cockerell = *Paliurus florissanti* Lesquereux.
Acer, fruits of, Lesquereux = *Acer bendirei* Lesquereux.
Acer sp. Berry = *Vitis washingtonensis* (Knowlton) Brown, n. comb.
Acer bendirei Lesquereux (part) = *Acer glabroides* Brown, n. name.
Acer bendirei Lesquereux (part) = *Platanus dissecta* Lesquereux.
Acer chaneyi Knowlton = *Acer osmonti* Knowlton.
Acer dimorphum Lesquereux = *Acer bendirei* Lesquereux.
Acer florissanti Kirchner (part) = *Acer osmonti* Knowlton.
Acer gigas Knowlton = *Acer osmonti* Knowlton.
Acer medianum Knowlton = *Acer bendirei* Lesquereux.
Acer merriami Knowlton (part) = *Acer bendirei* Lesquereux.
Acer merriami Knowlton (part) = *Vitis washingtonensis* (Knowlton) Brown, n. comb.
Acer minor Knowlton (part) = *Acer bendirei* Lesquereux.
Acer minor Knowlton (part) = *Acer glabroides* Brown, n. name.
Acer oregonianum Knowlton (part) = *Acer bendirei* Lesquereux.
Acer oregonianum Knowlton (part) = *Acer osmonti* Knowlton.
Acer osmonti Knowlton (part) = *Acer glabroides* Brown, n. name.
Acer osmonti Knowlton (part) = *Acer bendirei* Lesquereux.
Aesculus hesperia Berry = *Viburnum lantanafolium* Berry.
Aesculus simulata Knowlton = *Carya simulata* (Knowlton) Brown, n. comb.
Alnus prerhombifolia Berry = *Alnus carpinoides* Lesquereux.
Amygdalus alexanderi Berry = *Fagus washoensis* LaMotte.
Andromeda delicatula Lesquereux = *Cotinus fraterna* (Lesquereux) Cockerell.
Apocynophyllum latahense Berry (part) = *Magnolia latahensis* (Berry) Brown, n. comb.
Apocynophyllum latahense Berry (part) = *Quercus simulata* Knowlton.
Aralia whitneyi Lesquereux (part) = *Aralia republicensis* Brown, n. name.
Arbutus sp. Chaney = *Arbutus idahoensis* (Knowlton) Brown, n. comb.
Arbutus traini MacGinitie = *Arbutus idahoensis* (Knowlton) Brown, n. comb.
Arctostaphylos knowltoni Berry = *Vaccinium sophoroides* (Knowlton) Brown, n. comb.
Aristolochia whitebirdensis Ashlee = *Smilax magna* Chaney.
Betula aequalis? Lesquereux (part) = *Arbutus idahoensis* (Knowlton) Brown, n. comb.
Betula bryani Knowlton = *Betula fairii* Knowlton.
Betula elliptica Saporta (part) = *Alnus relatus* (Knowlton) Brown, n. comb.
Betula largei Knowlton = *Betula fairii* Knowlton.
Betula heteromorpha Knowlton (part) = *Betula fairii* Knowlton.
Betula heteromorpha Knowlton (part) = *Alnus relatus* (Knowlton) Brown, n. comb.
Betula thor Knowlton = *Alnus carpinoides* Lesquereux.
Carpites menthoides Knowlton = *Carpolithus* sp.
Carpites paulownia Knowlton = *Gordonia hesperia* Berry.
Carpites spokanensis Knowlton = bud scales.
Carpolithus hibiscoides Brown = *Carpites boraginoides* Knowlton.
Cassia obtusa Knowlton = *Salix inquirenda* Knowlton.
Cassia idahoensis Knowlton (part) = *Sophora spokanensis* Knowlton.
Cassia sophoroides (Knowlton) Berry (part) = *Sophora spokanensis* Knowlton.
Cassia sophoroides (Knowlton) Berry (part) = *Vaccinium sophoroides* (Knowlton) Brown, n. comb.
Castanea castaneaefolia (Unger) Knowlton = *Castanea orientalis* Chaney.
Castanea lesquereuxi LaMotte = *Fagus washoensis* LaMotte.
Celastrus fernquisti Knowlton = *Betula fairii* Knowlton.
Celastrus fraxinifolius Lesquereux = *Hydrangea fraxinifolia* (Lesquereux) Brown, n. comb.
Celastrus lacoei Lesquereux (part) = *Arbutus idahoensis* (Knowlton) Brown, n. comb.
Cercidium hesperium Ashlee = *Cercis spokanensis* Knowlton.
Cercis sp. Ashlee = *Cercis spokanensis* Knowlton.
Cercis idahoensis Berry (part) = *Cercis spokanensis* Knowlton.
Cercis idahoensis Berry (part) = *Vitis washingtonensis* (Knowlton) Brown, n. comb.
Clematis reticulata MacGinitie = *Mahonia reticulata* (MacGinitie) Brown, n. comb.
Comptonia acutiloba (Lesquereux) Cockerell = *Dipteronia insignis* (Lesquereux) Brown, n. comb.

[2b] Knowlton, F. H., Fossil plants from the Tertiary lake beds of south-central Colorado: U. S. Geol. Survey Prof. Paper 131, pp. 183-197, 1923.

Comptonia insignis (Lesquereux) Cockerell = *Dipteronia insignis* (Lesquereux) Brown, n. comb.
Corylus macquarrii (Forbes) Heer (part) = *Tilia oregona* LaMotte.
Crataegus heterodentata Chaney = *Acer negundoides* MacGinitie.
Diospyros princetonia Cockerell (part) = *Vaccinium sophoroides* (Knowlton) Brown, n. comb.
Equisetum, underground stem, Knowlton = *Carpolithus* sp.
Euonymus knowltoni Berry = *Hydrangea bendirei* (Ward) Knowlton.
Fagopsis longifolia (Lesquereux) Hollick = *Zelkova oregoniana* (Knowlton) Brown, n. comb.
Ficus interglacialis Hollick = *Carpolithus* sp.
Ficus planicostata Lesquereux? = *Celtis obliquifolia* Chaney.
Ficus ungeri Lesquereux = *Salix inquirenda* Knowlton.
Ficus? washingtonensis Knowlton = *Cercis spokanensis* Knowlton.
Fraxinus heeri Lesquereux = *Hydrangea fraxinifolia* (Lesquereux) Brown, n. comb.
Fraxinus praedicta Heer (part) = *Hydrangea fraxinifolia* (Lesquereux) Brown, n. comb.
Fraxinus ungeri Lesquereux (part) = *Cotinus fraterna* (Lesquereux) Cockerell.
Gleditschia praeaquatica Ashlee = *Cercis spokanensis* Knowlton.
Grewia crenata (Unger) Heer = *Cercidiphyllum crenatum* (Unger) Brown.
Hydrangea florissantia Cockerell = *Hydrangea fraxinifolia* (Lesquereux) Brown, n. comb.
Ilex latahensis Ashlee = *Mahonia simplex* (Newberry) Arnold.
Juglans affinis Kirchner = *Hydrangea fraxinifolia* (Lesquereux) Brown, n. comb.
Juglans cryptata Knowlton = *Carya egregia* (Lesquereux) LaMotte.
Juglans hesperia Knowlton = *Salix inquirenda* Knowlton.
Juglans oregoniana Lesquereux (part) = *Pterocarya mixta* (Knowlton) Brown, n. comb.
Juncus? crassulus Cockerell (part) = *Carpolithus* sp.
Laurus grandis Lesquereux = *Magnolia dayana* Cockerell.
Laurus princeps Heer (part) = *Arbutus idahoensis* (Knowlton) Brown, n. comb.
Laurus princeps Heer (part) = *Magnolia dayana* Cockerell.
Laurus princeps Heer (part) = *Quercus simulata* Knowlton.
Laurus similis Knowlton = *Umbellularia dayana* (Knowlton) Berry.
Leguminosites bonseri Berry = *Umbellularia dayana* (Knowlton) Berry.
Libocedrus sp. Dorf = *Cedrela pteraformis* (Berry) Brown.
Magnolia californica Lesquereux = *Magnolia latahensis* (Berry) Brown, n. comb.
Mahonia hollicki (Dorf) Arnold = *Mahonia reticulata* (MacGinitie) Brown, n. comb.
Malva? hesperia Knowlton = *Carpolithus* sp.
Meibomites knowltoni Berry = *Cercis spokanensis* Knowlton.
Meibomites lucens Knowlton = *Cercis spokanensis* Knowlton.
Menispermites latahensis Berry = *Vitis washingtonensis* (Knowlton) Brown, n. comb.
Myrica? idahoensis Knowlton = *Arbutus idahoensis* (Knowlton) Brown, n. comb.
Myrica lanceolata Knowlton = *Arbutus idahoensis* (Knowlton) Brown, n. comb.
Myrica oregoniana Knowlton = *Zelkova oregoniana* (Knowlton) Brown, n. comb.
Nyssa hesperia Berry = *Nyssa knowltoni* Berry.
Odostemon hollicki Dorf (part) = *Mahonia reticulata* (MacGinitie) Brown, n. comb.
Paliurus colombi Heer = *Cercidiphyllum crenatum* (Unger) Brown.
Paliurus haydeni Cockerell = *Cercis parvifolia* Lesquereux.
Philadelphus bendirei (Knowlton) Chaney (part) = *Sassafras hesperia* Berry.
Phyllites sp. Knowlton = *Salix spokanensis* (Berry) Brown, n. comb.
Phyllites amplexicaulis Knowlton = *Carpolithus* sp.
Phyllites bifurcies Knowlton = *Acer negundoides* MacGinitie.
Phyllites crustacea Knowlton = *Quercus simulata* Knowlton.
Phyllites pardeei Knowlton = *Philadelphus pardeei* (Knowlton) Brown, n. comb.
Phyllites peculiaris Knowlton = *Philadelphus pardeei* (Knowlton) Brown, n. comb.
Phyllites relatus Knowlton = *Alnus relatus* (Knowlton) Brown, n. comb.
Phyllites sophoroides Knowlton = *Vaccinium sophoroides* (Knowlton) Brown, n. comb.
Pinus knowltoni Chaney (part) = *Cedrela pteraformis* (Berry) Brown.
Pinus monticolensis Berry (part) = *Cedrela pteraformis* (Berry) Brown.
Pinus russelli LaMotte = *Cedrela pteraformis* (Berry) Brown.
Platanus appendiculata Lesquereux? (part) = *Aralia republicensis* Brown, n. name.
Populus, bud scales, Berry = bud scales.
Populus lesquereuxi Cockerell (part) = *Salix inquirenda* Knowlton.
Populus lindgreni Knowlton (part) = *Vitis washingtonensis* (Knowlton) Brown, n. comb.
Populus washingtonensis Knowlton = *Vitis washingtonensis* (Knowlton) Brown, n. comb.
Prunus rustii Knowlton (part) = *Alnus corallina* Lesquereux.
Prunus rustii Knowlton (part) = *Alnus relatus* (Knowlton) Brown, n. comb.
Pseudotsuga masoni MacGinitie (part) = *Cedrela pteraformis* (Berry) Brown.
Ptelea miocenica Berry (part) = *Carya egregia* (Lesquereux) LaMotte.
Pterocarya americana Lesquereux = *Populus lesquereuxii* Cockerell.
Quercus sp. Knowlton = *Quercus payettensis* Knowlton.
Quercus cf. *Q. pseudolyrata* Lesquereux = *Acer osmonti* Knowlton.
Quercus cognatus Knowlton = *Quercus payettensis* Knowlton.
Quercus duriuscula Knowlton = *Quercus pseudolyrata* Lesquereux.
Quercus obtusa Knowlton = *Quercus simulata* Knowlton.
Quercus praenigra Knowlton = *Quercus payettensis* Knowlton.
Quercus rustii Knowlton = *Quercus payettensis* Knowlton.
Quercus simulata Knowlton (part) = *Salix inquirenda* Knowlton.
Quercus simulata Knowlton (part) = *Umbellularia dayana* (Knowlton) Berry.
Quercus treleasii Berry = *Sophora spokanensis* Knowlton.
Quercus ursina Knowlton = *Quercus merriami* Knowlton.
Rhamnus spokanensis Berry = *Salix spokanensis* (Berry) Brown, n. comb.
Rhus bendirei Lesquereux = *Carya egregia* (Lesquereux) LaMotte.
Rhus subrhomboidalis Lesquereux = *Dipteronia insignis* (Lesquereux) Brown, n. comb.
Rhus typhinoides Lesquereux = *Salix inquirenda* Knowlton.
Rhus? sp. Knowlton = *Carya simulata* (Knowlton) Brown, n. comb.
Ribes fernquisti Knowlton = *Viburnum fernquisti* (Knowlton) Brown, n. comb.
Robinia? sp. Knowlton = *Salix spokanensis* (Berry) Brown, n. comb.
Rulac crataegifolium Knowlton = *Acer negundoides* MacGinitie.
Salix sp. Knowlton = *Umbellularia dayana* (Knowlton) Berry.
Salix dayana Knowlton (part) = *Sophora spokanensis* Knowlton.
Salix mixta Knowlton (part) = *Carya egregia* (Lesquereux) LaMotte.
Salix mixta Knowlton (part) = *Pterocarya mixta* (Knowlton) Brown, n. comb.
Salix perplexa Knowlton (part) = *Vaccinium sophoroides* (Knowlton) Brown, n. comb.
Salix remotidens Knowlton = *Salix inquirenda* Knowlton.

Salix varians Goeppert (part) = *Salix inquirenda* Knowlton.
Sapindus armstrongi Berry = *Cedrela pteraformis* (Berry) Brown.
Sapindus lancifolius Lesquereux = *Cedrela lancifolia* (Lesquereux) Brown, n. comb.
Sophora alexanderi Knowlton = *Sophora spokanensis* Knowlton.
Sorbus chaneyi LaMotte = *Fagus washoensis* LaMotte.
Trapa prenatans Dorf = *Trapa americana* Knowlton.
Tsuga latahensis Berry = bud scale.
Ulmus fernquisti Knowlton = *Zelkova oregoniana* (Knowlton) Brown, n. comb.
Ulmus speciósa Newberry (part) = *Ptelea miocenica* Berry.
Umbellularia dayana (Knowlton) Berry (part) = *Cedrela pteraformis* (Berry) Brown.
Umbellularia lanceolata Berry = *Laurus similis* Knowlton.
Vaccinium spokanense Berry = *Salix spokanensis* (Berry) Brown, n. comb.

SYSTEMATIC DESCRIPTIONS

PTERIDOPHYTA (FERNS)

Plate 45, figure 1. This fragment, showing a portion of a pinna with parts of five oblong, rounded, crenulate pinnules, is very similar to species of *Osmunda*, particularly *O. claytoniana* Linnaeus, which is found in wet situations in the eastern United States. Salmon, Idaho. Miocene.

Plate 45, figure 2. This terminal portion may represent a species of *Asplenium*. Thunder Mountain, Idaho. Miocene.

Plate 45, figure 3. The venation and shape of this fern suggest the genus *Aneimia*, particularly *A. coriacea* Gray of Cuba. Salmon, Idaho. Miocene.

ARTHROPHYTA (HORSETAILS)

Plate 45, figure 4. This is a chain of four successively smaller, coarsely wrinkled but very finely striated underground tubers of an *Equisetum*. Thunder Mountain, Idaho. Miocene.

Equisetum alexanderi Brown, n. sp.

Plate 45, figure 5

This is a portion of a slender stem showing three nodes. Three teeth of the sheath are visible on one side of the stem, making a total of 6 or 8 for the entire sheath. Below the sheath are three pits marking the former attachment of branches.

Occurrence: Latah formation, Spokane, Wash. Miocene.

SPERMATOPHYTA

TAXACEAE

Torreya bonseri (Knowlton) LaMotte

Plate 45, figure 22

Tumion bonseri Knowlton, U. S. Geol. Survey Prof. Paper 140, p. 25, pl. 10, fig. 3, 1926.
Torreya sp. Mason, Carnegie Inst. Washington Pub. 346, pt. 5, p. 146, pl. 1, figs. 5, 6, 1927.
Torreya bonseri (Knowlton) LaMotte, Carnegie Inst. Washington Pub. 455, pt. 5, p. 108, pl. 3, fig. 9, 1936.

The specimen illustrated here shows a feature not displayed by the type—namely, the narrow stomatal grooves paralleling the midrib.

Occurrence: Latah formation, Spokane, Wash.; Tipton, Oreg. (fig. 22). Miocene.

PINACEAE

Abies chaneyi Mason

Plate 45, figures 23, 24

Abies chaneyi Mason, Carnegie Inst. Washington Pub. 346, pt. 5, p. 149, pl. 4, figs. 1, 2, 7, 1927.

These specimens differ from those illustrated by Mason in having shorter, slenderer needles and somewhat larger scales. Whether these differences are variations in the species or indicate different species is here left an open question.

Occurrence: Tipton, Oreg. Miocene.

Abies sp.

Plate 45, figures 27, 28; plate 46, figures 1, 2

Cones 10 centimeters or more long and 2.5 centimeters in diameter, with numerous small, closely imbricated scales. Twigs, with short slightly curved needles, 1 centimeter long, blunt acuminate. Seeds 1 centimeter long with relatively broad wings.

These specimens may be compared in a general way with *Abies balsamea* (Linnaeus) Miller, of the northern United States and Canada.

Occurrence: Thunder Mountain, Idaho. Miocene.

Picea spp.

Plate 45, figures 29, 30. These appear to be partly disintegrated cones of *Picea*, but they may be a species of *Tsuga*. Tipton, Oreg. Miocene.

Plate 45, figures 18, 19. Probably seeds of *Picea*. Tipton, Oreg. Miocene.

Plate 45, figure 8. Except that this cone scale lacks the conspicuous basal bract displayed by the scales of the golden larch of eastern China, *Pseudolarix kaempferi* Gordon, it might pass for that or a related species. The cones of *Picea* do not disintegrate as readily as those of *Pseudolarix*, but it is nevertheless more probable that this scale belongs to a species of *Picea*. Republic, Wash. Miocene.

Pinus spp.

Plate 45, figure 9. A five-needled bundle with slender needles 3 to 4 centimeters long. This may represent a species like the foxtail pine, *Pinus aristata* Engelmann, or the white-bark pine, *P. albicaulis* Engelmann. Thunder Mountain, Idaho. Miocene.

Plate 45, figure 10. Short needles in bundles of twos and threes. Perhaps a piñon. Salmon, Idaho. Miocene.

Plate 45, figure 13. Long needles in twos, but Oliver reports a bundle with remains of a third needle and identifies this pine as *Pinus knowltoni* Chaney. Tipton, Oreg. Miocene.

Plate 45, figures 11, 12. These are staminate aments. Tipton, Oreg. Miocene.

Plate 45, figures 14–17, 20, 21. Seeds of pine. Tipton, Oreg., except figure 15, from Idaho City, Idaho, and figure 21, from Thunder Mountain, Idaho. Miocene.

Plate 45, figure 26. This large pine seed compares well with those of *Pinus ponderosa* Lawson. Spokane, Wash. Miocene.

Sequoia langsdorfii (Brongniart) Heer

Plate 45, figure 25

Sequoia langsdorfii (Brongniart) Heer, Flora tertiaria Helvetiae, Band 1, p. 54, pl. 20, fig. 2; pl. 21, fig. 4, 1855.
Knowlton, U. S. Geol. Survey Bull. 696, p. 594, 1919. (See synonymy and references.)
Oliver, Carnegie Inst. Washington Pub. 455, pt. 1, p. 15, 1934.
Brown, Jour. Paleontology, vol. 9, p. 573, pl. 67, figs. 1, 2 10, 1935.

Besides the small cone figured here there are remains of twigs of this species in the collections from Tipton.

Occurrence: Tipton, Oreg. Miocene.

Thuites sp.

Plate 45, figures 6, 7

Thuites sp. Knowlton, U. S. Geol. Survey Bull. 204, p. 26, pl. 1, fig. 3, 1902.

The stubby, branched appearance of the specimen shown in figure 6 suggests that it is a species of *Thuya* rather than *Libocedrus*, the remains of which are also found in the Latah formation at Spokane, Wash.

Occurrence: Latah formation, Spokane, Wash. (fig. 6); Republic, Wash. (fig. 7). Miocene.

SMILACEAE

Smilax magna Chaney

Plate 46, figure 15

Smilax magna Chaney, Walker Mus. Contr., vol. 2, p. 161, pl. 6, fig. 1, 1920.
Aristolochia whitebirdensis Ashlee, Northwest Sci., vol. 6, p. 78, pl. 1, fig. 3, 1932.

It is likely that *Smilax magna* was closely related to *S. wardii* Lesquereux,[3] from the Mascall formation of the John Day Basin, Oreg., the chief differences being that the latter had a more cordate base and was extremely elongated and narrow. Ashlee's *Aristolochia whitebirdensis*, from White Bird, Idaho, is undoubtedly *S. magna*. It is not impossible that two species of *Smilax* could have lived at the same locality, but the suspicion is also strong that a single species could have produced both *S. magna* and *S. lamarensis* Knowlton,[4] the latter also from both Spokane, Wash., and White Bird, Idaho.

Occurrence: Latah formation, Spokane, Wash. (fig. 15); White Bird, Idaho. Miocene.

SALICACEAE

Salix inquirenda Knowlton

Plate 47, figure 10

Salix inquirenda Knowlton, U. S. Geol. Survey Prof. Paper 140, p. 32, pl. 11, figs. 1, 2, 1926.
Berry, U. S. Geol. Survey Prof. Paper 154, p. 242, 1929.
Salix remotidens Knowlton, U. S. Geol. Survey Prof. Paper 140, p. 32, pl. 12, fig. 7, 1926.
Populus lesquereuxi Cockerell. Berry, U. S. Geol. Survey Prof. Paper 170, p. 35, 1931.
Salix varians Goeppert. Knowlton, U. S. Geol. Survey Bull. 204, p. 30, 1902.
Quercus simulata Knowlton. Berry, U. S. Geol. Survey Prof. Paper 154, p. 246, pl. 51, fig. 7 (not other figures), 1929.
Rhus typhinoides Lesquereux. Knowlton, U. S. Geol. Survey Prof. Paper 140, p. 44, pl. 27, fig. 5, 1926.
Juglans hesperia Knowlton, U. S. Geol. Survey 18th Ann. Rept., pt. 3, p. 723, pl. 99, fig. 8, 1898.
Ficus ungeri Lesquereux. Knowlton, idem, p. 731, pl. 101, fig. 5.
Cassia obtusa Knowlton, idem, p. 731, pl. 100, figs. 4, 5.
Berry, U. S. Geol. Survey Prof. Paper 154, p. 252 (not pl. 55, figs. 2, 3), 1929.

The teeth on all the specimens referred to in the synonymy are sharply serrate and thus differ characteristically from the rounded, somewhat crenate teeth exhibited by the types of *Populus lesquereuxi* Cockerell from the Florissant lake beds, to which Berry in 1931 referred *Salix inquirenda* Knowlton. The pair of prominent basal lateral veins in *Populus lesquereuxi* from Florissant also differentiates that species from *S. inquirenda*.

The last three species cited in the synonymy are from the Payette formation of Idaho. *Ficus ungeri*, although figured as having an entire margin, has in fact a margin with low, coarse, serrate teeth. *Cassia obtusa* is obscurely toothed.

Occurrence: Latah formation, Spokane, Wash. Miocene.

Salix spokanensis (Berry) Brown, n. comb.

Plate 46, figures 3–6, 8

Robinia? sp. Knowlton, U. S. Geol. Survey Prof. Paper 140, p. 44, pl. 28, figs. 7, 7a, 1926.
Rhamnus spokanensis Berry, U. S. Geol. Survey Prof. Paper 154, p. 257, pl. 57, figs. 4, 5, 1929.
Phyllites sp. Knowlton, U. S. Geol. Survey Prof. Paper 140, p. 49, pl. 29, fig. 5, 1926.
Vaccinium spokanense Berry, U. S. Geol. Survey Prof. Paper 154, p. 263, pl. 64, fig. 8, 1929.

The original descriptions of the several leaves cited in the synonymy need to be amended by recording an overlooked character that brings all of them within a single species. The leaves are described as having entire margins. On the contrary, they have conspicuous basal teeth, and one specimen here figured is well

[3] Lesquereux, Leo, Recent determinations of fossil plants from Kentucky, Louisiana, Oregon, California, Alaska, Greenland, etc., with descriptions of new species: U. S. Nat. Mus. Proc., vol. 11, p. 19, pl. 13, fig. 1, 1888.

[4] Berry, E. W., Revision of the flora of the Latah formation: U. S. Geol. Survey Prof. Paper 154, p. 240, pl. 63, fig. 15, 1929; Miocene plants from Idaho: U. S. Geol. Survey Prof. Paper 185, p. 105, pl. 19, fig. 7, 1934.

toothed more than halfway toward the apex. The smallest specimen shows the impressions of what appear to have been stipules.

The condition of being toothed near the base and not toward the apex is the reverse of the usual and makes a search for comparable living species relatively easy and fairly certain of success. The genera *Robinia*, *Rhamnus*, and *Vaccinium* are eliminated at once. In *Ailanthus altissima* (Miller) Swingle the basal teeth on the leaflets are few, large, and prominently glandular. These specimens have a venation quite different from that of *Ailanthus* and basal teeth that are only slightly, if at all, gland-tipped. Leaves with a venation and shape strikingly like these are found in several species of *Lonicera*, but the species of honeysuckle, although sometimes ciliate, are uniformly without teeth. In *L. japonica* there frequently appear leaves that are dissected into a number of rounded lateral lobes, which, however, are scarcely to be compared with the teeth of these fossil leaves.

The genus *Salix*, and particularly the species *S. commutata denudata* Bebb, a shrubby willow from the mountains of the Northwestern States, supplies leaves that duplicate fairly closely all the characters shown by the fossils.

Occurrence: Latah formation, Spokane, Wash. (figs. 3–6); Payette formation, Idaho City, Idaho (fig. 8). Miocene.

Populus eotremuloides Knowlton

Plate 47, figure 1

Populus eotremuloides Knowlton, U. S. Geol. Survey 18th Ann. Rept., pt. 3, p. 725, pl. 100, figs. 1, 2; pl. 101, figs. 1, 2, 1898.
Populus occidentalis Knowlton, idem, p. 727, pl. 99, fig. 14.
Populus eotremuloides Knowlton. Brooks, Carnegie Mus. Annals, vol. 24, p. 282, 1935.
LaMotte, Carnegie Inst. Washington Pub. 455, pt. 5, pl. 5, figs. 7, 9, 1936.

The specimen referred to by Brooks as being in the collections of the United States National Museum is here figured to show its very remarkable resemblance to *Populus trichocarpa hastata* Henry, of the Northwestern States.

Occurrence: Sucker Creek, Oreg. Miocene.

MYRICACEAE

Comptonia hesperia Berry

Plate 46, figures 11–14

Comptonia hesperia Berry, U. S. Geol. Survey Prof. Paper 154, p. 241, pl. 50, fig. 6, 1939.

There is no doubt that these leaves are those of *Comptonia* and not *Lyonothamnus*. Endo and Morita [5] have decided to call their similar material from the Tertiary deposits of Japan *Comptoniphyllum*.

[5] Endo, Seido, and Morita, Hikoji, Notes on the genera *Comptoniphyllum* and *Liquidambar:* Tohoku Imp. Univ. Sci. Repts., 2d ser. (Geology), vol. 15, no. 2, pp. 41–53, 3 pls., 1932.

The relationship of this species to *Myrica diforme* (Berry) Chaney, from Crooked River, Oreg., is not clear to the writer, but better material from Crooked River may indicate identity of these species.

Occurrence: Latah formation, Spokane, Wash. (fig. 11); Thunder Mountain, Idaho (figs. 12–14). Miocene.

JUGLANDACEAE

Carya egregia (Lesquereux) LaMotte

Plate 47, figure 4; plate 57, figure 4

Juglans egregia Lesquereux, Harvard Coll. Mus. Comp. Zoology Mem., vol. 6, no. 2, p. 36, pl. 9, fig. 12; pl. 10, fig. 1, 1878.
Berry, U. S. Geol. Survey Prof. Paper 170, p. 35, pl. 11, fig. 3, 1931.
Juglans oregoniana Lesquereux, Harvard Coll. Mus. Comp. Zoology Mem., vol. 6, no. 2, p. 35, pl. 9, fig. 10, 1878.
Knowlton, U. S. Geol. Survey Bull. 204, p. 36, 1902. [Except *Juglans hesperia* Knowlton, which is *Salix inquirenda* Knowlton.]
Chaney, Carnegie Inst. Washington Pub. 346, p. 104, 1927.
Hicoria pseudovata Hollick, New York Bot. Garden Mem., vol. 7, p. 395, pl. 30, figs. 1, 2, 1927.
Carya egregia (Lesquereux) LaMotte, Carnegie Inst. Washington Pub. 455, pt. 5, p. 116, pl. 4, figs. 5, 6; pl. 6, figs. 1, 2, 1936. (See synonymy and discussion.)
Ptelea miocenica Berry. LaMotte, idem, p. 133, pl. 11, fig. 4. [Not figs. 1, 2, which remain *Ptelea miocenica* Berry.]
Rhus bendirei Lesquereux, U. S. Nat. Mus. Proc., vol. 11, p. 15, pl. 9, fig. 2, 1888.
Knowlton, U. S. Geol. Survey Bull. 204, p. 70, 1902.
Juglans cryptata Knowlton, idem, p. 35, pl. 6, figs. 4, 5.
Salix mixta Knowlton, idem, p. 32, pl. 2, fig. 12 (leaflet on left). [Not leaflet on right, which is *Pterocarya mixta* (Knowlton) Brown.]

The specimens figured are examples of this apparently widespread species, which has been discussed by LaMotte. To his synonymy are now added several more items that in the writer's opinion belong here.

Occurrence: White Bird, Idaho (pl. 57, fig. 4); Tipton, Oreg. (pl. 47, fig. 4). Miocene.

Carya simulata (Knowlton) Brown, n. comb.

Aesculus simulata Knowlton, U. S. Geol. Survey Bull. 204, p. 78, pl. 15, figs. 1, 2, 1902.
Rhus? sp. Knowlton, idem, p. 70, pl. 14, fig. 6.

The leaflets of *Aesculus* differ chiefly from these fossils in having less undulatory secondary veins and marginal teeth that are blunt-pointed, serrate, and in most species mixed, with large teeth marking the terminations of the secondary veins and smaller teeth receiving their branches. The teeth of *Carya simulata* are sharp-pointed and fairly uniform in size. The leaflets of *Aesculus* disintegrate rapidly after falling and are not likely to persist long enough to be preserved in the fossil record.

Carya simulata has a general resemblance to *C. egregia* (Lesquereux) LaMotte but has more numerous, less camptodrome secondaries. It also resembles *Viburnum lantanafolium* Berry, except that the secondaries of that species depart from the midrib at narrower angles.

The relationship of *Carya simulata* to living species of *Carya* is not clear, but comparisons might be suggested with the pignut hickory, *Carya glabra* Sweet, of the eastern United States.

Occurrence: Mascall formation, John Day Basin, Oreg. Miocene.

Pterocarya mixta (Knowlton) Brown, n. comb.

Plate 47, figures 2, 3

Salix mixta Knowlton, U. S. Geol. Survey Bull. 204, p. 32, pl. 2, fig. 12 (leaflet on right), 1902. [Not leaflet on left, which is *Carya egregia* (Lesquereux) LaMotte.

Juglans oregoniana Lesquereux. Oliver, Carnegie Inst. Washington Pub. 455, pt. 1, p. 18, 1934.

Leaflets ovate-elliptic, pointed, with margins having numerous crenate-serrate teeth; bases cuneate to cordate, sessile or nearly so. Secondary veins numerous, forming conspicuous loops with the secondaries above well within the margin; branches from the loops to the teeth inconspicuous.

Although these leaflets have some resemblance to those of species of *Juglans*, yet the inconspicuous branches from the secondary veins to the marginal teeth ally them with *Pterocarya*. In *Carya* and *Juglans* the secondary veins either enter marginal teeth directly or send conspicuous branches to those teeth. No characteristic winged fruits of *Pterocarya* have been collected from the Latah formation unless some of those now called *Paliurus hesperia* Berry have been misidentified. The fruits of *Pterocarya paliurus* Batalin are so like those of *Paliurus orientalis* Hemsley, both from Hupeh Province, China, that distinction, especially of their fossil impressions, is difficult if not impossible.

Pterocarya mixta resembles a number of its Asiatic relatives but particularly *P. fraxinifolia* Spach.

The fossil species *Pterocarya americana* Lesquereux,[6] from Florissant, Colo., is equivalent to *Populus lesquereuxii* Cockerell.

Occurrence: Latah formation, Spokane, Wash. Miocene.

BETULACEAE

Alnus carpinoides Lesquereux

Plate 48, figures 4, 5

Alnus carpinoides Lesquereux, U. S. Geol. Terr. Rept., vol. 8, p. 243, pl. 50, fig. 11; pl. 51, figs. 4, 4a, 5, 1883.
Chaney, Carnegie Inst. Washington Pub. 349, pt. 1, pp. 7–10, pls. 2–7, 1925.
Oliver, Carnegie Inst. Washington Pub. 455, pt. 1, p. 19, 1934.
LaMotte, Carnegie Inst. Washington Pub. 455, pt. 5, p. 117, pl. 7, fig. 1, 1936.

Betula thor Knowlton, U. S. Geol. Survey Prof. Paper 140, p. 35, pl. 17, fig. 3, 1926.

Alnus prerhombifolia Berry, U. S. Geol. Survey Prof. Paper 154, p. 244, pl. 50, fig. 11, 1929.

[6] Lesquereux, Leo, The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 290, pl. 58, fig. 3, 1878.

This species seems to have been founded upon specimens that were pronouncedly broadly ovate-acuminate, with rounded-cuneate bases. The living species it most closely resembles is *Alnus tenuifolia* Nuttall, of the Western States. *Alnus carpinoides* has rather variable foliage, and it is possible that some fossil leaves from the Latah and other formations here segregated among three species—*A. carpinoides*, *A. relatus*, and *A. corallina*—may be confused and should be referred to *A. carpinoides* alone. There is, however, apparently no satisfactory basis for separating these fossil species except by arbitrarily choosing types on the basis of shape. It should also be noted that these fossil leaves resemble *Betula papyrifera* Marshall, of the northern United States.

Occurrence: Latah formation, Spokane, Wash. (fig. 5); Tipton, Oreg. (fig. 4); Salmon, Idaho. Miocene.

Alnus corallina Lesquereux

Plate 48, figures 1–3

Alnus corallina Lesquereux, U. S. Geol. Survey Terr. Rept., vol. 8, p. 243, pl. 51, figs. 1–3, 1883.
Brown, Jour. Paleontology, vol. 9, p. 575, pl. 67, fig. 15, 1935.

Alnus hollandiana Jennings, Carnegie Mus. Mem., vol. 8, no. 2, p. 413, pl. 24, fig. 8; pl. 25, fig. 3; pl. 28, fig. 1; pl. 30, figs. 1, 1a, 3, 1920.

Alnus microdontoides Jennings, idem, p. 415, pl. 24, fig. 7; pl. 30, figs. 2, 2a.

Prunus rustii Knowlton, U. S. Geol. Survey Prof. Paper 140, p. 43, pl. 24, figs. 4, 5, 1926. [Not Berry, U. S. Geol. Survey Prof. Paper 154, p. 252, pl. 55, fig. 1, 1929.]

The leaves of this species of *Alnus* resemble those of the living *A. rhombifolia* Nuttall and *A. rugosa* Sprengel in their ovate-elliptic shape and numerous small, uniform teeth and in the fact that nearly every secondary vein sends prominent branches to subsidiary marginal teeth.

The objection to the assignment of Knowlton's 1926 specimens and Berry's 1929 specimen to *Prunus* is based upon the well-known fact that the secondary veins of *Prunus* seldom, in evenly toothed leaves, run out directly into marginal teeth.

Occurrence: Salmon, Idaho (figs. 1, 2); Republic, Wash. (fig. 3). Miocene.

Alnus relatus (Knowlton) Brown, n. comb.

Plate 49, figures 1–6

Betula elliptica Saporta. Lesquereux, U. S. Geol. Survey Terr. Rept., vol. 8, p. 242, pl. 51, fig. 6, 1883.

Phyllites relatus Knowlton, U. S. Geol. Survey Prof. Paper 140, p. 48, pl. 28, fig. 8, 1926.

Prunus rustii Knowlton. Berry, U. S. Geol. Survey Prof. Paper 154, p. 252, pl. 55, fig. 1, 1929.

Betula heteromorpha Knowlton. Brooks, Carnegie Mus. Annals, vol. 24, p. 283, pl. 5, figs. 1–3, 1935.

Leaves narrowly elliptic, acuminate, with cuneate or slightly rounded bases. Main marginal teeth few, widely spaced, with few subsidiary teeth. Branches from the secondary veins to marginal teeth relatively few, but there is a marked tendency for the secondarise to form prominent connecting intramarginal loops.

This species can be matched most closely with *Alnus japonica* Siebold and Zuccarini, of Japan.

Occurrence: Latah formation, Spokane, Wash. (figs. 3, 4, 6); Salmon, Idaho (figs. 1, 2, 5). Miocene.

Betula fairii Knowlton

Plate 47, figures 5, 6, 7

Betula fairii Knowlton, U. S. Geol. Survey Prof. Paper 140, p. 33, pl. 17, fig. 4, 1926.
Berry, U. S. Geol. Survey Prof. Paper 154, p. 243, 1929.
Betula nanoides Knowlton, U. S. Geol. Survey Prof. Paper 140, p. 34, pl. 18, fig. 2, 1926.
Betula heteromorpha Knowlton. Knowlton, idem, p. 34, pl. 17, figs. 5, 6.
Berry, U. S. Geol. Survey Prof. Paper 154, p. 243, 1929.
Betula? largei Knowlton, U. S. Geol. Survey Prof. Paper 140, p. 34, pl. 17, figs. 1, 2, 1926.
Berry, U. S. Geol. Survey Prof. Paper 154, p. 244, pl. 50, fig. 4, 1929.
Brooks, Carnegie Mus. Annals, vol. 24, p. 284, pl. 5, figs. 4, 5; pl. 6, fig. 1, 1935.
Betula bryani Knowlton, U. S. Geol. Survey Prof. Paper 140, p. 34, pl. 17, fig. 1, 1926.
Celastrus fernquisti Knowlton, idem, p. 44, pl. 28, fig. 2.

That some of the described leaves here cited are small and others large does not alter the fact that fundamentally they have the same shape, venation, and marginal dentition and are therefore regarded as the same species. The resemblance of this species to *Betula luminifera* Winkler, of China, is extremely close.

Occurrence: Latah formation, Spokane, Wash. Miocene.

Betula vera Brown, n. sp.

Plate 48, figures 7–11

Leaves 10 centimeters or more long, ovate or oblong-ovate, acute at the apex, narrowed to an oblique, slightly cordate base, doubly serrate with rather uniform blunt teeth. Midrib strong, secondaries evenly spaced, straight or slightly curved, few except the lowermost having branches to subsidiary teeth.

This fine species appears to be an exact duplicate of the living yellow birch, *Betula lutea* Michaux, which is found in moist situations in the uplands of the Northeastern States and Canada.

Occurrence: Latah formation, Spokane, Wash. Miocene.

Corylus macquarrii (Forbes) Heer

Plate 50, figure 6

Corylus macquarrii (Forbes) Heer. Newberry, U. S. Geol. Survey Mon. 35, p. 61, pl. 32, fig. 5; pl. 48, fig. 4, 1898.
Chaney, Carnegie Inst. Washington Pub. 346, pt. 4, p. 104, 1927. (See discussion.)
Oliver, Carnegie Inst. Washington Pub. 455, pt. 1, p. 18, pl. 3, figs. 2, 4, 1934.

This portion of a leaf with craspedodrome secondary veins running into large, prominent, dentate teeth and with branches to subordinate smaller teeth has the form and venation of *Corylus macquarrii* (Forbes) Heer.

Occurrence: Tipton, Oreg. Miocene.

Ostrya oregoniana Chaney

Plate 48, figure 12

Ostrya oregoniana Chaney, Carnegie Inst. Washington Pub. 346, pt. 4, p. 106, pl. 9, fig. 12; pl. 10, figs. 1–4, 1927.
LaMotte, Carnegie Inst. Washington Pub. 455, pt. 5, p. 118, pl. 9, fig. 3, 1936.

This specimen with most of its secondary veins showing conspicuous branches to subsidiary teeth appears to match the specimen illustrated by Chaney's plate 10, figure 4.

Occurrence: Latah formation, Spokane, Wash. Miocene.

FAGACEAE

Castanea orientalis Chaney

Plate 49, figure 17

Castanea orientalis Chaney, Carnegie Inst. Washington Pub. 346, pt. 4, p. 110, pl. 12, figs. 1, 4, 1927.
Berry, U. S. Geol. Survey Prof. Paper 154, p. 240, pl. 51, figs. 4, 5, 1929.
Castanea castaneaefolia (Unger) Knowlton. Berry, U. S. Geol. Survey Prof. Paper 185, p. 108, 1934. (See synonymy and discussion.)

If there is any suggestive difference between the species cited in the synonymy, no one has yet pointed it out. Until that is done, if it can be done, they are hereby merged into one species. It is possible that some of the more obovate specimens heretofore identified as *Castanea orientalis* may in reality be forms of *Quercus clarnensis* Trelease.

Occurrence: Latah formation, Spokane, Wash.; White Bird, Idaho (fig. 17). Miocene.

Castanopsis convexa (Lesquereux) Brooks

Plate 49, figures 8–11

Castanopsis convexa (Lesquereux) Brooks, Carnegie Mus. Annals, vol. 24, p. 288, pl. 6, fig. 5; pl. 10, figs. 1, 3; pl. 12, figs. 1–6; pl. 13, figs. 4–6; pl. 18, figs. 3–5; pl. 20, fig. 4; pl. 21, fig. 16, 1935.

The four specimens figured here are examples of this species as originally conceived—that is, as a species having short lanceolate-oblong or elliptic leaves. They resemble the leaves of the bush chinquapin, *Castanopsis sempervirens* Dudley.

Occurrence: Latah formation, Spokane, Wash. (figs. 10, 11); Tipton, Oreg. (figs. 8, 9). Miocene.

Fagus washoensis LaMotte

Plate 51, figures 1–3, 8–10

Fagus pacifica Chaney. Oliver, Carnegie Inst. Washington Pub. 455, pt. 1, p. 19, 1934.
Berry, U. S. Geol. Survey Prof. Paper 185, p. 107, pl. 19, fig. 6; pl. 20, fig. 1, 1934.
Brooks, Carnegie Mus. Annals, vol. 24, p. 285, pl. 6, figs. 3, 4, 1935.
Fagus washoensis LaMotte, Carnegie Inst. Washington Pub. 455, pt. 5, pl. 119, pl. 8, figs. 2, 3, 5, 1936.
Castanea lesquereuxi LaMotte, idem, p. 120, pl. 9, fig. 6.
Sorbus chaneyi LaMotte, idem, p. 130, pl. 9, figs. 4, 5.
Amygdalus alexanderi Berry, Washington Acad. Sci. Jour., vol. 19, pp. 41–43, text fig. 1, 1929.

Although LaMotte says that *Fagus washoensis* differs from *F. pacifica* Chaney in being larger and in having more numerous secondaries, a longer petiole, and serrate rather than dentate teeth, one other important difference should be noted—namely, that *F. washoensis* is broadest near the middle of the blade, thus giving it an elliptic appearance, whereas *F. pacifica* is broadest at a point some distance below the middle of the blade, giving it an oblong, lance-shaped appearance.

An examination of the types of *Castanea lesquereuxi* LaMotte and *Sorbus chaneyi* LaMotte shows that they are large and small leaves, respectively, of *Fagus washoensis*, for they can be duplicated easily in the fossil collections from Tipton, Oreg., and White Bird, Idaho, and also with leaves from the living *Fagus americana* Sweet growing in the vicinity of Washington, D. C.

The specimen called *Amygdalus alexanderi* Berry, originally described as the impression of a peach stone, represents in fact two partly overlapping valves of a beech bur, as the accompanying figures of the type and a squeeze of its counterpart show (figs. 2, 3). This bur is somewhat larger than that ascribed to *Fagus pacifica* Chaney, from Crooked River, Oreg. It is associated with a large beechnut (fig. 1) and leaves in the Latah formation at Spokane, Wash. The leaves illustrated here, however, came from Tipton, Oreg.

The presence of *Amygdalus* in the fossil record of North America, though not improbable, rests uncertainly upon some rather doubtfully identified leaves and fruits.

Occurrence: Latah formation, Spokane, Wash. (figs. 1–3); Tipton, Oreg. (figs. 8–10). Miocene.

Quercus castaneopsis Lesquereux

Plate 50, figure 9

Quercus castaneopsis Lesquereux. Brown, U. S. Geol. Survey Prof. Paper 185, p. 55, 1934.

This large specimen, perfect except for the twisted tip, is an unusually fine example of the species. Until recently it was misplaced in a collection to which it did not originally belong in the United States National Museum.

Occurrence: Green River formation, Fossil, Wyo. Middle Eocene.

Quercus consimilis Newberry

Plate 50, figures 2–5

Quercus consimilis Newberry, U. S. Nat. Mus. Proc., vol. 5, p. 505, 1883; U. S. Geol. Survey Mon. 35, p. 71, pl. 43, figs. 2–5 (not figs. 7–10), 1898.
MacGinitie, Carnegie Inst. Washington Pub. 416, pt. 2, p. 52, pl. 5, fig. 5, 1933.
Oliver, Carnegie Inst. Washington Pub. 455, pt. 1, p. 20, 1934.

The writer has not had time to investigate fully the merits of uniting *Quercus consimilis* Newberry, *Q. simulata* Knowlton, and some other species, as has been proposed by several students. The probability that these leaves in whole or in part may represent *Castanopsis*, as claimed by Brooks,[7] has not, it is felt, been completely tested.

Occurrence: Latah formation, Spokane, Wash. (figs. 4, 5); Tipton, Oreg. (figs. 2, 3). Miocene.

Quercus merriami Knowlton

Quercus merriami Knowlton, U. S. Geol. Survey Bull. 204, p. 49, pl. 6, figs. 6, 7; pl. 7, figs. 4, 5, 1902; U. S. Geol. Survey Paper 140, p. 35, pl. 19, figs. 4, 5, 1926.
Berry, U. S. Geol. Survey Prof. Paper 154, p. 246, 1929.
Quercus ursina Knowlton, U. S. Geol. Survey Bull. 204, p. 51, pl. 7, figs. 2, 3, 1902.
Berry, U. S. Geol. Survey Prof. Paper 154, p. 246, 1929.

These leaves from a species belonging to the black-oak group are distinguished by being relatively narrow and by having elongated, sharpened lobes showing little tendency toward subordinate lobing.

Occurrence: Mascall formation, John Day Basin, Oreg.; Spokane, Wash. Miocene.

Quercus payettensis Knowlton

Plate 49, figures 12, 13

Quercus payettensis Knowlton, U. S. Geol. Survey 18th Ann. Rept., pt. 3, p. 730, pl. 102, fig. 9, 1898; U. S. Geol. Survey Prof. Paper 140, p. 37, pl. 21, figs. 5–7, 1926.
Berry, U. S. Geol. Survey Prof. Paper 154, p. 246, 1929.
Quercus cognatus Knowlton, U. S. Geol. Survey Prof. Paper 140, p. 36, pl. 20, figs. 1–4; pl. 21, figs. 1, 2, 1926.
Berry, U. S. Geol. Survey Prof. Paper 154, p. 245, 1929.
Brooks, Carnegie Mus. Annals, vol. 24, p. 292, pl. 16, fig. 2, 1935.
Dorf, Carnegie Inst. Washington Pub. 476, pt. 2, p. 113, pl. 2, fig. 1, 1936.
Quercus rustii Knowlton, U. S. Geol. Survey Prof. Paper 140, p. 36, pl. 21, figs. 3, 4, 1926.
Berry, U. S. Geol. Survey Prof. Paper 154, p. 246, 1929.
Quercus praenigra Knowlton, U. S. Geol. Survey Prof. Paper 140, p. 37, pl. 19, fig. 6, 1926.
Quercus sp. Knowlton, idem, p. 37, pl. 19, fig. 7; pl. 22, fig. 9.

These leaves from a species belonging to the black-oak group are distinguished by being relatively broad, with short sharp lobes showing little tendency toward subordinate lobing. The lower half of these leaves may frequently be without lobes.

Occurrence: Payette formation, Jackass Creek, Boise County, Idaho; Latah formation, Spokane, Wash. (figs. 12, 13). Miocene.

Quercus pseudolyrata Lesquereux

Plate 50, figures 7, 8

Quercus pseudo-lyrata Lesquereux. Knowlton, U. S. Geol. Survey Bull. 204, p. 48, 1902. (See synonymy and discussion.)
Oliver, Carnegie Inst. Washington Pub. 455, pt. 1, p. 20, pl. 5, fig. 4, 1934.
LaMotte, Carnegie Inst. Washington Pub. 455, pt. 5, p. 121, 1936.
Quercus duriuscula Knowlton, idem, p. 50, pl. 8, fig. 2.
Dorf, Carnegie Inst. Washington Pub. 476, pt. 2, p. 114, pl. 2, fig. 8, 1936.

[7] Brooks, B. W., Fossil plants from Sucker Creek, Idaho: Carnegie Mus. Annals, vol. 24, p. 285, 1935.

These leaves from a species belonging to the black-oak group are distinguished by the fact that their lobes tend to be obovate and themselves lobed or cut. The specimen *Quercus duriuscula*, confidently assigned by Knowlton to the white-oak group, was found when cleaned to have strongly pointed lobes. It is therefore regarded as a form of *Q. pseudolyrata*.

Occurrence: Mascall formation, John Day Basin, Oreg.; Tipton, Oreg. (figs. 7, 8). Miocene.

Quercus simulata Knowlton

Plate 50, figure 1

Quercus simulata Knowlton. See synonymy as given by Berry, U. S. Geol. Survey Prof. Paper 185, p. 109, 1934; and also those given by Brooks for *Castanopsis consimilis* (Newberry) Brooks, Carnegie Mus. Annals, vol. 24, p. 285, 1935, and *Castanopsis convexa* (Lesquereux) Brooks, idem, p. 288.
LaMotte, Carnegie Inst. Washington Pub. 455, pt. 5, p. 122, 1936.
Dorf, Carnegie Inst. Washington Pub. 476, pt. 2, p. 115, pl. 1, figs. 9, 10, 1936.
Quercus obtusa Knowlton, U. S. Geol. Survey Prof. Paper 140, p. 38, pl. 22, fig. 8, 1926.
Laurus princeps Heer. Knowlton, idem, p. 41, pl. 23, fig. 3.
Phyllites crustacea Knowlton, idem, p. 47, pl. 29, fig. 6.
Apocynophyllum latahense Berry, U. S. Geol. Survey Prof. Paper 154, p. 263, pl. 60, fig. 4 (not fig. 7), 1929.
Rhus merrilli Chaney. Berry, idem, p. 256, pl. 51, fig. 8.

The question whether any or all the leaves called *Quercus simulata* are a species of *Castanopsis*, as thought by Brooks, is, in the writer's opinion, not settled, and he prefers to await further study. The recent synonymy by LaMotte includes some items otherwise disposed of in this paper, as can be seen by consulting the section on changes of name and new combinations (pp. 165–167).

Occurrence: Latah formation, Spokane, Wash.; Tipton, Oreg. (fig. 1). Miocene.

ULMACEAE

Celtis obliquifolia Chaney

Plate 48, figure 6

Celtis obliquifolia Chaney, Carnegie Inst. Washington Pub. 349, pt. 3, p. 51, pl. 1, figs. 1, 3, 5, 1925; idem, Pub. 346, pt. 4, p. 115, pl. 13, fig. 12, 1927.
Ficus planicostata Lesquereux? Newberry, U. S. Geol. Survey Mon. 35, p. 88, pl. 46, fig. 1, 1898.

The venation, entire margin, and asymmetry of the leaf doubtfully referred to *Ficus planicostata* by Newberry substantiate its reference to *Celtis obliquifolia* Chaney. Thus far the stone fruits of *Celtis*, characterized by a distinctive reticulated surface, have not been reported from the deposits at Bridge Creek or Crooked River, Oreg.

Occurrence: Bridge Creek, Oreg. Miocene.

Zelkova oregoniana (Knowlton) Brown, n. comb.

Plate 51, figures 11–15

Myrica oregoniana Knowlton, U. S. Geol. Survey Bull. 204, p. 33, pl. 3, fig. 4, 1902.
Ulmus fernquisti Knowlton, U. S. Geol. Survey Prof. Paper 140, p. 39, pl. 19, fig. 2, 1926.
Fagopsis longifolia (Lesquereux) Hollick. Berry, U. S. Geol. Survey Prof. Paper 154, p. 245, pl. 50, fig. 7, 1929.

Leaves oblong-ovate or elliptic with cordate, rounded, and only slightly asymmetric bases. Tips long pointed. Margins with large, rounded, sometimes conical, blunt, single or double teeth, the subsidiary tooth missing or very obscure on some teeth. Secondary venation more or less undulate, occasionally forked. Finer venation produces a pattern of relatively larger areolae than in *Ulmus*.

The double teeth shown near the base at the left on Knowlton's figure 4 are the artist's interpolation of several offsets in the fossil impression. The teeth are single.

The leaves of this species possess characters common to both *Zelkova ulmoides* Schneider of southwestern Asia, and *Z. serrata* Makino of Japan. No fossil fruits assignable to this species have yet been detected in the strata from which the leaves were collected.

Occurrence: Mascall formation, John Day Basin, Oreg.; Spokane, Wash. (figs. 11, 13–15); Republic, Wash. (fig. 12). Miocene.

Ulmus speciosa Newberry

Ulmus speciosa Newberry, U. S. Nat. Mus. Proc., vol. 5, p. 507 1883; U. S. Geol. Survey Mon. 35, p. 80, pl. 45, figs. 2–4 8, 1898. [Not other figures, especially fig. 7, which is *Ptelea miocenica* Berry.]
Knowlton, U. S. Geol. Survey Bull. 204, p. 53, 1902; U. S. Geol. Survey Prof. Paper 140, p. 39, pl. 18, fig. 6, 1926.
Chaney, Carnegie Inst. Washington Pub. 346, pt. 4, p. 114, 1927. [Not pl. 12, fig. 5, which is *Ptelea miocenica* Berry.]
Berry, U. S. Geol. Survey Prof. Paper 156, p. 247, 1929; Prof. Paper 170, p. 34, 1931; Prof. Paper 185, p. 110, 1934.
Dorf, Carnegie Inst. Washington Pub. 476, pt. 2, p. 116, 1936.
Ulmus, fruit. Berry, U. S. Geol. Survey Prof. Paper 156, p. 247, pl. 51, fig. 1; pl. 64, figs. 3, 4, 1929.

The assumption that the fruits cited in the last member of the synonymy belong to the same species as the leaves is based upon the close resemblance of both fruits and leaves to those of *Ulmus americana* Linnaeus, of the eastern United States and Canada. The samaras called *U. speciosa* by Newberry and Chaney possess the form and the strong, reticulated venation of *Ptelea* fruits, but a restudy of the Miocene species of *Ulmus* based on better material than is now at hand may prove this assignment to be untenable.

Occurrence: Latah formation, Spokane, Wash.; Grand Coulee, Wash.; Bridge Creek, Oreg. Miocene.

MORACEAE

Ficus mississippiensis (Lesquereux) Berry

Plate 63, figure 4

Ficus mississippiensis (Lesquereux) Berry, U. S. Geol. Survey Prof. Paper 131, p. 9, pls. 6–8, 1923. (See synonymy.)
Brown, U. S. Geol. Survey Prof. Paper 154, p. 284, 1929.

Occurrence: Green River formation, Fossil, Wyo. Middle Eocene. Figured specimen in Museum of Paleontology, University of Michigan.

PLATANACEAE

Platanus dissecta Lesquereux

Plate 52, figures 1–3

Platanus dissecta Lesquereux, Harvard Coll. Mus. Comp. Zoology Mem., vol. 6, no. 2, p. 13, pl. 7, fig. 12; pl. 10, figs. 4, 5, 1878; U. S. Geol. Survey Terr. Rept., vol. 8, p. 249, pl. 56, fig. 4; pl. 57, figs. 1, 2, 1883.

Berry, U. S. Geol. Survey Prof. Paper 154, p. 248, pl. 53, figs. 1, 2; pl. 61, 1929; Prof. Paper 185, p. 111, pl. 21, fig. 2, 1934.

Brooks, Carnegie Mus. Annals, vol. 24, p. 294, pl. 17, figs. 2–4; pl. 18, figs. 1, 2, 1935.

Oliver, Carnegie Inst. Washington Pub. 455, pt. 1, p. 22, pl. 3, fig. 3, 1934.

LaMotte, Carnegie Inst. Washington Pub. 455, pt. 5, p. 129, 1936.

Acer trilobatum productum (Al. Braun) Heer. Lesquereux, U. S. Geol. Survey Terr. Rept., vol. 8, p. 253, pl. 59, figs. 1–4, 1883.

Platanus aspera Newberry, U. S. Geol. Survey Mon. 35, p. 102, pl. 42, fig. 2 [not fig. 1, which is *Tilia aspera* (Newberry) LaMotte, nor fig. 3, which is *Platanus condoni* (Newberry) Knowlton, nor other figures], 1898.

Acer bendirei Lesquereux, U. S. Nat. Mus. Proc., vol. 11, p. 14, pl. 5, fig. 5; pl. 6, fig. 1; pl. 7, fig. 1 [not pl. 8, fig. 1, which remains *A. bendirei*], 1888.

Celtis hesperius Berry, Torreya, vol. 32, pp. 40–42, text fig. 1, 1932.

As pointed out by Brooks, the specimen called *Celtis hesperius* Berry is in fact *Platanus dissecta*. It is refigured here to show the points on which its transfer from *Celtis* to *Platanus* was made—namely, the two incipient lobes, the large, sharp, scalloped teeth penetrated by secondary veins, and the large base of the petiole.

Occurrence: Tipton, Oreg. (fig. 1); Latah formation, Spokane, Wash. (fig. 2); Sucker Creek, Oreg. (fig. 3). Miocene.

LAURACEAE

Laurus similis Knowlton

Laurus similis Knowlton. Berry, U. S. Geol. Survey Prof. Paper 185, p. 121, 1934. (See synonymy, except last member, which is referred to *Umbellularia dayana* (Knowlton) Berry.)

Umbellularia lanceolata Berry, U. S. Geol. Survey Prof. Paper 154, p. 260, pl. 59, fig. 1, 1929.

LaMotte, Carnegie Inst. Washington Pub. 455, pt. 5, p. 127, 1936. (See discussion.)

The species *Umbellularia lanceolata* lacks the characteristic looped secondary venation of *Umbellularia* and appears to be only a narrow form of *Laurus similis*. These fossils may represent a species of *Persea*.

Occurrence: Latah formation, Spokane, Wash. Miocene.

Machilus americana Brown, n. sp.

Plate 53, figure 16

Leaf 6 centimeters long, entire, narrowly ovate, probably acuminate; base cuneate; petiole less than 1 centimeter long; secondary veins somewhat irregularly spaced, slightly undulate, camptodrome.

This specimen may be compared with the leaves of *Machilus henryi* Hemsley from southern China.

Occurrence: Latah formation, Spokane, Wash. Miocene.

Machilus asiminoides Brown, n. sp.

Plate 52, figures 9, 10

Leaves small, entire, oblanceolate, with blunt apex and gradually narrowed base; petiole relatively long, curved.

In venation and shape these small leaves are exceedingly like those of *Machilus ichangensis* Rehder and Wilson and *M. thunbergii* Nees, of southeastern China. Except for their long petioles they are also very similar to *Asimina triloba* (Linnaeus) Dunal, the pawpaw of the eastern United States.

Occurrence: Latah formation, Spokane, Wash. Miocene.

Sassafras hesperia Berry

Plate 53, figures 7–10

Sassafras hesperia Berry, U. S. Geol. Survey Prof. Paper 154, pl. 59, fig. 2, 1929.

Brooks, Carnegie Mus. Annals, vol. 24, p. 299, pl. 20, fig. 1, 1935.

Philadelphus bendirei Chaney. Oliver, Carnegie Inst. Washington Pub. 455, pt. 1, p. 21, 1934.

The type of this species, a leaf with a left-hand lobe, was mistakenly recorded as having come from the brickyard locality at Spokane, Wash. It came from Republic, Wash. The leaves on the living sassafras, *Sassafras variifolium* (Salisbury) Kuntze, are of four kinds in respect to shape—entire, right-hand lobed, left-hand lobed, and three-lobed. The specimen reported by Oliver as *Philadelphus bendirei* is a small entire leaf of *Sassafras hesperia*.

Occurrence: Republic, Wash. (fig. 8); Tipton, Oreg. (figs. 7, 9); Salmon, Idaho (fig. 10). Miocene.

Umbellularia dayana (Knowlton) Berry

Plate 52, figure 13

Salix dayana Knowlton, U. S. Geol. Survey Bull. 204, p. 31, pl. 2, figs. 9, 10, 1902; Prof. Paper 140, p. 32, pl. 12, fig. 1 [not fig. 2, which is *Sophora spokanensis* Knowlton], 1926.

Umbellularia dayana (Knowlton) Berry, U. S. Geol. Survey Prof. Paper 154, p. 260 [not pl. 58, fig. 4, which is *Cedrela pteraformis* (Berry) Brown], 1929.

Salix sp. Knowlton, U. S. Geol. Survey Prof. Paper 140, p. 33, pl. 12, figs. 1, 3, 1926.

Laurus similis Knowlton. Berry, U. S. Geol. Survey Prof. Paper 154, p. 259, pl. 58, fig. 2, 1929.

Quercus simulata Knowlton. Berry, idem, p. 246, pl. 51, fig. 6 [not other figures].

Leguminosites bonseri Berry, idem, p. 254, pl. 56, fig. 4.

The relationship of this species to *Umbellularia oregonensis* Chaney, from the Bridge Creek and Crooked River regions of Oregon, is not clear. It is probable that these leaves do not represent *Umbellularia*.

Occurrence: Latah formation, Spokane, Wash.; Salmon, Idaho (fig. 13). Miocene.

BERBERIDACEAE

Mahonia reticulata (MacGinitie) Brown, n. comb.

Plate 52, figure 4

Clematis reticulata MacGinitie, Carnegie Inst. Washington Pub. 416, p. 54, pl. 6, fig. 4, 1933.
Odostemon hollicki Dorf. MacGinitie, idem, p. 55, pl. 7, figs. 1, 3, 5.
Mahonia hollicki (Dorf) Arnold, Michigan Univ., Mus. Paleontology, Contr., vol. 5, no. 4, p. 61, pl. 2, figs. 3–8; pl. 3, figs. 5, 7, 9, 1936.

After a comparison of the type specimens of *Odostemon hollicki* Dorf, from the Pliocene of California, with the specimens called *O. hollicki* by MacGinitie, from the Miocene of Trout Creek, Oreg., the writer is convinced that the latter specimens represent a different species having smaller leaflets with coarser teeth. Arnold called attention to the fact that *Clematis reticulata* MacGinitie is an entire-margined leaflet of this species. The fragment figured here from Tipton, Oreg., appears to belong to *Mahonia reticulata* rather than *M. simplex*.

Occurrence: Tipton, Oreg. (fig. 4). Miocene.

Mahonia simplex (Newberry) Arnold

Berberis simplex Newberry, U. S. Nat. Mus. Proc., vol. 5, p. 514, 1883; U. S. Geol. Survey Mon. 35, p. 97, pl. 56, fig. 2, 1898.
Odostemon simplex (Newberry) Cockerell, Am. Mus. Nat. History Bull., vol. 24, p. 91, 1908.
Chaney, Carnegie Inst. Washington Pub. 346, p. 116, pl. 14, figs. 7–9, 11, 1927.
Mahonia simplex (Newberry) Arnold, Michigan Univ., Mus. Paleontology, Contr., vol. 5, no. 4, p. 58, pl. 1, figs. 1–3, 6, 7; pl. 2, figs. 1, 2, 1936.
Ilex latahensis Ashlee, Northwest Sci., vol. 6, p. 82, pl. 2, fig. 14, 1932.

A specimen of this species is present in the Mascall collection in the United States National Museum.

Occurrence: Mascall formation, John Day Basin, Oreg. Miocene.

CERATOPHYLLACEAE

Ceratophyllum praedemersum Ashlee

Plate 45, figure 32

Ceratophyllum praedemersum Ashlee, Northwest Sci., vol. 6, p. 78, pl. 1, fig. 2, 1932.

Although Ashlee's specimen is not well illustrated, it seems from his description that the object figured here may be his species. This specimen appears to be a stem with nodes, at each of which is a whorl of branched, threadlike filaments that may well be leaves like those on *Ceratophyllum demersum* Linnaeus, found in ponds and slow streams throughout most of North America.

Occurrence: Latah formation, Spokane, Wash. Miocene.

CERCIDIPHYLLACEAE

Cercidiphyllum crenatum (Unger) Brown

Cercidiphyllum crenatum (Unger) Brown, Jour. Paleontology, vol. 9, p. 575, pl. 68, figs. 1, 6, 8–10, 1935. (See synonymy.)
LaMotte, Carnegie Inst. Washington Pub. 455, pt. 5, p. 126, 1936.
Paliurus colombi Heer. Lesquereux, U. S. Nat. Mus. Proc., vol. 11, p. 16, 1888.
Grewia crenata (Unger) Heer. Knowlton, U. S. Geol. Survey Bull. 204, p. 80, 1902.

The specimens referred to by Knowlton and Lesquereux were inadvertently overlooked in the writer's publication of the new combination in 1935, but they belong with this species.

Occurrence: Mascall formation, John Day Basin, Oreg.

MAGNOLIACEAE

Magnolia dayana Cockerell

Magnolia dayana Cockerell, Am. Naturalist, vol. 44, p. 35, 1910. [For *M. lanceolata* Lesquereux, Harvard Coll. Mus. Comp. Zoology Mem., vol. 6, no. 2, p. 24, pl. 6, fig. 4, 1878.]
Knowlton, U. S. Geol. Survey Prof. Paper 140, p. 41, pl. 24, fig. 3, 1926.
Berry, U. S. Geol. Survey Prof. Paper 154, p. 250, 1929; Prof. Paper 185, p. 112, 1934.
Laurus grandis Lesquereux. Knowlton, U. S. Geol. Survey Prof. Paper 140, p. 41, pl. 24, fig. 1, 1926.
Berry, U. S. Geol. Survey Prof. Paper 154, p. 259, pl. 58, fig. 3, 1929.
Laurus princeps Heer. Lesquereux, U. S. Geol. Survey Terr. Rept., vol. 8, p. 250, pl. 58, fig. 2, 1883.
Knowlton, U. S. Geol. Survey Prof. Paper 140, p. 41, pl. 23, figs. 1, 2 [not fig. 3, which is *Quercus simulata* Knowlton], 1926.

None of the Latah specimens appear to conform to the characters illustrated by the types of *Laurus grandis* Lesquereux, from Corral Hollow, Calif., but all the specimens grouped under the present synonymy agree with the specimen first called *Magnolia dayana* Cockerell by Knowlton in 1926 as well as with those originally called *M. lanceolata* Lesquereux and later changed to *M. dayana* by Cockerell. That these leaves may be *Persea* or *Rhododendron* rather than *Magnolia* is a reservation to be kept in mind.

Occurrence: Latah formation, Spokane, Wash. Miocene.

Magnolia latahensis (Berry) Brown, n. comb.

Magnolia sp. Knowlton, U. S. Geol. Survey Prof. Paper 140, p. 41, pl. 27, fig. 1, 1926.
Magnolia californica Lesquereux. Berry, U. S. Geol. Survey Prof. Paper 154, p. 250, 1929.
Apocynophyllum latahense Berry, idem, p. 263, pl. 60, fig. 7 [not fig. 4, which is *Quercus simulata* Knowlton].

The irregular, undulatory, and forked secondary venation of these entire leaves differentiates them from

Magnolia dayana Cockerell. They resemble the living species *M. grandiflora* Linnaeus and *M. virginiana* Linnaeus, of the southeastern United States.

The specimens referred by Berry to *Magnolia californica* Lesquereux differ from Lesquereux's types sufficiently to make it possible to refer some to *M. latahensis* and one to *Fagus washoensis* LaMotte, as it has the secondary venation and marginal teeth of that species.

Occurrence: Latah formation, Spokane, Wash. Miocene.

SAXIFRAGACEAE

Hydrangea bendirei (Ward) Knowlton

Plate 53, figures 1, 2

Marsilea bendirei Ward, U. S. Geol. Survey 5th Ann. Rept., p. 446, 1885.
Porana bendirei (Ward) Lesquereux, U. S. Nat. Mus. Proc., vol. 11, p. 16, pl. 8, fig. 4, 1888.
Hydrangea bendirei Knowlton. Merriam, California Univ., Dept. Geology, Bull., vol. 2, p. 309, 1901.
Knowlton, U. S. Geol. Survey Bull. 204, p. 60, pl. 9, figs. 6, 7, 1902; Prof. Paper 140, p. 42, pl. 24, fig. 6, 1926.
Berry, U. S. Geol. Survey Prof. Paper 154, p. 251, 1929. [Not pl. 52, fig. 7, which is *Porana speirii* Lesquereux.]
Euonymus knowltoni Berry, U. S. Geol. Survey Prof. Paper 154, p. 255, pl. 56, fig. 9, 1929; Prof. Paper 185, p. 117, 1934.

The presence of undoubted sterile *Hydrangea* flowers in the Latah formation suggested a search for possible leaves that would confirm the identification. It is believed that those called *Euonymus knowltoni* are the required leaves, for they as well as the flowers compare well with those of the living *H. strigosa* Rehder, from northern Hupeh, China.

Occurrence: Latah formation, Spokane, Wash. Miocene.

Hydrangea fraxinifolia (Lesquereux) Brown, n. comb.

Plate 53, figures 5, 6

Fraxinus praedicta Heer. Lesquereux, U. S. Geol. Survey Terr. Rept., vol. 7, p. 229, pl. 40, fig. 3, 1878.
Celastrus fraxinifolius Lesquereux, U. S. Geol. Survey Terr. Rept., vol. 8, p. 184, pl. 33, figs. 2–4, 1883.
Fraxinus heerii Lesquereux, idem, p. 169, pl. 33, figs. 5, 6.
Juglans affinis Kirchner, St. Louis Acad. Sci. Trans., vol. 8, p. 184, pl. 13, fig. 2, 1898.
Hydrangea florissantia Cockerell, Am. Jour. Sci., 4th ser., vol. 26, p. 67, text fig. 2; p. 541, 1908. [For *Rhus rotundifolia* Kirchner, St. Louis Acad. Sci. Trans., vol. 8, p. 184, pl. 12, fig. 2, 1898.]
Knowlton, U. S. Nat. Mus. Proc., vol. 51, p. 269, 1916.

Although one of the sepals is missing from the type *Hydrangea* flower here refigured from the Florissant lake beds, there seems to be little doubt that the generic assignment is correct. The sepals are slightly petioled, whereas those of *H. bendirei* (Ward) Knowlton, from the Latah formation at Spokane, Wash., appear to be sessile. The flowers of *H. bendirei* are uniformly larger than those of *H. fraxinifolia*.

The presence of *Hydrangea* flowers in the Florissant beds prompted a search of the collections for possible confirmatory leaves, with the result that those formerly called *Celastrus fraxinifolius*, together with others cited in the synonymy, are selected as the most probable representatives of the species. They, like the similar but larger leaves from the Latah formation, compare very well with the leaves of *H. strigosa* Rehder, from western Hupeh, China. The leaf identified as *Fraxinus praedicta* Heer by Lesquereux is fragmentary, and it cannot be referred to the European types from Oeningen, Germany.

Occurrence: Florissant, Colo. Miocene.

Philadelphus pardeei (Knowlton) Brown, n. comb.

Plate 62, figures 5–10

Phyllites pardeei Knowlton, U. S. Geol. Survey Prof. Paper 140, p. 48, pl. 29, fig. 13, 1926.
Phyllites peculiaris Knowlton, idem, p. 48, pl. 29, fig. 2.

This species is characterized by having a cuneate to rounded base, remotely spaced, dentate teeth, and a tendency toward palmate venation. The curving secondary veins run rather directly into marginal teeth. Except for this fact, these leaves simulate those of *Philadelphus lewisii* Pursh, of the Northwestern States. A living species also closely comparable to the fossils is *Viburnum stellatum* Hemsley, of Mexico. It is possible that these leaves may be variant forms of *Viburnum fernquisti* (Berry) Brown.

Occurrence: Latah formation, Spokane, Wash. Miocene.

HAMAMELIDACEAE

Liquidambar californicum Lesquereux

Plate 61, figures 9, 10

Liquidambar californicum Lesquereux. Berry, U. S. Geol. Survey Prof. Paper 185, p. 113, 1934. (See synonymy and discussion.)
Oliver, Carnegie Inst. Washington Pub. 455, pt. 1, p. 21, 1934.

Occurrence: Potlatch Creek, between Arrow Junction and Juliaetta, Latah County, Idaho.

ROSACEAE

Amelanchier dignatus (Knowlton) Brown

Plate 53, figure 11

Amelanchier dignatus (Knowlton) Brown, Jour. Paleontology, vol. 9, p. 577, pl. 69, figs. 5, 6, 1935. (See synonymy and discussion.)

Occurrence: Latah formation, Spokane, Wash. Miocene.

Cercocarpus antiquus Lesquereux

Plate 57, figure 6

Cercocarpus antiquus Lesquereux, Harvard Coll. Mus. Comp. Zoology Mem., vol. 6, no. 2, p. 37, pl. 10, figs. 6–11, 1878; U. S. Geol. Survey Terr. Rept., vol. 8, p. 265, pl. 45 B, fig. 2, 1883.
Oliver, Carnegie Inst. Washington Pub. 455, pt. 1. p. 22, 1934.

Although this specimen is fragmentary, it can be readily identified as belonging to *Cercocarpus antiquus* Lesquereux.

Occurrence: Tipton, Oreg. Miocene.

Cercocarpus praeledifolius Berry

Plate 56, figure 13

Cercocarpus praeledifolius Berry, U. S. Geol. Survey Prof. Paper 154, p. 252, pl. 64, fig. 7, 1929.

Occurrence: Latah formation, Spokane, Wash. Miocene.

Chamaebatiaria creedensis Brown, n. sp.

Plate 57, figures 8, 9

These specimens, which resemble small ferns or mosses, are bipinnate leaves with minute, obovate, ultimate divisions. Appendages similar to these divisions appear along the rachis.

This species may be compared with the living fernbush or desert-sweet, *Chamaebatiaria millefolium* (Torrey) Maximowicz, a fragrant shrub, 2 to 6 feet high, that grows at altitudes of 5,500 to 9,500 feet along the east slopes of the Sierra Nevada and along hillsides and canyons from southern Oregon to Arizona. *Chamaebatiaria creedensis* is likely to be confused with a somewhat similar fossil from another genus, *Chamaebatia prefoliolosa* Brown, described from the lake beds at Salmon, Idaho. The latter, however, has tripinnate leaves like its living counterpart, *Chamaebatia foliolosa* Bentham.

Occurrence: Creede formation, Creede, Colo. Miocene.

LEGUMINOSAE

Cercis parvifolia Lesquereux

Plate 54, figures 2–5

Cercis parvifolia Lesquereux, U. S. Geol. Survey Terr. Rept., vol. 8, p. 201, pl. 31, figs. 5–7, 1883.
Knowlton, U. S. Nat. Mus. Proc., vol. 51, p. 276, pl. 25, figs. 1, 2, 1916.
Paliurus haydeni Cockerell, Am. Mus. Nat. History Bull., vol. 24, p. 102, 1909. [For *P. orbiculatus* Saporta. Lesquereux, U. S. Geol. Survey Terr. Rept., vol. 8, p. 188, pl. 38, fig. 12, 1883.]

The leaf called *Paliurus haydeni* cannot be distinguished from *Cercis parvifolia* and is therefore assigned to that species. Additional leaves and a pod from the H. F. Wickham collection received in 1934 by the National Museum are figured. There being no other similar fruits assignable to *Cercis* from the Florissant lake beds, this pod is assumed to belong to the species that produced the leaves of *Cercis parvifolia*.

Occurrence: Florissant, Colo. Miocene.

Cercis spokanensis Knowlton

Plate 54, figures 8–12

Cercis? spokanensis Knowlton, U. S. Geol. Survey Prof. Paper 140, p. 43, pl. 29, fig. 9, 1926.
Meibomites lucens Knowlton, idem, p. 44, pl. 28, fig. 10.
Ficus? washingtonensis Knowlton, idem, p. 40, p.l 25; pl. 26, figs. 1–3.
Berry, U. S. Geol. Survey Prof. Paper 154, p. 248, pl. 54, figs. 1–3; pl. 55, figs. 5, 6; pl. 62, 1929; Prof. Paper 185, p. 111, 1934.
Meibomites knowltoni Berry, U. S. Geol. Survey Prof. Paper 154, p. 253, pl. 56, fig. 7, 1929.
Cercis idahoensis Berry, Torrey Bot. Club. Bull., vol. 57, p. 240, text fig. 1; pl. 9, figs. 1–3 [not fig. 4, which is *Vitis washingtonensis* (Knowlton) Brown], 1931; U. S. Geol. Survey Prof. Paper 185, p. 114 [not pl. 21, fig. 1, which is *V. washingtonensis*]; pl. 22, figs. 1–3 [not fig. 4, which is *V. washingtonensis*]; pl. 23, figs. 5, 6 [not figs. 3, 4, which are *V. washingtonensis*], 1934.
Cercis sp. Ashlee, Northwest Sci., vol. 6, p. 80, pl. 1, fig. 7 [not fig. 7 A, which is *V. washingtonensis*], 1932.
Cercidium hesperium Ashlee, idem, p. 80, pl. 2, fig. 9.
Gleditschia praeaquatica Ashlee, idem, p. 80, pl. 2, fig. 8.

The presence of well-preserved *Cercis*-like pods in the Latah and related formations prompted a reexamination of all the available leguminous material for the purpose of determining what and how much of it might belong to a single species. The result is the synonymy given above.

First of all, a statement about the pods. They are remarkably like pods of living species of *Cercis* but differ in being rounder at the ends and in having wider wings. Moreover, the venation of the wings is transverse, whereas that of living *Cercis* is parallel to the margin, or only very slightly oblique. It would seem, therefore, that, instead of *Cercis*, a closely related genus would be indicated for these pods; but a search through the Leguminosae of the United States National Herbarium failed to produce a satisfactory suggestion. The pods are therefore tentatively left in the genus *Cercis*.

Besides general agreement in shape and in their finer venation pattern, all the leaves cited in the synonymy agree in two particulars that unite them uncontrovertibly in a single species—namely, a swollen top of the petiole at the base of the blade and two strong pairs of lateral primary veins. This kind of acropetiolar enlargement so conspicuous in *Cercis* and other legumes is absent in *Ficus*, to which some of these fossil leaves were assigned, and also in the leaves associated by Berry with the *Cercis* pods but now transferred to *Vitis*. The latter leaves, moreover, have secondary veins and branches that run squarely into marginal teeth or toothlike undulations. In *Cercis* the lateral primaries are camptodrome and never run squarely into the margin, but they and their branches loop upward well within the margin to the veins next above.

Meibomia has a pinnate, not palmate venation and is therefore eliminated as a reference for the leaves here designated *Meibomites*.

Two of the larger fossil leaves, although like the smaller ones and like *Cercis* in general, have pointed lobes near the apex, thus suggesting reference to a genus other than *Cercis*, the living species of which only rarely exhibit such lobes. Species of living leguminous genera, such as *Pueraria* and *Strophostyles*, and some

species of *Passiflora* that occasionally display pointed lobes, differ from the fossils in having only one pair of lateral primary veins, or possibly a very inconspicuous second pair, and the pods of the legumes are unlike the fossils.

The conclusion from this evidence, therefore, is that the *Cercis*-like pods were produced by the same plant that bore the *Cercis*-like leaves. What relationship, if any, there is between this species and the somewhat similar leaves from Chalk Bluffs, Calif., called *Ficus sordida* Lesquereux,[8] the writer is not prepared to say.

Occurrence: Latah formation, Spokane, Wash. (figs. 8, 9, 11, 12); White Bird, Idaho (fig. 10). Miocene.

Sophora spokanensis Knowlton

Plate 60, figures 1, 2

Sophora spokanensis Knowlton, U. S. Geol. Survey Prof. Paper 140, p. 44, pl. 28, fig. 6, 1926.
Berry, U. S. Geol. Survey Prof. Paper 154, p. 253, pl. 56, figs. 5, 6, 1929; Prof. Paper 185, p. 116, 1934.
Sophora alexanderi Knowlton, U. S. Geol. Survey Prof. Paper 140, p. 43, pl. 28, figs. 3–5, 1926.
Berry, U. S. Geol. Survey Prof. Paper 154, p. 253, pl. 56, figs. 2, 3, 1929; Prof. Paper 185, p. 116, 1934.
Cassia idahoensis Knowlton. Berry, U. S. Geol. Survey Prof. Paper 154, p. 252, pl. 55, figs. 2, 3, 1929; Prof. Paper 185, p. 114, 1934.
Cassia sophoroides (Knowlton) Berry, U. S. Geol. Survey Prof. Paper 154, p. 253, pl. 56, fig. 1, 1929.
Salix dayana Knowlton, U. S. Geol. Survey Prof. Paper 140, p. 32, pl. 12, fig. 2 [not fig. 1, which is *Umbellaria dayana* (Knowlton) Berry], 1926.
Quercus treleasii Berry, U. S. Geol. Survey Prof. Paper 154, p. 247, pl. 52, figs. 1–3, 1929.

The 50 or more specimens of this species in the United States National Museum collection from the Latah formation show that these leaves vary greatly in shape, although the fundamental venation remains the same. If more than one species is represented there seems to be no satisfactory method of separating them. That this is a species of *Sophora* may be doubted, for equally good comparisons can be made with *Robinia*.

Occurrence: Latah formation, Spokane, Wash. Miocene.

RUTACEAE

Ptelea miocenica Berry

Plate 51, figures 4, 5

Ptelea miocenica Berry, U. S. Geol. Survey Prof. Paper 170, p. 39, pl. 12, fig. 7, 1931.
MacGinitie, Carnegie Inst. Washington Pub. 416, pt. 2, p. 59, pl. 11, fig. 1, 1933.
LaMotte, Carnegie Inst. Washington Pub. 455, pt. 5, p. 133, pl. 11, figs. 1, 2, 1936. [Not fig. 4, which is *Carya egregia* (Lesquereux) LaMotte.]
Dorf, Carnegie Inst. Washington Pub. 476, pt. 2, p. 119, pl. 2, figs. 5, 7, 1936.
Ulmus speciosa Newberry, U. S. Geol. Survey Mon. 35, p. 80, pl. 45, fig. 7, 1898. [Not other figures.]
Chaney, Carnegie Inst. Washington Pub. 346, pt. 4, p. 114, pl. 12, fig. 5, 1927.

[8] Lesquereux, Leo, Fossil plants of the auriferous gravel deposits of the Sierra Nevada: Harvard Coll. Mus. Comp. Zoology Mem., vol. 6, no. 2, p. 17, pl. 4, figs. 6, 7, 1878.

It is possible that several species of *Ptelea* are here confused and that some specimens may represent *Ulmus* or some other genus instead of *Ptelea*. Dorf's figure 7, unfortunately upside down and not showing the remains of the calyx, which are present in the specimen itself, represents the best preserved and most authentic fossil *Ptelea* fruit the writer has yet seen. LaMotte's figure 1 also represents a good specimen and resembles most closely Newberry's *Ulmus speciosa*, here refigured (fig. 4). Chaney's figure 5 appears to be a small example of the latter. Berry's type of *Ptelea miocenica*, also refigured here (fig. 5) because the original figure depicts veins not present in the specimen, resembles the large samaras of some species of *Ulmus* more closely than those of *Ptelea*. MacGinitie's figure 1, although fragmentary, may well represent *Ptelea* foliage. It is evident that better material must be collected before the uncertainties here indicated can be resolved.

Occurrence: Bridge Creek, Oreg. (fig. 4); Grand Coulee, Wash. (fig. 5). Miocene.

MELIACEAE

Cedrela lancifolia (Lesquereux) Brown, n. comb.

Plate 60, figures 3, 4

Sapindus lancifolius Lesquereux, U. S. Geol. Survey Terr. Rept., vol. 8, p. 182, pl. 32, figs. 3–6 [not pl. 37, fig. 9, which is *Oreodaphne lancifolia* (Lesquereux) Brown], 1883.

The writer, in a previous paper,[9] written before the discovery of the *Cedrela* seed here figured from the Florissant collections, made *Sapindus lancifolius* Lesquereux synonymous with *S. dentoni* Lesquereux, from the Green River formation. Now, although they are strikingly similar, they must be separated, the former to become *Cedrela lancifolia* and the latter to remain, together with *S. winchesteri* Knowlton, as species of *Sapindus*. That they may be species of *Cedrela* seems extremely likely, but no *Cedrela* seeds have yet been reported from the Green River formation to confirm this suspicion.

Lesquereux's figures of *Sapindus lancifolius*, with the exception of figure 3, show petioled leaflets with symmetric bases. The specimens themselves, however, are noticeably asymmetric, though not as strongly so as the additional specimen figured here. The secondary veins of these leaflets are more numerous and the tips are more attenuated than in most leaflets of modern species of *Cedrela*. These petioled leaflets must not be confused with those of *S. coloradensis* Cockerell, which are sessile or only slightly petiolulate.

The seed is smaller than that of *Cedrela pteraformis* (Berry) Brown, from the Latah formation at Spokane, Wash.

Occurrence: Florissant, Colo. Miocene.

[9] Brown, R. W., The recognizable species of the Green River flora: U. S. Geol. Survey Prof. Paper 185, p. 61, 1934.

Cedrela pteraformis (Berry) Brown

Plate 52, figure 12; plate 60, figures 5–10

Cedrela pteraformis (Berry) Brown, Jour. Paleontology, vol. 9, p. 579, pl. 67, fig. 21, 1935. (See synonymy.)
Umbellularia dayana (Knowlton) Berry, U. S. Geol. Survey Prof. Paper 154, p. 260, pl. 58, fig. 4, 1929.
Sapindus armstrongi Berry, idem, p. 254, pl. 63, fig. 14.
Pinus knowltoni Chaney. Mason, Carnegie Inst. Washington Pub. 346, pt. 5, p. 148, pl. 2, fig. 3, 1927.
Pinus monticolensis Berry. LaMotte, Carnegie Inst. Washington Pub. 455, pt. 5, p. 110, pl. 5, figs. 1, 4, 1936.
Pinus russelli LaMotte, idem, p. 110, pl. 5, figs. 2, 3.
Pseudotsuga masoni MacGinitie. LaMotte, idem, p. 111, pl. 2, figs. 6, 7, 1936.
Libocedrus sp. Dorf, Carnegie Inst. Washington Pub. 476, pt. 2, p. 108, pl. 1, fig. 4, 1936.

The leaflets of living species of *Cedrela* are more or less asymmetric, entire, blunt-pointed, and with regularly spaced, camptodrome secondary veins. In size they vary considerably in the same or different species. A leaflet of *C. mexicana* Roemer from Mexico is figured here for comparison with the fossil leaves cited in the synonymy. The presumption is ventured that these leaves and seeds represent a single biologic species. To this assemblage of evidence for the presence of *Cedrela* in some Miocene floras of the Western States is now added what appears to be the capsule of *Cedrela* from deposits near Tipton, Oreg. This fruit is an obovate, blunt-pointed capsule, the base of which is not subtended by calyx lobes but is naked, as are the mature capsules of living *Cedrela*.

It may be that several species of *Cedrela* are here made synomymous with *Cedrela pteraformis*, but more material must be collected and studied to determine this possibility. It seems likely that some and perhaps all of the leaflets called *Sapindus oregonianus* Knowlton are in reality leaflets of *Cedrela*.

Occurrence: Latah formation, Spokane, Wash. (figs. 5–8, 10); Tipton, Oreg. (fig. 9). Miocene.

ANACARDIACEAE

Cotinus fraterna (Lesquereux) Cockerell

Cotinus fraterna (Lesquereux) Cockerell, Torreya, vol. 6, p. 12, 1906.
Knowlton, U. S. Nat. Mus. Proc., vol. 51, p. 279, pl. 24, fig. 1, 1916. (See synonymy.)
Andromeda delicatula Lesquereux, U. S. Geol. Survey Terr. Rept., vol. 8, p. 175, pl. 34, figs. 10, 11, 1883.
Fraxinus ungeri Lesquereux. Knowlton, U. S. Nat. Mus. Proc., vol. 51, p. 286, pl. 22, fig. 3, 1916.

The conspicuous forking of the secondary veins readily identifies these oblanceolate long-petioled leaves.

Occurrence: Florissant, Colo. Miocene.

Rhus longepetiolata (Lesquereux) Brown

Plate 55, figures 2, 3

Rhus longepetiolata (Lesquereux) Brown, U. S. Geol. Survey Prof. Paper 185, p. 60, 1934. (See synonymy and discussion.)

The specimens figured here have somewhat larger teeth than the types but are otherwise in agreement.

Occurrence: Green River formation, Fossil, Wyo. Middle Eocene. Figure 2 in Museum of Paleontology, University of Michigan. Figure 3 in United States National Museum.

CELASTRACEAE

Euonymus pacificus Brown, n. sp.

Plate 56, figures 10, 11

Leaves ovate-lanceolate, sessile or short-petioled, crenulate, with blunt apex and cuneate to rounded base. Secondary veins unite to form conspicuous loops well within the margin. Ultimate venation is a rather striking uniform quadrangular meshwork pattern.

The living counterpart of this species seems to be the strawberry bush, *Euonymus americanus* Linnaeus, of the eastern United States.

Occurrence: Latah formation, Spokane, Wash. Miocene.

ACERACEAE

Acer bendirei Lesquereux

Plate 58, figures 20–22

Acer bendirei Lesquereux, U. S. Nat. Mus. Proc., vol. 11, p. 14, pl. 8, fig. 1 [not pl. 5, fig. 5; pl. 6, fig. 1; pl. 7, fig.1, which are *Platanus dissecta* Lesquereux], 1888.
Acer dimorphum Lesquereux, idem, p. 15, pl. 9, fig. 1.
Acer, fruits of. Lesquereux, idem, p. 15, pl. 6, figs. 2, 3.
Acer oregonianum Knowlton, U. S. Geol. Survey Bull. 204, p. 75, pl. 13, figs. 5–8, 1902.
Oliver, Carnegie Inst. Washington Pub. 455, pt. 1, p. 24, 1934.
Acer minor Knowlton, idem, p. 76, pl. 14, fig. 2 [not fig. 3, which is *A. negundoides* MacGinitie].
Acer medianum Knowlton, idem, p. 76, pl. 14, figs. 4, 5.
Acer osmonti Knowlton. Chaney, Carnegie Inst. Washington Pub. 346, pt. 4, p. 126, pl. 18, figs. 8, 9, 1927.
Acer merriami Knowlton. Berry, U. S. Geol. Survey Prof. Paper 170, p. 39, pl. 13, fig. 13, 1931.
MacGinitie, Carnegie Inst. Washington Pub. 416, pt. 2, p. 61, pl. 10, fig. 1, 1933.
LaMotte, Carnegie Inst. Washington Pub. 455, pt. 5, p. 135, pl. 12, fig. 7, 1936.
Dorf, Carnegie Inst. Washington Pub. 476, pt. 2, p. 120, pl. 3, fig. 8, 1936.

Both the leaves and fruits associated here compare very well with those of *Acer macrophyllum* Pursh, of the Pacific region from California to Alaska.

The fruits, although somewhat variable in size, may be distinguished by the fact that the lower wing margin usually narrows abruptly and forms a deep, rounded sinus behind the seed.

The most typical fossil leaf of this species so far figured is that called by MacGinitie *Acer merriami*. The type of *A. merriami* Knowlton, from the Mascall formation, cited by MacGinitie, is a large-lobed leaf with a strongly cordate base, fairly large scalloped dentate teeth, and a pronounced pinnate secondary venation. It is clearly an example of *Platanus dissecta* Lesquereux.

Occurrence: Salmon, Idaho (fig. 21); Tipton, Oreg. (figs. 20, 22). Miocene.

Acer glabroides Brown, n. name

Plate 58, figures 13–15

Acer bendirei Lesquereux. Knowlton, U. S. Geol. Survey Prof. Paper 140, p. 45, pl. 27, fig. 3, 1926.

Acer osmonti Knowlton. Chaney, Carnegie Inst. Washington Pub. 346, pt. 4, p. 126, pl. 17, fig. 6; pl. 18, figs. 1, 3, 5, 1927.

Oliver, Carnegie Inst. Washington Pub. 455, pt. 1, p. 24, 1934.

Brooks, Carnegie Mus. Annals, vol. 24, p. 298, pl. 20, fig. 2, 1935.

LaMotte, Carnegie Inst. Washington Pub. 455, pt. 5, p. 137, 1936.

Dorf, Carnegie Inst. Washington Pub. 476, pt. 2, p. 121, 1936.

Acer minor Knowlton. Berry, U. S. Geol. Survey Prof. Paper 154, p. 256, pl. 64, fig. 2, 1929.

Acer trilobatum productum? (Alexander Braun) Heer. Knowlton, U. S. Geol. Survey 18th Ann. Rept., pt. 3, p. 733, pl. 102, fig. 3, 1898.

Some of the leaves and fruits associated here have severally or jointly been compared with those of the dwarf maple, *Acer glabrum* Torrey, of the Western States.

The fruits of this species, although resembling those of *Acer bendirei* Lesquereux in many respects, are smaller, and their lower wing margin generally continues in a smooth curve, more or less conspicuously, along the base of the seed to the scar of attachment.

Occurrence: Salmon, Idaho (fig. 13); Latah formation, Spokane, Wash. (fig. 14); Bridge Creek, Oreg. (fig. 15). Miocene.

Acer lesquereuxii Knowlton

Plate 58, figure 3

Acer lesquereuxii Knowlton, U. S. Geol. Survey Bull. 152, p. 26, 1898; Prof. Paper 131, p. 169, 1923.

Brown, U. S. Geol. Survey Prof. Paper 185, p. 61, 1934.

No other maple-leaf species than *Acer lesquereuxii* having been reported from the Green River formation, it is assumed that the samara here figured, also the first from that formation, belongs to the same species. This winged seed is 2.3 centimeters long and displays a rather short scar of attachment. This samara must not be confused with *Anacardites schinoloxus* Brown,[10] which, although superficially like a maple seed, is a winged anacardiaceous fruit.

Occurrence: Green River formation, Fossil, Wyo. Middle Eocene. Figured specimen in Museum of Paleontology, University of Michigan.

Acer negundoides MacGinitie

Plate 58, figure 1

Acer negundoides MacGinitie. Brown, Jour. Paleontology, vol. 9, p. 580, pl. 69, figs. 9–11, 1935. (See synonymy and discussion.)

LaMotte, Carnegie Inst. Washington Pub. 455, pt. 5, p. 136, pl. 1, figs. 3, 4, 1936.

Dorf, Carnegie Inst. Washington Pub. 476, pt. 2, p. 121, pl. 3, fig. 2, 1936.

[10] Brown, R. W., Additions to the flora of the Green River formation: U. S. Geol. Survey Prof. Paper 154, p. 288, pl. 73, fig. 8, 1929.

Rulac crataegifolium Knowlton, U. S. Geol. Survey Bull. 204, p. 77, pl. 16, fig. 7, 1902.

Phyllites bifurcies Knowlton, idem, p. 85, pl. 16, fig. 2.

Crataegus heterodentata Chaney, Walker Mus. Contr., vol. 2, p. 175, pl. 16, figs. 1, 2, 1920.

Although the fossil samaras of box elder are not uncommon in some of the Miocene floras of the Western States, no undoubted compound leaves with the required characters have yet been reported. Knowlton's *Rulac crataegifolium* and the fragment called *Phyllites bifurcies*, however, appear to be leaflets of such a compound leaf, for they can be matched easily with leaflets from *A. negundo* Linnaeus. Because of the fragmentary and somewhat doubtful status of these species, the writer urges that an exception be made here to a strict application of the rules of nomenclature in order that so apt a term as *negundoides* be not lost.

Occurrence: Latah formation, Spokane, Wash. (fig. 1); Mascall formation, John Day Basin, Oreg. Miocene.

Acer osmonti Knowlton

Plate 58, figures 16–18

Acer osmonti Knowlton, U. S. Geol. Survey Bull. 204, p. 72, pl. 13, fig. 3, 1902.

Acer gigas Knowlton, idem, p. 76, pl. 14, fig. 1.

Acer chaneyi Knowlton, U. S. Geol. Survey Prof. Paper 140, p. 45, pl. 27, fig. 2, 1926.

Berry, U. S. Geol. Survey Prof. Paper 154, p. 256, pl. 63, fig. 13, 1929.

MacGinitie, Carnegie Inst. Washington Pub. 416, pt. 2, p. 61, 1933.

Oliver, Carnegie Inst. Washington Pub. 455, pt. 1, p. 26, pl. 5, fig. 3, 1934.

Brooks, Carnegie Mus. Annals, vol. 24, p. 297, pl. 19, fig. 5; pl. 21, fig. 1a, 1935.

Dorf, Carnegie Inst. Washington Pub. 476, pt. 2, p. 120, 1936.

Quercus cf. *Q. pseudo-lyrata* Lesquereux. Knowlton, U. S. Geol. Survey Prof. Paper 140, p. 36, pl. 22, fig. 2, 1926.

Acer florissanti Kirchner. Berry, U. S. Geol. Survey Prof. Paper 185, p. 118, pl. 24, figs. 5–7, 1934.

Acer oregonianum Knowlton. Berry, idem, p. 118, pl. 24, fig. 1.

The type of this species is indistinguishable from those described by Berry from White Bird, Idaho, and the latter appear to differ from *Acer florissanti* Kirchner, from Florissant, in being less sharply lobed, but a close relationship is indicated. These leaves are most nearly like those of the silver maple, *A. saccharinum* Linnaeus, of the eastern United States. The comparison is emphasized by the fact that associated with the leaves at White Bird are samaras that also simulate those of the silver maple more closely than any other species. The beak is pointed and the scar of attachment very oblique and short.

Occurrence: Latah formation, Spokane, Wash. (fig. 16); Mascall formation, John Day Basin, Oreg.; Tipton, Oreg. (fig. 17); White Bird, Idaho (fig. 18). Miocene.

Dipteronia insignis (Lesquereux) Brown, n. comb.

Plate 59, figures 10–12

Myrica insignis Lesquereux, U. S. Geol. and Geog. Survey Terr. Ann. Rept. for 1874, p. 312, 1876; U. S. Geol. Survey Terr. Rept., vol. 7, p. 135, pl. 65, figs. 7, 8, 1878.
Comptonia insignis Cockerell, Colorado Univ. Studies, vol. 3, p. 173, 1906; Am. Mus. Nat. History Bull., vol. 24, p. 81, 1908.
Berry, Am. Naturalist, vol. 40, p. 1906.
Brown, U. S. Geol. Survey Prof. Paper 185, p. 54, 1934.
Comptonia acutiloba (Lesquereux) Cockerell, Colorado Univ. Studies, vol. 3, p. 173, 1906; Am. Mus. Nat. History Bull., vol. 24, p. 81, 1908. [Described as *Myrica latiloba* Heer var. *acutiloba* Lesquereux, U. S. Geol. Survey Terr. Rept., vol. 7, p. 134, pl. 17, fig. 13, 1878.]
Rhus subrhomboidalis Lesquereux, U. S. Geol. Survey Terr. Rept., vol. 8, p. 195, pl. 41, figs. 16–19, 1883.

All the leaflets cited in the synonymy can be matched satisfactorily by the variable leaflets from the living *Dipteronia sinensis* Oliver, of central and western China, and it is assumed that they belonged to the same species that produced the characteristic winged samaras recorded now for the first time from Florissant.

The samaras do not differ greatly from those called *Dipteronia americana* Brown,[11] from Republic, Wash., but the accompanying leaves, especially those formerly called *Comptonia insignis* Cockerell, appear to be more strongly toothed or incised than those of *D. americana*, and the species are therefore tentatively held to be distinct. The writer, until he found the *Dipteronia* seeds in the Florissant collections, thought that *C. insignis* represented the leaflets of *Koelreuteria*, but that probability must be left to the leaflets called *Rhus hilliae* Lesquereux.

Occurrence: Florissant, Colo. Miocene.

SAPINDACEAE

Dilodendron boreale Brown, n. sp.

Plate 59, figure 9

Only one fragmentary leaflet of this species has yet appeared in the Latah formation, but enough of it is preserved to permit identification. The leaflet is 4 centimeters long, elliptic-lanceolate, with apparently a slightly rounded, inequilateral base. Tip missing. The few teeth are long and rounded on both upper and lower margins to a blunt point. The notches between the teeth are deep and acute. A secondary vein, curving slightly, runs into each tooth, and an intermediate secondary runs to the notch, where it forks, sending a minute branch to each adjacent tooth.

This leaflet is almost identical with those of *Dilodendron bipinnatum* Radlkofer, a small tree of Bolivia, Peru, and Brazil. It differs from the leaflets of a somewhat similar tree, *Dipterodendron costaricense* Radlkofer, of Central America and Panama, chiefly in having a rounded not a sharply cuneate base. Some of the leaflets of *Dipteronia americana* Brown, from Republic, Wash., are superficially like *Dilodendron boreale* but differ in having double teeth, the smaller subsidiary teeth being entered by branches from the secondary vein that enters the main tooth.

Occurrence: Latah formation, Spokane, Wash. Miocene.

RHAMNACEAE

Paliurus florissanti Lesquereux

Plate 56, figure 7

Paliurus florissanti Lesquereux, U. S. Geol. Survey Terr. Rept., vol. 7, p. 274, pl. 50, fig. 18, 1878.
Acalypha myricina Cockerell, Torreya, vol. 9, p. 117, 1909.

Occurrence: Florissant, Colo. Miocene.

Paliurus hesperius Berry

Plate 56, figures 8, 9

Paliurus hesperius Berry, Am. Jour. Sci., 5th ser., vol. 16, p. 40, figs. 1–3, 1928; U. S. Geol. Survey Prof. Paper 154, p. 257, pl. 57, fig. 1, 1929; Prof. Paper 170, p. 39, pl. 13, figs. 1–5, 1931; Prof. Paper 185, p. 119, 1934.

The leaf figured here is somewhat narrower than the types but illustrates the same kind of venation and marginal dentition. The fruit is like those figured from Grand Coulee, Wash. It is possible that these leaves may represent *Ceanothus* or *Zizyphus* rather than *Paliurus*, and the fruits may belong to *Pterocarya mixta* (Knowlton) Brown, n. comb.

Occurrence: Latah formation, Spokane, Wash. Miocene.

Rhamnus idahoensis Brown

Plate 56, figure 4

Rhamnus idahoensis Brown, Jour. Paleontology, vol. 9, p. 581, pl. 69, fig. 13, 1935.

The small and somewhat fragmentary type from Salmon, Idaho, was compared with *Rhamnus alnifolia* L'Héritier. The present specimen from Spokane, Wash., is larger, shows the serrulate margin to better advantage, and suggests that the species is almost identical with *R. purshiana* De Candolle, of the Northwestern States.

Occurrence: Salmon, Idaho; Latah formation, Spokane, Wash. (fig. 4). Miocene.

VITACEAE

Vitis washingtonensis (Knowlton) Brown, n. comb.

Plate 56, figures 5, 6; plate 57, figures 1, 2

Populus washingtonensis Knowlton, U. S. Geol. Survey Prof. Paper 140, p. 31, pl. 15, fig. 1, 1926.
Populus lindgreni Knowlton. Knowlton, U. S. Geol. Survey Prof. Paper 140, p. 31, pl. 14, figs. 4–7, 1926. [Not other Knowlton references.]
Berry, U. S. Geol. Survey Prof. Paper 185, p. 106, 1934.
Acer merriami Knowlton. Knowlton, U. S. Geol. Survey Prof. Paper 140, p. 45, pl. 28, fig. 1, 1926. [Not other Knowlton references.]

[11] Brown, R. W., Miocene leaves, fruits, and seeds from Idaho, Oregon, and Washington: Jour. Paleontology, vol. 9, p. 580, pl. 67, figs. 6, 12, 1935.

Acer sp. Berry, U. S. Geol. Survey Prof. Paper 154, pl. 57, fig. 6, 1929.
Menispermites latahensis Berry, idem, p. 249, pl. 52, fig. 4.
Cercis idahoensis Berry, Torrey Bot. Club Bull., vol. 57, p. 240, pl. 9, fig. 4 [not figs. 1–3], 1930; U. S. Geol. Survey Prof. Paper 185, p. 114, pl. 21, fig. 1; pl. 22, fig. 4 [not figs. 1–3]; pl. 23, figs. 3, 4 [not figs. 5, 6], 1934.

The margins of these leaves vary from being merely undulate to having large rounded lobelike teeth or short rounded dentate teeth. Besides the fact that the venation is fundamentally the same in all the leaves included in the foregoing synonymy, both lobed and unlobed forms, a conspicuous feature of that venation is that the secondaries and their branches run either into teeth or squarely to the margin where teeth should be. In *Cercis* the lateral primaries as well as their branches form loops well within the margin and never run completely into the margin. In *Populus*, except perhaps *P. alba* Linnaeus, the teeth, even if superficially appearing dentate, under magnification are seen to be either crenate or crenate-serrate. The same criticisms eliminate the species of Menispermaceae as biologic equivalents of the lobed specimens called *Menispermites latahensis*.

The leaves of most living species of Vitaceae have more pointed leaves and a stronger tendency toward palmate venation than is shown by these fossils. Nevertheless, the venational and marginal characters suggest *Vitis* more strongly than any other genus. No seeds of *Vitis* have yet been reported from the Latah formation at Spokane, but a seed, *V. bonseri* Berry, is recorded from similar beds at Grand Coulee, where the leaves are also abundant.

Occurrence: Latah formation, Spokane, Wash. (pl. 56, fig. 6); White Bird, Idaho (pl. 56, fig. 5; pl. 57, figs. 1, 2). Miocene.

TILIACEAE

Tilia aspera (Newberry) LaMotte

Plate 62, figure 4

Tilia aspera (Newberry) LaMotte, Carnegie Inst. Washington Pub. 455, pt. 3, p. 45, pl. 1, figs. 1–3; pl. 2, figs. 1, 2, 1935. (See synonymy.)
LaMotte, Carnegie Inst. Washington Pub. 455, pt. 5, p. 138, 1936.

The statement by LaMotte that "*Tilia hesperia* occurs associated with leaves of *T. aspera* in the Latah upper Miocene of Spokane, Washington", needs modification, for the specimens identified by Berry as *Platanus aspera* (now *T. aspera*) are *P. dissecta* Lesquereux, with one exception, which is a large leaf of *Cebatha heteromorpha* (Knowlton) Berry.

Occurrence: Bridge Creek, Oreg.; Latah formation, Spokane, Wash. (fig. 4). Miocene.

Tilia oregona LaMotte

Platanus aspera Newberry [part], U. S. Geol. Survey Mon. 35, p. 102, pl. 59, fig. 3, 1898.
Tilia sp. Chaney, Am. Jour. Sci., 5th ser., vol. 8, p. 131, 1934.
Tilia oregona LaMotte, Carnegie Inst. Washington Pub. 455, pt. 3, p. 47, pl. 3, figs. 1–6, 1935.
Corylus macquarrii (Forbes) Heer. Newberry, U. S. Geol. Survey Mon. 35, p. 61, pl. 48, fig. 4 [not pl. 32, fig. 5], 1898.

Newberry's citation of the occurrence of *Corylus macquarrii* did not state that the specimen here made synonymous with *Tilia oregona* came from Bridge Creek, Oreg. Although these leaves may be compared with some species of *Tilia*, their symmetrical bases and generally doubly serrate, blunt or rounded teeth arouse a persistent suspicion that they may be the leaves of *Acer* instead of *Tilia*, particularly resembling the nonlobed leaves of *A. tataricum* Linnaeus, of southeastern Europe and Asia. LaMotte's reference of Newberry's figure 3 to this species does not seem to be justified. The strongly asymmetric base and long coarse teeth show that it is a small leaf of *T. aspera* (Newberry) LaMotte.

Occurrence: Bridge Creek, Oreg. Miocene.

STERCULIACEAE

Sterculia coloradensis Brown

Plate 61, figure 13

Sterculia coloradensis Brown, U. S. Geol. Survey Prof. Paper 154, p. 290, pl. 74, figs. 6, 7, 1929.

The present specimen is figured here to amplify the conception of the species, which was founded upon somewhat imperfect specimens. There is apparently a close relationship between this species and *Sterculia wilcoxensis* Berry,[12] from the Wilcox group.

Occurrence: Green River formation, Fossil, Wyo. Middle Eocene. Figured specimen in Museum of Paleontology, University of Michigan.

DILLENIACEAE

Tetracera spokanensis Brown, n. sp.

Plate 63, figures 6, 7

Leaves large, narrowly obovate, with entire margins halfway or more toward the apex, then with low, distant serrate teeth marking the extremities of the curved, equally spaced secondary veins. The nature of the tip is unknown, because that feature is missing in the smaller specimen and appears to have been damaged in the larger specimen. The general appearance of these leaves suggests that of some oaks, beeches, and chestnuts, but the finer, more subdued cross venation between the secondaries, the entire margin on the lower half of the blade, and the conspicuous obovateness seem, as a group of characters, to be more closely duplicated in leaves of the genus *Tetracera*, particularly in *T. volubilis* Linnaeus, from Mexico and Central America. (Compare sheet 1135757 of the U. S. National Herbarium.)

This species differs from *Tetracera oregona* Chaney and Sanborn [13] in being more obovate in shape and in

[12] Berry, E. W., The lower Eocene floras of the southeastern United States: U. S. Geol. Survey Prof. Paper 131, p. 17, pl. 14, figs. 1, 2; pl. 15, figs. 3, 4, 1922.
[13] Chaney, R. W., and Sanborn, E. I., The Goshen flora of west-central Oregon: Carnegie Inst. Washington Pub. 439, p. 87, pl. 31, figs. 5–7, pl. 32, fig. 1, 1933.

having less prominent teeth. There is perhaps more than a resemblance between *T. spokanensis* and the oaks called *Quercus nevadensis* Lesquereux,[14] from Chalk Bluffs, Calif.

Occurrence: Latah formation, Spokane, Wash. Miocene.

TERNSTROEMIACEAE

Gordonia hesperia Berry

Plate 52, figures 5-8

Ternstroemites idahoensis (Knowlton) Berry, U. S. Geol. Survey Prof. Paper 154, p. 258, pl. 58, fig. 1, 1929. [For *Myrica? idahoensis* Knowlton, U. S. Geol. Survey 18th Ann. Rept., pt. 3, p. 724, pl. 99, fig. 7, 1898, which has been transferred to *Arbutus idahoensis* (Knowlton) Brown.]

Gordonia idahoensis (Knowlton) Berry, Am. Jour. Sci., 5th ser., vol. 18, pp. 429–432, 1929.

Gordonia hesperia Berry, idem, p. 430, text figs. 1, 2, 1929 [not to include *Carpolithus pteraformis* Berry, which is *Cedrela pteraformis* (Berry) Brown]; U. S. Geol. Survey Prof. Paper 170, p. 41, pl. 13, figs. 7, 8, 1931.

Carpites paulownia Knowlton, U. S. Geol. Survey Prof. Paper 140, p. 50, pl. 29, fig. 12, 1926.

As the first two members of the synonymy are based upon a type that is now transferred to another genus, the suggested name for this species, on the reasonable assumption that the leaves and seeds belong together, is *Gordonia hesperia* Berry. The leaves of *G. hesperia* resemble those of *Arbutus idahoensis* (Knowlton) Brown very closely but can be distinguished by the fact that the secondary venation of *A. idahoensis* is more irregular, undulatory, and forked, and the marginal teeth are rounded, crenate-serrate, whereas those of *G. hesperia* are sharply serrate with the tips sometimes incurved. These leaves, although assigned to *Gordonia*, also bear a strong resemblance to those of the cherry laurel, *Prunus laurocerasus* Linnaeus, of southeastern Europe and southwestern Asia. The capsule *Carpites paulownia* Knowlton, because of the remnants of calyx at its base, is now thought to be the fruit of *Gordonia* rather than *Cedrela*.

Occurrence: Latah formation, Spokane, Wash. Miocene.

TRAPACEAE

Trapa americana Knowlton

Plate 55, figures 5, 6

Trapa americana Knowlton. (See synonymy by Brown, Jour. Paleontology, vol. 9, p. 581, pl. 67, fig. 17, 1935.)

Trapa prenatans Dorf, Carnegie Inst. Washington Pub. 476, pt. 2, p. 122, pl. 3, fig. 6, 1936.

The specimen figured by the writer in 1935 came from diatomaceous beds equivalent to the Latah formation, on Potlatch Creek between Arrow Junction and Juliaetta, Latah County, Idaho. Those figured here came from the same locality as the types—namely, half a mile northeast of Idaho City, on the north side of the road leading to Norman. At this site the reddish-brown sandy clay contains many impressions of these nuts and a few fragmentary dicotyledonous leaves, but none of the leaves can be identified as belonging to *Trapa*.

These large specimens resemble those called *Trapa yokoyamae* Nathorst,[15] from Japan, except that Nathorst describes his specimens as having been four-horned, whereas the Idaho specimens appear to have had only two horns, unless the cavities at the sides represent crushed horns.

Occurrence: Payette formation, Idaho City, Idaho. Miocene.

ARALIACEAE

Aralia republicensis Brown, n. name

Plate 55, figure 7

Platanus appendiculata Lesquereux? Berry, U. S. Geol. Survey Prof. Paper 154, p. 249, pl. 52, fig. 5, 1929.

Aralia whitneyi Lesquereux. Berry, idem, p. 260.

The venation, as well as the entire margins of these specimens, suggests that they represent a single species. In addition to the evidence from these morphologic characters is the fact that wherever a "*Platanus*" or "*Aralia*" leaf of this kind without acropetiolar appendages occurs, one with such appendages is also usually present. Such association must be regarded as more than coincidence.

These leaves differ from *Platanus appendiculata* Lesquereux in having entire margins and more numerous, regular, equally spaced secondary veins. They differ from *Aralia whitneyi* Lesquereux chiefly in having fewer, shorter, and broader lobes, but a close relationship between these species is nevertheless suspected.

Occurrence: Republic, Wash. Miocene.

CORNACEAE

Cornus ovalis Lesquereux

Plate 63, figure 5

Cornus ovalis Lesquereux, Harvard Coll. Mus. Comp. Zoology Mem., vol. 6, no. 2, p. 23, pl. 6, figs. 1, 2, 1878.

Chaney, Carnegie Mus. Washington Pub. 346, pt. 4, p. 131, pl. 19, figs. 1–3 [probably not fig. 4, which may be *Hydrangea*], 1927.

The specimen figured here can be matched easily with leaves from the Pacific dogwood, *Cornus nuttallii* Audubon. It appears to be indistinguishable from the species described by Lesquereux from Table Mountain, Calif., and by Chaney from Crooked River, Oreg. *C. ovalis* differs from *C. acuminata* Berry,[16] from Republic, Wash., in having a much more broadly oval shape. The tip of this specimen is not preserved, so that comparison of the two specimens as regards that feature cannot be made.

Occurrence: Latah formation, Spokane, Wash. Miocene.

[14] Lesquereux, Leo, Fossil plants of the auriferous gravel deposits of the Sierra Nevada: Harvard Coll. Mus. Comp. Zoology Mem., vol. 6, no. 2, p. 5, pl. 2, figs. 3, 4, 1878.

[15] Nathorst, A. G., Zur fossilen Flora Japan's: Paleont. Abh., Band 4, Heft 3, p. 21, pl. 7 (23), figs. 6–8, 1888.

[16] Berry, E. W., Revision of the flora of the Latah formation: U. S. Geol. Survey Prof. Paper 154, p. 260, pl. 59, fig. 3, 1929.

Nyssa knowltoni Berry

Plate 62, figures 1–3

Nyssa knowltoni Berry, U. S. Geol. Survey Prof. Paper 154, p. 261, pl. 59, fig. 7, 1929; Prof. Paper 185, p. 122, 1934.
Nyssa hesperia Berry, U. S. Geol. Survey Prof. Paper 170, p. 42, pl. 13, figs. 9–11, 1931.

The two leaves figured here show that occasional pointed lobes or teeth on leaves of this species indicate a probable relationship with *Nyssa aquatica* Marshall, of the southeastern United States. There being no other detectable leaf species, it is assumed that the characteristic seeds called *N. hesperia* belong to *N. knowltoni*.

Occurrence: Latah formation, Spokane, Wash. Miocene.

ERICACEAE

Arbutus idahoensis (Knowlton) Brown, n. comb.

Plate 59, figures 2–4

Myrica? idahoensis Knowlton, U. S. Geol. Survey 18th Ann. Rept., pt. 3, p. 724, pl. 99, fig. 7, 1898.
Myrica lanceolata Knowlton, idem, p. 724, pl. 99, figs. 5, 6.
Betula aequalis? Lesquereux. Knowlton, idem, p. 728, pl. 102, fig. 5.
Arbutus sp. Chaney, Carnegie Inst. Washington Pub. 349, pt. 2, p. 36, 1925.
Celastrus lacoei Lesquereux. Berry, U. S. Geol. Survey Prof. Paper 154, p. 255, 1929.
Laurus princeps Heer. Berry, idem, p. 259, pl. 58, fig. 5.
Arbutus traini MacGinitie, Carnegie Inst. Washington Pub. 416, pt. 2, p. 64, pl. 12, fig. 3; pl. 13, figs. 1, 2, 1933.
Brooks, Carnegie Mus. Annals, vol. 24, p. 300, pl. 21, fig. 3, 1935.
Oliver, Carnegie Inst. Washington Pub. 455, pt. 1, p. 26, 1934.

These leaves are lanceolate-elliptic and generally with margins having rounded crenate-serrate teeth. They resemble most closely the leaves of *Arbutus arizonica* Sargent, of southern Arizona and Mexico. That they are not variant leaves of *A. matthesii* Chaney, with which they are associated in the Latah flora, is problematic. Some of these leaves are difficult to distinguish from those of *Gordonia idahoensis* (Knowlton) Berry.

Occurrence: Latah formation, Spokane, Wash. (figs. 2–4); near Montour, Gem County, Idaho; Trout Creek, Oreg. Miocene.

Arbutus matthesii Chaney

Plate 59, figures 1, 5, 6

Arbutus matthesii Chaney, Carnegie Inst. Washington Pub. 346, pt. 3, p. 131, pl. 20, figs. 1, 3–5, 1927.

The leaves illustrated here are reproduced to show further variability in this species, which is most like *Arbutus menziesii* Pursh, of the Pacific coast region. The margins of *A. matthesii* may be entire or sharply serrate, as in *A. menziesii*.

Occurrence: Latah formation, Spokane, Wash. Miocene.

Vaccinium sophoroides (Knowlton) Brown, n. comb.

Plate 61, figures 1–3, 11

Phyllites sophoroides Knowlton, U. S. Geol. Survey Prof. Paper 140, p. 48, pl. 26, fig. 8, 1926.
Cassia sophoroides (Knowlton) Berry, U. S. Geol. Survey Prof. Paper 154, p. 253 [not pl. 56, fig. 1, which is *Sophora spokanensis* Knowlton], 1929.
Diospyros princetonia Cockerell. Berry, U. S. Geol. Survey Prof. Paper 154, p. 263, pl. 59, fig. 6; pl. 60, figs. 1–3, 1929.
Salix perplexa Knowlton, U. S. Geol. Survey Prof. Paper 140, p. 32, pl. 12, fig. 5, 1926.
Arctostaphylos knowltoni Berry, U. S. Geol. Survey Prof. Paper 154, p. 261, pl. 59, fig. 4, 1929.

These entire-margined oblanceolate leaves can be definitely assigned to the Ericaceae instead of *Cassia*, *Diospyros*, or *Salix*. The basis for this positive assurance is the minutely papillated appearance of the under surface, a feature shown by living species of Ericaceae but not by *Cassia*, *Diospyros*, or *Salix*. The revolute, entire margin, mucronulate apex, camptodrome venation, and shape of these leaves can be duplicated in the genera *Azalea* and *Vaccinium*, although most of the species of *Azalea* that compare with the fossils in shape have serrulate margins. The venation of the fossils agrees best with that in the leaves of the farkleberry, *Vaccinium arboreum* Marshall, of the eastern United States. The writer therefore has the impression that these leaves represent a species of *Vaccinium*.

Occurrence: Latah formation, Spokane, Wash. Miocene.

Vaccinium bonseri serrulatum Berry

Plate 61, figure 8

Vaccinium bonseri serrulatum Berry, U. S. Geol. Survey Prof. Paper 154, p. 262, pl. 63, figs. 19, 20, 1929.

This small leaf seems to be the same species as that described by Berry from the Latah formation at Spokane, Wash.

Occurrence: Thunder Mountain, Idaho. Miocene.

EBENACEAE

Diospyros andersonae Knowlton

Plate 60, figures 12–17, 21

Diospyros andersonae Knowlton, U. S. Geol. Survey Prof. Paper 140, p. 46, pl. 27, fig. 6, 1926.

The well-preserved calyx, *Diospyros andersonae*, described by Knowlton indicated that persimmon leaves and seeds might also be found in the Latah formation. Those figured here, resembling closely *D. virginiana* Linnaeus, of the southeastern United States, are believed to belong to the same species that produced the calyx. The seeds are somewhat smaller than those of *D. virginiana* but agree in every other particular, as can be seen by comparison with a figured specimen of that species (fig. 18).

Occurrence: Latah formation, Spokane, Wash. Miocene.

CAPRIFOLIACEAE

Viburnum fernquisti (Berry) Brown, n. comb.

Plate 56, figure 2

Ribes fernquisti Berry, U. S. Geol. Survey Prof. Paper 154, p. 251, pl. 63, fig. 21, 1929; Prof. Paper 170, p. 38, pl. 12, fig. 2, 1931.

Describing this species, Berry remarked:

With the exception that some modern leaves of *Ribes* tend to have a cordate base, this Latah species shows all the foliar features of the genus, especially in the form of the teeth and in the position and disposition of the veins.

Most species of *Ribes* are or tend to be five- or more-lobed, each lobe consisting of mammillately rounded, sometimes double teeth, so that the general appearance of the leaf is that of being cut-lobed. The venation accordingly tends to be virgate rather than curving-craspedodrome, as in these fossils. In short, the fossils can be matched much more closely with the leaves of the aceroid viburnums, such as *Viburnum opulus* Linnaeus, *V. pauciflorum* Pylaie, and *V. acerifolium* Linnaeus, and are therefore transferred to that genus.

Occurrence: Latah formation, Spokane, Wash.; Grand Coulee, Wash.; Coeur d'Alene, Idaho (fig. 2). Miocene.

Viburnum lantanafolium Berry

Plate 63, figure 1

Viburnum lantanafolium Berry, U. S. Geol. Survey Prof. Paper 154, p. 264, pl. 60, fig. 6, 1929.
Oliver, Carnegie Inst. Washington Pub. 455, pt. 1, p. 27, figs. 1, 2, 1934.
Aesculus hesperia Berry, idem, p. 256, pl. 56, fig. 8.

Although these leaves resemble the leaflets of *Aesculus* somewhat in shape, they differ in having a more undulatory secondary venation and marginal teeth that are fairly uniform in size, rounded-conical, abruptly blunt-pointed, mostly dentate but some with a slight tendency to be crenate-serrate. The teeth of *Aesculus* are blunt-rounded, serrate, and in most species mixed, with large teeth marking the termination of the secondary veins and smaller teeth receiving their branches. The narrow angle of departure from the midrib of the undulatory and much branched secondary veins, the obovate shape, and the uniform size of the teeth suggest the genus *Viburnum*, and especially the obovate leaves of such living species as *V. lantana* Linnaeus, of southeastern Europe and Asia, *V. dilatatum* Thunberg, of Japan, and *V. erubescens* Wallich, of China.

Fossil leaves that resemble *Viburnum lantanafolium* are those called *Aesculus simulata* Knowlton,[17] from the Mascall formation in the John Day Basin, Oreg., but the secondary veins of *A. simulata* are more numerous, are less strongly branched, and in general depart from the midrib at a wider angle; and the teeth have a sharper appearance. In short, *Aesculus simulata* probably represents a species of *Carya* rather than *Aesculus* or *Viburnum*.

Occurrence: Latah formation, Spokane, Wash.; Tipton, Oreg. (fig. 1). Miocene.

FOSSILS OF UNCERTAIN BOTANIC AFFINITY

Porana speirii Lesquereux

Plate 61, figure 14

Porana speirii Lesquereux. Brown, Jour. Paleontology, vol. 9, p. 583, pl. 69, figs. 1–3, 1935. (See synonymy and discussion.)

Occurrence: Green River formation, Fossil, Wyo. Middle Eocene. Figured specimen in Museum of Paleontology, University of Michigan.

Carpites boraginoides Knowlton

Plate 62, figure 13

Carpites boraginoides Knowlton, U. S. Geol. Survey Prof. Paper 140, p. 49, pl. 29, fig. 7, 1926.
Carpolithus hibiscoides Brown, Jour. Paleontology, vol. 9, p. 584, pl. 67, fig. 19, 1935.

Instead of being an aggregation of four nutlets, as Knowlton thought, suggesting the family Boraginaceae, these objects are five-loculed fruits, but their identity is unknown.

Occurrence: Latah formation, Spokane, Wash. Miocene.

Carpolithus sp.

Plate 63, figures 2, 3

Equisetum, underground stem. Knowlton, U. S. Geol. Survey Prof. Paper 140, p. 24, pl. 9, fig. 1; pl. 26, fig. 5; pl. 29, fig. 8, 1926.
Malva? hesperia Knowlton, idem, p. 47, pl. 29, fig. 11.
Berry, U. S. Geol. Survey Prof. Paper 185, p. 120, pl. 24, fig. 2, 1934.
Phyllites amplexicaulis Knowlton, U. S. Geol. Survey Prof. Paper 140, p. 47, pl. 29, fig. 3, 1926.
Carpites menthoides Knowlton, idem, p. 49, pl. 26, fig. 4.
Berry, U. S. Geol. Survey Prof. Paper 154, p. 264, 1929.
Ficus interglacialis Hollick, New York Bot. Garden Jour., vol. 16, p. 405, pls. 34, 35, 1927.
Berry, U. S. Geol. Survey Prof. Paper 170, p. 37, 1931.

The writer has nothing to add toward the identification of this many-named but as yet botanically unidentified species, except to point out that the five names in the synonymy apply to different views or phases of the same objects.

Occurrence: Latah formation, Spokane, Wash. (fig. 3); White Bird, Idaho (fig. 2). Miocene.

Carpolithus sp.

Plate 61, figure 15

Juncus? crassulus Cockerell. Berry, U. S. Geol. Survey Prof. Paper 154, p. 240, 1929.

The specimens from the Latah formation compared by Berry with *Juncus crassulus* Cockerell,[18] from the

[17] Knowlton, F. H., Fossil flora of the John Day Basin, Oreg.: U. S. Geol. Survey Bull. 204, p. 78, pl. 15, figs. 1, 2, 1902.

[18] Cockerell, T. D. A., The fossil flora of Florissant, Colo.: Am. Mus. Nat. History Bull., vol. 24, p. 79, pl. 10, figs. 44, 45, 1908.

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Florissant lake beds, are entirely different objects. *J. crassulus* Cockerell (pl. 61, fig. 16) is a small spherical fruit with the remains of two styles and is surrounded at the base by a ciliated or fringed perianth twice as long as the fruit itself. It is therefore not like any living species of *Juncus*.

The Latah specimens are cymose clusters of small spherical fruits, each of which is surrounded by a five-lobed, united perianth and surmounted by two styles. These also are apparently not related to *Juncus*.

Occurrence: Latah formation, Spokane, Wash. Miocene.

Leaves

Plate 49, figures 14, 15. These are narrow, lanceolate leaves, sparingly toothed near the apex. The venation and areolation suggest affinity with *Quercus* or *Castanopsis*. Tipton, Oreg. Miocene.

Plate 49, figure 16. This is a sparingly small-toothed lanceolate leaf in which all the secondary veins run into marginal teeth. Affinity with *Quercus* or *Alnus* is suggested. Spokane, Wash. Miocene.

Plate 53, figure 12. A thick, oblanceolate leaf with sharply serrate margin. The venation is obscure. Probably *Berberis*. Republic, Wash. Miocene.

Plate 53, figures 13, 14. Small, lanceolate, petioled leaves with serrate margins. They may represent a species of *Salix*. Spokane, Wash. Miocene.

Plate 54, figure 6. An ovate, entire-margined leaf. Secondaries few, widely but regularly spaced, camptodrome. Spokane, Wash. Miocene.

Plate 55, figure 1. An ovate leaf with sparingly toothed margin. Spokane, Wash. Miocene.

Plate 55, figure 4. An orbicular, entire-margined leaf with a long, stout petiole. Fossil, Wyo. Middle Eocene.

Plate 57, figure 5. This is the upper half of a leaf with large, conical double teeth. Tipton, Oreg. Miocene.

Plate 59, figure 14. An elongated leaf with serrate margin and a secondary venation that appears irregular, broken, and branched. It bears a close resemblance to the illustrations of *Rhus myricaefolia* Lesquereux.[19] Spokane, Wash. Miocene.

Bud scales

Carpites spokanensis Knowlton, U. S. Geol. Survey Prof. Paper 140, p. 49, pl. 26, fig. 6, 1926.

Populus, bud scales, Berry, U. S. Geol. Survey Prof. Paper 154, p. 243, pl. 50, fig. 4; pl. 63, fig. 8; Prof. Paper 185, p. 106, 1934.

Tsuga latahensis Berry, U. S. Geol. Survey Prof. Paper 154, p. 239, pl. 63, figs. 3, 4, 1929.

The writer has examined more than a hundred specimens of bud scales from the Latah and related deposits and is convinced that several genera are represented, notably *Ulmus*, *Fagus*, *Liriodendron*, *Tilia*, and perhaps *Populus*. Their separation, however, is a difficult matter, involving perhaps more guesswork than application of sound distinguishing criteria.

Occurrence: Latah formation, Spokane, Wash.; Tipton, Sumpter quadrangle, Oreg.; White Bird, Idaho. Miocene.

Flowers

Plate 59, figure 7. A distorted calyx, probably of *Diospyros*. Spokane, Wash. Miocene.

Plate 61, figure 12. A five-parted calyx or corolla. Fossil, Wyo. Middle Eocene.

Miscellaneous

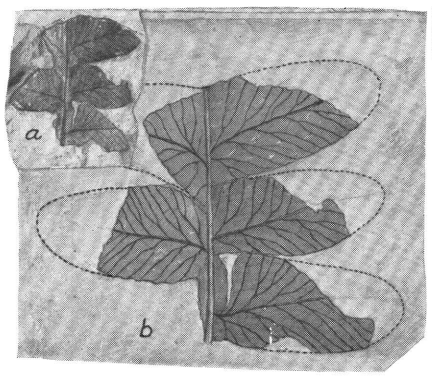
Plate 45, figure 31. Plant or animal (?). Fossil, Wyo. Middle Eocene.

Plate 60, figure 20. An open cone of a conifer simulating a calyx of persimmon (*Diospyros*). Florissant, Colo. Miocene.

[19] Lesquereux, Leo, Fossil plants of the auriferous gravel deposits of the Sierra Nevada: Harvard Coll. Mus. Comp. Zoology Mem., vol. 6, no. 2, p. 31, pl. 1, figs. 5–7, 1878.

PLATES 45-63

PLATE 45



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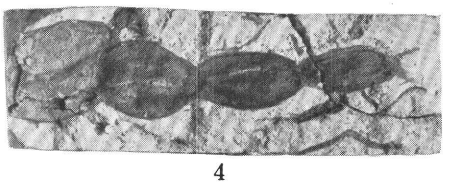
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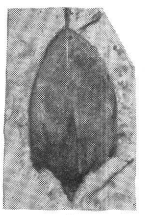
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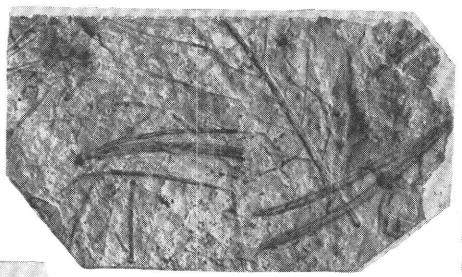
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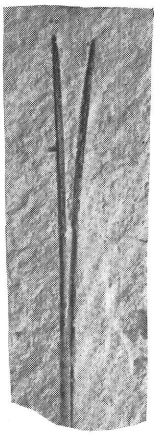
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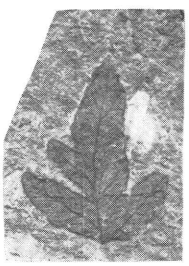
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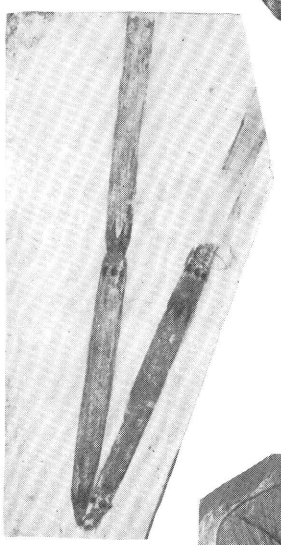
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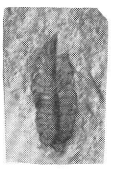
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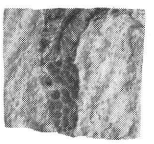
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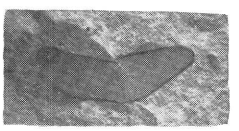
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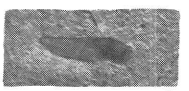
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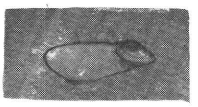
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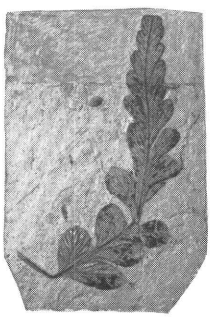
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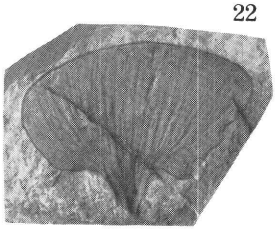
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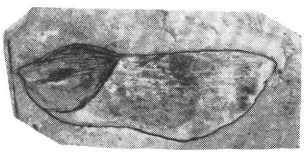
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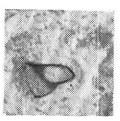
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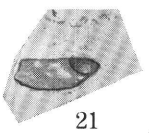
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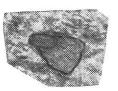
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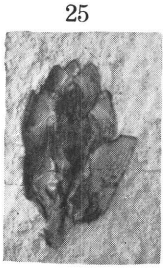
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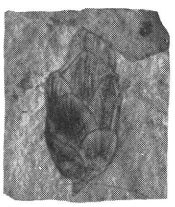
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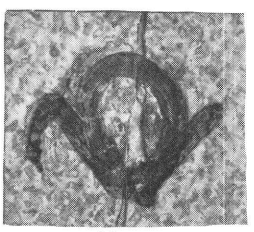
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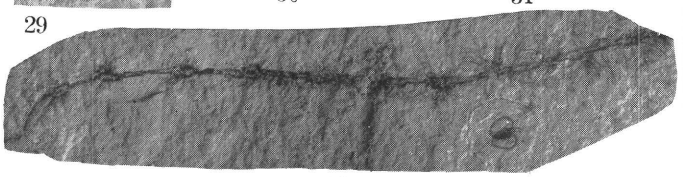
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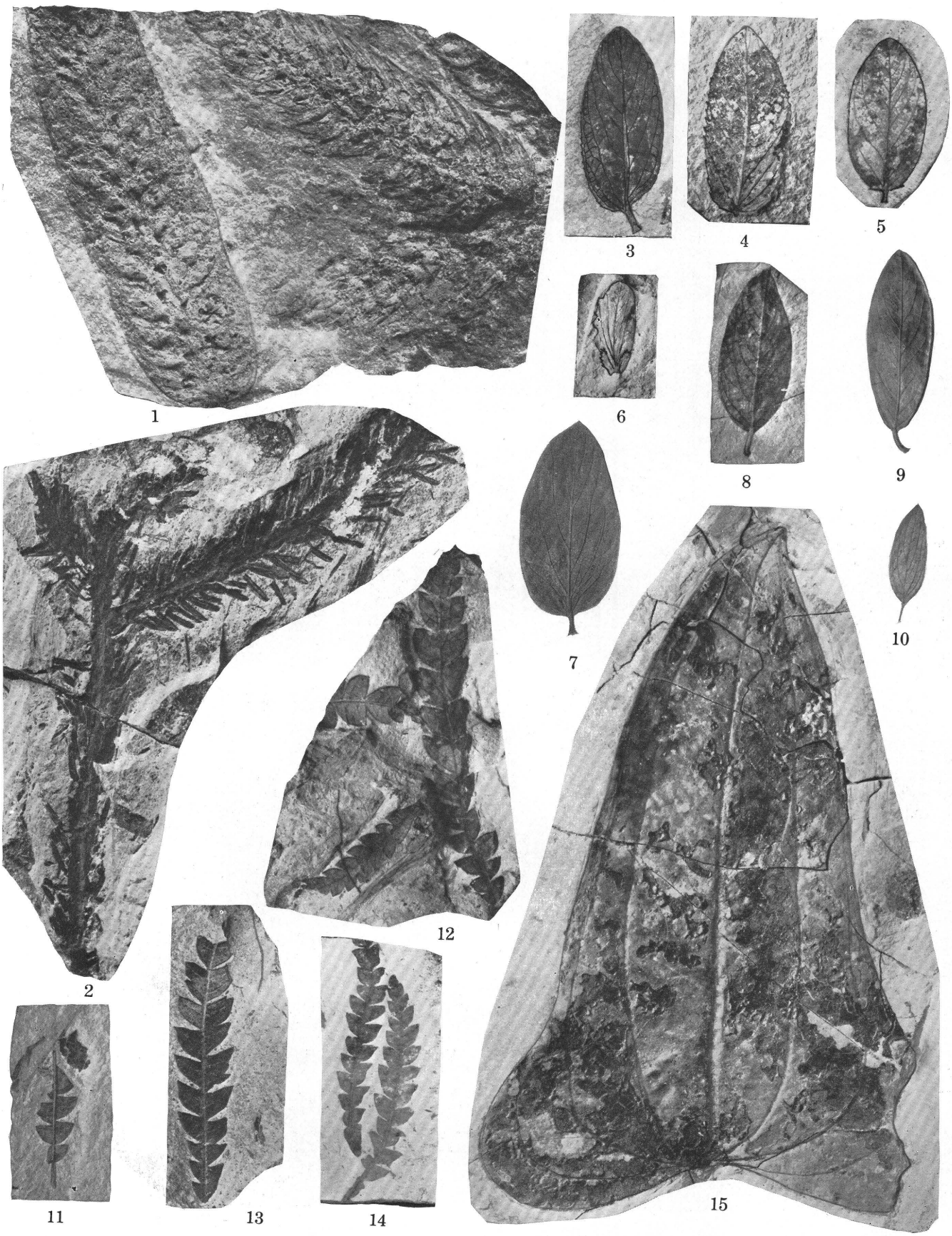
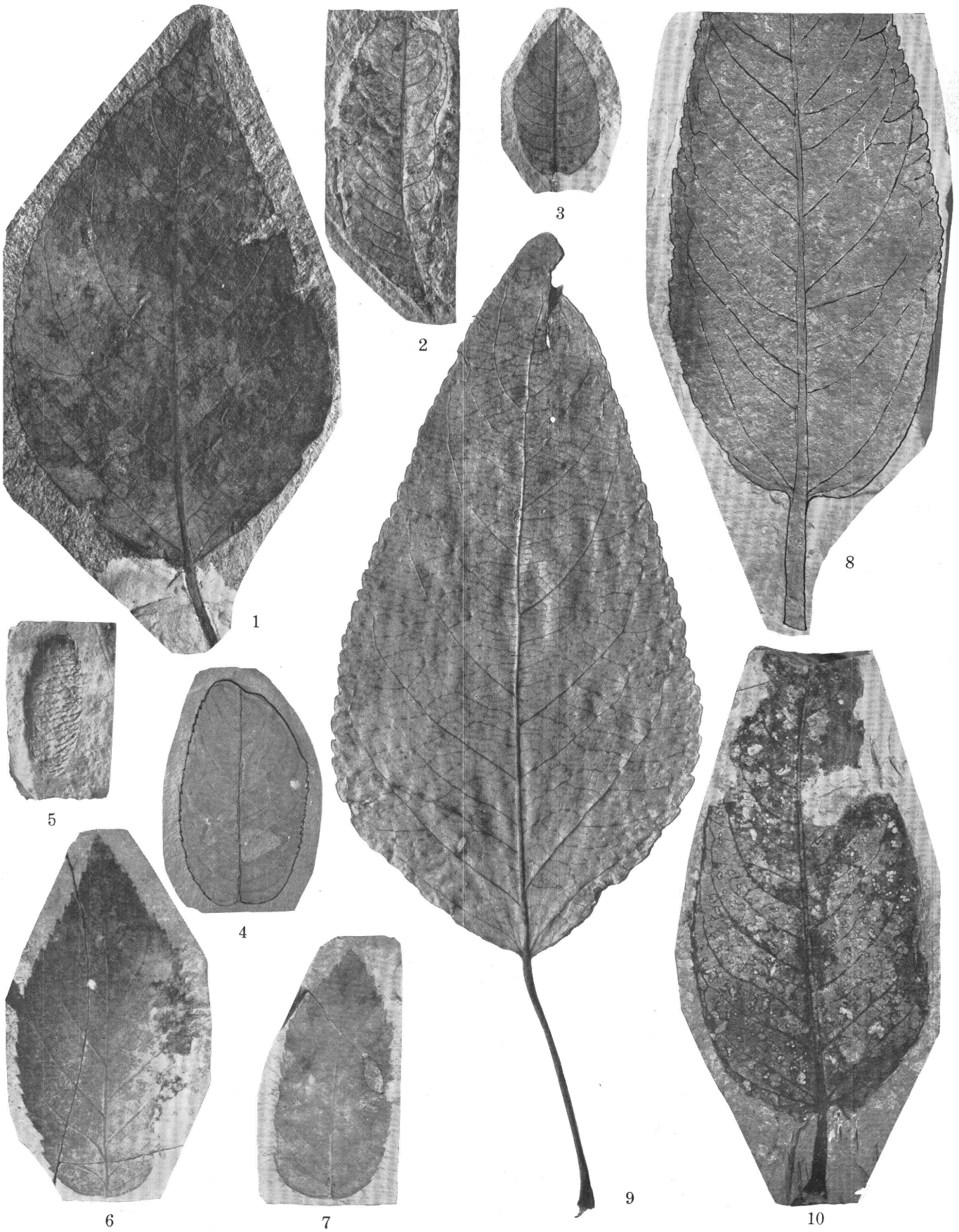
FOSSIL PLANTS FROM THE WESTERN UNITED STATES.



FOSSIL PLANTS FROM THE WESTERN UNITED STATES.

PLATE 46

PLATE 47



FOSSIL PLANTS FROM THE WESTERN UNITED STATES.

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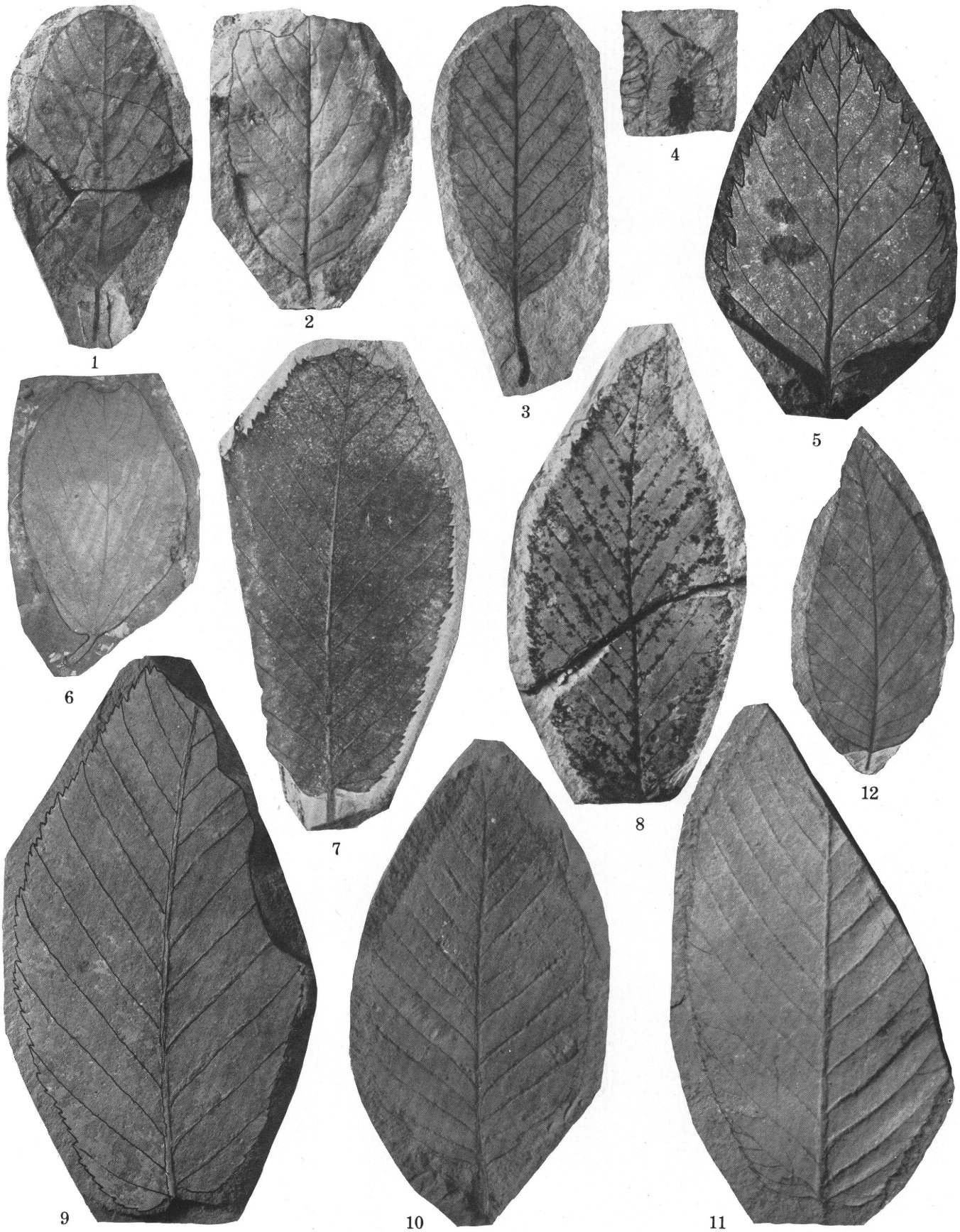
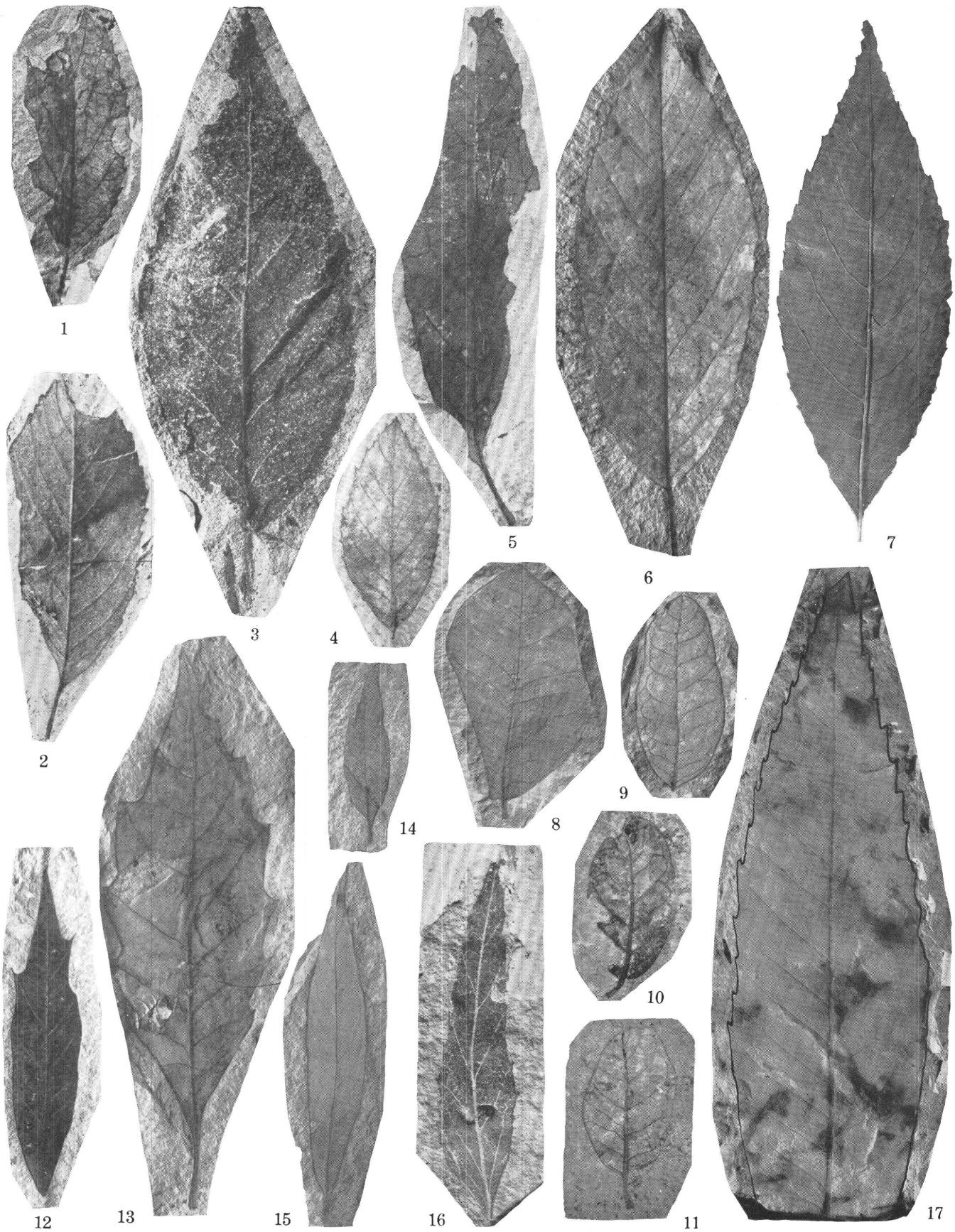


FOSSIL PLANTS FROM THE WESTERN UNITED STATES.

PLATE 48

PLATE 49



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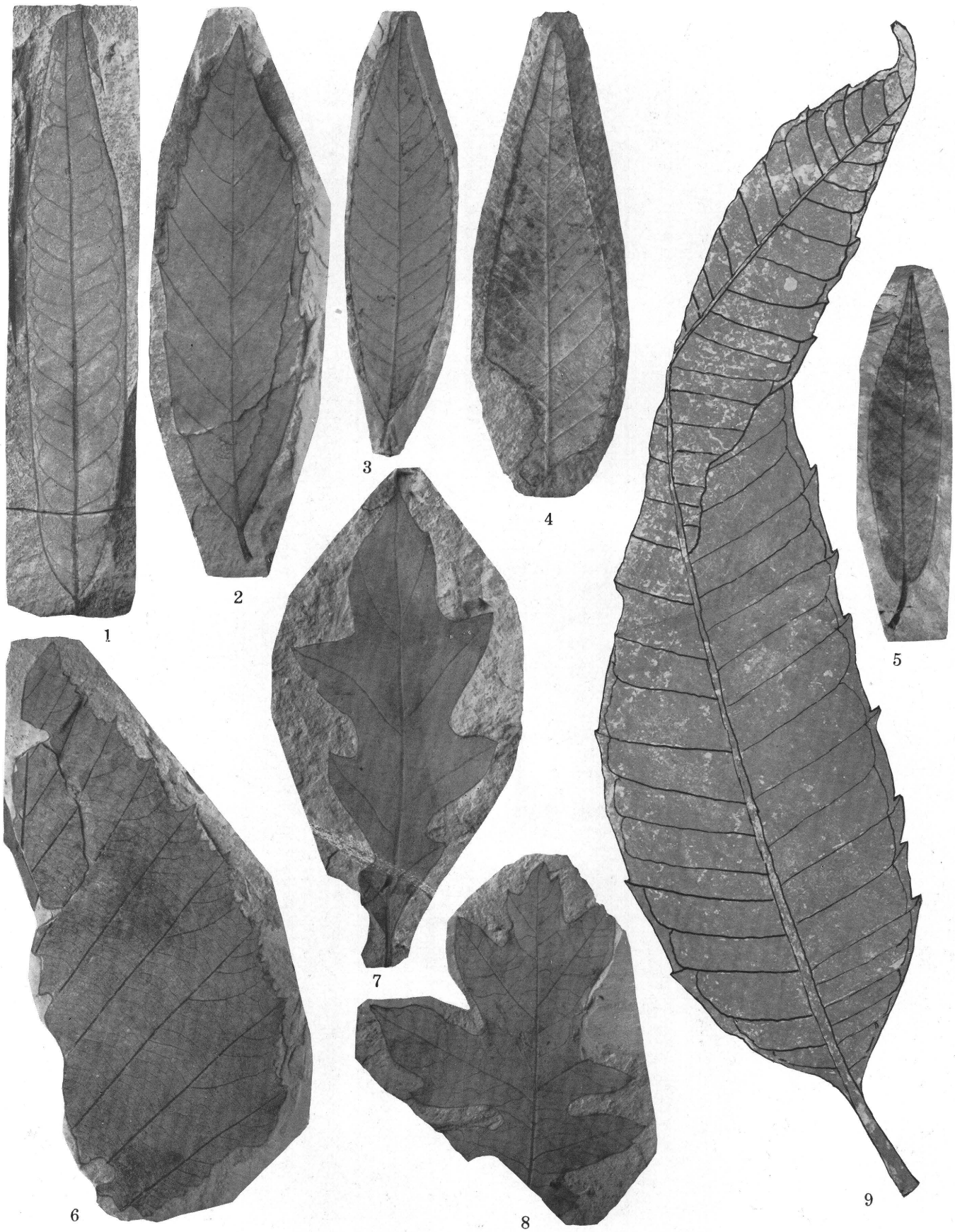
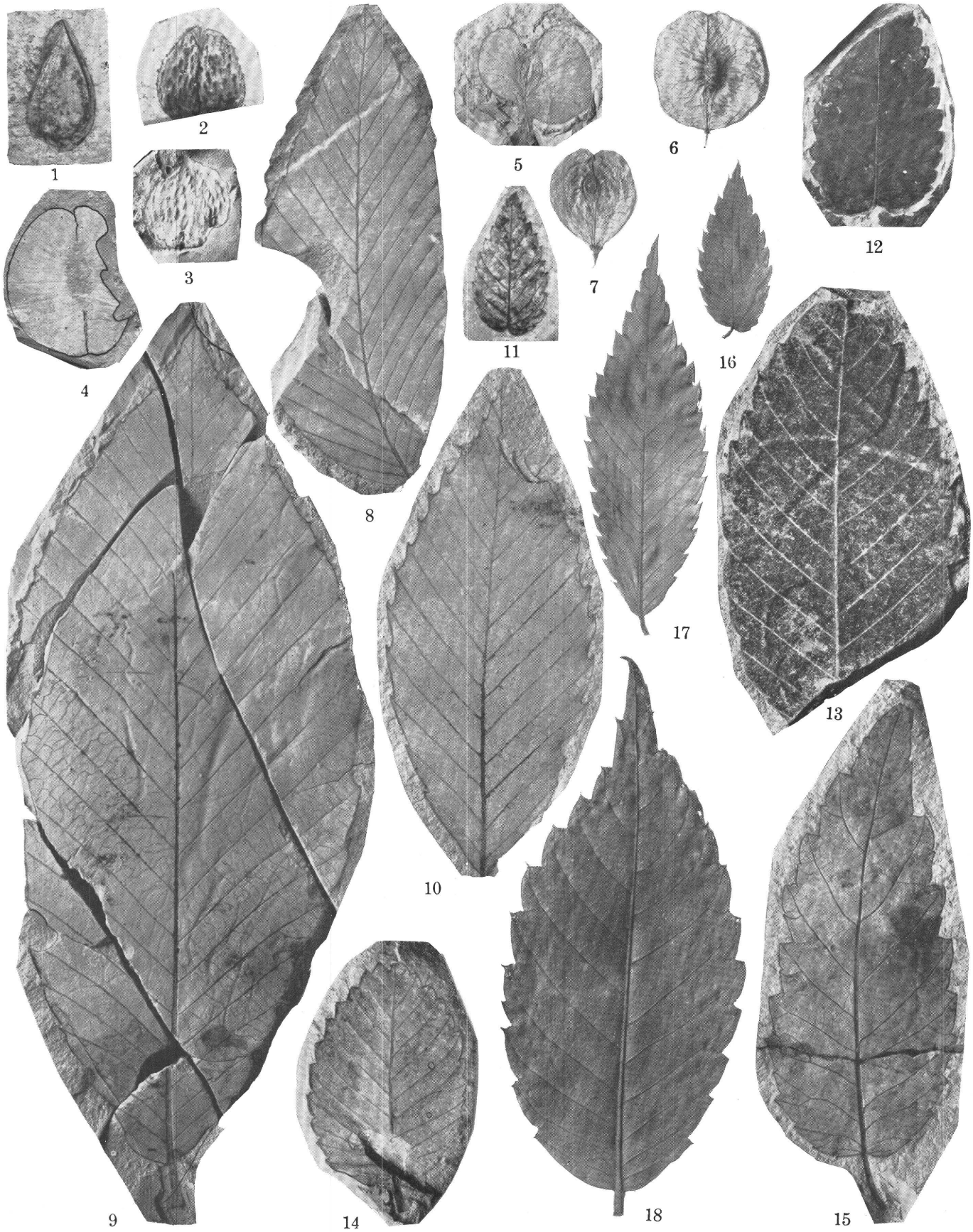


FOSSIL PLANTS FROM THE WESTERN UNITED STATES.

PLATE 50

PLATE 51



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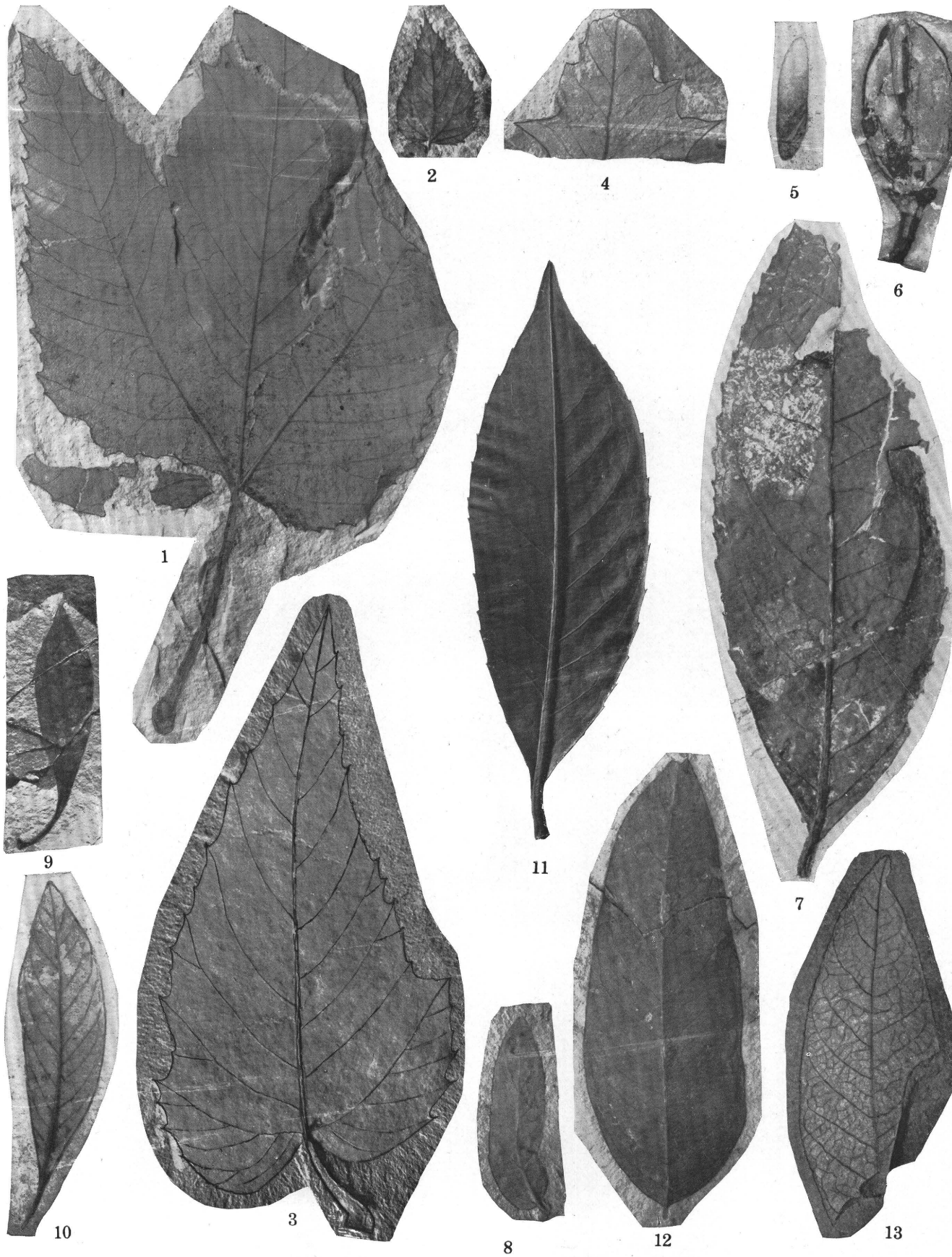
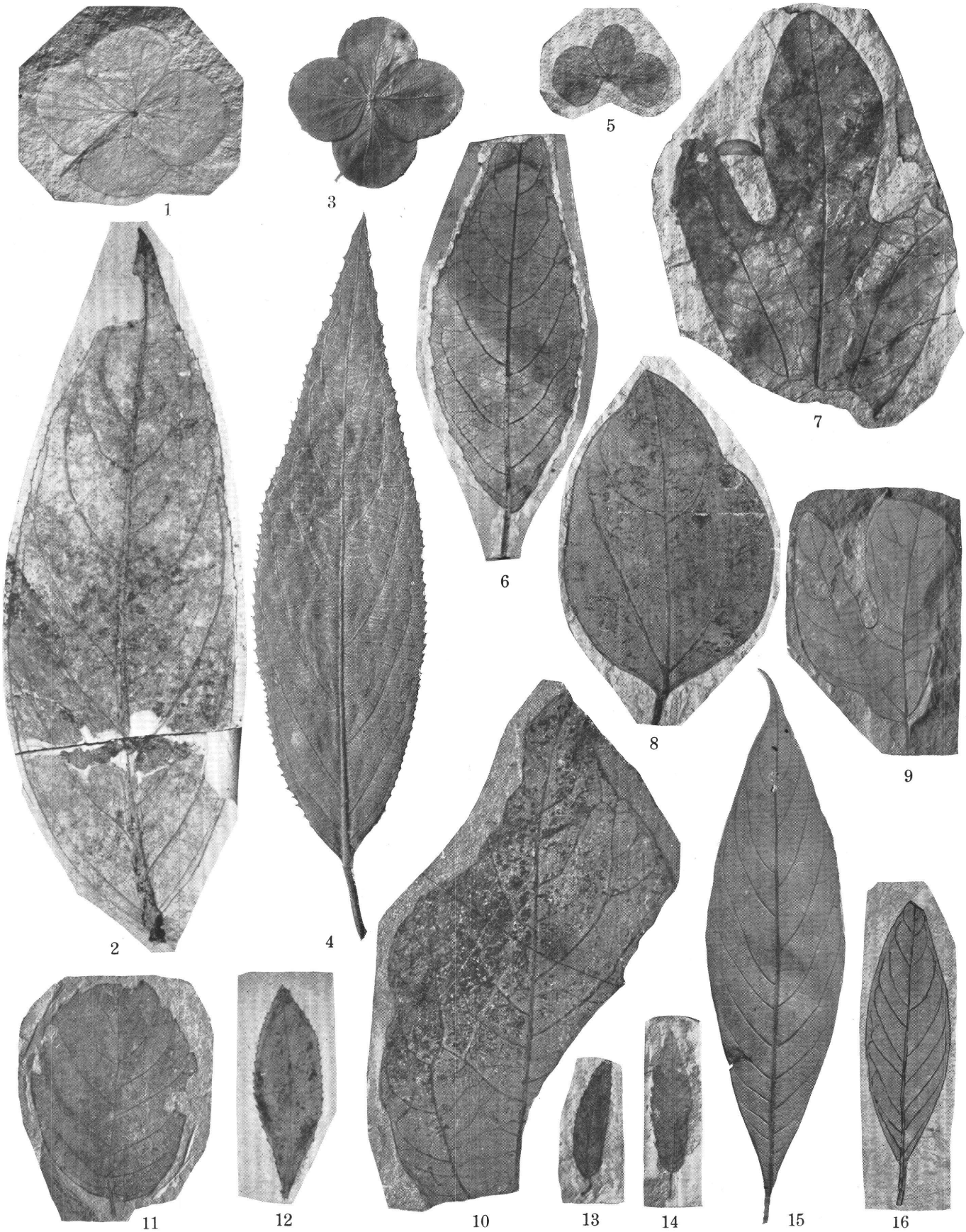


FOSSIL PLANTS FROM THE WESTERN UNITED STATES.

PLATE 52

PLATE 53



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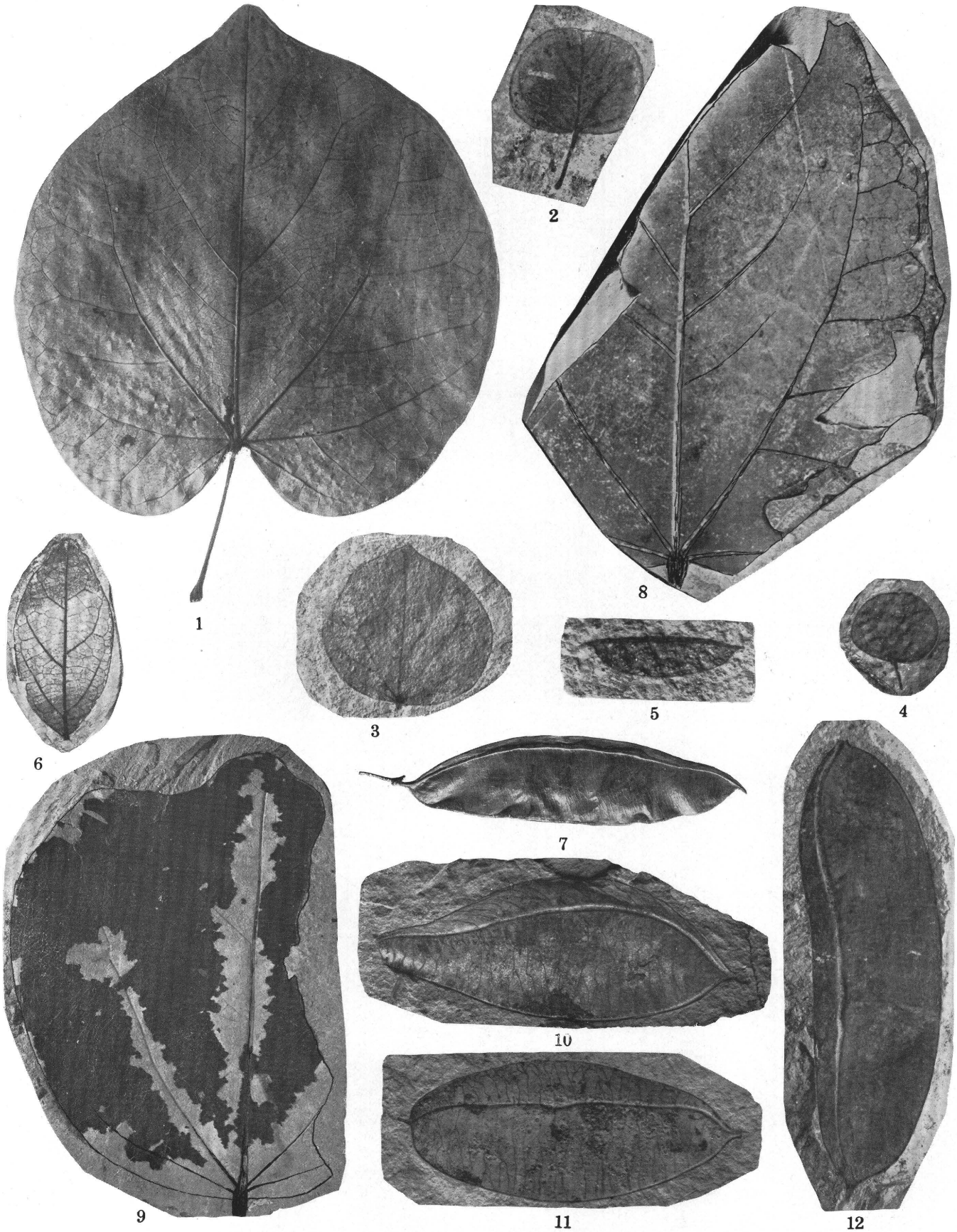

FOSSIL PLANTS FROM THE WESTERN UNITED STATES.

PLATE 54

PLATE 55

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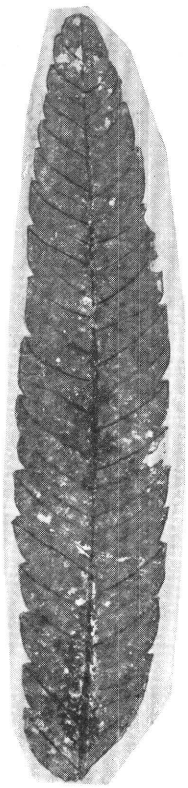

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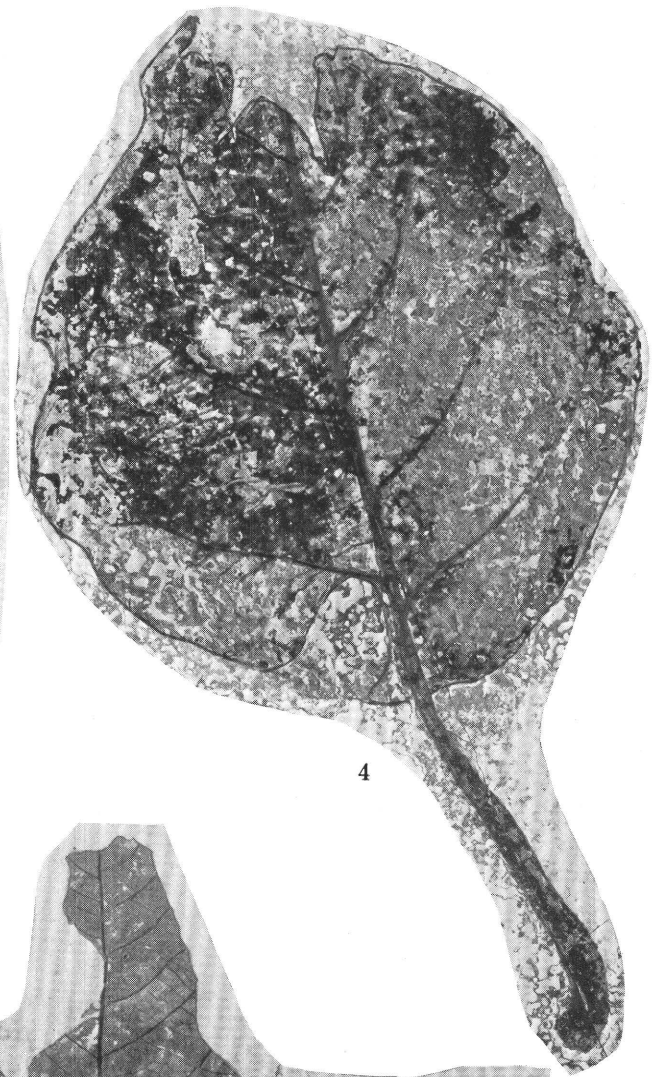

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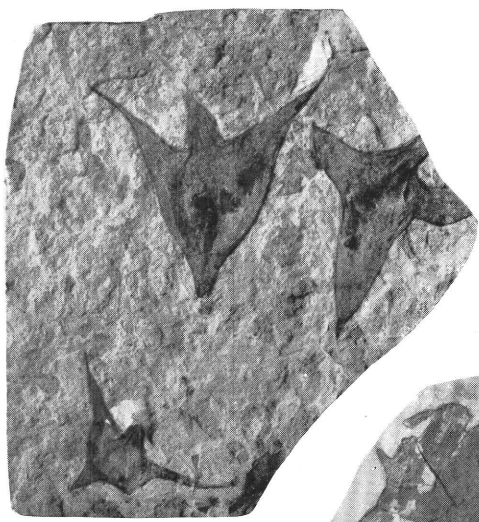

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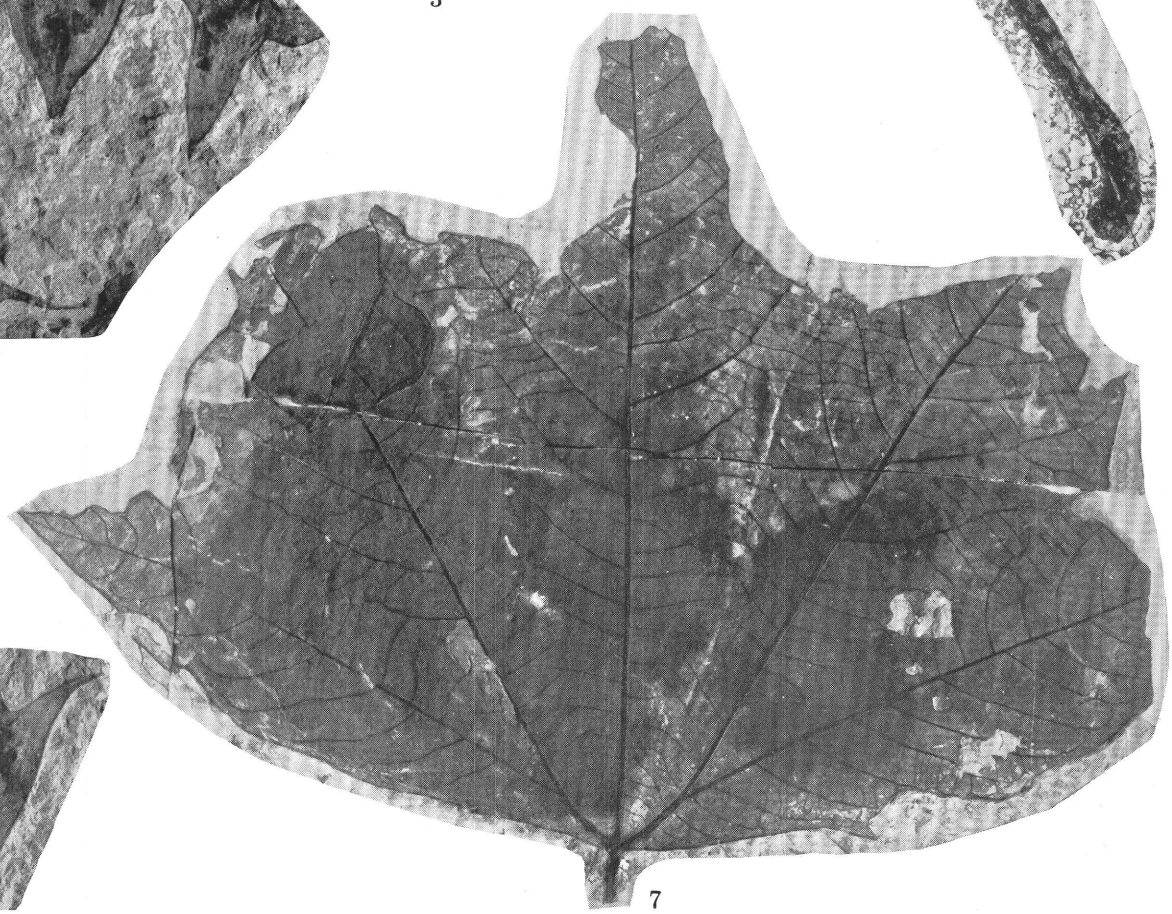

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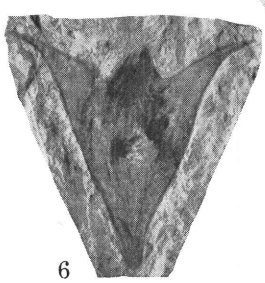

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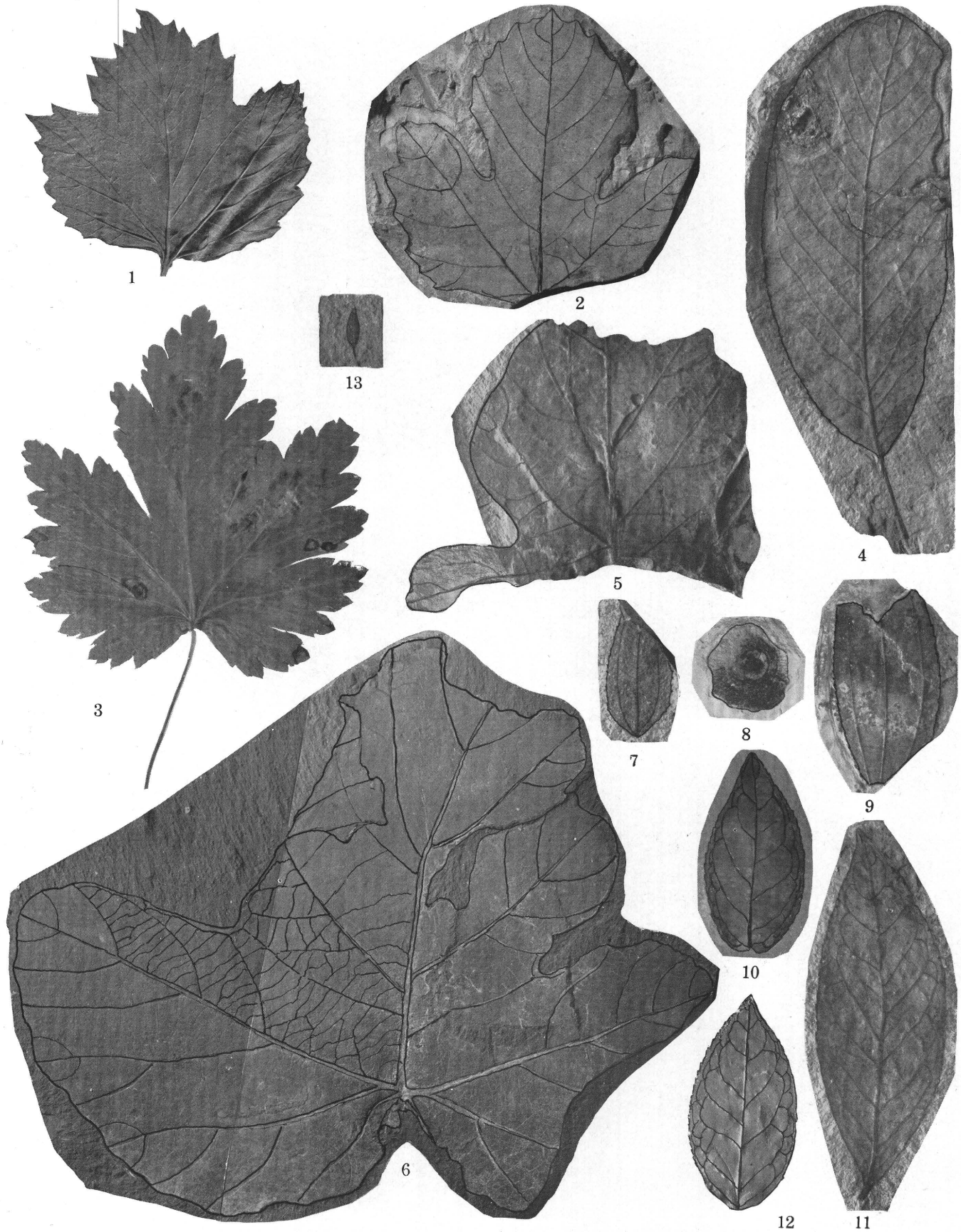
FOSSIL PLANTS FROM THE WESTERN UNITED STATES.



FOSSIL PLANTS FROM THE WESTERN UNITED STATES.

PLATE 56

PLATE 59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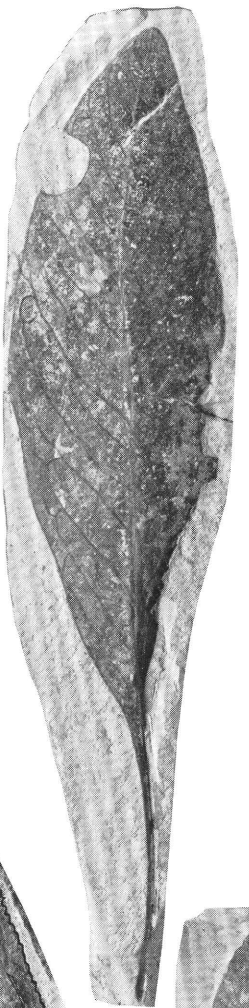
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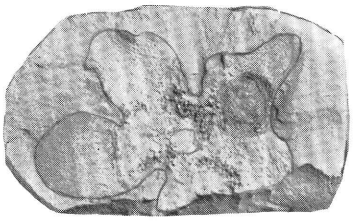
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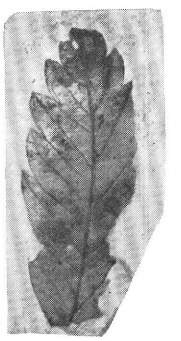
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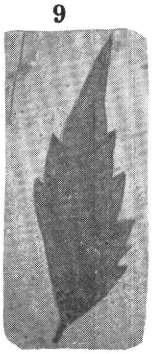
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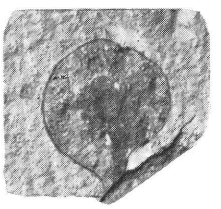
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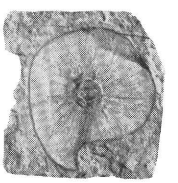
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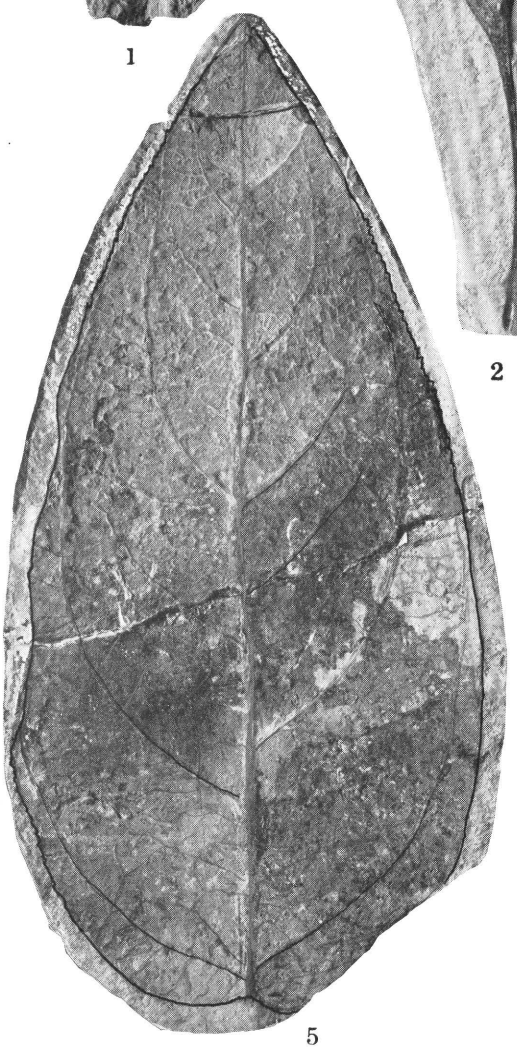
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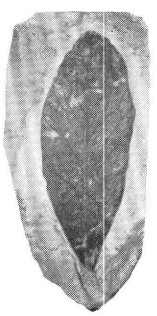
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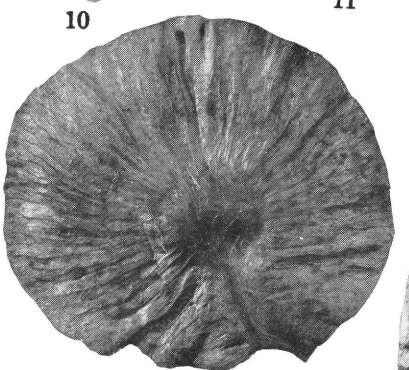
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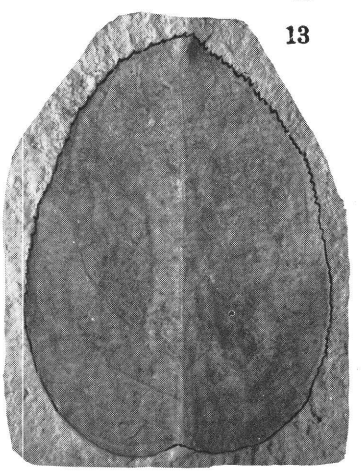
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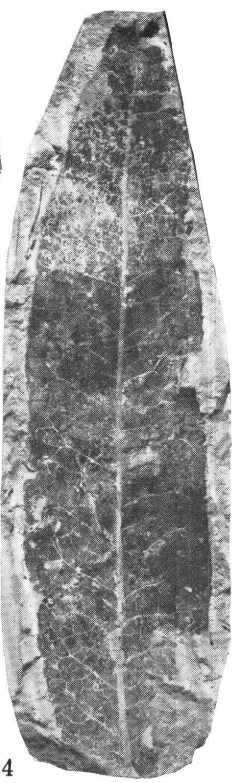
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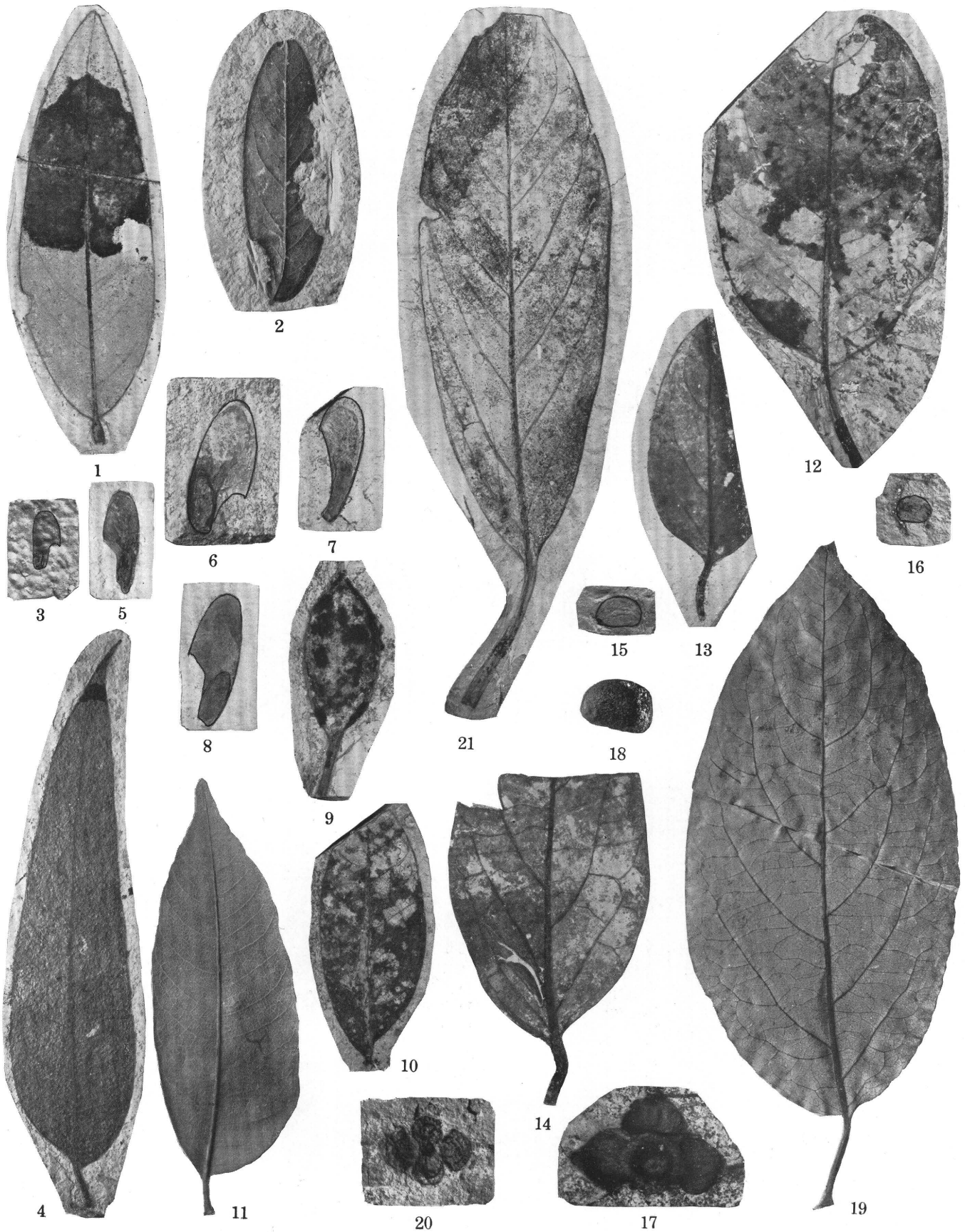
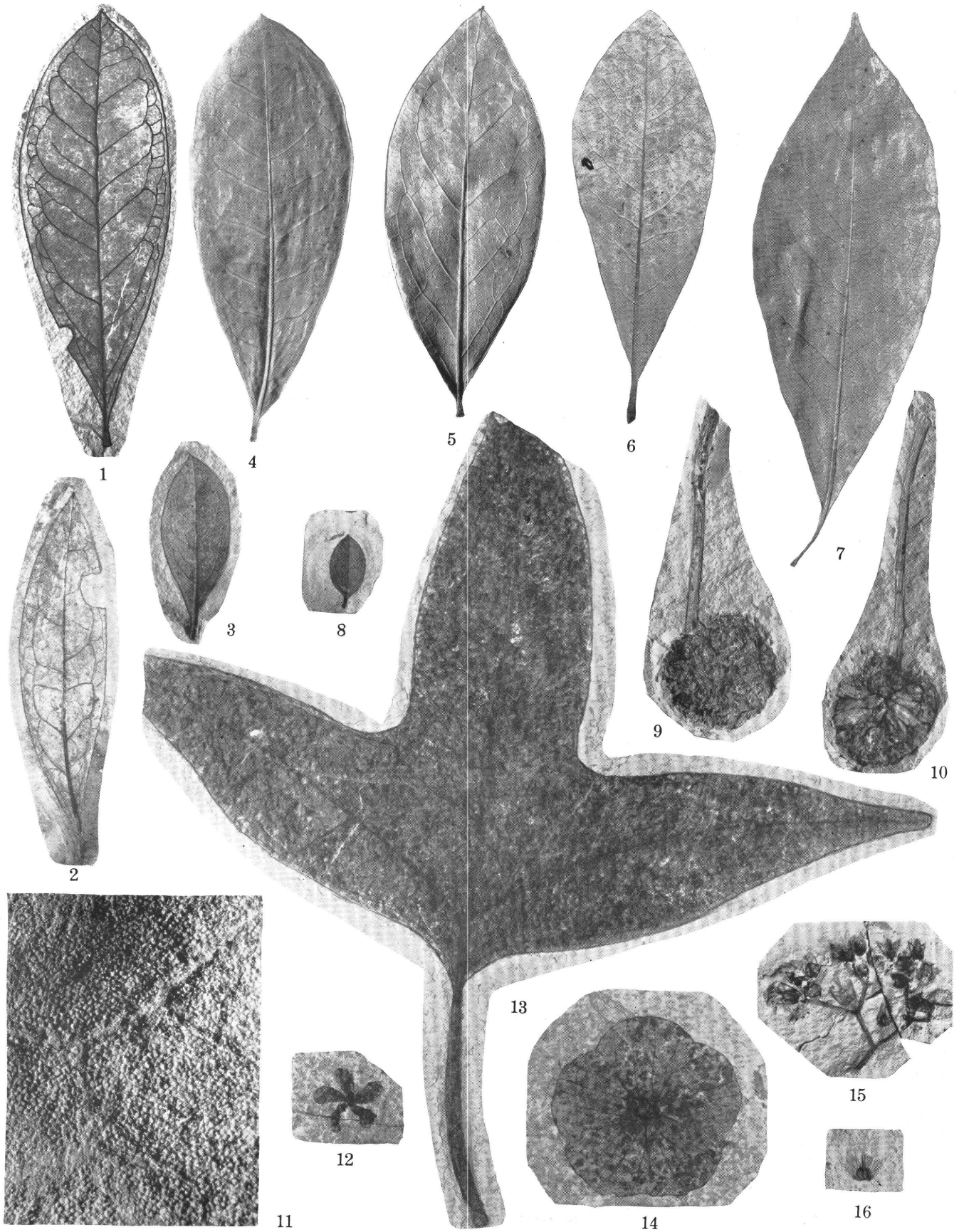
FOSSIL PLANTS FROM THE WESTERN UNITED STATES.



FOSSIL PLANTS FROM THE WESTERN UNITED STATES.

PLATE 60

PLATE 61



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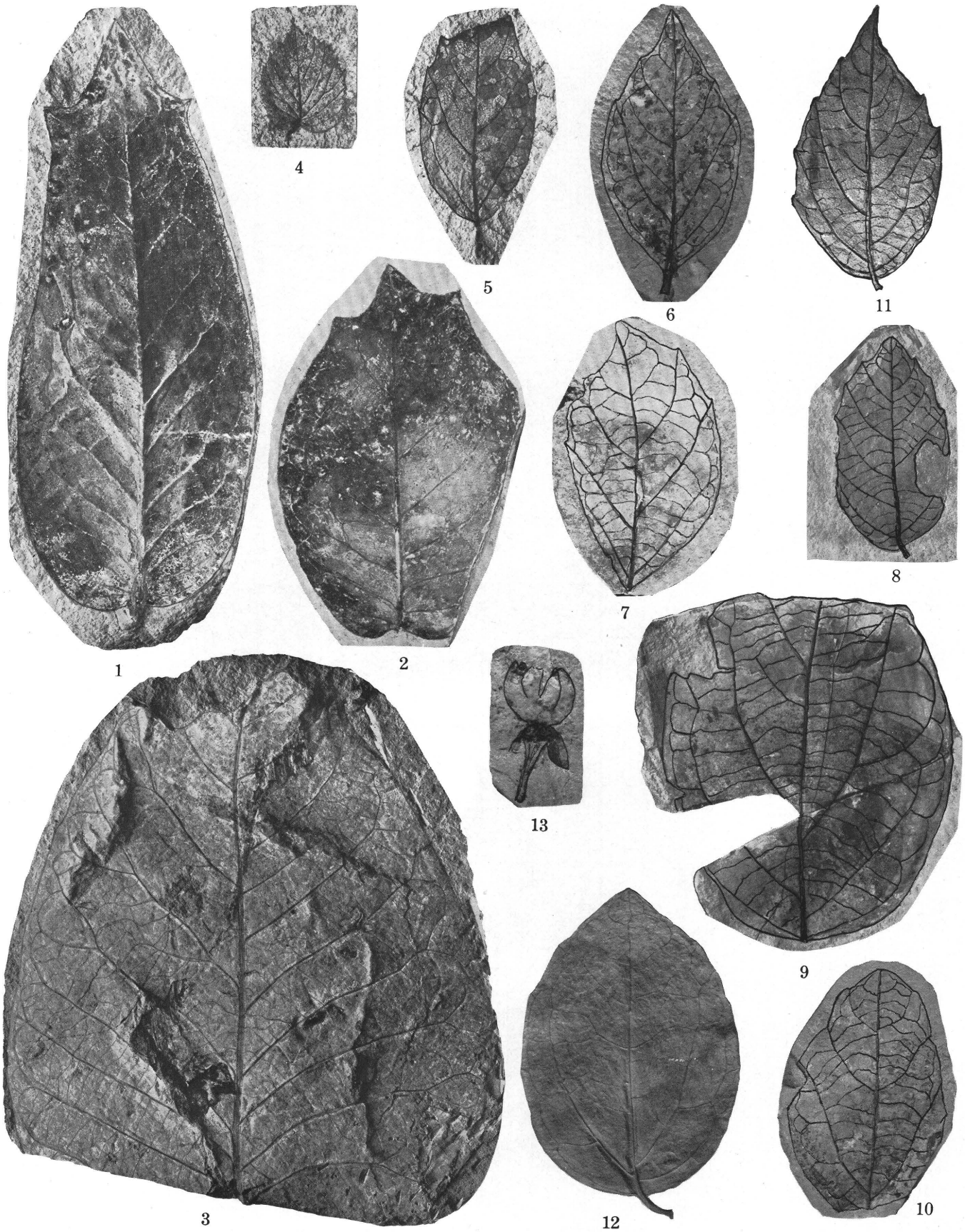
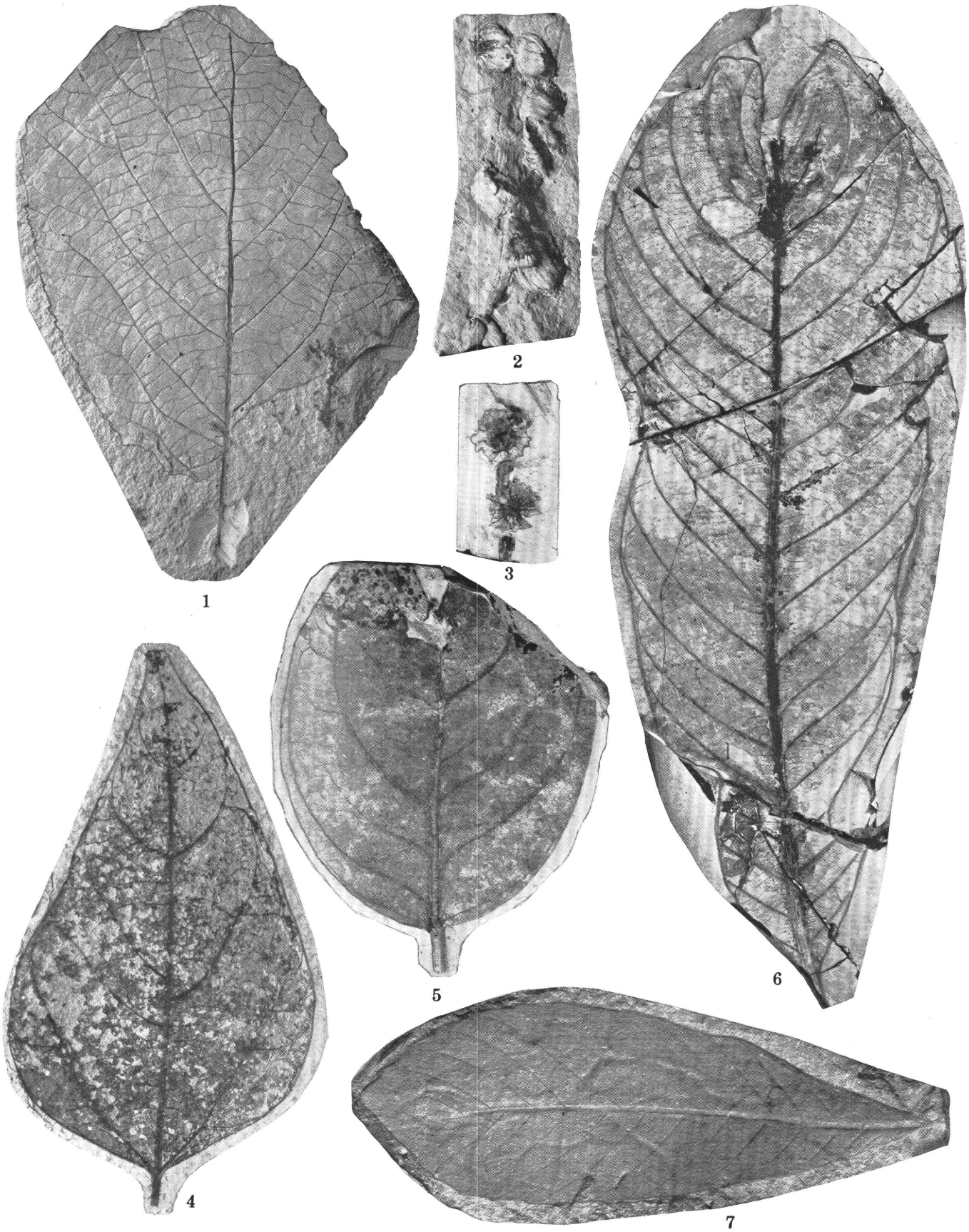


FOSSIL PLANTS FROM THE WESTERN UNITED STATES.

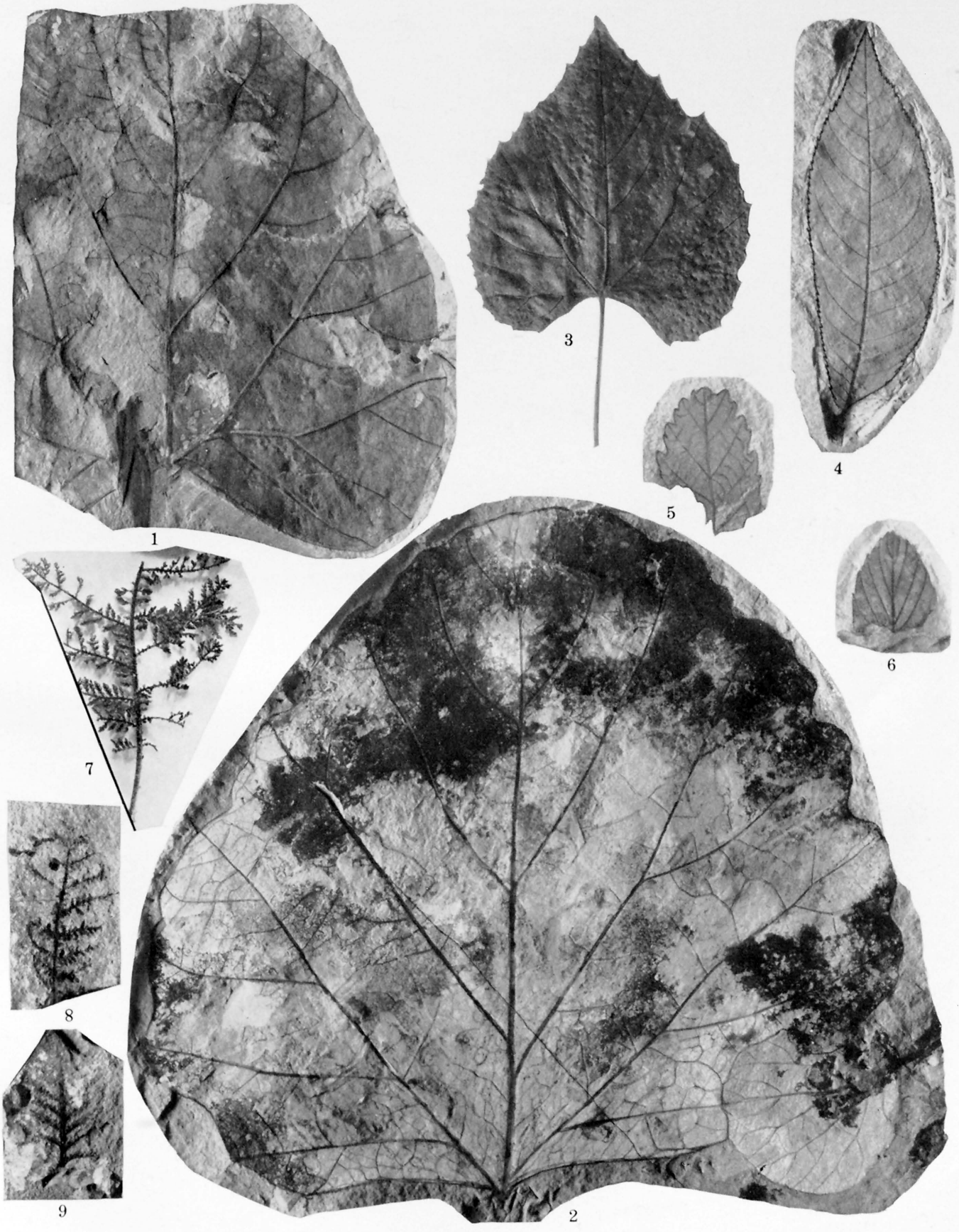
PLATE 62

PLATE 63



FOSSIL PLANTS FROM THE WESTERN UNITED STATES.

PLATE 57



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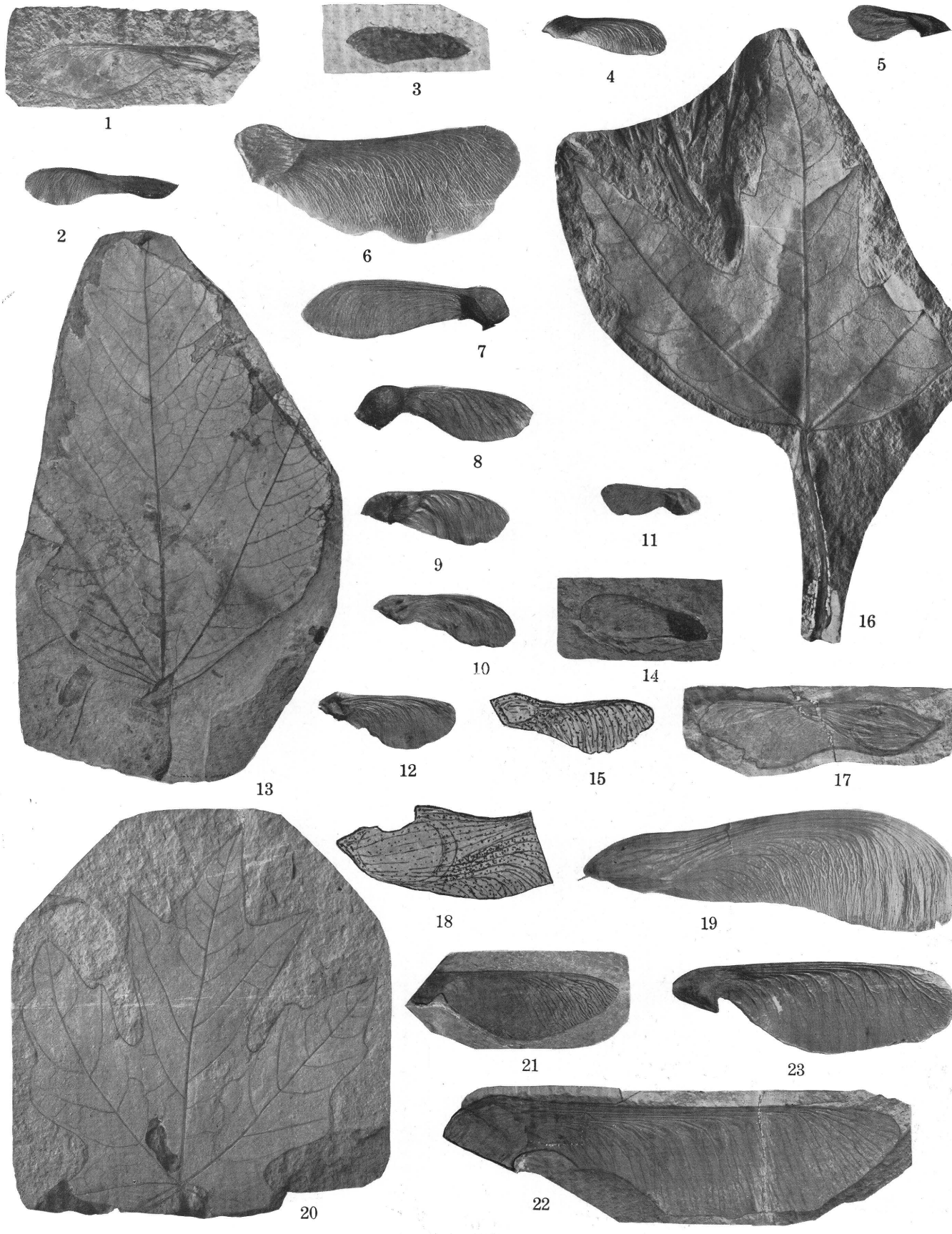

FOSSIL PLANTS FROM THE WESTERN UNITED STATES.

PLATE 58