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MIOCENE PLANTS FROM IDAHO

BY

EDWARD WILBER BERRY

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MIOCENE PLANTS FROM IDAHO

By EDWARD WILBER BERRY

ABSTRACT

The author describes 75 species of plants from the Miocene of about 30 localities in Idaho. These plants represent 40 genera in 28 families and 17 orders, and the most common types are species of *Acer*, *Quercus*, *Populus*, *Betula*, and *Laurus*. There are 2 ferns, 3 monocotyledons, and 70 dicotyledons, 18 of which are no longer present in the northwestern United States. There are some xerophytic types, but the majority are mesophytic, possibly indicating a mixture from different altitudes. The beds are correlated with the Latah formation and considered to be of upper Miocene age.

INTRODUCTION

The material that forms the basis for the following report was collected by Virgil R. D. Kirkham, formerly of the Idaho Bureau of Mines and Geology, during field work for that organization in 1927 and 1928, and was studied by me for the United States Geological Survey. Preliminary reports were furnished to the Idaho Bureau of Mines and Geology under dates of December 29, 1927, and February 25, 1929, covering respectively the collections of the two years. Since that time I have had an opportunity to revise my tentative conclusions in connection with work on similar Miocene floras from various places in Washington and Oregon and to recognize some few additional forms from Idaho.

No attempt will be made to present even a summary of the local geology. The region has been studied by Russell, Lindgren, Lupton, Laney, Kirhkam, Piper, Johnson, Pardee, Bryan, and others, and recently Kirkham has published several papers discussing it, of which the two cited below [1] give a full summary of the history of its study.

As will be seen subsequently, the floras known as Latah and Payette have much in common and appear to be partly contemporaneous. Whether or not the formational units so designated correspond as to their upper and lower limits cannot be determined from the scanty floras known at the present time. Both seem to have been deposited during the same episode in the geologic history of this general region, but whether their stratigraphic relations to the various basalt sheets are as simple as they have been pictured must be left to others to decide.

[1] Kirkham, V. R. D., and Johnson, M. M., The Latah formation in Idaho: Jour. Geology, vol. 37, pp. 483–504, 1929. Kirhkam, V. R. D., Revision of the Payette and Idaho formations: Idem, vol. 39, pp. 193–239, 1931.

PREVIOUS STUDIES

In 1898 Lindgren [2] proposed the name "Payette formation" for the lake beds in the Idaho Basin from which Knowlton [3] described 32 species of plants, of which 17 were considered new and 5 were not specifically determined. The age indicated was considered to be upper Miocene. Full references to earlier workers (Hayden, Peale, St. John, and others) are given in Lindgren's paper.

Shortly afterward Russell [4] mentioned similar plant-bearing lacustrine sedimentary rocks interstratified with flows of Columbia River basalt from localities farther north in Idaho, and the same author some years earlier had referred in print to similar occurrences in the State of Washington.

In 1902 Knowlton [5] changed his opinion of the age of the Payette flora from upper Miocene to upper Eocene, because of its similarity to the flora of the beds at Bridge Creek in the John Day Basin, which at that time were regarded as upper Eocene.

In 1923 Bryan proposed the name "Latah formation" for similar lacustrine plant-bearing beds in eastern Washington, the detailed account of which, with a discussion by Knowlton of the contained flora, was published in 1926.[6] In 1929 I prepared a revision of the Latah flora [7] based upon large additional collections, and more recently I have described an extension of this flora in the Grand Coulee region,[8] near the western boundary of Grant County, Wash.

It is entirely unnecessary for me to give any further historical details of the study centering around the Latah or Payette formations, or to attempt a summary of the geology, as I have never been in the region, and more especially as these and related subjects have been rather fully discussed in the papers by Kirkham already cited.

[2] Lindgren, Waldemar, Mining districts of the Idaho Basin and the Boise Ridge, Idaho: U.S. Geol. Survey 18th Ann. Rept., pt. 3, pp. 625–719, 1898.

[3] Knowlton, F. H., idem, pp. 721–744.

[4] Russell, I. C., Geology and water resources of Nez Perce County, Idaho: U.S. Geol. Survey Water-Supply Papers 53 and 54, 1901.

[5] Knowlton, F. H., Fossil flora of the John Day Basin, Oregon.: U.S. Geol. Survey Bull. 204, p. 110, 1902.

[6] Pardee, J. T., and Bryan, Kirk, Geology of the Latah formation: U.S. Geol. Survey Prof. Paper 140, pp. 1–81, 1926.

[7] Berry, E. W., A revision of the flora of the Latah formation: U.S. Geol. Survey Prof. Paper 154, pp. 225–265, pls. 49–64, 1929.

[8] Berry, E.W., A Miocene flora from Grand Coulee, Wash.: U.S. Geol Survey Prof. Paper 170, pp. 31–42, pls. 11–13, 1931.

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FOSSILS AT PRESENT KNOWN FROM THE LATAH FORMATION IN IDAHO

Pteridophyta:
- Polypodiales:
  - Polypodiaceae:
    - Pteris sp.
    - Dryopteris idahoensis Knowlton.

Coniferophyta:
- Pinales:
  - Cupressinaceae:
    - Sequoia langsdorfii (Brongniart) Heer.
    - Glyptostrobus europaeus (Brongniart) Heer.
    - Taxodium dubium (Sternberg) Heer.
    - Taxodium, cone.
    - Taxodium, seed.
    - Libocedrus praedecurrens Knowlton.
  - Abietineaceae:
    - Pinus monticolensis Berry.
    - Pinus, needle.

Spermatophyta:
- Monocotyledonae:
  - Pandanales:
    - Typhaceae:
      - Typha lesquereuxi Cockerell.
  - Naiadales:
    - Naiadaceae:
      - Potamogeton heterophylloides Berry.
  - Liliales:
    - Smilacaceae:
      - Smilax lamarensis Knowlton.
- Dicotyledonae:
  - Salicales:
    - Salicaceae:
      - Salix knowltoni Berry.
      - Salix florissanti Knowlton and Cockerell.
      - Populus lesquereuxi Cockerell.
      - Populus eotremuloides Knowlton.
      - Populus lindgreni Knowlton.
      - Populus sp.
      - Populus, bud scales.
  - Fagales:
    - Betulaceae:
      - Betula fairi Knowlton.
      - Betula heteromorpha Knowlton.
      - Betula largei Knowlton.
      - Ostrya oregoniana Chaney.
    - Fagaceae:
      - Fagus pacifica Chaney.
      - Fagopsis longifolia (Lesquereux) Hollick.
      - Castanea castaneaefolia (Unger) Knowlton.
      - Quercus cognata Knowlton.
      - Quercus duriuscula Knowlton.
      - Quercus idahoensis Knowlton.
      - Quercus payettensis Knowlton.
      - Quercus simulata Knowlton.
      - Quercus treleasii Berry.
      - Quercus spokanensis var. gracilis Berry.
      - Quercus, cupule.
  - Urticales:
    - Moraceae:
      - Ficus? washingtonensis Knowlton.
    - Ulmaceae:
      - Ulmus brownelli Lesquereux.
      - Ulmus speciosa Newberry.
  - Platanales:
    - Platanaceae:
      - Platanus dissecta Lesquereux.

Spermatophyta—Continued.
- Dicotyledonae—Continued.
  - Ranales:
    - Berberidaceae:
      - Odostemon simplex (Newberry) Cockerell.
    - Menispermaceae:
      - Cebatha heteromorpha (Knowlton) Berry.
    - Magnoliaceae:
      - Magnolia dayana Cockerell.
  - Rosales:
    - Pomaceae:
      - Amelanchier scudderi Lesquereux.
    - Hamamelidaceae:
      - Liquidambar californicum Lesquereux.
      - Liquidambar, fruit.
    - Caesalpiniaceae:
      - Cassia sophoroides (Knowlton) Berry.
      - Cassia idahoensis Knowlton.
      - Cercis idahoensis Berry.
    - Papilionaceae:
      - Sophora alexanderi Knowlton.
      - Sophora spokanensis Knowlton.
  - Sapindales:
    - Anacardiaceae:
      - Rhus merrilli Chaney.
    - Celastraceae:
      - Euonymus knowltoni Berry.
    - Aceraceae:
      - Acer bendirei Lesquereux.
      - Acer chaneyi Knowlton.
      - Acer florissanti Kirchner.
      - Acer merriami Knowlton.
      - Acer minor Knowlton.
      - Acer oregonianum Knowlton.
  - Rhamnales:
    - Rhamnaceae:
      - Paliurus hesperius Berry.
  - Malvales:
    - Tiliaceae:
      - Tilia hesperia Berry.
    - Malvaceae:
      - Hibiscus occidentalis Berry.
      - Malva? hesperia Knowlton.
  - Parietales:
    - Ternstroemiaceae:
      - Gordonia idahoensis (Knowlton) Berry.
  - Laurales:
    - Lauraceae:
      - Laurus grandis Lesquereux.
      - Laurus princeps Heer.
      - Laurus similis Knowlton.
      - Umbellularia lanceolata Berry.
      - Umbellularia dayana (Knowlton) Berry.
  - Umbellales:
    - Cornaceae:
      - Nyssa hesperia Berry.
      - Nyssa knowltoni Berry.

Position uncertain:
- Phyllites payettensis Knowlton.
- Carpites boraginoides Knowlton.
- Carpites menthoides Knowlton.
- Fraxinus?, samaras.
- Calyx.

Mollusca: Lampsilis, valves.

Insecta: Itonid or phylloxerid galls.

Pisces: Leuciscus, scales and bones.

LOCAL DISTRIBUTION

It has not seemed worth while to tabulate the local distribution in Idaho of the plants enumerated above, as the collections are very unequal in extent. About 30 plant-bearing localities were discovered by Kirkham, but some of these failed to yield anything well enough preserved to be determinable. Others containing excellent material were insufficiently explored. The largest variety of forms came from a locality south of Juliaetta, in Nez Perce County, and from the localities in the vicinity of Whitebird, in Idaho County, and some of these promise to prove as rich as the localities near Spokane, Wash., if they are ever intensively worked.

Premature conclusions as to local distribution are almost certain to prove unsound, as has been proved by the later collections from the Spokane region, which completely changed the earlier expressed statements regarding the relative abundance of particular species.

Thus far conifers are sparingly represented in the collections from Idaho, but the same thing was true of the collections from Spokane described by Knowlton, whereas the later collections from the identical outcrops furnished 13 species, some of which proved to be exceedingly abundant.

RELATIONSHIPS

From the Latah formation of Idaho, 78 different kinds of organic remains are recorded, all but three of which are plants. These three comprise insect leaf galls, valves of *Lampsilis*, and the scales, spines, and bones of a small cyprinoid fish which are referred to the genus *Leuciscus* and which, although rather intractable systematically, are of considerable interest, as I have found them to be widespread in the western Miocene and present at numerous localities in Idaho, Washington, Oregon, and Nevada.

Many of the plant-bearing beds at localities associated with the Columbia River lavas and elsewhere in this general region contain diatoms, and some are typical diatomaceous earths. Except for Mann's account [9] of the diatoms from the Latah formation at Spokane, these have been almost entirely neglected, although they are likely to prove most valuable when they shall have become stratigraphically understood. A great variety of species may be contained in a small sample, whereas most collectors of higher plants are likely to be satisfied with specimens of three or four species if the time and labor of collecting a large flora and the exigencies of transport discourage complete collections.

A specimen of diatomaceous earth from a locality about 5 miles south of Juliaetta, Nez Perce County, was examined for me by Dr. Mann but not thoroughly studied. He reported spicules of fresh water sponges and three species of *Melosira*—*M. distans* (Ehrenberg) Kuetzing, *M. granulata* (Ehrenberg) Ralfs, and *M. crenulata* Kuetzing. The first two of these are recorded from the Latah formation at Spokane. A critical study of this and other samples would undoubtedly disclose a large number of forms, inasmuch as 85 species were identified in a single sample from Spokane.

Of the 75 different kinds of plant remains recorded in the following pages there is obviously considerable duplication as to botanic species. This duplication is of two kinds—first, the recognition of too many species in such genera as *Acer* and *Quercus*, owing to failure to evaluate or the impossibility of evaluating the range of specific variation; and second, the separate listing of *Taxodium* cones and seeds, undetermined pine needles, *Populus* bud scales, *Liquidambar* fruits, and things of that sort which almost certainly belonged to associated species based upon foliar remains. The pragmatic excuse for my procedure is the experience that these objects are normally much less common as fossils than foliar remains, and if they are merely alluded to in the discussion of foliar species they are almost invariably overlooked by students using the text.

The plants thus far collected from the Miocene of Idaho are about half the number that will probably be eventually discovered, as more than 150 are now known from the Latah beds in eastern Washington, owing largely to the perseverance and industry of two or three interested collectors in Spokane. Furthermore, the distribution among the natural orders of the plants already discovered shows the former presence in Miocene Idaho of an extensive flora.

There are 40 definitely determined genera distributed in 28 families and 17 orders. The genera with largest representation are *Acer* and *Quercus*, which are both probably overelaborated. The next largest representation is in the genera *Populus*, *Betula*, and *Laurus*, each with 3 species. The family best represented is the Fagaceae, with 10 nominal species. The next is the Aceraceae, with 6 nominal species. The Salicaceae and Lauraceae have 5 species each, and the Betulaceae and Cupressinaceae have 4 species each. The order best represented is the Fagales, with 14 species. Next are the Sapindales, with 8; the Rosales, with 7; and the Pinales, Salicales, and Laurales, with 5 each.

But two ferns, representing the genera *Pteris* and *Dryopteris* were found, and they are very rare in the collections. The coniferophytes are represented by 5 genera and 5 or 6 species, and their remains appear to be individually much less abundant in the Idaho collections than in those from Washington. Only 3 monocotyledons have been recognized, and these represent 3 genera, 3 families, and 3 orders. All the numerous dicotyledons thus far discovered represent

[9] Mann, Albert, The fossil diatom deposit at Spokane: U.S. Geol. Survey Prof. Paper 140, pp. 51–55, pl. 30, 31, 1926.

the choripetalous alliance, although the supposed *Fraxinus* would prove an exception to this statement if its determination is verified.

The Gamopetalae are as a rule sparingly represented in Tertiary floras, owing partly to their relatively late evolution, but also to the herbaceous habit of so many of the species and thus lesser likelihood of successful preservation as compared with deciduous trees. That Gamopetalae were present in the Miocene flora of Idaho is indicated by the 14 species belonging to this alliance which are recorded from beds of this age in Washington.

When the Latah flora of Washington is compared with the present collections from Idaho, it is obvious that many types of the former are not known from the latter. This is perhaps not surprising, as only half as many species are known from the Idaho localities. None of the following have been found in the collections studied from Idaho:

Bryophyta
Lycopodium
* Equisetum
Woodwardia
Woodsia
Ginkgo
Tumion
Tsuga
Hicoria
Comptonia
Alnus
Carpinus
Menispermites
Liriodendron
Ribes
Hydrangea
* Prunus
Cercocarpus
Meibomites
* Sapindus
* Celastrus
* Aesculus
Rhamnus
Sassafras
Aralia
Cornus
Ericaceae
Diospyros
Apocynophyllum
Porana
Viburnum

The five species marked with an asterisk (*) have been reported by either Knowlton or Chaney from the Payette formation farther south in Idaho, which Kirkham considers to be the same as that which is here called Latah. Accidents of preservation or discovery, especially in an area inadequately explored, probably account for most of this difference, and it may be expected to become less marked with future exploration, as has already been suggested.

ENVIRONMENTAL CONDITIONS

A discussion of the tentative conclusions regarding the ecology to be drawn from the Latah flora was given in connection with the description of the flora from the Spokane area.[10] As the known flora from that area was twice as large as that known from Idaho, there is no point in attempting an elaborate analysis of the latter.

Among the 40 genera recorded from the Miocene of Idaho, the following 18, or 45 percent, are not present in the existing flora of the northwestern United States: *Cassia, Castanea, Cebatha, Euonymus, Fagus, Ficus, Glyptostrobus, Gordonia, Liquidambar, Magnolia, Malva?, Nyssa, Ostrya, Paliurus, Sophora, Taxodium, Tilia, Ulmus.*

The Latah flora of Washington, which has been much more thoroughly collected, contains the following additional exotic genera: *Arisaema, Carpinus, Celastrus, Comptonia, Diospyros, Ginkgo, Hicoria, Hydrangea, Liriodendron, Porana, Ptelea, Sapindus, Sassafras,* and *Viburnum.*

If to these are added genera represented by relict species, confined to particular situations in the western United States but absent in the existing flora of Idaho, this list can be extended by the addition of the genera *Aesculus, Cercis, Libocedrus, Platanus,* and *Umbellularia.* Following a suggestion of Clements,[11] Chaney [12] has emphasized two principal ecologic groups in the Oregon and related Miocene. These are the redwood association and the redwood border association, the latter being compared with the modern oak-madroño association.

The method is valuable for furnishing circumstantial evidence in cases of doubt, but it seems to me that there is great danger of overstressing it. For example, I can see nothing of the sort in the Miocene floras of Idaho or in those around Spokane, and as some of the more prominent elements in this supposed Miocene redwood forest, including its redwood representative, *Sequoia langsdorfii,* are holarctic in distribution, generalizations become absurd. Mason, in a recent paper,[13] writes that this method "seems to be an excellent working hypothesis in the treatment of at least the later Cenozoic floras."

If a Miocene forest in which more than half the flora belongs to genera found in southeastern Asiatic or southeastern North America mesophytic hardwood forests at the present time, and not found in the western United States at the present time, is a redwood association, then the term becomes a name without much meaning. The fact that the genera of the Miocene flora which still survive on the Pacific slope are represented in the Miocene by species less like such survivors than they are like survivors in Asia or southeastern North America, for example, *Cercis* and *Gordonia,* shows that the problem is almost infinitely more complex than has been believed. I hold no brief for such a genus as *Glyptostrobus,* but the logic that rules out *Glyptostrobus* would also rule out *Ginkgo,* the Cenozoic history of which is very similar but so well known and conclusive that no one can dispute the occurrence of *Ginkgo.* It is probably true that it is impossible to be sure of always distinguishing the fossil foliage of *Sequoia* and *Taxodium,* but this does not mean that *Taxodium* was not present in Miocene Idaho or did not have a holarctic range in Tertiary time. Cones, cone scales, seeds, and staminate aments have been found at too many localities, including Idaho, to exclude *Taxodium* as a normal element in Miocene temperate floras.

[10] Berry, E. W., op. cit. (Prof. Paper 154), pp. 233–234.

[11] Clements, F. E., Plant succession: Carnegie Inst. Washington Pub. 242, p. 362, 1916.

[12] Clements, F. E., and Chaney, R. W., Methods and principles of paleo-ecology, Carnegie Inst. Washington Yearbook 22, p. 319, 1924. Chaney, R. W., Quantitative studies of the Bridge Creek flora: Am. Jour. Sci., 5th ser., vol. 8, p. 131, 1924; A comparative study of the Bridge Creek flora and the modern redwood forest: Carnegie Inst. Washington Pub. 349, 1925.

[13] Mason, H. L., Fossil records of some west American conifers: Carnegie Inst. Washington Pub. 346, 1927.

In the same way most of the genera recognized are not subject to the uncertainty attending the determinations of leaves of a more remote time, such as Eocene or Upper Cretaceous, because most of the Miocene leaves are too much like existing ones to be mistaken, and the leaves are frequently associated with the fruits, as in *Liriodendron*, *Cercis*, *Ulmus*, *Ptelea*, and *Diospyros*.

In general the Idaho plants, with the possible exception of the oaks, are overwhelmingly mesophytic in facies and entirely temperate in their climatic significance. The essential similarity of the Miocene floras in Idaho and adjacent States indicates a more widespread uniform environment than exists at the present time, and this in turn indicates slight topographic relief. So far as Idaho is concerned the temperature appears to have been higher than it is at present and the rainfall ample. The rainfall appears to have been greater than it is today and more evenly distributed throughout the year.

Certain modern regions, like the mesophytic hardwood region of Maryland or Virginia or the uplands of central China, despite many differences in detail, give a fairly accurate picture of what the floras and environments were like in the western United States during Miocene time. The facts that these Miocene floras were essentially holarctic in their distribution and that the surviving ecologic groups in the western United States are in general what might be called relict and restricted groups seem to me to impair the value of the restricted groups in interpreting the Miocene floras until the detailed history of extinction, emigration, immigration, and adaptation is completely worked out for the whole area from Miocene time to the present.

AGE

Of the 75 plants listed in the accompanying table of distribution the only ones without a recorded outside distribution are the calyx, the supposed *Fraxinus* samaras, a pine needle, cones and seeds of *Taxodium*, *Populus* sp., and *Quercus spokanensis gracilis*. These represent accidental finds likely to turn up at any time in late Miocene deposits in this general region and entirely lack significance for purposes of close correlation. Of the species recorded from Idaho, 57 have been found in the Latah beds of Washington, and there can be no doubt that most if not all of the Idaho plant-bearing outcrops are of about the same age as the Washington beds.

Among the 18 forms from Idaho that have not been found in Washington the following 6 Payette forms may possess some significance:

Dryopteris idahoensis.
Gordonia idahoensis.
Odostemon simplex.
Phyllites payettensis.
Populus eotremuloides.
Salix knowltoni.

Four of these are also found in the deposit at Bridge Creek, namely:

Fagus pacifica.
Odostemon simplex.
Ostrya oregoniana.
Ulmus brownelli.

This might mean that some of the Idaho localities are slightly older than the others, as the deposits of Bridge Creek seem definitely earlier Miocene than the Latah, but this loses much of its significance from the fact that two of the plants common to the beds at Bridge Creek occur also at Florissant, Colo. It seems quite evident that if there is any chronologic sequence in the plant-bearing beds it will require much more extensive collections to work them out.

Whether the Payette is of the same age, slightly older, or slightly younger than the flora discussed in the present paper cannot be determined from the data available at the present time. The Payette flora is very imperfectly known and has received little modern study. Chaney's preliminary announcement [14] of such a restudy lists 51 species, some of which were tentative identifications. Of these, 23 are represented in the present paper. This is a relatively large identical element and includes some of the more characteristic Latah forms, such as *Betula heteromorpha*, *Glyptostrobus europaeus*, *Laurus princeps*, *Umbellularia lanceolata*, *Populus lindgreni*, *Platanus dissecta*, *Quercus idahoensis*, *Q. payettensis*, *Q. simulata*, *Sequoia langsdorfii*, and *Ulmus speciosa*. The age of the two floras cannot be very different, and they may well be contemporaneous, as Kirkham has suggested. This is likely to be the case, because so large an identical element in two floras, one of which is poorly known, is generally taken to indicate contemporaneity, and the identical forms become more numerous as the incompletely known beds are more thoroughly explored.

Another flora of Miocene age, which is badly in need of a more modern study, is that of the Ellensburg formation in Washington, about 200 miles west of the Idaho plant localities. Only 4 or 5 of the Idaho plants are among the 16 reported from the Ellensburg, but I suspect that more careful collecting and study would greatly increase this number.

The accompanying table gives the recorded occurrences of Idaho plants in other areas, and none of these require especial comment. It seems certain that they are approximately contemporaneous with the Mascall flora of the John Day Basin in Oregon, the Florissant flora of Colorado, and that of the St. Eugene silt of British Columbia.

The exact position of any of these in the standard world section of the later Tertiary is still a matter of opinion rather than proof. My own conviction is that they are upper Miocene, and I would not be surprised if it were eventually shown that some of them, such as those bordering the Columbia River lavas, may have continued into what might properly be called Pliocene.

[14] Chaney, R. W., Notes on the flora of the Payette formation: Am. Jour. Sci., 5th ser., vol. 4, pp. 214–222, 1922.

Outside occurrences of Idaho Miocene plants

	Spokane, Wash., and vicinity	Grand Coulee, Wash.	Payette, Idaho	Mascall formation, Oregon	Beds on Bridge Creek, southeast Oregon	Ellensburg formation, Washington	Eagle Creek formation, Oregon	Yellowstone Park	Florissant, Colo.	California	St. Eugene silt, British Columbia	Esmeralda formation, Nevada	Pliocene, California	Elko, Nev.
Acer bendirei Lesquereux	×			×				×		×				
Acer chaneyi Knowlton	×				?									
Acer florissanti Kirchner									×	?				
Acer merriami Knowlton	×	×												
Acer minor Knowlton	×			×										
Acer oregonianum Knowlton	×	×		×	?									
Amelanchier scudderi Lesquereux	×				×				×					
Betula fairi Knowlton	×													
Betula heteromorpha Knowlton	×		×		×		×							
Betula largei Knowlton	×	×												
Carpites boraginoides Knowlton	×	×												
Carpites menthoides Knowlton	×													
Cassia idahoensis Knowlton	×		×											
Cassia sophoroides (Knowlton) Berry	×													
Castanea castaneaefolia (Unger) Knowlton	×	×												
Cebatha heteromorpha (Knowlton) Berry	×	×												
Cercis idahoensis Berry	×													
Dryopteris idahoensis Knowlton			×											
Euonymus knowltoni Berry	×	×												
Fagopsis longifolia (Lesquereux) Hollick	×			×			×	×	×					×
Fagus pacifica Chaney					×									
Ficus washingtonensis Knowlton	×	×												
Glyptostrobus (europaeus (Brongniart) Heer	×	×	×	×					×					
Gordonia idahoensis (Knowlton) Berry			×											
Hibiscus occidentalis Berry	×													
Laurus grandis Lesquereux	×							×		×				
Laurus princeps Heer	×		×					?		×				
Laurus similis Knowlton	×	×	×				×							
Libocedrus praedecurrens Knowlton	×	×	?	?									?	
Liquidambar californica Lesquereux	×			×			×		×	×				
Liquidambar, fruits	×	×	×	×			×		×	×				
Magnolia dayana Cockerell	×				×	×				×				
Malva? hesperia Knowlton	×													
Nyssa hesperia Berry	×	×												
Nyssa knowltoni Berry	×													
Odostemon simplex (Newberry) Cockerell			×		×				×					
Ostrya oregoniana Chaney					×									
Paliurus hesperius Berry	×	×												
Phyllites payettensis Knowlton			×	×										
Pinus monticolensis Berry	×													
Platanus dissecta Lesquereux	×	×	×	×		×		×		×	×			
Populus, bud scales	×	×												
Populus eotremuloides Knowlton			×											
Populus lesquereuxi Cockerell	×	×							×					
Populus lindgreni Knowlton	×	×	×	×		×								
Potamogeton heterophylloides Berry	×													
Pteris sp	×													
Quercus congata Knowlton	×	×												
Quercus duriuscula Knowlton				×										
Quercus idahoensis Knowlton			×											
Quercus payettensis Knowlton	×	×	×											
Quercus sp. (cupule)	×	×												
Quercus simulata Knowlton	×	×	×				×					×		
Quercus treleasi Berry	×	×												
Rhus merrilli Chaney	×				×									
Salix florissanti Knowlton and Cockerell	×			×					×					
Salix knowltoni Berry			×									×		
Sequoia langsdorfii (Brongniart) Heer	×	×	×	×	×				×				×	×
Smilax lamarensis Knowlton	×							×						
Sophora alexanderi Knowlton	×	×												
Sophora spokanensis Knowlton	×	×												
Taxodium dubium (Sternberg) Heer	×	×	×	×					×					
Tilia hesperia Berry	×						?							
Typha lesquereuxi Cockerell	×		×						×			×		
Ulmus brownelli Lesquereux					×				×				×	×
Ulmus speciosa Newberry	×	×	×		×		?							
Umbellularia dayana (Knowlton) Berry	×			×										
Umbellularia lanceolata (Knowlton) Berry	×	×	×			?								

SYSTEMATIC DESCRIPTIONS

Phylum PTERIDOPHYTA

Order POLYPODIALES

Family POLYPODIACEAE

Genus PTERIS Linné

Pteris sp. Berry

Fern fragment Knowlton, U.S. Geol. Survey Prof. Paper 140, p. 24, pl. 9, fig. 10, 1926.

Pteris sp., Berry, U.S. Geol. Survey Prof. Paper 154, p. 237, 1929.

Based on a very incomplete fragment from the Latah formation of the Spokane region, Washington. Much additional material has been collected, and it is hoped that eventually enough will be in hand to disclose the habit. It appears to have been not very different from the existing and widespread *Pteris aquilina* Linné. A somewhat similar form has been described by Dorf [15] from the Pliocene of California as *Pteris calabazensis*.

The present form has been found at but a single locality in Idaho and in a very fragmentary condition.

Occurrence: 11 miles east of Lewiston on north bank of Clearwater River, Nez Perce County.

Genus DRYOPTERIS Adanson

Dryopteris idahoensis Knowlton

Plate 19, figures 2, 3

Dryopteris idahoensis Knowlton, U.S. Geol. Survey 18th Ann. Rept., pt. 3, p. 721, pl. 99, figs. 1, 2, 1898.

Gleichenia? obscura Knowlton, U.S. Geol. Survey 21st Ann. Rept., pt. 2, p. 210, pl. 30, figs. 1–4, 1901.

Dryopteris? gleichenoides Knowlton, U.S. Geol. Survey 21st Ann. Rept., pt. 2, p. 211, pl. 30, figs. 5–7, 1901.

Dryopteris obscura (Knowlton) Berry, U.S. Nat. Mus. Proc., vol. 72, art. 23, p. 5, 1927.

This species was described from the Payette formation near Marsh, Idaho, and was based on very fragmentary material of an apparently bipinnate frond. A single fragment of a pinna is contained in the recent collections. This is cut nearly to the rachis into rather conical obtusely pointed segments. The midvein is stout, and there are three or four pairs of once-forked laterals proximad and about two pairs of simple laterals distad to each segment. All the material is sterile, so that the generic reference is somewhat uncertain. I can see no ground for maintaining the distinctness of *Dryopteris obscura* (Knowlton) Berry, which was described by Knowlton from the Esmeralda formation of western central Nevada.

Occurrence: Sec. 17, T. 9 N., R. 2 W., Alkali Creek, Lewis County.

[15] Dorf, Erling, Pliocene floras of California: Carnegie Inst. Pub. 412, p. 67, pl. 5, figs. 1, 2, 1930.

Phylum CONIFEROPHYTA

Order PINALES

Family CUPRESSINACEAE

Genus TAXODIUM L. C. Richard

Taxodium dubium (Sternberg) Heer [16]

This species has been discussed and illustrated in a number of recent publications. The leafy twigs are widely distributed in the Tertiary and are with difficulty distinguished from those of *Sequoia*. The twigs are frequently associated with cone scales, seeds, or fragments of staminate aments, all of which are strikingly similar to those of the modern bald cypress. The leafy twigs are represented at five localities in Idaho, at two of which cone scales occur associated with them and at one of these seeds also occur.

Occurrence: 3.8 miles east of Whitebird, Idaho County (seeds, cone scales, and twigs); 1 mile and 1.1 miles east of Arrow Junction, Nez Perce County (twigs); 5 miles south of Juliaetta, Nez Perce County (twigs and cone scales); Edwards ranch, Stanley Hill, near St. Maries, Coeur d'Alene, Kootenai County (twigs).

Taxodium, cone

Plate 19, figure 4

It is unusual to find an entire *Taxodium* cone fossil, as they usually fall apart when mature. The present cone is essentially like that of the existing *Taxodium distichum* (Linné) Richard but is more prolate and slightly larger. There can scarcely be any question that it is a cone of the same species whose twigs are so abundant at this horizon and which I have referred to the holarctic *T. dubium* (Sternberg) Heer. At the first locality named below both seeds and twigs are found in association with the cone, and at the second locality detached cone scales are associated with the twigs.

Occurrence: 3.8 miles east of Whitebird, Idaho County; 5 miles south of Juliaetta, Nez Perce County.

Genus GLYPTOSTROBUS Endlicher

Glyptostrobus europaeus (Brongniart) Heer [17]

Plate 19, figure 1

Taxodium europaeum Brongniart, Annales sci. nat., vol. 30, p. 168, 1833.

Glyptostrobus europaeus Heer, Flora, tertiaria Helvetiae, vol. 1, p. 51, pls. 19, 20, 1855.

Glyptostrobus ungeri Lesquereux, U.S. Geol. Survey Terr. Rept., vol. 8, p. 139, pl. 22, figs. 1–6a, 1883 (Mascall).

Sequoia affinis Lesquereux, U.S. Geol. Survey Terr. Rept., vol. 7, p. 75, pl. 7, figs. 3–5; pl. 65, figs. 1–4, 1878 (Florssant and Elko).

This species has been recorded from a vast number of holarctic localities and Cenozoic horizons, and in all

[16] The more or less complete synonymy of this ubiquitous species has been repeatedly published in recent years and need not be given in the present connection.

[17] A rather full synonymy of this much identified form was published in U.S. Geol. Survey Prof. Paper 91, pp. 169–170, 1916.

probability some of the identifications are erroneous. I would be the last to insist that the twigs or staminate aments preserved as impressions afford conclusive evidence of the presence in Miocene Idaho of a species of this genus, whose existing representative is so restricted at the present time.[18] At the same time the ecologic redwood-association method of Chaney does not, it seems to me, afford any logical basis for questioning the former presence of *Glyptostrobus* in North America, especially as so many Cenozoic trees of western North America from Eocene to Pliocene show such unmistakable relationships with Chinese survivors.

Occurrence: 11 miles east of Lewiston on north bank of Clearwater River, Nez Perce County; 3.8 miles east of Whitebird, Idaho County.

Genus SEQUOIA Endlicher

Sequoia langsdorfii (Brongniart) Heer

Sequoia langsdorfii Knowlton, U.S. Geol. Survey Prof. Paper 140, p. 26, pl. 9, figs. 3–6, 1926.
Berry, U.S. Geol. Survey Prof. Paper 154, p. 237, 1929.
Chaney, Carnegie Inst. Washington Pub. 346, p. 102, 1927.
Dorf, Carnegie Inst. Washington Pub. 412, p. 73, pl. 6, figs. 5, 6, 1930.
Sequoia angustifolia Lesquereux, U.S. Geol. Survey Terr. Rept. vol. 7, p. 77, pl. 7, figs. 6–10, 1878.

This species is exceedingly common in the Idaho Miocene, where it is represented by quantities of characteristic leafy twigs. The twigs have been fully illustrated by Knowlton in the paper cited above. It is a common form, somewhat variable, and likely to be confused with *Taxodium dubium*.

It is a very wide ranging Tertiary form, probably not always correctly identified. It seems that the form from Elko, Nev., which Lesquereux made the type of *Sequoia angustifolia*, is the same as these other western Miocene occurrences. Dorf records it from the Pliocene of California and states that these specimens are indistinguishable from the modern redwood.

Occurrence: 11 miles east of Lewiston on north bank of Clearwater River, Nez Perce County; half a mile northeast, 1 mile east, and 1.1 miles east of Arrow Junction, Nez Perce County; 5 miles south of Juliaetta, Nez Perce County; 1 mile east and 3.8 miles east of Whitebird, Idaho County; Edwards ranch, Stanley Hill, Coeur d'Alene, Kootenai County.

Genus LIBOCEDRUS Endlicher

Libocedrus praedecurrens Knowlton

Libocedrus praedecurrens Knowlton, U.S. Geol. Survey Prof. Paper 140, p. 28, pl. 8, fig. 8, 1926.
Berry, U.S. Geol. Survey Prof. Paper 154, p. 237, 1929.

This species is rather common in the Latah around Spokane, and some excellent specimens have come to light since my revision of the Latah flora was published in 1929. It is present also at Grand Coulee, in Grant County, Wash. Specifically unnamed *Libocedrus* is recorded by Chaney from the Mascall formation in Oregon, from the Payette formation in Idaho, and from Trout Creek, Oreg. A *Libocedrus*, either this species or the modern Pacific *L. decurrens* Torrey, is recorded by Dorf [19] from the Pliocene of California.

Mason [20] has recently referred the material from the Mascall formation to the modern species, which it may represent, but this is uncertain, and such a method is apt to lead to false conclusions.

Occurrence: 3.8 miles east of Whitebird, Idaho County.

Family ABIETINEACEAE

Genus PINUS Linné

Pinus monticolensis Berry

Pinus monticolensis Berry, U.S. Geol. Survey Prof. Paper 154, p. 238, pl. 49, figs. 5, 8, 1929.

The present species was described as follows from several specimens found in the Latah formation at Republic and Spokane, Wash.:

> Whole fruit of medium size, ranging in length from 17 to 26 millimeters and in maximum width from 4 to 9 millimeters. The inner margin is nearly straight, with the seed at the base. The seed is about twice as long as it is wide and but moderately elevated. The tip of the wing may be almost evenly rounded, as in the narrower specimen figured, or it may be subtruncate, as in the wider specimen figured. The outer wing margin may be but slightly rounded and subparallel with the inner margin, or it may flare at the top and narrow downward, in all specimens forming an outer margin nearly or quite to the base of the seed.

These seeds are very close to those of the existing western white or silver pine, *Pinus monticola* Douglas, which has a wide range on a variety of soils in the mountains west of the Continental Divide, from southern British Columbia and northern Montana to Washington, Oregon, and California. Toward its northern limits it is most common and largest in moist valleys. In Idaho it reaches its greatest development on gentle north slopes and flats. They are also comparable to the seeds of *Pinus ponderosa* Lawson, the widespread western yellow pine.

Occurrence: 3.8 miles east of Whitebird, Idaho County.

Pinus, needle

A single needle of Pinus, obviously not specifically determinable, is associated with *Libocedrus* twigs and leaves of *Quercus simulata* at the locality cited.

Occurrence: Sec. 5, T. 11 N., R. 6 W., north of Weiser, Washington County.

[18] Henry, A., and McIntyre, M., The swamp cypresses, *Glyptostrobus* of China and *Taxodium* of America, with notes on allied genera: Roy. Irish Acad. Proc. vol. B13, pp. 90–116, 1926.

[19] Dorf, Erling, Pliocene floras of California: Carnegie Inst. Washington Pub. 412, p. 74, 1930.

[20] Mason, H. L., Fossil records of some west American conifers: Carnegie Inst. Washington Pub. 346, p. 155, 1927.

Phylum SPERMATOPHYTA

Class ANGIOSPERMAE

Subclass MONOCOTYLEDONAE

Order PANDANALES

Family TYPHACEAE

Genus TYPHA Linné

Typha lesquereuxi Cockerell

Typha lesquereuxi Cockerell, Torrey Bot. Club Bull., vol. 33, p. 307, 1906; Am. Mus. Nat. Hist. Bull., vol. 24, p. 79, pl. 10, fig. 46, 1908.
Knowlton, U.S. Nat. Mus. Proc., vol. 51, p. 251, 1916.
Berry, idem, vol. 72, art. 23, p. 6, figs. 13–15, 1927.
Chaney, Carnegie Inst. Washington Pub. 346, p. 107, 1927.
Typha latissima lesquereux, U.S. Geol. Survey Terr. Rept., vol. 8, p. 141, pl. 23, figs. 4, 4a, 1883. [Not Al. Braun.]
Spathyema? nevadensis Knowlton, U.S. Geol. Survey 21st Ann. Rept., pt. 2, p. 211, pl. 30, figs. 17, 18, 1900.
Typha? sp. Knowlton, U.S. Geol. Survey Prof. Paper 140, p. 28, pl. 9, fig. 11, 1926.
Berry, U.S. Geol. Survey Prof. Paper 154, p. 239, 1929.

Fragments of linear monocotyledonous leaves similar to the small fragment from Spokane which Knowlton tentatively referred to the genus *Typha* are common in the recent collections from both Washington and Idaho. It is found also in the Miocene of Wyoming, Colorado, Nevada, and Oregon.

Occurrence: 1½ miles north of Arrow Junction, Nez Perce County; about 15 miles north of Weiser, Washington County.

Order NAIADALES

Family NAIADACEAE

Genus POTAMOGETON Linné

Potamogeton heterophylloides Berry

Potamogeton heterophylloides Berry, U.S. Geol. Survey Prof. Paper 154, p. 240, pl. 50, figs. 1–3, 1929.
Potamogeton sp., Knowlton, U.S. Geol. Survey Prof. Paper 140, p. 29, pl. 10, figs. 5, 6, 1926.

The fragment which Knowlton described from the Latah formation was subsequently found to represent a common species in these beds around Spokane. The leaves vary considerably in size, ranging from 3 to 8 centimeters in length. The tip, absent in the type, is abruptly narrowed to a point.

It resembles the existing *Potamogeton heterophyllus* Schreber, which is found nearly all over North America as well as in Europe. Our eastern *P. nuttalli* Chamisso and Schlechtendal has submerged leaves even more like the fossil. The species is sparingly represented in Idaho.

Occurrence: 11 miles east of Lewiston on north bank of Clearwater River, Nez Perce County.

Order LILIALES

Family SMILACEAE

Genus SMILAX Linné

Smilax lamarensis Knowlton

Plate 19, figure 7

Smilax lamarensis Knowlton, U.S. Geol. Survey Mon. 32, pt. 2, p. 685, pl. 121, figs. 3, 4, 1899.
Berry, U.S. Geol. Survey Prof. Paper 154, p. 240, 1929.

This species was described from the so-called "Miocene" of Yellowstone Park and was compared with the existing *Smilax rotundifolia* Linné and *S. pseudochina* Linné. It might equally be compared with *S. hispida* Muhlenberg, *S. walteri* Pursh, or others, but such comparisons have but slight ecologic or geographic significance. The single specimen from Idaho is as large as the maximum forms from Yellowstone Park, being 14.5 centimeters long and 8.75 centimeters in maximum width in the lower part. The outline is ovate, the apex being acute and the base broadly rounded or slightly cordate and conspicuously decurrent. There are three principal acrodrome primaries from the extreme base; outside of these are thinner acrodrome primaries; and if the base is unusually wide, as in the Idaho material, there may be a still thinner vein from the base on one or both sides which is confined to the basal part of the leaf. The species is a handsome one, and the only difference from the type is its thinner texture, if indeed the type was really of firm texture as described. This thinness is indicated by the way the primaries stand out, by the deformed lamina, and by the thin secondaries. A single small leaf of this species was found in the Latah formation at Spokane, Wash.

Smilax has been recorded from the upper Miocene at Florissant, Colo., from the Eagle Creek formation of Oregon, and from the Mascall formation of Oregon. The species at Florissant is *Smilax labidurommae* Cockerell,[21] a considerably smaller deltoid form with a truncate base. The Eagle Creek species, *S. magna* Chaney,[22] is not very different from the Idaho form. The Mascall species is *S. wardii* Lesquereux,[23] an elongated hastate-sagittate leaf, very different from the present species.

This genus, with well-defined characters, goes back certainly as far as the early Eocene and probably to

[21] Cockerell, T. D. A., Two new plants from the Tertiary rocks of the West: Torreya, vol. 14, p. 135, text fig. 1, 1914.

[22] Chaney, R. W., The flora of the Eagle Creek formation: Walker Mus. Contr., vol. 2, no. 5, p. 161, pl. 6, fig. 1, 1920.

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

the later Cretaceous. The existing species number about 200 and are widely distributed, chiefly in moist environments, most abundantly in tropical America and Asia. There are about 20 species in temperate North America, several extending as far northward as southern Canada.

Occurrence: 3.8 miles east of Whitebird, Idaho County.

Subclass DICOTYLEDONAE

Order SALICALES

Genus POPULUS Linné

Populus lesquereuxi Cockerell

Populus heeri Lesquereux, U.S. Geol. Survey Terr. Rept., vol. 8, p. 151, pl. 30, figs. 1–8; pl. 31, fig. 11, 1883. [Not Saporta.]

Populus lesquereuxi Cockerell, Torrey Bot. Club Bull., vol. 33, p. 307, 1906; Colorado Univ. Studies, vol. 3, p. 172, 1906; Am. Naturalist, vol. 44, p. 44, fig. 8, 1910.

Knowlton, U.S. Nat. Mus. Proc., vol. 51, p. 261, 1916.

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; U.S. Geol. Survey Prof. Paper 170, p. 35, 1931.

Kirkham and Johnson, Jour. Geology, vol. 37, p. 498, 1929.

The Latah species named *Salix inquirenda* by Knowlton is represented at Grand Coulee, Wash., and in Idaho and appears to me to be identical with the common Florissant form which Lesquereux determined as *Populus heeri* Saporta but which Cockerell has shown to be different from that European species. The extremely long and stout petiole, which is preserved in much of the present material, is also confirmatory of the reference to *Populus* instead of to *Salix*, which never has such long petioles.

Occurrence: 1 mile east of Whitebird, Idaho County; 5 miles south of Juliaetta, Nez Perce County.

Populus lindgreni Knowlton

Populus lindgreni Knowlton, U.S. Geol. Survey 18th Ann. Rept., pt. 3, p. 725, pl. 100, fig. 3, 1898; U.S. Geol. Survey Bull. 204, p. 29, pl. 2, fig. 1, 1902; U.S. Geol. Survey Prof. Paper 140, p. 31, pl. 14, figs. 4–7, 1926.

Berry, U.S. Geol. Survey Prof. Paper 154, p. 243, 1929.

This species, described originally from the Payette formation of Idaho, was subsequently recorded from the Mascall and Latah formations. Chaney has reported it recently from the Blue Mountains, Oreg., and Ellensburg, Wash.

It is present in all sizes and is one of the commonest species in the Latah deposits around Spokane, Wash., and at the Idaho localities studied by Kirkham. Moreover, it is one of those forms with a well-marked individuality, making it easy to recognize, and appears to be a true *Populus*, which does not seem to be the case with many of the western Cenozoic species that have been referred to that genus.

Occurrence: 1 mile and 3.8 miles east of Whitebird, Idaho County; 1 mile and 1.1 miles east and half a mile northeast of Arrow Junction, Nez Perce County; 5 miles south of Juliaetta, Nez Perce County; Edwards ranch, Stanley Hill, Coeur d'Alene, Kootenai County.

Populus eotremuloides Knowlton

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.

This somewhat inchoate form was described by Knowlton from the Payette formation at Marsh, Idaho, and as its name indicates was compared with the living *Populus tremuloides* Michaux. The fossil species lacks pronounced individuality, and I am not at all certain that it is a *Populus*.

Occurrence: 1½ miles north of Arrow Junction and T. 36 N., R. 3 W., Nez Perce County.

Populus sp.

Undeterminable fragmentary leaves or what appear to be *Populus*, possibly belonging to one or the other of the associated named species, are present at three localities.

Occurrence: About 10½ and 11 miles east of Lewiston, Nez Perce County; 3 miles east of Whitebird, Idaho County.

Populus, bud scales

Characteristic bud scales of *Populus* are not uncommon in the present collection, as well as in the Latah around Spokane [24] and at Grand Coulee. They are truncate at the base, acute at the tip, 1.25 to 2 centimeters long, longitudinally veined, and of considerable thickness. They are involute, as shown by the splitting of specimens that have been flattened during fossilization. They are in every way comparable with the large and more or less resinous outer winter bud scales of the existing species and presumably belong to one of the species represented by leaves.

Occurrence: Southeast of Moscow, Latah County.

Genus SALIX Linné

Salix knowltoni Berry

Myrica lanceolata Knowlton, U.S. Geol. Survey 18th Ann. Rept., pt. 3, p. 724, pl. 99, figs. 5, 6, 1898.

Kirkham and Johnson, Jour. Geology vol. 37, p. 497, 1929.

Salix knowltoni Berry, U.S. Nat. Mus. Proc., vol. 72, art. 23, p. 9, pl. 2, fig. 1, 1927.

This species, wrongly referred to *Myrica*, was described by Knowlton from the Payette formation at Shafer Creek, Boise County, Idaho, and it has also been recorded under its proper designation from the Esmeralda formation of Mineral County, Nev. The type material was very incomplete but showed no features of the genus *Myrica*. The material from the Esmeralda formation, although not rare, was also exceedingly fragmentary. The present material adds

[24] Berry, E. W., A revision of the flora of the Latah formation: U. S. Geol. Survey Prof. Paper 154, p. 243, pl. 50, fig. 4; pl. 63, fig. 8, 1929.

little if anything to our ideas of this inadequately known species.

Occurrence: 11 miles east of Lewiston on north bank of Clearwater River, Nez Perce County.

Salix florissanti Knowlton and Cockerell

Salix florissanti Knowlton and Cockerell, U.S. Geol. Survey Bull. 696, p. 566, 1919.
Berry, U.S. Geol. Survey Prof. Paper 154, p. 242, pl. 64, fig. 16, 1929.
Salix amygdalaefolia Lesquereux, U.S. Geol. Survey Terr. Rept., vol. 8, p. 156, pl. 31, figs. 1, 2, 1883.
Knowlton, U.S. Geol. Survey Bull. 204, p. 30, 1902.
Lesquereux, U.S. Nat. Mus. Proc., vol. 11, p. 17, 1888.
Cockerell, Am. Mus. Nat. Hist. Bull., vol. 24, p. 82, 1908.
Salix bryani Knowlton, U.S. Geol. Survey Prof. Paper 140, p. 33, pl. 12, fig. 6, 1926.

This typical small, toothed willow leaf occurs in the Latah of Washington, in the Mascall of Oregon, and at Florissant, Colo.

Occurrence: Southeast of Moscow, Latah County: 11 miles east of Lewiston on north bank of Clearwater River, Nez Perce County.

Order FAGALES

Family BETULACEAE

Genus OSTRYA Scopoli

Ostrya oregoniana Chaney

Ostrya oregoniana Chaney, Carnegie Inst. Washington Pub. 346, p. 106, pl. 9, fig. 12; pl. 10, figs. 1–4, 1927.

This species was based upon both leaves and fruits from the Crooked River Basin, 11 miles east of Post, Oreg. I have been unable to recognize certainly the leaves in the Idaho collections, but there are several characteristic examples of the involucres of the fruits.

The foregoing are the only fossil occurrences of the genus known from rocks of pre-Pleistocene age in North America, although it has been recorded from several localities in the Tertiary of Europe. Four existing species are recognized—one of the mesophytic hardwood forest in southeastern North America; another of very local occurrence in the canyon of the Colorado in Arizona at altitudes between 6,000 and 7,000 feet; a third in southern Europe and southwestern Asia; and the fourth in northern Japan.

Occurrence: 3.8 miles east of Whitebird, Idaho County.

Genus BETULA Linné

Betula fairi Knowlton

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, op. cit., p. 34, pl. 18, fig. 2.

I cannot see any adequate features distinguishing the forms that Knowlton referred to the two species cited above; in fact, I suspect that both represent merely small leaves of the associated and more abundant *Betula heteromorpha* Knowlton.

Occurrence: 1 mile and 1.1 miles east of Arrow Junction, Nez Perce County.

Betula largei Knowlton

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. 12, 1929.
Kirkham, Jour. Geology, vol. 38, p. 662, 1930.

This species was described by Knowlton from the Latah formation of Washington and queried because he thought it might be an *Alnus* or *Corylus*. It is, however, a *Betula* and very similar to the existing *B. luminifera* Winkler, of central China, which it resembles much more closely than it does any existing North American birches.

Occurrence: 11 miles east of Lewiston on north bank of Clearwater River, Nez Perce County; near St. Maries, Kootenai County.

Betula heteromorpha Knowlton

Betula heteromorpha Knowlton, U.S. Geol. Survey Bull. 204, p. 39, pl. 3, figs. 6, 7; pl. 5, fig. 1, 1902; U.S. Geol. Survey Prof. Paper 140; p. 34, pl. 17, figs. 5, 6, 1926.
Chaney, Walker Mus. Contr., vol. 2, no. 5, p. 165, 1920.
Berry, U.S. Geol. Survey Prof. Paper 154, p. 243, 1929.
Betula bryani Knowlton, U.S. Geol. Survey Prof. Paper 140, p. 34, pl. 18, fig. 1, 1926.
Kirkham and Johnson, Jour. Geology, vol. 37, p. 496, 1929.
Betula thor Knowlton, U.S. Geol. Survey Prof. Paper 140, p. 35, pl. 17, fig. 3, 1926.
Kirkham and Johnson, op. cit., p. 496.

This species, described originally from the upper part of the Clarno formation of the John Day Basin in Oregon, is very common in the Latah formation and occurs also in the Eagle Creek formation. The forms which Knowlton described as *Betula bryani* and *B. thor* are nothing but variants of *B. heteromorpha*, with which they are connected by insensible gradations. These leaves are separated with difficulty from those of some of the existing western species of *Alnus*. The variations of this Latah species of *Betula* can be matched among the leaves of the existing *B. occidentalis* Hooker, which it so closely resembles and which occurs along stream borders in rich soil through British Columbia, Washington, Idaho, and Montana.

Occurrence: 1 mile and 3.8 miles east of Whitebird, Idaho County; 1 mile and 1.1 miles east and half a mile northeast of Arrow Junction, Nez Perce County; near St. Maries, Kootenai County.

Family FAGACEAE

Genus FAGUS Linné

Fagus pacifica Chaney

Plate 19, figure 6; plate 20, figure 1

Fagus pacifica Chaney, Carnegie Inst. Washington Pub. 346, p. 108, pl. 10, figs. 6–9, 1927.

This species was based on characteristic leaves and fruit from Miocene beds in the Crooked River Basin, Oregon. Leaves identical with those from Oregon, mostly but not always larger in size, are not uncommon in Idaho.

Occurrence: Southeast of Moscow, Latah County; 10½ miles east of Lewiston, Nez Perce County; 3.8 miles east of Whitebird, Idaho County.

Genus FAGOPSIS Hollick

Fagopsis longifolia (Lesquereux) Hollick

Fagopsis longifolia Hollick, Torreya, vol. 9, p. 2, text figs. 1, 2, 1909.
Knowlton, U.S. Nat. Mus. Proc., vol. 51, p. 265, pl. 20, fig. 5, 1916.
Chaney, Am. Jour. Sci., 5th ser., vol. 2, p. 90, 1921.
Planera longifolia Lesquereux, U.S. Geol. and Geog. Survey Terr. Ann. Rept. for 1872, p. 371, 1873; U.S. Geol. Survey Terr. Rept., vol. 7, p. 189, pl. 27, figs. 4–6, 1878.
Newberry, U.S. Geol. Survey Mon. 35, p. 81, pl. 58, fig. 3, 1898.
Penhallow, Roy. Soc. Canada Trans., 2d ser., vol. 8, p. 70, 1902; Report on Tertiary plants of British Columbia, p. 73, 1908.
Knowlton, U.S. Geol. Survey Mon. 32, pt. 2, p. 712, 1899.
Quercus semielliptica Goeppert. Lesquereux, U.S. Geol. and Geog. Survey Terr. Ann. Rept. for 1871, p. 286, 1872.
Fagus longifolia (Lesquereux) Hollick and Cockerell, Am. Mus. Nat. Hist. Bull., vol. 24, p. 88 (footnote), 1908.
Zelkowa longifolia (Lesquereux) Engler, in Engler and Prantl, Naturlichen Pflanzenfamilien, Teil 3, Abt. 1, p. 65, 1888.
Myrica oregoniana Knowlton, U.S. Geol. Survey Bull. 204, p. 33, pl. 3, fig. 4, 1902.
Chaney, Walker Mus. Contr., vol. 2, no. 5, p. 163, 1920.

The finding of attached fruits by Hollick in 1909 conclusively showed these leaves to be referable to the Fagaceae, and it is difficult to see any reason for not referring them directly to the modern genus *Fagus*. Not having examined the fruits personally, I have retained Hollick's genus *Fagopsis* for the present.

The species is represented in the Latah formation by small leaves, which depart from the type merely in having the base somewhat more oblique than in most of the Florissant leaves. To the same species belongs the form from the Mascall formation referred by Knowlton to the genus *Myrica*.

The species as now conceived is an abundant and widely ranging Miocene type in western North America, occurring in British Columbia; at Elko station, Nev.; in the Yellowstone Park; in the Mascall formation of Oregon; in the Puente formation of California; and in the Eagle Creek formation of Oregon.

The Washington and Idaho forms are similar to *Ulmus brownelli* Lesquereux but are relatively shorter and wider, with less ascending secondaries and lacking the acuminate tip.

Occurrence: About 15 miles north of Weiser, Washington County.

Genus CASTANEA Adanson

Castanea castaneaefolia (Unger) Knowlton

Castanea ungeri Heer. Lesquereux, U.S. Geol. Survey Terr. Rept., vol. 8, p. 246, pl. 52, figs. 1, 3–7, 1883.
Knowlton, in Lindgren, Jour. Geology, vol 4, p. 890, 1896; U.S. Nat. Mus. Proc., vol. 17, p. 219, 1894; Geol, Soc. America Bull., vol. 5, p. 581, 1893.
Castanea pulchella Knowlton, U.S. Geol. Survey Mon. 32, pt. 2, p. 702, pl. 86, figs. 6–8; pl. 87, figs. 1–3, 1899.
Dryophyllum longipetiolatum Knowlton, U.S. Geol. Survey Mon. 32, pt. 2, p. 710, pl. 88, figs. 6, 7, 1899.
Castanea castaneaefolia (Unger) Knowlton, U.S. Geol. Survey Bull. 152, p. 60, 1898; U.S. Geol. Survey Prof. Paper 140, p. 35, pl. 18, figs. 7, 8; pl. 19, fig. 1, 1926.
Berry, U.S. Geol. Survey Prof. Paper 154, p. 245, 1929.

Although the name of this species goes back to the European *Fagus castaneaefolia* of Unger, I am not prepared to admit the identity of the American form with that from the Old World. At the same time I do not think it necessary to take up a new specific name for the American Miocene species, especially as most European records are under Heer's name *Castanea ungeri*. Until a comparison of actual material from both hemispheres has been made the question cannot be settled, and perhaps not then. I am convinced, however, that, even if the leaves are not distinguishable, two different botanic species are represented.

The form that I have assigned to this species is widely distributed and not uncommon at several localities in Idaho. It ranges from small to very large leaves, and there is considerable variation in relative width, spacing of the veins, and character of the teeth. I am quite sure that but a single species is represented in this material.

As I conceive the species it is present in the Miocene of California, Oregon, Washington, Idaho, and Yellowstone Park and possibly occurs in western Canada, from which it has been recorded by Penhallow.[25] *Castanea pulchella* Knowlton and *Dryophyllum longipetiolatum* Knowlton from the Miocene of Yellowstone Park were differentiated from one another and from *C. castaneaefolia* (Unger) Knowlton on such variable features as the length of the petiole, the spacing of the secondaries, and the degree of extension of the marginal teeth, all characters which have no specific value. It is possible to select specimens of the leaves of any of the existing species of *Castanea* that will show wider limits of variation of these features. Moreover, in all the fossil occurrences that I have referred to *C. castaneaefolia* where there is an abundance of material the same variations are encountered. Several hundred *Castanea* leaves have been collected in the plant beds of Fossil Forest Ridge, in Yellowstone Park, which in my opinion is just the situation where all sizes and variants of a single botanic species should be found. Moreover, it is highly improbable that there should be several species of the same genus living at the same time in a region and occupying the same environmental niche, and even if this is conceivable it is hardly probable that the species would be distinguishable by the leaves.

Occurrence: 1 mile and 2½ miles east of Whitebird, Idaho County; secs. 12 and 13, T. 10 N., R. 3 W., and Linson Valley, Washington County; T. 36 N., R. 4 W., Nez Perce County; near St. Maries, Kootenai County.

[25] Penhallow, D. P., Notes on Cretaceous and Tertiary plants of Canada: Roy. Soc. Canada Trans., 2d ser., vol. 8, p. 69, 1902; Report on Tertiary plants of British Columbia: Canada Geol. Survey Rept. 1013, p. 43, 1908.

Genus QUERCUS Linné

Quercus cognata Knowlton

Quercus cognatus Knowlton, U.S. Geol. Survey Prof Paper 140, p. 36, pl. 20, figs. 1–4; pl. 21, figs. 1, 2, 1926.

The form of oak to which Knowlton gave this name is one of the commonest types in the Latah formation of Washington and more rare in Idaho. As Knowlton has pointed out, it approaches very closely *Q. pseudolyrata* Lesquereux,[26] of the Mascall formation of Oregon, and *Q. merriami* Knowlton,[27] of the Mascall and Latah formations.

I can see no valid reason for discriminating *Q. cognata* and *Q. merriami*, and both *Q. payettensis* Knowlton [28] and *Q. rusti* Knowlton [29] are, I believe, variants of the same botanic species. The leaves of the lobate species of oaks are always variable, and this series of Miocene forms differ in relative width, number of lobes, and extent to which the lobes are incised or extended. It is also highly improbable that there should have been as many species of *Quercus* in the western Miocene as the literature indicates.

Occurrence: 1 mile east of Whitebird, Idaho County; 5 miles south of Juliaetta, Nez Perce County.

Quercus duriuscula Knowlton

Quercus duriuscula Knowlton, U.S. Geol. Survey Bull. 204, p. 50, pl. 8, fig. 2, 1902.

This species was described by Knowlton from the Mascall formation of Oregon and was based on insufficient material.

Similar material was found at a single locality in Idaho.

Occurrence: Southeast of Moscow, Latah County.

Quercus idahoensis Knowlton

Quercus idahoensis Knowlton, U.S. Geol. Survey 18th Ann. Rept., pt. 3, p. 729, pl. 102, fig. 4, 1898.

Quercus horniana Kirkham and Johnson, Jour. Geology, vol 37, p. 497, 1929.

This species was described by Knowlton from the Payette formation at Marsh, Boise County, Idaho. In my study of the Kirkham collection, specimens from one locality were compared with *Quercus horniana* Lesquereux, but I subsequently decided that they were closer to *Q. idahoensis*, although I am not at all sure that the two can be maintained as distinct species.

Some of the forms from Grand Coulee, Wash., which I have considered to be variants of *Q. mccanni* [30] are also very similar and perhaps identical.

Occurrence: Southeast of Moscow, Latah County; 11 miles east of Lewiston on north bank of Clearwater River, Nez Perce County.

Quercus payettensis Knowlton

Plate 20, figures 2, 3

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, 129.

This species was described by Knowlton from the Payette formation at Jackass Creek, Boise County, Idaho, and occurs also in the Latah formation of Washington.

It is quite obvious to any student of our western Miocene oaks that too many species have been recognized, especially in cases like the present, where the species was founded on such meager material that the natural variation could not be taken into consideration. I believe that *Quercus payettensis* probably belongs to the same botanic species as the form that has been called *Q. cognata*, but feel that it would be unwise to make changes until someone undertakes a critical revision of all the Miocene species of *Quercus* of western North America.

Quercus payettensis resembles the leaves of *Q. duraznillo pinetorum* Trelease, a small tree found at altitudes of about 6,500 feet in the Mexican State of Sonora.

Occurrence: 11 miles east of Lewiston on north bank of Clearwater River, Nez Perce County; 5 miles south of Juliaetta, Nez Perce County; 1 mile east of Whitebird, Idaho County; Edwards ranch, Stanley Hill, Coeur d'Alene, Kootenai County.

Quercus simulata Knowlton

Plate 20, figure 6

Quercus simulata Knowlton, U.S. Geol. Survey 18th Ann. Rept., pt. 3, p. 728, pl. 101, figs. 3, 4, pl. 102, figs. 1, 2, 1898; U.S. Geol. Survey Prof. Paper 140, p. 38, pl. 22, figs. 3, 4, 1926.
Chaney, Walker Mus. Contr., vol. 2, no. 5, p. 168, pl. 12, fig. 1, 1920.
Berry, U.S. Geol. Survey Prof. Paper 154, p. 246, pl. 51, figs. 6, 7, 9–11, 1929; U.S. Geol. Survey Prof. Paper 170, p. 36, 1931.

Salix elongata Knowlton, U.S. Geol. Survey Prof. Paper 140, p. 32, pl. 12, fig. 4, 1926. [Not O. Weber.]

Quercus chaneyi Knowlton, idem, p. 38, pl. 22, fig. 1.

Quercus praenigra Knowlton, idem, p. 37, pl. 19, fig. 6. Kirkham and Johnson, Jour. Geology, vol. 37, p. 497, 1929.

This species was described by Knowlton from the Payette formation of Idaho and was identified by the same author from the Latah formation and by Chaney from the Eagle Creek formation. I have recently detected it in the Esmeralda formation of Nevada.

It is exceedingly common and variable in both the Payette and Latah formations. At Grand Coulee, Wash., it is probably the most abundant species, and here again it shows its characteristic great variability, both in form and in size. It ranges from narrowly to broadly lanceolate, with entire or sparingly toothed margins, either acuminate or bluntly tipped, and with the base ranging from rounded to narrowly cuneate. Formerly I suggested comparisons with the existing

[26] Lesquereux, Leo, Report on the fossil plants of the auriferous gravel deposits of the Sierra Nevada: Harvard Coll. Mus. Comp. Zoology Bull., vol. 6, no. 2, p. 8, pl. 2, figs. 1, 2, 1878.

[27] Knowlton, F. H., Fossil flora of the John Day Basin, Oreg.: U.S. Geol. Survey Bull. 204, p. 49, pl. 6, figs. 6, 7; pl. 7, figs. 4, 5, 1902.

[28] Knowlton, F. H., The fossil plants of the Payette formation: U.S. Geol. Survey 18th Ann. Rept., pt. 3. p. 730, pl. 102, fig. 9, 1898.

[29] Knowlton, F. H., Flora of the Latah formation of Spokane, Wash., and Coeur d'Alene, Idaho: U.S. Geol. Survey Prof. Paper 140, p. 36, pl. 21, figs. 3, 4, 1926.

[30] Berry, E. W., U.S. Geol. Survey Prof. Paper 170, p. 36, pl. 11, figs. 5-7, 1932.

Quercus hypoleuca Engelmann of the West or *Q. phellos* Linné of the East.

I have subsequently had occasion to compare this and our other western Miocene oaks with the existing species of Mexico and Central America, with the result that I find a great similarity between *Quercus simulata* and a group of Mexican species, many of them shrubs or small trees, largely described in recent years by Trelease. These are *Q. acapulcensis* Trelease, *Q. obscura* Trelease, *Q. transmontana* Trelease, *Q. vinimea* Trelease, and *Q. hypoleuca* Engelmann. All of these are forms of the western Sierra Madre. *Quercus mexicana* Humboldt and Bonpland is also similar to the fossil form. This is a species of the Mexican table-land and adjacent Cordillera. This resemblance between several of the oaks of the western Miocene and existing species of Mexico seems to be more than fortuitous, and I believe that it is of real significance.

Occurrence: Southeast of Moscow, Latah County; 11 miles east of Lewiston on north bank of Clearwater River, 1½ miles north of Arrow Junction, and 5 miles south of Juliaetta, Nez Perce County; 3.8 miles east of Whitebird, Idaho County.

Quercus spokanensis Knowlton var. gracilis Berry, n.var.

Plate 20, figures 4, 5

Several specimens of this form have been collected, all somewhat inequilateral and thus suggesting that they may represent leaflets. The long, stout, curved petiole is opposed to such an interpretation, however, and the resemblance to various fossil and living species of *Quercus* suggests their relationship with that genus. They may be described as follows: Leaves of medium size, oval or elliptical, widest at or below the middle, about equally tapering to both ends, the tip acute but not extended, and the base cuneate. Texture subcoriaceous. Margins fairly uniformly toothed except at the extreme base. Teeth somewhat variable in form, inequilateral dentate and almost large enough in the median region to merit the term lobes rather than teeth. Length 6.5 to 8 centimeters; maximum width 3.25 to 4 centimeters. Petiole stout, curved, preserved for a length of 1.5 centimeters in a minimum-sized leaf. Midvein stout, prominent. Secondaries of medium size, 9 to 12 pairs, diverging from the midvein at angles of about 45°, subparallel, uniformly spaced, relatively straight, and normally craspedodrome. Occasionally, as in one of the specimens figured, where the margin fails to develop a tooth the corresponding secondary may be camptodrome. Tertiaries mostly percurrent.

This form shows sufficient resemblance to *Quercus spokanensis* Knowlton,[31] of the Latah, to permit its description as a variety of that species. It is a smaller, less robust form, with more rounded teeth and more ascending, thinner secondaries. The two are doubtless related. It is not like any existing western species known to me but does resemble the smaller leaves of *Quercus resinosa* Liebmann, of the western Sierra Madre region of Mexico.

Occurrence: Locality 1, southeast of Montour, Gem County.

Quercus treleasii Berry

Quercus treleasii Berry, U.S. Geol. Survey Prof. Paper 154, p. 247, pl. 52, figs. 1–3, 1929; U.S. Geol. Survey Prof. Paper, 170, p. 37, 1931.

This species was described as follows:

Leaves of relatively small but variable size, ovate or subelliptical in outline, somewhat narrowed distad to the obtusely pointed tip. Base rounded. Margins entire. Texture coriaceous. Length ranging from 3.25 to 9 centimeters. Maximum width ranging from 1.5 to 3 centimeters. Petiole short and stout. Midvein stout and prominent. Secondaries stout, prominent; 5 to 7 pairs diverge from the midvein at wide angles, pursue rather angular courses, and are camptodrome in the marginal region. The areolation consists of stout nervilles in a fine mesh.

It is abundant in the Latah formation around Spokane and at Grand Coulee, Wash. Like some of the associated oaks, *Quercus treleasii* shows similarities to several existing Mexican species. These are *Q. repanda* Humboldt and Bonpland, a shrub of the Mexican table-land; *Q. chihuahuensis* Trelease and its varieties of the western Sierra Madre; and *Q. lecompteana* Trelease and *Q. oleoides* Chamisso and Schlechtendal, the first a shrub and the second a small tree, both found in the eastern Sierra Madre.

Occurrence: 3.8 miles east of Whitebird, Idaho County.

Quercus sp. Knowlton

Quercus cup Knowlton, U.S. Geol. Survey Prof. Paper 140, p. 39, pl. 21, fig. 10, 1926.
Berry, U.S. Geol. Survey Prof. Paper 154, p. 247, 1929.

Capsules and crushed acorns of oaks are not uncommon at several localities in Washington and Idaho. They obviously belong to some of the species based on leaves, but it is entirely impossible to determine which ones or whether all the fruits represent a single species.

Occurrence: 1 mile east of Whitebird, Idaho County; Edwards ranch, Stanley Hill, Coeur d'Alene, Kootenai County.

Order URTICALES

Family ULMACEAE

Genus ULMUS Linné

Ulmus speciosa Newberry, U.S. Nat. Mus. Proc., vol. 5, p. 507, 1883; U.S. Geol. Survey Mon. 26, p. 80, pl. 45, figs. 3–4, 7 (not figs. 2, 5, 8), 1895 [1896].
Knowlton, U.S. Geol. Survey Bull. 204, p. 53, 1902; U.S. Geol. Survey Prof. Paper 140, p. 39, pl. 18, fig. 6, 1926.
Penhallow, Report on Tertiary plants of British Columbia, p. 94, 1908.
Chaney, Walker Mus. Contr., vol. 2, no. 5, p. 171, 1920.
Berry, U.S. Geol. Survey Prof. Paper 154, p. 247, 1929.

Knowlton in his preliminary account of the Latah flora regards the large leaves (Newberry's figs. 3 and

[31] Knowlton, F. H., Flora of the Latah formation: U.S. Geol. Survey Prof. Paper 40, p. 37, pl. 19, fig. 3, 1926.

4) as typical for this species. The smaller leaves described by Newberry are referred by Chaney to his Eagle Creek species, *Ulmus tanneri*. Newberry's figure 2 and *Quercus pseudoamericana* Lesquereux, which Knowlton united with *Ulmus speciosa*, differ from the others in the very highly developed dimorphic teeth and are here excluded from that species.

Only one specimen of *Ulmus speciosa* was contained in the collections from the Latah formation studied by Knowlton, but it is abundant in the recent collections and occurs in all sizes and also exhibits great variations in marginal characters. Dentate and serrate teeth occur on the same leaf, and although there is a tendency for them to be simple they usually show some subordinate teeth, and individual specimens have such teeth well developed.

The type came from the upper part of the Clarno formation of Oregon, and it is doubtfully recorded from supposed Oligocene beds in British Columbia and occurs also in the Eagle Creek formation of Oregon. It is associated in the Latah with *Ulmus* fruits, which differ from any previously described.

Occurrence: Half a mile northeast and 1.1 miles east of Arrow Junction, Nez Perce County; about 4 miles southeast of Whitebird, Idaho County; sec. 13, T. 10 N., R. 3 W., and Linson Valley, Washington County.

Ulmus brownelli Lesquereux

Ulmus brownelli Lesquereux U.S. Geol. Survey Terr. Rept., vol. 8, p. 160, pl. 28, figs. 2, 4, 1883.
Chaney, Carnegie Inst. Washington Pub. 345, p. 113, pl. 12, figs. 3, 6–8, pl. 13, figs. 1, 3, 4, 6, 1927.
Dorf, Carnegie Inst. Washington Pub. 412, p. 92, pl. 10, figs. 1–3, 10, 1930.
Myrica callicomaefolia Lesquereux, op. cit., p. 146, pl. 26, figs. 5–14.
Rhus? *drymeja* Lesquereux, U.S. Geol. and Geog. Survey Terr. Ann. Rept. for 1873, p. 416, 1874.
Ulmus hilliae Lesquereux, U.S. Geol. Survey Terr. Rept., vol. 8, p. 160, pl. 28, figs. 1, 3, 1883.
Cockerell, Am. Naturalist, vol. 44, p. 40, fig. 5, 1910.
Callicoma microphylla Lesquereux, U.S. Geol. Survey Terr. Rept., vol. 7, p. 246, pl. 43, figs. 2–4, 1878.
Myrica drymeja Cockerell, op. cit., p. 42, fig. 6.
Myrica oregoniana Knowlton, U.S. Geol. Survey Bull. 204, p. 33, pl. 3, fig. 4, 1902.

Opinions as to the precise limits of this species differ, and Chaney would exclude some of the synonyms cited above. As remarked under the discussion of *Fagopsis longifolia*, it is possible that the two have been confused.

Ulmus brownelli is said to be especially characterized by its small size, simply serrate margin, and asymmetric base. Chaney refers certain fruits from the Crooked River Basin in Oregon to this species and emphasizes the resemblance of both leaves and fruit to those of the living *U. parvifolia* Jacquin, of northern China and Japan.

As at present conceived *Ulmus brownelli* is known from Florissant, Colo. (the type locality); White River, Wyo.; Elko, Nev.; Crooked River and John Day Basin, Oreg.; and Pliocene at Lafayette Dam, Calif.

Occurrence: 5 miles south of Juliaetta, Nez Perce County.

Family MORACEAE

Genus FICUS LINNÉ

Ficus? washingtonensis Knowlton, emended

Ficus? washingtonensis Knowlton, U.S. Geol. Survey Prof. Paper 140, p. 40, pl. 25; pl. 26, figs. 1–3, 1926.
Berry, U.S. Geol. Survey Prof. Paper 154, p. 248, 1929; U.S. Geol. Survey Prof. Paper 170, p. 37, 1931.

This species as described by Knowlton from the Latah formation was based on a small amount of material. Since then a large number of specimens of all sizes and showing a considerable range of variation have been collected. *Ficus* is, or at least seems, rather anomalous in the present floral association, but extended search has failed to disclose a generic substitute.

Occurrence: Cove locality 2, about 8 miles east of Weiser, Washington County; Edwards ranch, Stanley Hill, Coeur d'Alene, Kootenai County.

Order PLATANALES

Family PLATANACEAE

Genus Platanus Linné

Platanus dissecta Lesquereux

Plate 21, figure 2

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.
Knowlton, in Smith, U.S. Geol. Survey Geol. Atlas, Ellensburg folio (no. 86), p. 3, 1903.
Berry, U.S. Geol. Survey Prof. Paper 154, p. 248, pl. 53, figs. 1, 2, pl. 61, 1929.
Acer trilobatum productum (Al. Braun) Heer. Lesquereux, U.S. Geol. Survey Terr. Rept., vol. 8, p. 253, pl. 59, fig. 3, 1883.

This species, described originally from the Miocene auriferous gravel of California, has subsequently been recorded from a number of localities in Washington, Oregon, Idaho, and Nevada. The leaves of *Platanus dissecta* Lesquereux did not differ appreciably from the leaves of the existing *P. racemosa* Nuttall, a large tree of the canyon bottoms and alluvial stream benches from Shasta County on the north to Lower California on the south and from the foothills of the southern Sierra Nevada to the coast. This Recent species has evidently retreated to streams with the progressive aridity of the region and must have undoubtedly enjoyed a less restricted range in its early history. It may be a descendant of the Miocene *Platanus dissecta*.

Occurrence: 2½ miles east of Whitebird, Idaho County; sec. 13, T. 10 N., R. 3 W., and Linson Valley, Washington County; sec. 17, T. 9 N., R. 2 W., Alkali Creek, Payette County; near St. Maries, Kootenai County.

Order RANALES

Family BERBERIDACEAE

Genus ODOSTEMON Rafinesque

Odostemon simplex (Newberry) Cockerell

Plate 23, figures 1, 2

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.
Knowlton, U.S. Geol. Survey Bull. 204, p. 56, 1902.
Odostemon simplex Cockerell, Am. Mus. Nat. Hist. Bull., vol. 24, p. 91, 1908.
Chaney, Carnegie Inst. Washington Pub. 346, p. 116, pl. 14, figs. 7–9, 11, 1927; Am. Jour. Sci., vol. 4, p. 216, 1922.
Odostemon florissantensis Cockerell, op. cit., p. 91.

This species was described by Newberry from the beds on Bridge Creek, in the John Day Basin in Oregon, and he correctly recognized its existing relatives. If the hair-splitting taxonomists are followed in reviving Rafinesque's genus for the western barberries, it belongs in *Odostemon*.

In 1908 Cockerell proposed a second species based upon material from Florissant, Colo., but as Chaney points out in recording this species from the Miocene beds of the Crooked River Basin in Oregon [32] the leaves show considerable variability, and the fancied differences upon which *Odostemon florissantensis* was erected disappear when more than one or two specimens are examined. I agree with Chaney that but a single species has been recognized in our western Miocene. It is not uncommon in the so-called Payette at one of the Idaho localities and was previously recorded by Chaney [33] from this region. A fossil species from the middle Eocene (Green River) has recently been described by Hollick.[34]

Several existing shrubby species are widely distributed in the coniferous forests from the Rocky Mountains to the Pacific coast, and one with smaller leaves occurs in the more arid parts of the Southwest.

Occurrence: Locality 1, north of Weiser, Washington County.

Family MENISPERMACEAE

Genus CEBATHA Forskal

Cebatha heteromorpha (Knowlton) Berry

Populus heteromorpha Knowlton, U.S. Geol. Survey Prof. Paper 140, p. 30, pl. 12, fig. 8–10; pl. 13, figs. 1–7; pl. 14, figs. 1–3; pl. 15, figs. 3–5, 1926.
Populus fairii Knowlton, idem, pl. 15, fig. 2, pl. 16, figs, 1–3. Kirkham and Johnson, Jour. Geology, vol. 37, p. 497, 1929.
Cebatha multiformis Hollick, New York Bot. Garden Mem., vol. 7, p. 406, pl. 38, figs. 1–6; pl. 39, figs. 1–3, 1927.
Cissampelos dubiosa Hollick, idem, p. 408, pl. 37, figs. 4, 5, (6, 7?); pl. 39, fig. 4.
Cebatha heteromorpha Berry, U.S. Geol. Survey Prof. Paper 170, p. 37, 1931.

This exceedingly variable species is the most abundant form in the Latah formation both around Spokane and at Grand Coulee. It occurs in all sizes and shapes and shows a corresponding range of variation in its marginal characters. These have been sufficiently illustrated in the large suite of specimens figured by Knowlton and Hollick. As Knowlton suspected, the forms called *fairi* are not distinct from the type, but every gradation is represented, and leaves with 3, 4, or 5 primaries are not distinctive. Every locality in the recent collections that contains one contains the other. Hollick, in describing the flora from the St. Eugene silt of British Columbia, recognized the botanic affinity of these leaves but refrained from including Knowlton's supposed *Populus* of the Latah formation with the British Columbia material, because he thought there was a great difference in age between the two outcrops. It has since been shown that the Latah is younger than Knowlton supposed it to be, and the evidence is fairly strong that the St. Eugene silt is much older than Hollick thought.[35] The older paleobotanists referred a great many fossil leaves to *Populus* which show no relationship to that genus. Knowlton in his account of *Populus heteromorpha* recognized that it was unlike any existing *Populus* but convinced himself that it was a *Populus* because it resembled *P. arctica* Heer, of the early Tertiary, which I have shown is also not a *Populus*.

Occurrence: 10½ miles east of Lewiston on north bank of Clearwater River, Nez Perce County, 1 mile and 1.1 miles east of, half a mile northeast of, and 1½ miles north of Arrow Junction, Nez Perce County; 5 miles south of Juliaetta, Nez Perce County; half a mile, 1 mile, and 3.8 miles east of Whitebird, Idaho County; near St. Marie , Kootenai County.

Family MAGNOLIACEAE

Genus MAGNOLIA Linné

Magnolia dayana Cockerell

Magnolia lanceolata Lesquereux, Harvard Coll. Mus. Comp. Zoology Mem., vol. 6, p. 24, pl. 6, fig. 4, 1878.
Knowlton, U.S. Geol. Survey Bull. 204, p. 58, 1900.
Magnolia dayana Cockerell, Am. Naturalist, vol. 44, p. 35, 1910.
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.

This species has been recorded previously from the Miocene of California, the upper part of the Clarno formation of Oregon, the Ellensburg and Latah of Washington, and the supposed Eocene of southwestern Oregon.

Occurrence: 1 mile east of Whitebird, Idaho County; 5 miles south of Juliaetta, Nez Perce County. Specifically undeter-

[32] Chaney, R. W., Geology and paleontology of the Crooked River Basin, with special reference to the Bridge Creek flora: Carnegie Inst. Washington Pub. 346, p. 117, 1927.

[33] Chaney, R. W., Notes on the flora of the Payette formation [Idaho and Oregon]: Am. Jour. Sci., 5th ser., vol. 4, p. 216, 1922.

[34] Hollick, Arthur, New species of fossil plants from the Tertiary shales near De Beque, Colo.: Torrey Bot. Club Bull., vol. 56, p. 95, pl. 2, fig. 2, 1929.

[35] Berry, E. W., The age of the St. Eugene silt in the Kootenay Valley, British Columbia: Roy. Soc. Canada Trans., 3d ser., vol. 23, sec. 4, pp. 47–48, 1929.

mined leaves of *Magnolia* which may represent this species occur half a mile northeast and 1 mile east of Arrow Junction, Nez Perce County.

Order ROSALES

Family ROSACEAE

Genus AMELANCHIER Medicus

Amelanchier scudderi Cockerell

Amelanchier scudderi Cockerell, Torrey Bot. Club Bull., vol. 33, p. 310, text fig. 4, 1906.
Berry, U.S. Geol. Survey Prof. Paper 154, p. 252, pl. 55, fig. 4, 1929.
Amelanchier grayi Chaney, Carnegie Inst. Pub. 346, p. 120, pl. 14, figs. 3–5, 1927.

This species was based on a single incomplete specimen from Florissant, Colo., so that whatever variation was present cannot be determined. The complete leaves in the Latah formation around Spokane are not exactly like the type but are so similar that I have no doubt that they represent the same botanic species. They are relatively slightly longer and narrower and consequently have more secondaries; the base is rounded like the tip, instead of being broadly cuneate, and the teeth are more numerous. The Latah leaves were described as follows:

> Leaves almost orbicular, widest in the middle and about equally rounded at the apex and base. Midvein straight and fairly stout. Secondaries thin, 7 or 8 pairs, mostly simple, regularly curved and subparallel, rarely forked, camptodrome. Areolation typical of the genus. Lower margins entire, upper two-thirds with regular teeth. Teeth with a broad crenatelike base and an ultimate apiculate serration. Each tooth receives a short tertiary veinlet.

More recently Chaney has described from the Miocene beds of the Crooked River Basin in Oregon what he considers to be a new species. It is my impression that this is the same species that is represented in the Latah and at Florissant. The two leaves which Chaney figures might be considered to represent the extremes of variation among his specimens, and these differ from one another quite as much as the Florissant specimen differs from the Latah specimen or as either differs from the Crooked River material.

This is distinctly an *Amelanchier* and not a *Malus*. It is close to the existing *A. alnifolia* Nuttall, from some of the leaves of which it is scarcely distinguishable. *A. alnifolia* is a tall shrub or small tree ranging from Alaska through the Coast Ranges to northern California and eastward to northern Michigan. It is found alike in moist valleys, meadows, and dry slopes but makes its best growth in the rich bottom lands of the lower Columbia River and the similar meadow lands around Puget Sound.

The genus is widely distributed throughout the North Temperate Zone. It is abundant at Florissant.

Occurrence: Southeast of Moscow, Latah County.

Family HAMAMELIDACEAE

Genus LIQUIDAMBAR Linné

Liquidambar californicum Lesquereux, emended

Liquidambar californicum Lesquereux, Harvard Coll. Mus. Comp. Zoology Mem., vol. 6, no. 2, p. 14, pl. 6, fig. 7c; pl. 7, figs. 3, 6, 1878.
Chaney, Walker Mus. Contr., vol. 2, no. 5, p. 174, 1920.
Berry, U.S. Geol. Survey Prof. Paper 154, p. 250, 1929.
Liquidambar europaeum Lesquereux, U.S. Geol. Survey Terr. Rept., vol. 8, p. 159, pl. 32, fig. 1, 1883.
Newberry, U.S. Geol. Survey Mon. 35, p. 100, pl. 47, figs. 1–3, 1898.
Knowlton, U.S. Geol. Survey Bull. 204, p. 62, 1902; U.S. Nat. Mus. Proc., vol. 17, p. 226, 1894; Geol. Soc. America Bull., vol. 5, p. 585, 1893.
Chaney, op. cit., p. 174.
Liquidambar protensum Lesquereux, U.S. Nat. Mus. Proc., vol. 11, p. 13, pl. 8, fig. 3, 1888.
Knowlton, U.S. Geol. Survey Bull. 204, p. 62, 1902.
Liquidambar sp. Knowlton, in Lindgren, Jour. Geology, vol. 4, p. 890, 1896.
Liquidambar europaeum patulum Knowlton, U.S. Geol. Survey Bull. 204, p. 62, pl. 10, fig. 5, 1902.
Liquidambar europaeum Al. Braun. Lesquereux, U.S. Nat. Mus. Proc., vol. 11, p. 14, 1888.
Liquidambar sp.? Knowlton, U.S. Geol. Survey Bull. 204, p. 63, pl. 12, fig. 4, 1902.
Liquidambar pachyphyllum Knowlton, idem, p. 63, pl. 9, fig.1.
Chaney, op. cit., p. 174, pl. 15, figs. 2, 3.
Knowlton, U.S. Geol. Survey Prof. Paper 140, p. 42, pl. 22, fig. 7; pl. 29, fig. 1, 1926.
Liquidambar convexum Cockerell, Am. Mus. Nat. Hist. Bull., vol. 24, p. 94, pl. 7, fig. 16, 1908.
Liquidambar acutilobum Chaney, op. cit., p. 175, pl. 15, fig. 4.

Knowlton recorded 5 different forms of *Liquidambar* from the Mascall formation, and Chaney 4 forms from the Eagle Creek formation. To anyone who has collected the leaves of our existing *Liquidambar styraciflua* Linné or who contemplates Heer's excellent figures of *L. europaeum* Al. Braun, from the Swiss Miocene, it must be obvious that there is the widest variation in size, degree of lobation, and relative proportions in the same species; somewhat less but still considerable variation in texture; and still less variation in the marginal teeth and details of venation. When a variety of species, based on foliar features, are described from a single outcrop, such a differentiation does violence to the facts. All the western American Miocene leaves of *Liquidambar* could readily be matched among the material of *L. europaeum* from the type locality at Oeningen, Baden, or they could equally well be matched among the leaves of our existing sweet gum, *L. styraciflua*. If it is reasonable to conclude that the existing American species has not come down unchanged since Tertiary time, it is equally unreasonable to suppose that an identical Miocene species inhabited Europe and western North America.

If Braun's name is discarded for American forms, the oldest available is *Liquidambar californicum* Lesquereux, which I consider includes all the nominal species that have been referred to this genus from the western American Miocene.

The material in the Latah formation, although not abundant, admirably illustrates the usual situation. Knowlton figured both 3-lobed and 5-lobed forms from the Latah formation as *Liquidambar pachyphyllum*. The present collection contains narrow acuminately lobed, 3-lobed leaves with a cuneate base and larger 5-lobed leaves with broad lobes and a cordate base. The venation and the very characteristic margin are identical in both, and I have not the slightest doubt that all the Latah leaves represent a single species.

The species, as conceived by me, is found in California, Oregon, Washington, and Colorado. Undoubtedly the fine fruit associated with the leaves in Washington and Idaho belongs to it. This too is not at all different from the fruits of our existing eastern American species.

Occurrence: 3.8 miles east of Whitebird, Idaho County (associated with fruits); 1 mile and 1.1 miles east of Arrow Junction, Nez Perce County.

Liquidambar, fruit

Liquidambar fruit Knowlton, U.S. Geol. Survey Prof. Paper 140, p. 42, pl. 10, fig. 10, 1926.
Berry, U.S. Geol. Survey Prof. Paper 170, p. 38, 1931.

Knowlton described and figured a rather well preserved fruit from the Latah formation at Spokane and suggested its probable relationship to the associated leaves which he identified as *Liquidambar pachyphyllum* Knowlton but which I regard as simply a variant of the common Miocene *L. californicum* Lesquereux. Subsequently additional fruits have been collected from the Latah formation in Washington. I have no doubt that these fruits belong to this species.

The material from Grand Coulee, Wash., is especially interesting, as there are no traces of leaves in the collection and over a dozen of the fruits. In several specimens more or less of the peduncle is preserved. This is unusually stout, and in one small specimen in which it appears to be complete it is only 4 centimeters in length. The presence of fruits and no leaves may be explained as due to water transport of the material, as the fruits are dry when shed and readily float, and the leaves decay in water more rapidly than most other leaves.

In Idaho the fruits have been found at one locality associated with leaves and at two localities where the leaves have not been discovered.

Occurrence: 3.8 miles east of Whitebird (with leaves), and about 4 miles southeast of Whitebird, Idaho County; Linson Valley, Washington County; 5 miles south of Juliaetta, Nez Perce County.

Family CAESALPINIACEAE

Genus CASSIA Linné

Cassia idahoensis Knowlton

Cassia obtusa Knowlton, U.S. Geol. Survey 18th Ann. Rept., pt. 3, p. 731, pl. 100, figs. 4, 5, 1898 [not Clos, 1845].
Cassia idahoensis Knowlton, U.S. Geol. Survey Bull. 696, p. 146, 1919.
Berry, U.S. Geol. Survey Prof. Paper 154, p. 252, pl. 55, figs. 2, 3, 1929.

This species was described in 1898 from the Payette formation at Marsh, Idaho. It is rather common at various localities in the Latah formation around Spokane, Wash.

Occurrence: 3.8 miles east of Whitebird, Idaho County.

Cassia sophoroides (Knowlton) Berry

Phyllites sophoroides Knowlton, U.S. Geol. Survey Prof. Paper 140, p. 48, pl. 26, fig. 8, 1926.
Cassia sophoroides Berry, U.S. Geol. Survey Prof. Paper 154, p. 253, pl. 56, fig. 1, 1929.

The single imperfect specimen of this species from the locality at Edwards ranch, Stanley Hill, Coeur d'Alene, Idaho, was referred by Knowlton to the form genus *Phyllites*, although its leguminous character was recognized. These leaflets are inequilateral throughout; the petiolule is stout and about 3 millimeters long; the tip is usually slightly more extended than in Knowlton's type.

Although these features are shared by a large number of genera of the leguminous alliance, they conform to that found in many species of *Cassia*, both recent and fossil, and as this genus is one more likely to occur in this strictly temperate flora than tropical genera with similar leaflets, I transferred it to *Cassia*. It is not uncommon in the Latah formation around Spokane, Wash.

Occurrence: 1 mile east of Whitebird, Idaho County; 5 miles south of Juliaetta, Nez Perce County.

Genus CERCIS Linné

Cercis idahoensis Berry

Plate 21, figure 1; plate 22; plate 23, figures 3–6

Cercis idahoensis Berry, Torrey Bot. Club Bull., vol. 57, p. 240, text fig. 1, pl. 9, 1931.

Leaves prevailingly large: diameters reaching 14 centimeters, although small ones are represented. Orbicular or reniform with a prevailingly rounded apex and a wide and more or less deeply excavated cordate base. Texturally the leaves appear to have been thin but stiff. Margins entire, but they may be faintly and irregularly undulate. Peticle stout, presumably long, although no specimens show a length of more than 2 centimeters. Venation prominent. Midvein stout. A stout lateral primary diverges from

the base of the midvein on each side; this immediately gives off a basal secondary on the outside, which may be thin and submarginal or stouter and subprimary in appearance; 2 to 10 millimeters farther out the lateral primaries fork, and each fork gives off, usually at acute angles, sweepingly curved secondaries; or distally the disposition and equal size of the two may more properly be called a fork. The midvien gives off three or four pairs of stout secondaries at acute angles; these ascend in sweeping curves and either fork distally or give off curved tertiary branches. All ultimate endings are camptodrome very close to the leaf margin. The internal tertiaries are well marked, transversely inosculating, frequently diminishing in the midregion to form veins of quaternary magnitude disposed in isodiametric polygonal areolation, very characteristic of the genus *Cercis* but hard to define intelligibly.

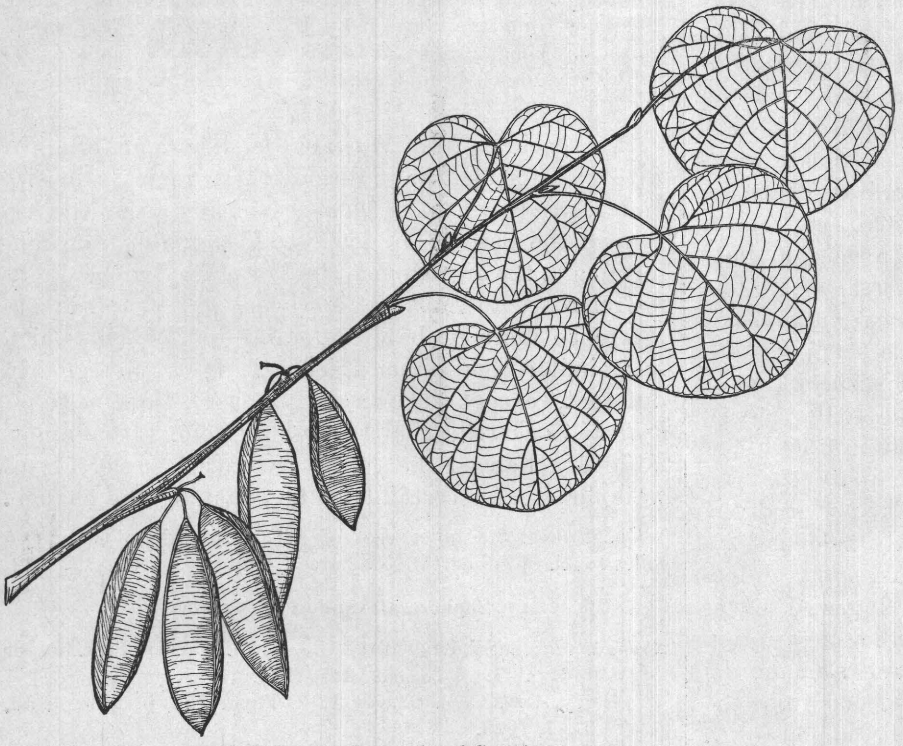


FIGURE 4.—Restoration of *Cercis idahoensis* Berry.

These leaves are exceedingly abundant near Whitebird, where they are associated with the pods. The rather brittle matrix and the apparent brittleness of the leaves have prevented the recovery of any perfect specimens, and the margins are seldom complete. However, all sizes and all parts are represented, and some of the smaller leaves are nearly perfect. Pods large, relatively wide, tapering gradually proximad, abruptly contracted distad to an asymmetric mucronate tip, which may be as much as 2 millimeters long, ventral and dorsal sutures present, the ventral straighter than the dorsal but more curved than in the existing pods of *Cercis*. Substance thin. Sides transversely reticulate-veined; ventral wings more obliquely veined. The fossil pods are abundant in association with the leaves but are usually badly broken. A nearly complete small pod is shown in figure 4. The largest one seen, complete except at the proximal end, has a preserved length of 10.5 centimeters and a maximum width of 3.25 centimeters. The indicated length is about 12 centimeters. These pods agree in all their essential features with the living pods but are less linear in profile and also much larger. They are approached most nearly in both size and outline by the pods of the California redbud, *Cercis occidentalis* Torrey, which is usually a chaparral shrub on gravelly or rocky soils of low mountain slopes, canyons, and stream borders found from Mendocino County and the region about Mount Shasta southward to San Diego County. Occasionally in favorable situations it reaches the size of a small tree.

It goes without saying that the species is a handsome one, and the size and abundance of both leaves and pods and the abundant associated leaves of sycamore and other species would imply that it was an arborescent and not a shrubby form. I have compared these leaves with those of all the existing species of *Cercis*. Only *C. canadensis* of southeastern North America and *C. chinensis* of southeastern Asia are normally as large as the fossil. Its form is approached by *C. chinensis*, as well as by the European and southwestern Asiatic *C. siliquastrum* and the western American *C. occidentalis*. The outline and venation of *C. occidentalis* are most like the fossil but are only from one-fourth to one-third the size. Next in resemblance is *C. chinensis*, with orbicular, cordate, abruptly pointed leaves, as large or larger than the fossil. The pods of *C. chinensis* are, however, much smaller and narrower than the fossil pods—in fact, none of the existing species has as large or as wide pods. The most similar are those of *C. occidentalis* Torrey, and these are only about half the size of the fossil pods, with which, however, they agree in outline, texture, and venation.

It would seem that this western American Miocene *Cercis* stood in an ancestral relationship to the existing *Cercis occidentalis*, which in the less favorable environmental conditions that followed the Miocene epoch became a prevailingly shrubby form with smaller leaves and pods. Some relationship may also exist between the fossil form and the Chinese *Cercis chinensis*.

The existing species of *Cercis* number 8 and are confined to the Southeastern States, Texas, Arizona, California, southern Europe, and southwestern, central, and eastern Asia. The species of the Southeastern States and China are small mesophytic trees; the others, particularly the California and Arizona species, have become reduced in response to dry, semiarid environments.

The fossil species number 22 and include the existing eastern American *Cercis canadensis* in the Pleistocene of Canada and North Carolina and the south European *C. siliquastrum* in the Pleistocene of France and Italy. The genus makes its appearance in the lower Eocene of the West and the Gulf States and in the upper Eocene of central Europe. In the later Tertiary its distribution was holarctic, and its post-Pliocene history has been one of progressive reduction and discontinuity in distribution. Three nominal Miocene species have been heretofore recorded from the western United States. These comprise a doubtfully determined leaf from the Esmeralda formation of west-central Nevada,[36] fragments of pods from the Miocene beds of the Crooked River Basin in Oregon,[37] and a fragment of a pod from the Latah formation near Spokane, Wash.[38] The only one of these at all like the Idaho species is the third—*Cercis? spokanensis* Knowlton. This was based on a single fragment of a very small and more pointed pod. I suspect that it may represent the same species as the Idaho fossils, but nothing so small has been found in the Idaho collections, and the type is so inadequate that no positive conclusions are warranted. The pod from the Crooked River Basin in Oregon clearly belongs to a different species. The small leaf from Nevada differs decidedly in venation from the minimum-sized leaves of *C. idahoensis*. Long after the foregoing description was written E. E. Alexander, of Spokane, sent me the original and counterpart of a complete pod from the Latah formation which is identical with the pods of *C. idahoensis* except that it is somewhat smaller, but which is much larger and much more inflated than *C.? spokanensis* Knowlton. This occurrence suggests that *C.? spokanensis* was based on a small or abnormal pod of *C. idahoensis*, but as Knowlton's material was so incomplete that it is practically unrecognizable I do not feel justified in taking up his name for this very complete later material.

Occurrence: 3.8 miles east of Whitebird, Idaho County.

[36] Knowlton, F. H., U.S. Geol. Survey 21st Ann. Rept., pt. 2, p. 217, pl. 30, fig. 23, 1900.

[37] Chaney, R. W., Geology and paleontology of the Crooked River Basin: Carnegie Inst. Washington Pub. 346, p. 125, pl. 15, fig. 5, 1927.

[38] Knowlton, F. H., Flora of the Latah formation: U.S. Geol. Survey Prof. Paper 140, p. 43, pl. 29, fig. 9, 1926.

Family PAPILIONACEAE

Genus SOPHORA Linné

Sophora spokanensis Knowlton

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.

This species is common in the Latah formation and was characterized as follows:

Leaflets showing considerable variation in size and outline, even on a single leaf; varying from elongate-elliptical to ovate-lanceolate; generally widest medially but sometimes in the lower half. Apex narrowly to broadly rounded and nearly equilateral. Base broadly rounded, inequilateral. Petiolule short and stout, 2 millimeters or less in length. Midvein stout, prominent. Secondaries thin, somewhat irregularly spaced, diverging from the midvein at angles of 45° or less, camptodrome. Length from 2.5 to 4.5 centimeters; a single terminal leaflet, obviously undeveloped, is 1.5 centimeters long and about 4 millimeters in maximum width.

One specimen from Washington shows part of a leaf with eight leaflets in position; these increase in size and relative width as well as spacing from the tip toward the base. The leaf is odd-pinnate, thus conforming to the arrangement in *Sophora*. I much doubt its reference to *Sophora*, however, and it appears to me to be more probably referable to *Robinia*, which has similar, odd-pinnate leaves. It is not greatly different, except for its larger size, from *Robinia brittoni* Cockerell, from Florissant, Colo. I have not, however, changed the generic reference, preferring to wait for greater certainty before making the change.

Occurrence: 3.8 miles east of Whitebird, Idaho County; 5 miles south of Juliaetta, Nez Perce County.

Sophora alexanderi Knowlton

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, fig. 7, 1929.

This fine species is not uncommon in the Latah formation in Washington but thus far has been found only as detached leaflets.

Occurrence: 3.8 miles east of Whitebird, Idaho County; Edwards ranch, Stanley Hill, Coeur d'Alene, Kootenai County.

Order SAPINDALES

Family ANACARDIACEAE

Genus RHUS Linné

Rhus merrilli Chaney

Rhus merrilli Chaney, Carnegie Inst. Washington Pub. 346, p. 125, pl. 16, figs. 1, 2, 1927.

The type of this species came from the Miocene beds of the Crooked River Basin, in eastern Oregon.

It is said to bear a close resemblance to *Rhus sylvestris* Seemann and Zuccarini, of central and southern China and Chosen, and is thus another link in the community of relationship between the present Chinese flora and the Miocene flora of western North America. It occurs in the Latah formation at Spokane, Wash.

Occurrence: 1 mile east of Whitebird, Idaho County; 5 miles south of Juliaetta, Nez Perce County.

Family CELASTRACEAE

Genus EUONYMUS Linné

Euonymus knowltoni Berry

Euonymus knowltoni Berry, U.S. Geol. Survey Prof. Paper 154, p. 255, pl. 56, fig. 9, 1929.

This species was described as follows from the Latah formation at Spokane, Wash.:

Leaves of medium size, ovate-lanceolate. Tip acuminate, not greatly produced. Base broadly cuneate. Texture subcoriaceous. Margin with fine, closely spaced, inconspicuous serrate teeth. Length about 11 centimeters; maximum width, near the middle of the leaf, about 3.5 centimeters. Petiole not preserved. Midvein stout and prominent. Secondaries thin, 5 or 6 irregularly spaced pairs; diverging from the midvein at angles of about 45°, more in the tip; sweeping upward in long ascending curves and arching along the margins. Tertiaries thin, typical of the Celastraceae, and exactly matched in the genus *Euonymus*.

The genus makes its appearance in the basal Eocene but has heretofore been unknown in American post-Eocene deposits, although common in European deposits of later Tertiary age and present in the existing flora of North America, in which there are about 5 temperate species and 5 or 6 additional in Central America.

The existing species number about 65 and are widely distributed throughout the Northern Hemisphere but massed in the southeastern Asiatic region. Two survive as shrubs in the moister parts of the Pacific coastal region.

Occurrence: 3.8 miles east of Whitebird, Idaho County.

Family ACERACEAE

Genus ACER Linné

Acer merriami Knowlton

Acer merriami Knowlton, U.S. Geol. Survey Bull. 204, p. 74, pl. 14, fig. 7, 1902; U.S. Geol. Survey Prof. Paper 140, p. 45, pl. 28, fig. 1, 1926.
Berry, U.S. Geol. Survey Prof. Paper 154, p. 256, 1929; U. S. Geol. Survey Prof. Paper 170, p. 39, pl. 13, fig. 13, 1931.

The maples from the western Miocene are in a state of confusion, too many species have been described, and specific names have also usually been given to the detached fruits. The present specimens are referred to *Acer merriami* because they are decidedly three-lobed and have but 3 primaries, although I do not regard either of these features as good specific characters.

Occurrence: Southeast of Moscow, Latah County; 1.1 miles east and half a mile northeast of Arrow Junction, Nez Perce County; 5 miles south of Juliaetta, Nez Perce County.

Acer bendirei Lesquereux

Plate 23, figure 7

Acer bendirei Lesquereux, U.S. Nat. Mus. Proc., vol. 11, p. 14, pl. 5, fig. 5; pl. 6, fig. 1; pl. 7, fig. 1; pl. 8, fig.1, 1888.
Knowlton, U.S. Geol. Survey Bull. 204, p. 73, 1902.
Acer trilobatum productum Lesquereux, U.S. Geol. Survey Terr. Rept., vol. 8, p. 253, pl. 59, figs. 1, 2, 4 [not 3], 1883 [not Heer].
Penhallow, Canada Geol. Survey Rept. 1013, p. 35, 1908.
Acer vivarium Knowlton, U.S. Geol. Survey Mon. 32, pt. 2, p. 735, pl. 98, fig. 4, 1899.
Kirkham and Johnson, Jour. Geology, vol. 37, p. 496, 1929.

This somewhat anomalous species was described by Lesquereux from the Mascall formation of the John Day Basin, Oreg., and is said to be present in the Miocene at Spanish Ranch, Calif., and on the Horsefly River, British Columbia. It shows considerable variation in size and form. It is essentially trilobate, with long, narrow ascending lobes, and some specimens have the peculiar auriculate base shown in Lesquereux's plate 7, figure 1. This is also present in some of the specimens in the collection which I have studied. It seems probable that *Acer vivarium*, described by Knowlton from the Miocene of Yellowstone Park, should be referred to this species. It has the same trilobate form, with narrow ascending lateral lobes and ascending secondaries, the same produced aquiline teeth, and the sole difference is a cuneate base. Inasmuch as *Acer bendirei*, as conceived by Lesquereux, shows considerable variability in the character of the base, there is little point in maintaining *A. vivarium* as a distinct species. This species is markedly different from *A. florissanti* Kirchner, with which it is often associated.

Occurrence: T. 37 N., R. 3 W., between 5 and 6 miles south of Juliaetta, on west side of Potlatch River, Nez Perce County; 1 mile east of Whitebird, Idaho County; near St. Maries, Kootenai County.

Acer minor Knowlton

Acer minor Knowlton, U.S. Geol. Survey Bull. 204, p. 76, pl. 14, figs. 2, 3, 1902; U.S. Geol. Survey Prof. Paper 140, p. 45, pl. 27, fig. 4, 1926.
Berry, U.S. Geol. Survey Prof. Paper 154, p. 256, pl. 64, fig. 2, 1929.

This species was described originally by Knowlton from the Mascall formation of the John Day Basin, Oreg., and was one of three species of fruits founded largely on differences of size. A very imperfect specimen from the Latah formation at Deep Creek, northwest of Spokane, was referred to this species in 1926 by Knowlton, who remarked that maples seem to be rare in the Spokane area. Subsequent collections in this area show this not to have been the case, as both leaves and fruits are not at all uncommon. Presumably the present fruit represents one of the leaf species. One other type of maple fruit has been described from both the Spokane region and Idaho—*Acer oregonianum* Knowlton. This is three to four times the size of *A. minor*, with more spreading wings and less oval seed

cavities. I have no doubt that the two represent different species and not merely differences in size and form of a single species.

Occurrence: Southeast of Moscow, Latah County.

Acer oregonianum Knowlton

Plate 24, figure 1

Acer, fruits of, Lesquereux, U.S. Nat. Mus. Proc., vol. 11, p. 15, pl. 6, figs. 2, 3, 1888.

Acer oregonianum Knowlton, U.S. Geol. Survey Bull. 204, p. 75, pl. 13, figs. 5–8, 1902.

Berry, U.S. Geol. Survey Prof. Paper 154, p. 255, pl. 57, fig. 2; pl. 63, fig. 11, 1929.

These rather characteristic large maple samaras were first noted by Lesquereux and were named by Knowlton in his account of the flora of the Mascall formation of the John Day Basin, Oreg. They have recently been found to be not at all uncommon in the Latah formation around Spokane, Wash.

Knowlton compared *Acer oregonianum* with the fruits of the existing *A. macrophyllum* Pursh, which they much resemble. They are somewhat smaller than these and about equally like the existing *A. circinatum* Pursh. Both these modern species are abundant on stream banks and rich bottoms of British Columbia, Washington, Oregon, and California, in areas of deep moist soil and abundant precipitation. Over 15 species of *Acer* have been described from the Miocene of the Pacific slope of North America, but there is a certain duplication in the unavoidable practice of giving different names to the leaves and fruits. The genus is common at Florissant, Colo., and in the California, Mascall, and Eagle Creek Miocene. Chaney[39] has recently figured similar fruits from the Bridge Creek beds of the Crooked River Basin, Oreg., which he refers to the leaf species *A. osmonti* on the ground that they are associated in the same stratum. The original specimens from Van Horn's ranch were thought by Lesquereux to belong with the leaves which he described as *A. dimorphum*. The danger of considering dissociated leaves and fruit as belonging to the same species, even when they are the sole representatives of a genus at the same outcrop, is well illustrated by the presence of these fruits in the Latah formation associated with the leaves of *A. merriami* Knowlton and *A. chaneyi* Knowlton and their occurrence in Idaho associated with the leaves of *A. bendirei* Lesquereux and *Acer florissanti* Kirchner.

Occurrence: 3.8 miles east of Whitebird, Idaho County.

Acer florissanti Kirchner

Plate 24, figures 5–7

Acer florissanti Kirchner, St. Louis Acad. Sci. Trans., vol. 8, p. 181, pl. 11, fig. 1, 1898.

Cockerell, Am. Mus. Nat. Hist. Bull., vol. 24, p. 101, 1908.

Knowlton, U.S. Nat. Mus. Proc., vol. 5, p. 282, 1916.

Acer sp. Berry, U.S. Geol. Survey Prof. Paper 154, pl. 57, fig. 6, 1929.

This handsome species (fig. 5) has hitherto been unknown outside of several localities in the Florissant Basin, Colo. It is exceedingly abundant in all sizes south of Juliaetta, Idaho, and shows considerable variation in form. I have compared the Idaho material with all the species of *Acer* described from our western Miocene, of which there are too many and most of which have very indefinite limits. I suspect that the form from the California Miocene which Lesquereux[40] referred to *A. arcticum* Heer belongs to this species. Although the sinuses are less deeply cut, it closely resembles the Recent *A. dasycarpus* in size, lobation, venation, and teeth.

Occurrence: 3.8 miles east of Whitebird, Idaho County; 5 miles south of Juliaetta, Nez Perce County.

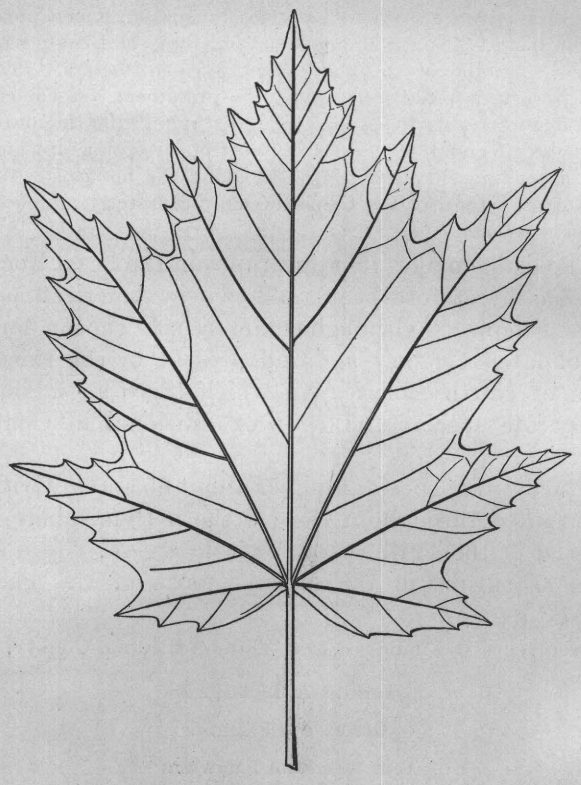


FIGURE 5.—Restoration of *Acer florissanti* Kirchner.

Acer chaneyi Knowlton

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.

This species was described by Knowlton from the Latah formation at Spokane. The leaves are handsome, with long, slender, much cut lobes, and appear to be very similar to if not identical with *Acer osmonti* Knowlton,[41] described from the John Day Basin and

[39] Chaney, R. W., Geology and paleontology of the Crooked River Basin: Carnegie Inst. Washington Pub. 346, p. 126, pl. 18, fig. 9, 1927.

[40] Lesquereux, Leo, Report on the fossil plants of the auriferous gravel deposits of the Sierra Nevada: Harvard Coll. Mus. Comp. Zoology Mem., vol. 6, p. 60, 1878.

[41] Knowlton, F. H., Fossil flora of the John Day Basin, Oreg.: U.S. Geol. Survey Bull. 204, p. 72, pl. 13, fig. 3, 1902.

present also in the Crooked River Basin of Oregon.[42] The fruits that I have called *A. oregonianum* are the same as those that Chaney refers to *A. osmonti*.

Occurrence: 5 miles south of Juliaetta, Nez Perce County.

Order RHAMNALES

Family RHAMNACEAE

Genus PALIURUS Jussieu

Paliurus hesperius Berry

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; U.S. Geol. Survey Prof. Paper 170, p. 39, pl. 13, figs. 1–5, 1931.

This exceedingly interesting species was described as follows:

Leaves of medium size, broadly ovate, widest below the middle; the apex pointed but not extended; base broadly rounded or slightly cordate. Texture subcoriaceous. Margins with closely spaced, prevailingly small, crenate teeth. Length about 7 centimeters; maximum width about 4.5 centimeters. Petiole not preserved. Midvein stout, prominent. Lateral primaries diverge from the base at acute angles; these are as stout as the midvein and curve upward and barely escape being acrodrome by uniting with short secondaries from the distal part of the midvein. The lateral primaries give off on the outside several camptodrome secondaries. The areolation is a fine mesh indistinctly preserved.

These leaves are not uncommon in the Latah formation at Spokane; they occur sparingly at Grand Coulee and also in Nez Perce County, Idaho, about 85 miles east of south of Spokane.

The fruits are discoidal, peltate, pedunculate; the essential part depressed turbinate, the margin extended horizontally as a broad scarious, veined wing. The wing margin is irregularly sinuate. The veins are radial in direction, slightly undulate, and may be simple or once or twice forked.

As preserved the whole fruit departs slightly from circular in outline, being about 1.2 by 1.6 centimeters in diameter. The type comprised two specimens which are counterparts, split in the plane of the wing, which is well preserved. The fruit substance is gone in the central part of both specimens and was probably lost when the specimen was split open, since one counterpart shows the cast of the apical umbone above the wing and the other shows a cast of the proximal part below the wing. These are slightly deformed by pressure during fossilization but preserve the details in a remarkable way.

The fossil agrees with the fruits of the recent species of *Paliurus* in every feature except that it is slightly smaller, in this respect being closest to the existing *P. aculeatus* Lamarck, although the existing forms show considerable variation in the size of their fruits, and I have not enough material to be sure of the limits of variation in either the existing or the fossil forms. The fruits of *P. aculeatus* which I have seen are more robust, with a larger essential part, which is much more massive proximad below the wing, with the wings thicker, the venation less visible, and the peduncle shorter. The fossil is more like the fruits of *P. orientalis* Franchet that I have seen, in relative proportions, in the thinner wing with greater visibility of the veins, and in the relative length of the peduncle. No leaves are associated with the fossil, but at about the same horizon, both at this locality and in the Latah formation at Spokane, there are leaves of a *Paliurus* which are nearer to *P. orientalis* than they are to the other existing species. It is probable that leaves and fruit represent the same Miocene species.

The genus *Paliurus* of Jussieu contains two or three existing species of shrubs or small trees with cordate or ovate, palmately three-veined and usually small leaves with stipular thorns. The fruits are coriaceous, peltate, umbonate, with a horizontal marginal, radiately veined wing. In existing floras they are restricted to dry-soil habitats from Spain on the west to Japan on the east.

Occurrence: 10½ miles east of Lewiston on north bank of Clearwater River, Nez Perce County.

Order MALVALES

Family TILIACEAE

Genus TILIA Linné

Tilia hesperia Berry

Tilia hesperia Berry, U.S. Geol. Survey Prof. Paper 154, p. 258, pl. 57, fig. 3, 1929.

Leaves large, broadly ovate and inequilateral, of thin texture, about 15 or 16 centimeters in length and 9 centimeters in maximum width below the middle. Apex acuminate. Base missing. Midvein stout and relatively straight. Secondaries stout, about 6 alternate pairs, diverging about 45°, curving upward, craspedodrome, giving off one or more craspedodrome branches on the outside toward their tips. The basal pair are not differentiated from their fellows except for the series of craspedodrome tertiaries which they give off on the outside. The inner tertiaries are regularly spaced, subpercurrent, frequently inosculating veins of considerable caliber. The margin is regularly serrate, with relatively small teeth.

This leaf is about the size of the larger leaves of the existing species of *Tilia* of southeastern North America, from which it differs primarily in its somewhat less relative width and more produced tip. The only western Tertiary species known to me, *T. populifolia* Lesquereux, from Florissant, is similar except that the basal secondaries are differentiated as lateral primaries. A second Miocene species, *T. pedunculata* Chaney, is based on a fruit bract of a linden from the Eagle Creek formation of Oregon. As no foliage was discovered in the Eagle Creek formation, it is possible that this fruit bract may represent the botanic species of which *T. hesperia* is the foliage.

The genus *Tilia* is found at the present time widely distributed in the humid North Temperate Zone except in western America, central Asia, and the Himalayan region.

Occurrence: 1½ miles north of Arrow Junction, Nez Perce County.

[42] Chaney, R. W., Geology and paleontology of the Crooked River Basin: Carnegie Inst. Washington Pub. 346, p. 126, pl. 17, fig. 6; pl. 18, figs. 1, 3, 5, 1927.

Family MALVACEAE

Genus HIBISCUS Linné

Hibiscus? occidentalis Berry

Hibiscus? occidentalis Berry, U.S. Geol. Survey Prof. Paper 154, p. 258, pl. 64, figs. 13–15, 1929.

Carpels small, compressed, ovate, broadly rounded distad, asymmetrically contracted proximad. Embryo nearly straight. Carpel wall finely netted-veined, with scarious margin about 1 millimeter wide, radially veined. Length about 6 millimeters. Maximum width about 3 millimeters.

These objects were described from the Latah formation, where they are not uncommon. They appear to be definitely referable to the Malvaceae, and probably to the genus *Hibiscus*. They are as yet confined to the Latah and Idaho localities and are strong presumptive evidence of the contemporaneity of these deposits.

The genus *Hibiscus*, heretofore unknown in the fossil state, so far as I am aware, comprises nearly 200 Recent species, widely distributed in warm and temperate regions.

Occurrence: T. 37 N., R. 33 W., between 5 and 6 miles south of Juliaetta, on west side of Potlatch River, Nez Perce County.

Genus MALVA Linné

Malva? hesperia Knowlton

Plate 24, figure 2

Malva? hesperia Knowlton, U.S. Geol. Survey Prof. Paper 140, p. 47, pl. 29, fig. 11, 1926.

This species was described by Knowlton from the Latah formation of Washington, in which it is not uncommon. It was tentatively referred to this genus because the carpels appeared smooth, although I very much doubt this determination, as the existing species are confined to the Old World. There is no doubt that it belongs in this family, but the genus remains uncertain.

Occurrence: 1 mile east of Whitebird, Idaho County.

Family TERNSTROEMIACEAE

Genus GORDONIA Ellis

Gordonia idahoensis (Knowlton) Berry

Myrica? idahoensis Knowlton, U.S. Geol. Survey 18th Ann. Rept., pt. 3, p. 724, pl. 99, fig. 7, 1898; U.S. Geol. Survey Bull. 696, p. 395, 1919.

Ternstroemites idahoensis Berry, U.S. Geol. Survey Prof. Paper 154, p. 258, pl. 58, fig. 1, 1929.

This species was described from the Payette formation of Idaho and doubtfully referred to the genus *Myrica* by Knowlton. If the type had shown the venation, that it was not related to *Myrica* would have been obvious. Characteristic leaves are present in the Latah formation of Washington. These range in lengths from 6 to 10 centimeters and in maximum width from 1.7 to 2.6 centimeters. The midvein becomes characteristically thickened and prominent in the lower half of the leaf. The marginal teeth show some variation as to size and are obsolete below. The secondaries are largely immersed, about 8 camptodrome pairs.

Its reference to the Ternstroemiaceae was recognized by me, and in 1929 I referred it to the form genus *Ternstroemites*. The subsequent discovery of large numbers of characteristic winged seeds of *Gordonia* in association with these leaves[43] warrants their reference to that genus.

Gordonia has not heretofore been recognized in the fossil state except from Oriental deposits of relatively recent age (Pleistocene). In the living flora it has about 16 species of shrubs and trees—2 in the coastal region from Virginia to Louisiana and the remainder in southeastern Asia. Thus its presence in Washington and Idaho is another link connecting the present-day floras of southeastern Asia and southeastern North America, and, as is true of many of the associated genera, the Miocene seeds are more like their Asiatic survivors than they are like those of the surviving species in the southeastern United States.

Occurrence: 1 mile east of Whitebird, Idaho County; 5 miles south of Juliaetta, Nez Perce County.

Order LAURALES

Family LAURACEAE

Genus LAURUS of authors

Laurus grandis Lesquereux

Laurus grandis Lesquereux, U.S. Geol. Survey Terr. Rept., vol. 8, p. 251, pl. 58, figs. 1, 3, 1883.
Knowlton, U.S. Geol. Survey Mon. 32, pt. 2, p. 725, pl. 93, fig. 3; pl. 95, fig. 1, 1899 [not Knowlton, 1926].
Berry, U.S. Geol. Survey Prof. Paper 154, p. 259, pl. 58, fig. 3, 1929.

This species was described by Lesquereux from the Miocene of California and was subsequently recorded by Knowlton from the Miocene of Yellowstone National Park and by Knowlton and me from the Latah formation around Spokane, Wash.

Occurrence: 3.8 miles east of Whitebird, Idaho County; near St. Maries, Kootenai County.

Laurus princeps Heer

Laurus princeps Heer, Flora tertiaria Helvetiae, vol. 2, p. 77, pl. 89, figs. 16, 17; pl. 90, figs. 17, 20, 1856.
Lesquereux, U.S. Geol. Survey Terr. Rept., vol. 8, p. 250, pl. 58, fig. 2, 1883.
Knowlton, U.S. Geol. Survey Mon. 32, pt. 2, p. 725, pl. 95, fig. 3, 1899.
Berry, U.S. Geol. Survey Prof. Paper 154, p. 259, pl. 58, fig. 5, 1929.

Laurus grandis Knowlton, U.S. Geol. Survey Prof. Paper 140, p. 41, fig. 1, 1926.

This species differs from *Laurus grandis*, with which it was confused by Knowlton, in the more extended tip

[43] Berry, E. W., *Gordonia* from the Miocene of Idaho and Washington: Am. Jour. Sci., vol. 18, pp. 429–432, 1929.

and less ascending secondaries. The specimens show some variation in these features and also vary considerably in size.

The type was from the European Miocene, and the propriety of considering a western American form identical with it is highly questionable. Some of Heer's leaves are considerably smaller and narrower, but his plate 90, figure 20, is practically identical with Idaho specimens so identified.

The features are well marked and clearly lauraceous. The species occurs in the auriferous gravel of California, is abundant in the Latah formation of eastern Washington, and probably is represented in the Miocene of Yellowstone Park.

Occurrence: 1 mile and 3.8 miles east of Whitebird, Idaho County; 5 miles south of Juliaetta, Nez Perce County.

Laurus similis Knowlton

Laurus similis Knowlton, U.S. Geol. Survey 20th Ann. Rept., pt. 3, p. 48, pl. 5, figs. 1–4, 1900.
Chaney, Walker Mus. Contr., vol. 2, no. 5, p. 173, 1920.
Knowlton, U.S. Geol. Survey Prof. Paper 140, p. 41, pl. 23, figs. 4–6; pl. 24, fig. 2, 1926.
Berry, U.S. Geol. Survey Prof. Paper 154, p. 259, pl. 58, fig. 2, 1929.

As may be gathered from the previously figured material, this species, as conceived by its describer, exhibits considerable variability. It was originally described from the west side of the Cascade Range in Oregon and subsequently recorded by Chaney from the Eagle Creek formation. It is abundant in the Latah formation, Knowlton having recorded it from several localities, and several more were added by me.

Occurrence: 10½ miles east of Lewiston on north bank of Clearwater River, Nez Perce County; 5 miles south of Juliaetta, Nez Perce County; 3.8 miles east of Whitebird, Idaho County.

Genus UMBELLULARIA Nuttall

Umbellularia lanceolata Berry

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

Leaves mostly small, lanceolate; widest medially and usually slightly more tapering distad than proximad, although occasionally the reverse is true. Margins entire, sometimes faintly undulate. Texture coriaceous. Length 6.5 to 8.5 centimeters; maximum width 1.5 to 1.85 centimeters. Tip acuminate. Base narrowly cuneate. Petiole stout, its length unknown. Midvein stout, prominent. Secondaries 4 to 6 stout, subopposite to alternate pairs, hence widely but fairly regularly spaced, curved, ascending, ultimately camptodrome. Areolation finely meshed, lauraceous.

This characteristic form, which was described from the Latah formation around Spokane, Wash., differs from the associated *Umbellularia dayana* in its generally smaller size, lanceolate outline, narrower base, and much more ascending secondaries.

Occurrence: 3.8 miles east of Whitebird, Idaho County.

Umbellularia dayana (Knowlton) Berry

Salix dayana Knowlton, U.S. Geol. Survey Bull. 204, p. 31, pl. 2, figs. 9, 10, 1902; U.S. Geol. Survey Prof. Paper 140, p. 32, pl. 12, figs. 1, 2, 1926.
Umbellularia dayana Berry, U.S. Geol. Survey Prof. Paper 154, p. 260, pl. 58, fig. 4, 1929.

This species, described as a willow from the Mascall formation of Oregon, was recorded by Knowlton from Coeur d'Alene, Idaho, and by me from Spokane, Wash. The venation is not that of *Salix* but is typically lauraceous, and I have therefore transferred it to the genus *Umbellularia*.

Chaney [44] thinks that it is closely related to and possibly identical with *Salix californica* Lesquereux, which he points out resembles the living *S. lasiolepis* Bentham and *S. sessilifolia* Nuttall.

It is an ovate-lanceolate, entire-margined form and lacks any very distinctive diagnostic features.

The genus *Umbellularia*, represented in the living flora by a single species which is associated with the redwood and which ranges from the Rogue River Valley in Oregon southward through the Coast Ranges and along the western slopes of the Sierra Nevada to the San Bernardino Mountains, is represented in the upper part of the Clarno formation of the John Day Basin in Oregon by *U. oregonensis* (Knowlton and Cockerell) Chaney.

Occurrence: Edwards ranch, Stanley Hill, Coeur d'Alene, Kootenai County; 1 mile and 1.1 miles east of Arrow Junction, Nez Perce County.

Order UMBELLALES

Family CORNACEAE

Genus NYSSA Linné

Nyssa hesperia Berry

Nyssa hesperia Berry, U.S. Geol. Survey Prof. Paper 170, p. 42, pl. 13, figs. 9–11, 1931.

Stones of medium size, prolate spheroidal or slightly compressed in form, widest medially and about equally rounded at both ends, with about 10 prominent wide rounded ribs separated by narrow deep sulci. About 1.5 centimeters or slightly less in length and about 7.5 millimeters in diameter. All the specimens collected are preserved as casts in the clays, and they show various degrees of flattening. The type came from the Latah formation at Spokane, Wash. These stones are very much smaller, more rounded at the ends, and with fewer ribs than *Nyssa magnifica* (Knowlton) Berry [45] of the Latah formation. They are associated with the leaves described as *N. knowltoni* Berry [46] in both the Latah and the Payette.

The stones of *Nyssa* are very abundant in the earlier Tertiary of North America, a great variety having

[44] Chaney, R. W., Geology and paleontology of the Crooked River Basin: Carnegie Inst. Washington Pub. 346, p. 103, 1927.
[45] Berry, E. W., A revision of the flora of the Latah formation: U.S. Geol. Survey Prof. Paper 154, p. 261, 1929.
[46] Idem, p. 261, pl. 59, fig. 7.

been described from the Eocene lignites of Brandon, Vt., but for some reason they are much rarer in the later Tertiary, where we know only this species, the second species from the Latah and its equivalents, and a third species from the Calvert Miocene of Virginia. But two American Miocene species based upon leaves are known—the one mentioned above and a second from the Eagle Creek and other Miocene beds in Oregon.

Species of *Nyssa* based upon the stones alone are always of doubtful specific distinctness, and a great many so-called species of stones from other and very different horizons both in this country and abroad might be mentioned which resemble the present species, but such comparisons lack any real value.

Occurrence: 2½ miles east of Whitebird, Idaho County; sec. 12, T. 10 N., R. 3 W., below lava, Linson Valley, Washington County.

Nyssa knowltoni Berry

Nyssa knowltoni Berry, U.S. Geol. Survey Prof. Paper 154, p. 261, pl. 59, fig. 7, 1929.

This species was described from the Latah formation at Spokane, Wash., as follows:

Leaves elliptical, bluntly pointed at the apex, rounded at the base, of thin texture. Margins entire except for a few scattered blunt points distad. Length about 10 centimeters; maximum width, near the middle of the leaf, 6.5 centimeters. Petiole not preserved. Midvein stout, prominent, curved. Secondaries stout, 10 or 11 pairs, irregularly spaced and more crowded toward the base; they diverge from the midvein at wide angles and are camptodrome. Tertiaries mostly percurrent, thin.

This may represent the foliage of the same botanic species which furnished the *Nyssa* fruits described above.

Occurrence: 3.8 miles east of Whitebird, Idaho County.

POSITION UNCERTAIN

Carpites menthoides Knowlton

Carpites menthoides Knowlton, U.S. Geol. Survey Prof. Pape 140, p. 49, pl. 26, fig. 4, 1926.
Berry, U.S. Geol. Survey Prof. Paper 154, p. 264, 1929.

Specimens ranging from 1 to 2 centimeters in diameter are contained in the recent collections. I regard their implied relationship with the Labiateae as entirely problematic and very improbable.

Occurrence: 3.8 miles east of Whitebird, Idaho County.

Fraxinus?, samaras

Plate 24, figures 3, 4

Eleven mostly fragmentary specimens of these objects have been collected. They are about 4.5 centimeters long and 1 centimeter in maximum width, entire-margined, rounded distad and bluntly pointed proximad, longitudinally veined or ribbed.

The manner in which they are broken and their textural appearance seem to indicate a thin, stiff, scarious condition.

In size and general appearance the objects are much like the samaras of *Fraxinus*, but they show no trace of the essential part of ash paddles and I regard their determination as such as highly problematic.

Occurrence: 3.8 miles east of Whitebird, Idaho County.

Calyx

Plate 24, figure 8

A single incomplete specimen of what appears to be a rotate, quinquepartite, gamosepalous calyx. The divisions are 5, lanceolate, keeled, and with somewhat thickened tips. The central region is thickened, and the divisions appear to be faintly netted-veined.

The botanic affinity of this specimen is uncertain. Similar objects have sometimes been referred to *Diospyros*, but this seems a highly improbable relationship. They have also been referred to *Porana*, and I would not be surprised if they were ultimately found to be referable to some Asiatic genus of the Convolvulaceae. There is not enough recent material of this family available for comparison to make such a search profitable at the present time.

Occurrence: 3.8 miles east of Whitebird, Idaho County.

Phyllites payettensis Knowlton

Phyllites obscurus Knowlton, U.S. Geol Survey 18th Ann. Rept., pt. 3, p. 735, pl. 99, figs. 10, 11, 1898. [Homonym, Hollick, 1896.]
Phyllites payettensis Knowlton, U.S. Geol. Survey Bull. 152, p. 163, 1898.
Phyllites inexpectans Knowlton, U.S. Geol. Survey Bull. 204, p. 86, pl. 16, fig. 6, 1902.

This species was described by Knowlton from the Payette formation of Boise County, Idaho, and he also described what appears to be the same thing from the Mascall formation of the John Day Basin, Oreg. As none of the specimens show the venation, their generic relations remain unknown. They might belong to some ericaceous genus such as *Arctostaphylos* or *Vaccinium*, both of which are present in the Latah formation of Washington.

Occurrence: Sec. 31, T. 13 N., R. 4 W., about 15 miles north of Weiser, Washington County.

MOLLUSCA

Genus LAMPSILIS Rafinesque

Lampsilis sp.

Valves of *Lampsilis* are not uncommon in the collections. No attempt has been made to identify them specifically.

Occurrence: About 22 miles northeast of Payette in Washington County.

INSECTA

Itonid or phylloxerid galls

Plate 19, figure 5

A leaf of *Fagus pacifica* Chaney is partly covered with well-developed galls of some itonid or phylloxerid form. Similar galls occur on a great variety of existing plants, but it is impossible to arrive at any precise conclusions regarding the fossil forms. I know of none which are exactly like the present fossil, but there is no point in attempting to fix its position more accurately.

Occurrence: 3.8 miles east of Whitebird, Idaho County.

PISCES

Genus LEUCISCUS Rond

Leuciscus sp.

Berry, U.S. Geol. Survey Prof. Paper 154, p. 226, pl. 49, figs. 1, 2, 1929.

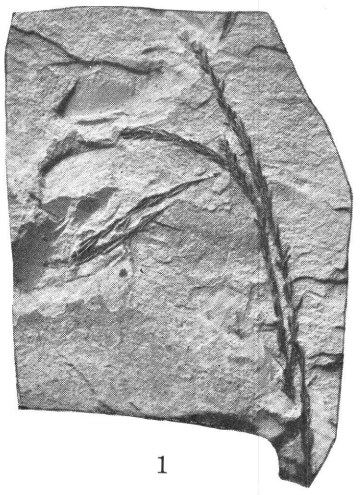
Spines, vertebrae, and especially the scales of a small cyprinoid fish were found to be exceedingly common in the Latah formation around Spokane. These were naturally compared with *Leuciscus turneri* Lucas,[47] from the Esmeralda formation of Nevada, and represent the same or a closely related form.

Similar remains and identical scales are not uncommon in the Kirkham collections.

Occurrence: 5 miles south of Juliaetta, Nez Perce County; 11 miles east of Lewiston, Nez Perce County; about 15 miles north of Weiser, Washington County; Cobb, Umatilla County, Oreg.

[47] Lucas, F. A., in Turner, H. W., The Esmeralda formation: U.S. Geol. Survey 21st Ann. Rept., pt. 2, p. 223, pl. 31, 1900.

PLATES 19–24



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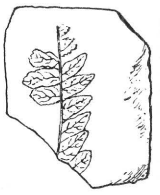

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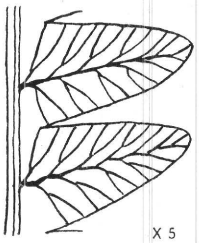

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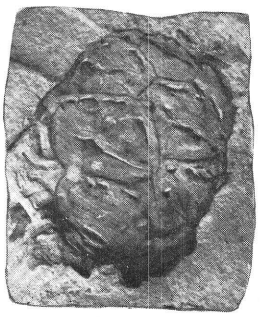

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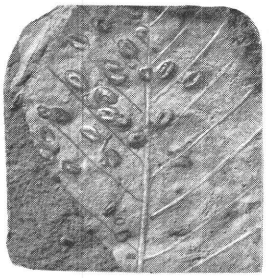

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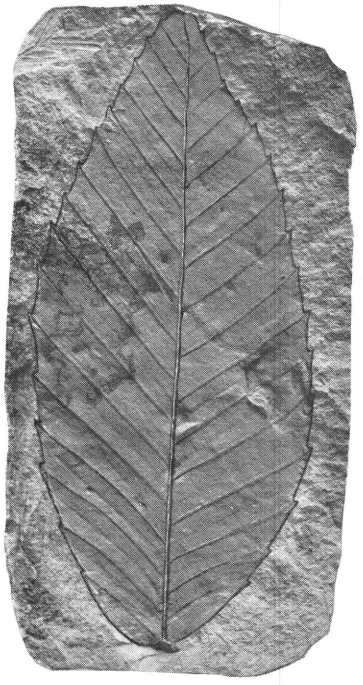

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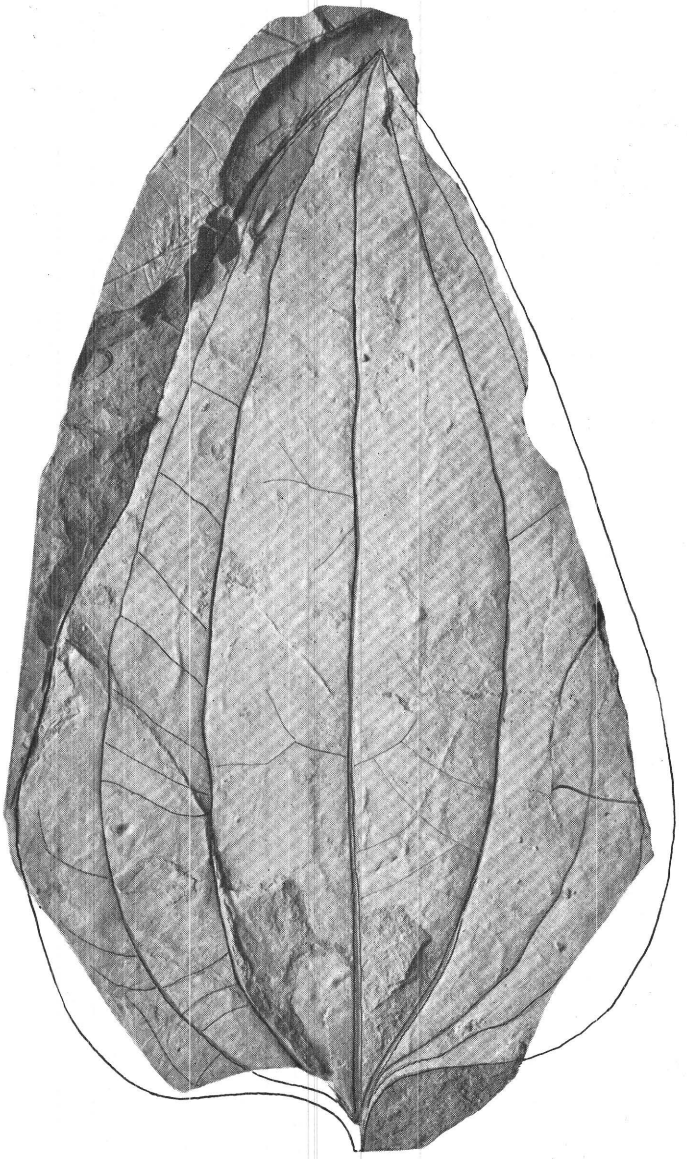
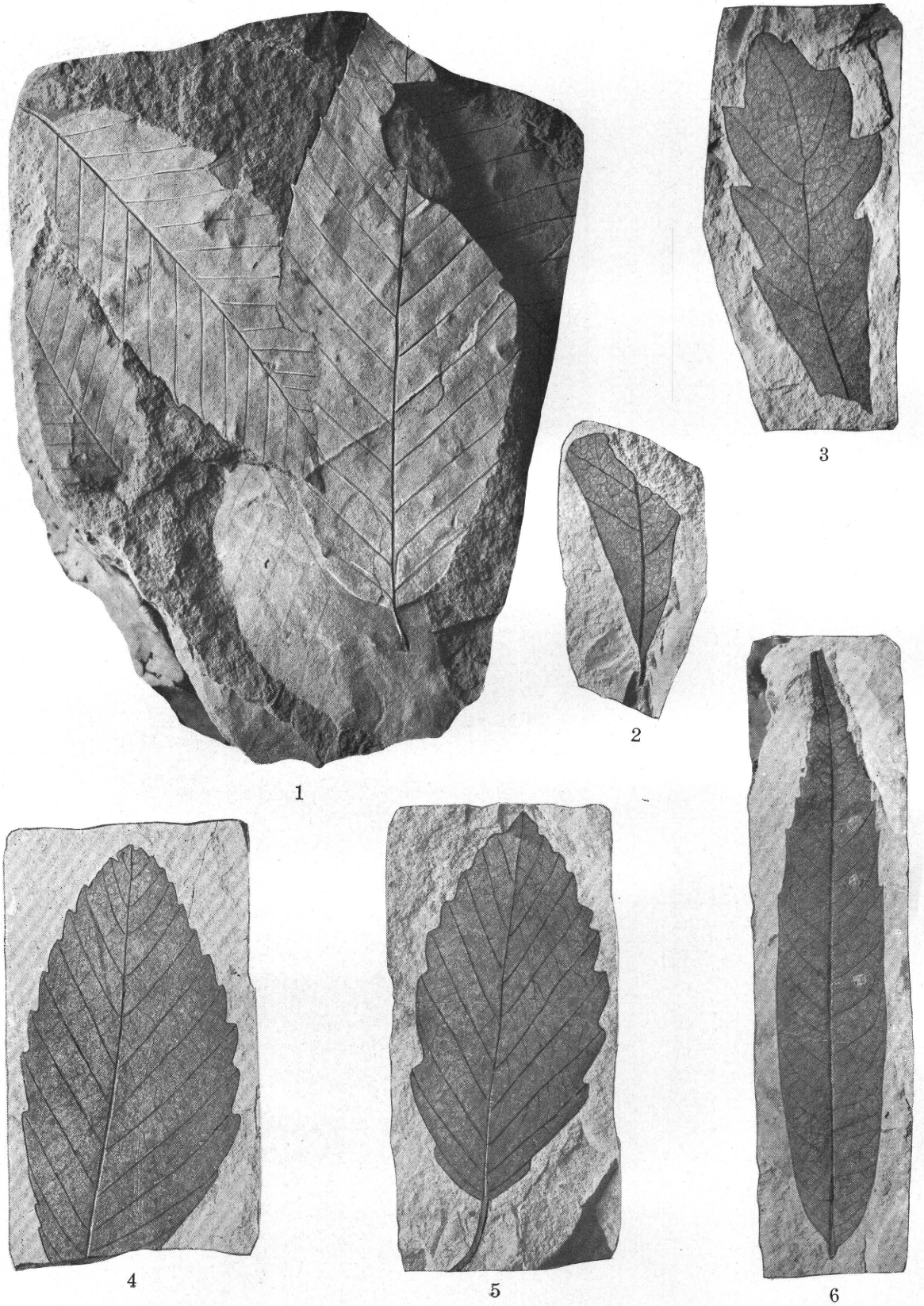


7

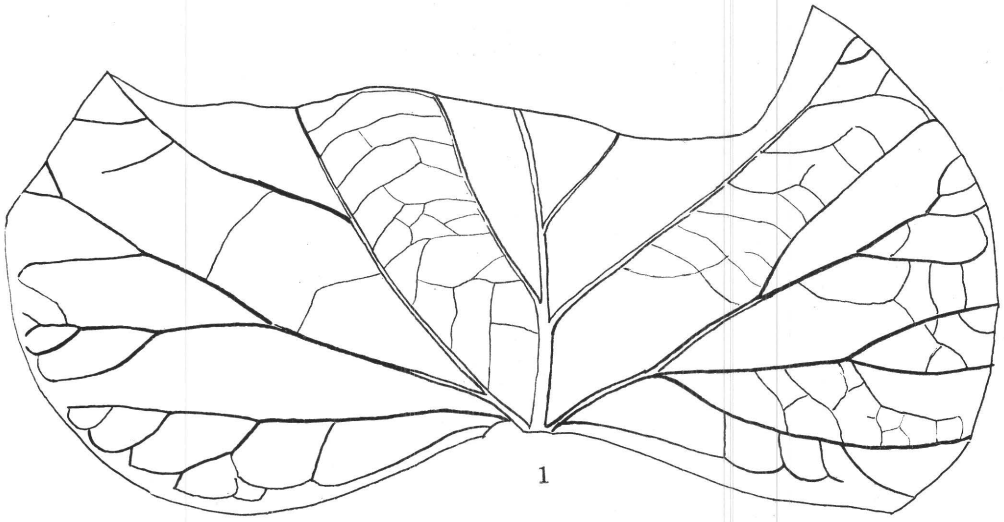
MIOCENE PLANTS FROM IDAHO.

1. *Glyptostrobus europaeus* (Brongniart) Heer, twig, 19½ miles east of Lewiston (p. 103).
2. *Dryopteris idahoensis* Knowlton, part of pinna, Alkali Creek (p. 103).
3. Two segments of specimen shown in figure 2, enlarged to show form and venation.
4. *Taxodium*, cone, 3.8 miles east of Whitebird (p. 103).
5. Itonid or phylloxerid galls on a leaf of *Fagus pacifica* Chaney, 3.8 miles east of Whitebird (p. 123).
6. *Fagus pacifica* Chaney, 3.8 miles east of Whitebird (p. 107).
7. *Smilax lamarensis* Knowlton, large leaf, 3.8 miles east of Whitebird (p. 105).



MIOCENE PLANTS FROM IDAHO.

1. *Fagus pacifica* Chaney, 3.8 miles east of Whitebird (p. 107).
2, 3. *Quercus payettensis* Knowlton, 11 miles east of Lewiston (p. 109).
4, 5. *Quercus spokanensis* var. *gracilis* Berry, n. var., southeast of Montour (p. 110).
6. *Quercus simulata* Knowlton (*Quercus chaneyi* form), 3.8 miles east of Whitebird (p. 109).



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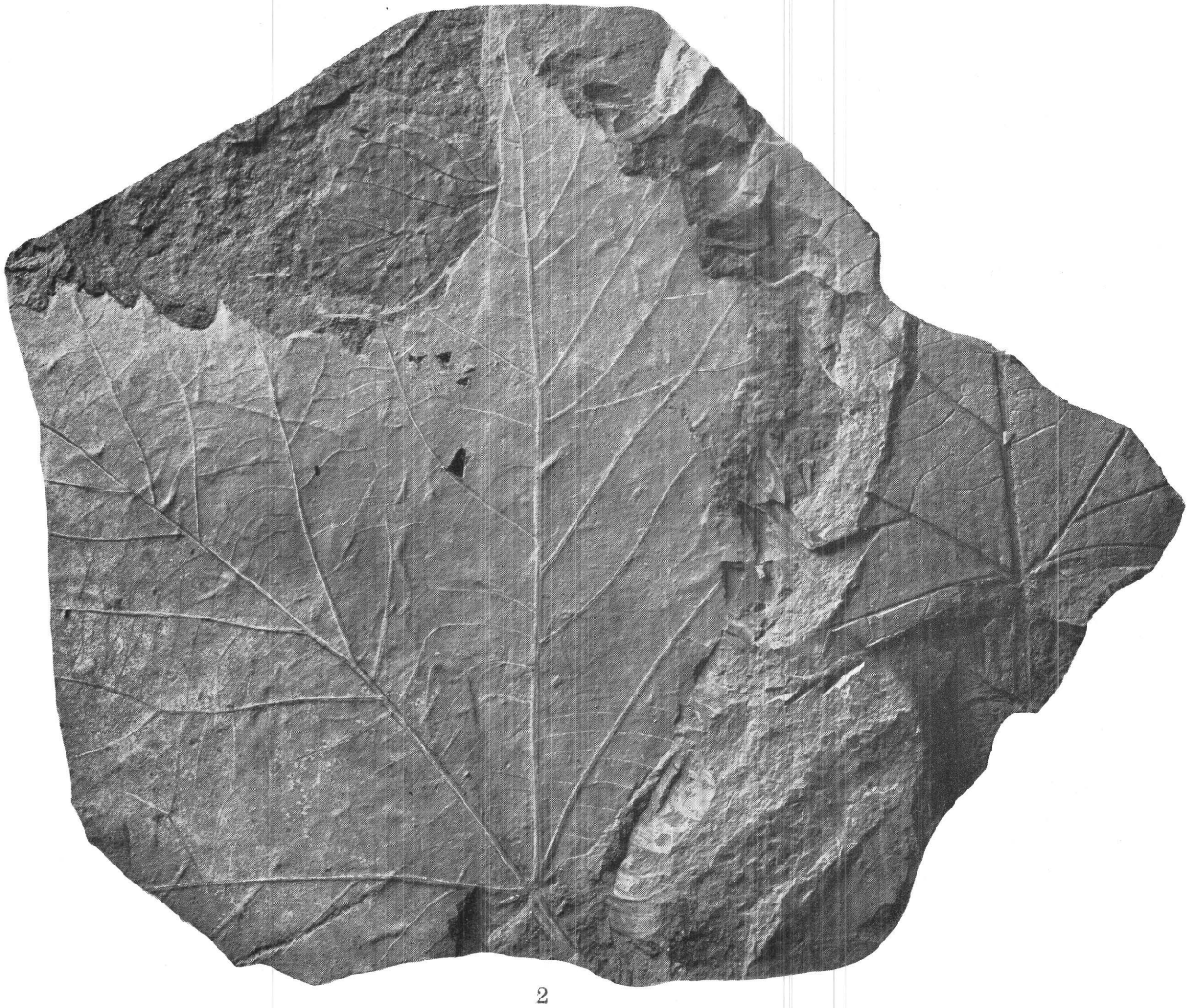
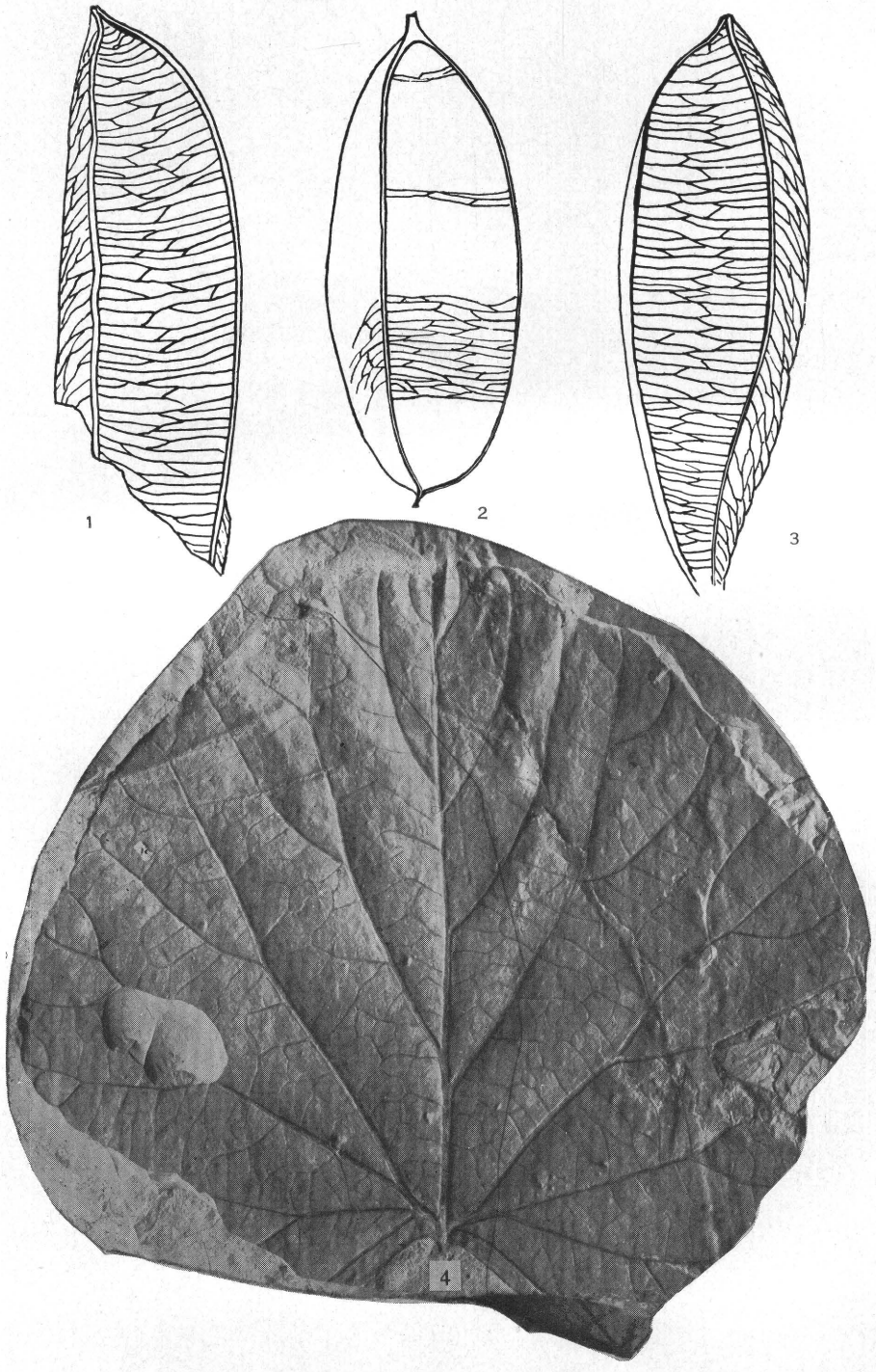


2

MIOCENE PLANTS FROM IDAHO.

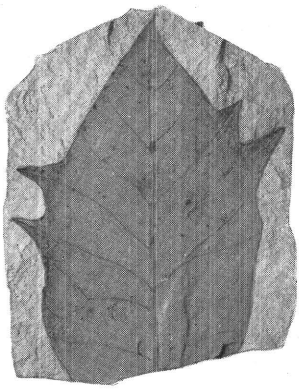
1. *Cercis idahoensis* Berry, base of leaf, 3.8 miles east of Whitebird (p. 114).
2. *Platanus dissecta* Lesquereux, 3.8 miles east of Whitebird (p. 111).



MIOCENE PLANTS FROM IDAHO.

1-4, *Cercis idahoensis* Berry (p. 114). **1, 3,** Pods, 3.8 miles east of Whitebird. **2,** Pod, Spokane, Wash. **4,** Leaf, 3.8 miles east of Whitebird.

1



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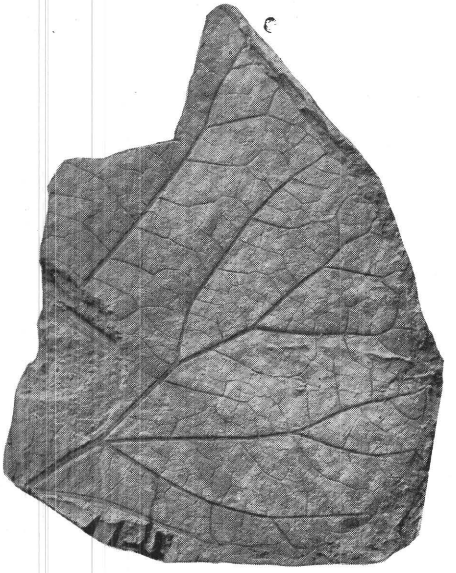

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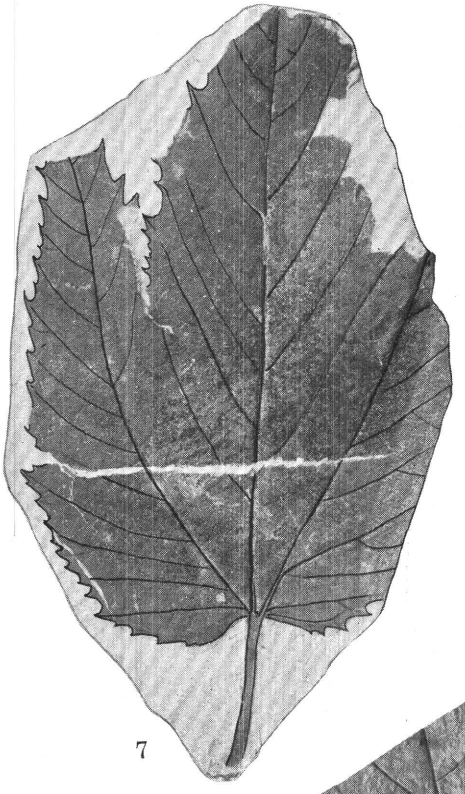

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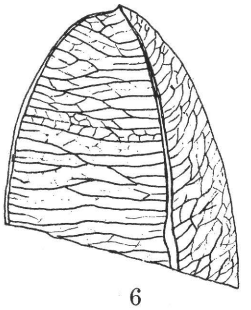

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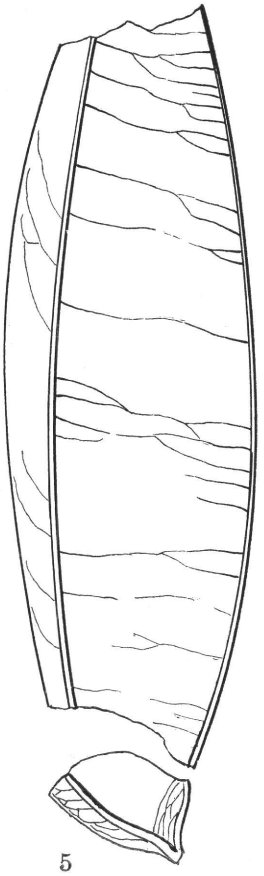
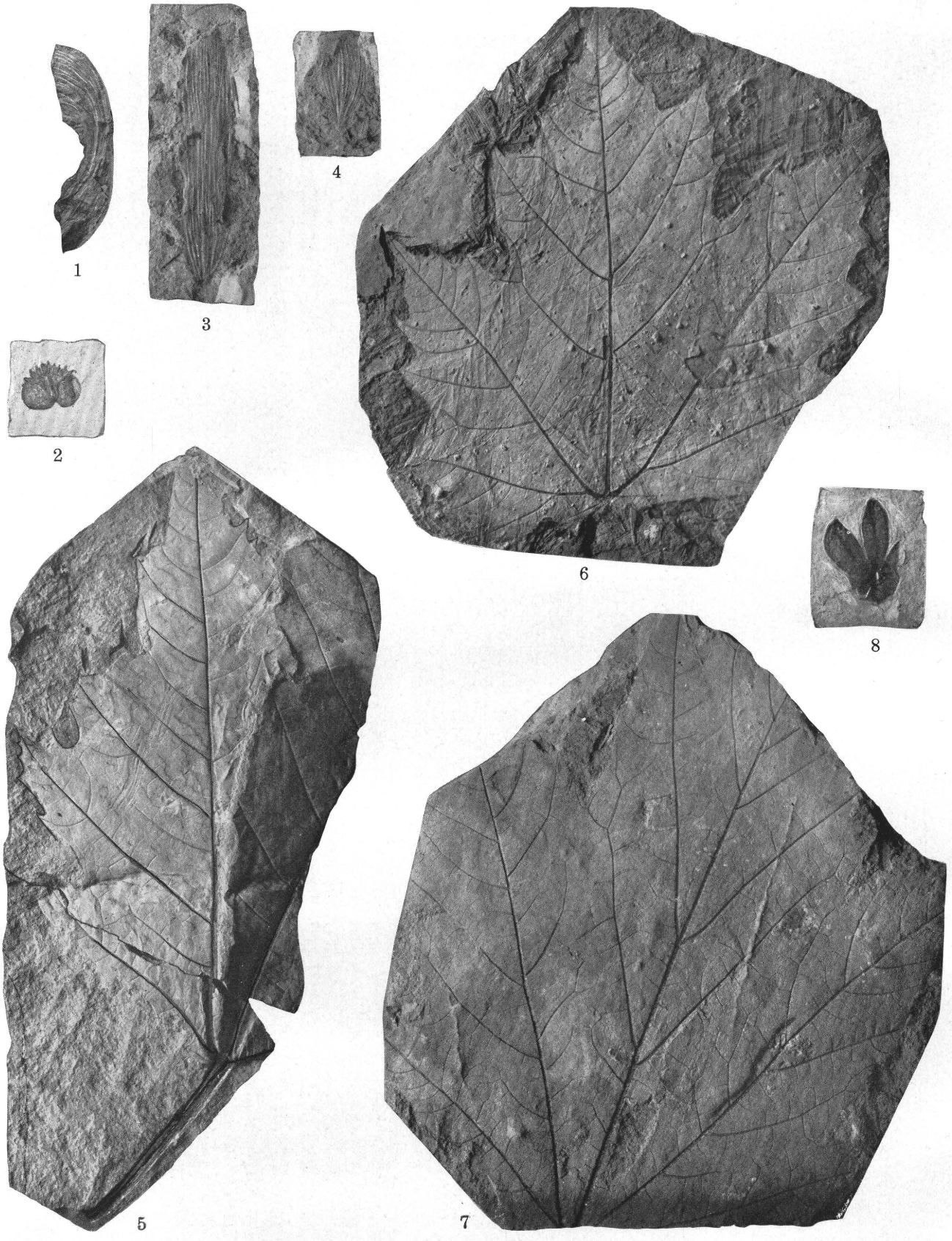


5

4

MIOCENE PLANTS FROM IDAHO.

1, 2. *Odostemon simplex* (Newberry) Cockerell, north of Weiser (p. 112).
3, 4. *Cercis idahoensis* Berry, leaves, 3.8 miles east of Whitebird (p. 114).
5, 6. *Cercis idahoensis* Berry, pods, 3.8 miles east of Whitebird.
7. *Acer bendirei* Lesquereux, 1 mile east of Whitebird (p. 117).



MIOCENE PLANTS FROM IDAHO.

1. *Acer oregonianum* Knowlton, 3.8 miles east of Whitebird (p. 118).
2. *Malva? hesperia* Knowlton, 1 mile east of Whitebird (p. 120).
3, 4. *Fraxinus?*, samaras, 3.8 miles east of Whitebird (p. 122).
5–7. *Acer florissanti* Kirchner, 3.8 miles east of Whitebird (p. 118).
8. Calyx, 3.8 miles east of Whitebird (p. 122).