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A LOWER LANCE FLORULE FROM HARDING COUNTY, SOUTH DAKOTA

BY

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ILLUSTRATIONS

A LOWER LANCE FLORULE FROM HARDING COUNTY, SOUTH DAKOTA

By EDWARD WILBER BERRY

For the last few years Mr. Henry E. Lee, of Rapid City, S.Dak., has been sending me selected material from the lower part of the Lance formation of Harding County, S.Dak., the exact locality being what is locally known as the Jump Off, an erosion basin of the headwaters of the South Fork of the Grand River, 10 miles north of the East Short Pine Hills.[1] The matrix is a soft gray friable sandstone, and consequently only the coarser, more resistant plants are preserved. In view of the coarseness of the matrix the preservation is excellent, although usually the finer details of venation are obscure. In the sands overlying the plant beds are thin seams of impure lignite.

Our knowledge of the Lance flora rests almost entirely upon more or less tentative determinations by the late F. H. Knowlton of collections made by coal parties of the United States Geological Survey. None of these collections, so far as I know, have been critically studied, and our knowledge of the flora is consequently very incomplete.

Although a large amount of field work has been done in several States on the various post-Montana and pre-Wasatch lithologic units that have been mapped, the question of their exact correlation and relationship is still unanswered and has given rise to great difference of opinion. In his catalog of the Mesozoic and Cenozoic plants of North America Knowlton,[2] an ardent advocate of the Tertiary age of the Lance and related formations, published a series of floral lists of the Lance, †Black Buttes,[3] Fort Union, Paskapoo, Raton, Denver, Dawson, Evanston, Livingston, and Hanna formations. None of these lists, except that for the Raton, were based on a monographic study, the others representing compilations from older workers and lists of tentative determinations. Consequently, it has been impossible for anyone to make a precise evaluation of these floras. This is especially true of the flora ascribed to the Lance. In the publication cited this formation is credited with 123 species, and hardly any specimens of any of these have been described or figured from Lance material, the list merely representing identifications of specimens, many of them fragmentary, with previously described species, principally from the Fort Union. Thus the Lance flora so far as recorded shows substantially the same facies as the Fort Union and appears to differ appreciably from the floras of the Denver, Dawson, and Raton along the Rocky Mountain front.

With the above-mentioned limitations in mind, it may be said that the Lance flora is essentially an assemblage of trees and shrubs of the Temperate Zone. This remains true even though it is recognized that many of the older determinations are misleading.

It has always been a matter of surprise that the floras of the Denver, Dawson, Raton, and other formations along the Rocky Mountain front had so much more in common with those of the Mississippi Gulf embayment than that of the Lance, for it seems impossible to postulate climatic or other environmental factors that would cause such a difference and, whatever may be the exact place of these western floras in world chronology, everyone is, I think, in agreement that there is slight if any age difference between them.

I have no solution for this problem, nor do I believe its solution is possible until all the floras in question shall have been critically studied by modern methods, although I have a suspicion that many of the present differences will disappear when identifications are revised.

The lower Lance flora from Harding County is too meager for extended comment, as but 10 species are described in the present paper. These species are as follows:

Coniferophyta:
- Pinales:
  - Cupressinaceae:
    - Sequoia nordenskiöldi Heer.

Angiospermae:
- Monocotyledonae:
  - Scitaminales:
    - Cannaceae:
      - Canna cf. C. magnifolia Knowlton.
  - Arecales:
    - Arecaceae:
      - Sabalites cf. S. ungeri (Lesquereux) Knowlton.
- Dicotyledonae:
  - Salicales:
    - Salicaceae:
      - Salix lancensis Berry.

[1] See Winchester, D. E., and others, The lignite field of northwestern South Dakota: U.S.Geol. Survey Bull. 627, p. 55, pl. 1, 1916.

[2] Knowlton, F. H., U.S.Geol. Survey Bull. 696, 1919.

[3] A dagger (†) preceding a geologic name indicates that the name has been abandoned or rejected for use in classification in publications of the U.S. Geological Survey.

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Angiospermae—Continued.
Dicotyledonae—Continued.
Ranales:
Magnoliaceae:
Magnolia dakotana Berry.
Rhamnales:
Rhamnaceae:
Rhamnites knowltoni Berry.
Vitaceae:
Vitis dakotana Berry.
Laurales:
Lauraceae:
Laurus wardiana Knowlton.
Gentianales:
Oleaceae:
Fraxinus leii Berry.
Position uncertain:
Carpites lakesii.

An undeterminable species of *Sapindus* and fragments of still other species generically unidentifiable are also present. As will be seen from the foregoing list the 10 species represent as many genera in 9 families and 8 orders. Nine of them are angiosperms, and of these 2 are monocotyledons and 7 are dicotyledons. All the dicotyledons belong to the choripetalous division except the *Fraxinus*.

When these are compared with the floral list compiled for the Lance, but 2 of the 10 named species are found in that list. These are *Sabalites* cf. *S. ungeri* and *Sequoia nordenskiöldi*. The *Sabalites* is one of those fan palms whose specific identity cannot be established with certainty and which have a recorded geologic range from the Upper Cretaceous (Medicine Bow and Vermejo formations) to the Raton and Fort Union formations. The *Sequoia*, more certainly determined, also ranges from the Upper Cretaceous (Estevan formation) to the Fort Union and Arctic Eocene.

Furthermore, of the 10 named species from Harding County, the following 5 occur in undoubted Cretaceous beds:

Canna cf. C. magnifolia (Vermejo)
Carpites lakesii (Laramie)
Laurus wardiana (Laramie)
Sabalites cf. S. ungeri (Medicine Bow, Vermejo)
Sequoia nordenskiöldi (Estevan)

Whatever may be the contrast between the Lance flora as a whole and the admitted Cretaceous flora, certainly a florule of 10 species, of which 4 are new and 5 others are known in Cretaceous beds, cannot be said to show a very striking non-Cretaceous and Eocene facies.

Comparison of the Harding County species with the flora recorded from the Fort Union or its supposed equivalents (Paskapoo, Ravenscrag) shows that but 4 of the 10 occur in these formations. This Lance florule is therefore somewhat more like Cretaceous floras than it is like Fort Union floras.

One species of the present florule is found in the White Mud formation of western Canada, 1 in the Animas formation, 2 in the Denver formation, and 3 in the Raton formation. The detailed ranges of all these species in other formations than the Lance are shown in the following table:

Occurrence of Lance florule of Harding County in other formations

	Previously recorded from Lance	Laramie formation	Livingston formation	Deposits at Point of Rocks, Wyo.	Medicine Bow formation	Fort Union formation	Paskapoo formation	White Mud formation	Ravenscrag formation	Animas formation	Beds of Fort Union age, Yellowstone Park	Denver formation	Vermejo formation	Raton formation	Midway (?) formation	Wilcox formation	Arctic Eocene	Estevan formation
Canna cf. C. magnifolia													×	×				
Carpites lakesi		×																
Fraxinus leii									×									
Laurus wardiana		×										×			×			
Magnolia dakotana																		
Rhamnites knowltoni			?	?			?			×		×		×		×		
Sabalites cf. S. ungeri	×				×	?							×	×				
Salix lancensis											?							
Sequoia nordenskiöldi	×					×	×		×								×	×
Vitis dakotana								×										

I have also tabulated below the number of species in the more prominent genera or groups in several comparable floras. It is not without interest that of the 14 genera and the groups of ferns, gymnosperms, and palms listed in the table, none of the genera and but a single gymnosperm and a single palm are represented in the florule under discussion. To show the contrast with the lower Eocene of the Mississippi Gulf embayment I have introduced the corresponding statistics for the Wilcox Eocene. This really gives but a slight idea of the real contrast, because there are scores of genera and literally several hundred species in the lower Eocene of the Southern States that are wholly unrepresented in the floras of the Western Interior.

Genera or groups in the Lance formation represented in other formations

	Lance formation	Deposits at Black Buttes, Wyo.	Denver formation	Dawson arkose	Evanston formation	Livingston formation	Hanna formation	Fort Union formation	Paskapoo formation	Ravenscrag formation	Raton formation	Wilcox formation
Aralia	5	------	1	------	------	------	------	7	2	2	2	4
Betula	1	------	3	------	1	------	------	5	------	------	------	------
Celastrus	6	------	3	------	------	------	------	10	------	3	2	6
Corylus	2	------	------	------	------	------	------	5	3	------	------	------
Ferns	3	1	9	8	------	1	------	11	4	3	7	15
Ficus	5	8	14	12	2	------	1	8	------	3	17	25
Gymnosperms	13	3	1	2	------	3	------	13	18	6	------	7
Grewiopsis	3	3	1	1	------	------	------	3	------	1	1	3
Hicoria	2	------	1	------	------	------	------	4	1	1	------	2
Juglans	2	2	5	1	2	2	1	6	5	2	10	4
Palms	5	1	11	3	------	------	------	1	------	1(?)	11	7
Platanus	9	4	6	5	------	------	3	6	2	4	9	1
Populus	13	1	12	1	1	------	5	25	6	1	2	------
Pterospermites	3	------	1	------	------	------	------	4	------	2	------	------
Quercus	4	4	7	2	2	3	2	4	5	4	4	------
Rhamnus	------	2	7	1	1	------	------	2	------	2	6	8
Viburnum	6	3	3	------	------	------	------	20	11	6	5	------

As I have already stated, I am not prepared to suggest an explanation of the facts above presented, but it is clear that the problem of the floras of the latest Cretaceous and earliest Tertiary in the Western Interior is by no means settled, nor solvable without a large amount of additional work; and that many of our stock traditions as to what they are and what they mean in terms of age or environment are quite as likely to prove erroneous as to prove correct.

Order CONIFERALES

Genus SEQUOIA Endlicher

Sequoia nordenskiöldi Heer

Sequoia nordenskiöldi Heer, Die Miocene Flora und Fauna Spitzbergens: Flora fossilis arctica, Band 2, Abt. 3, p. 36, pl. 2, fig. 13b; pl. 4, figs. 1, 4–38, 1870.

Newberry, U.S. Geol. Survey Mon. 35, p. 20, pl. 26, fig. 4, 1898.

Knowlton, Washington Acad. Sci. Jour., vol. 11, pp. 185, 189, 190, 198, 203, 211, 213, 214, 1909.

This species was originally described by Heer from the so-called "Miocene of Spitsbergen", and it has since been recorded from Greenland, Saskatchewan, and Alberta, and commonly and widely in the Lance and Fort Union of the western United States. The specific limits of remains of this sort are impossible of evaluation, and I feel sure that both in the Arctic and in the western interior of the United States what has been called *Sequoia brevifolia* Heer has often been confused with the present species. Both leafy twigs and cones occur in the lower Lance of Harding County.

Subclass MONOCOTYLEDONAE

Order SCITAMINALES

Family CANNACEAE

Genus CANNA Linné

Canna cf. C. magnifolia Knowlton

Unmistakable fragments of the leaves of *Canna* are present in the lower Lance of Harding County. I was disposed at first to compare them with the Wilcox species *Canna eocenica* Berry,[4] but now think that they more probably represent *Canna magnifolia* Knowlton.[5] Several species of *Canna* have been described in recent years, and unless the material is unusually well preserved it is practically impossible to differentiate them.

Canna magnifolia comes from the Vermejo formation of Colorado. There is a second somewhat doubtful species in the Puget group of Vancouver and three species in the lower, middle, and upper Eocene of the Gulf Coastal Plain.

Order ARECALES

Family ARECACEAE

Genus SABALITES Saporta

Sabalites cf. S. ungeri (Lesquereux) Knowlton

Remains of a fan palm probably represent this species, which has been referred successively to *Geo-*

[4] Berry, E. W., The lower Eocene floras of southeastern North America: U.S.Geol. Survey Prof. Paper 91, p. 181, pl. 15, figs. 7, 8, 1916.

[5] Knowlton, F. H., Geology and paleontology of the Raton Mesa and other regions in Colorado and New Mexico. U.S.Geol. Survey Prof. Paper 101, p. 254, pl. 36, fig. 3, 1917 [1918].

nomites and *Sabal*. It occurs in the Vermejo and Raton formations of New Mexico and is especially abundant in the Raton in that State and the adjacent part of Colorado.

The recognition of genera of fossil palms and even more so of species is often highly dubious, and it is possible that the present remains may represent what has been called *Sabal grandifolia* Newberry, a nominal Lance and Fort Union species, or *Sabal eocenica* (Lesquereux) Knowlton, a common post-Laramie species in Wyoming, Colorado, and New Mexico.

Subclass DICOTYLEDONAE

Order SALICALES

Family SALICACEAE

Genus SALIX Linné

Salix lancensis Berry, n. sp.

Plate 25, figure 8

I have compared the material from the lower Lance with all the described late Cretaceous and early Tertiary species of *Salix*, and it appears to be new. The material is so scanty, however, that diagnosis is attempted with a great deal of hesitation, although it has more definite generic characters than most of the numerous lanceolate leaves that authors have referred to this genus.

Leaves linear-lanceolate, about 9 centimeters in length by 10 to 13 millimeters in maximum width, which is in the lower half of the leaf. Texture subcoriaceous. Margin with small closely spaced serrate teeth. Apex acuminate. Base abruptly and slightly round pointed. Midvein stout and prominent. Secondaries thin, closely spaced, ascending, camptodrome.

I suspect that the leaves from the beds of Fort Union age in the Yellowstone Park, which Knowlton [6] referred to *Salix lavateri* Heer, represent this species, as it somewhat resembles that European Miocene form but is smaller and with pointed instead of rounded teeth. In looking over the records of *Salix lavateri* it is clear that the specimens from Alaska [7] and Greenland [8] which Heer referred to that species are not like one another and neither belongs to the same species as the European leaves.

[6] Knowlton, F. H., Fossil flora of the Yellowstone National Park: U.S.Geol. Survey Mon. 32, p. 697, 1899.

[7] Heer, Oswald, Flora fossilis alaskana: Flora fossilis arctica, Band 2, Abt. 2, p. 27, pl. 2, fig. 10, 1869.

[8] Heer, Oswald, Die fossile Flora Gronlands, pt. 2; Idem, Band 7, p. 76, pl. 67, fig. 5, 1883.

Order RANALES

Family MAGNOLIACEAE

Genus MAGNOLIA Linné

Magnolia dakotana Berry, n. sp.

Plate 25, figures 6, 7

Leaves relatively small, broadly ovate and tending to be slightly cordate, about 10 centimeters in length and 6 centimeters in maximum width, near the middle of the leaf. Margin entire but inclined to be more or less undulate, especially proximad. The leaf substance is not thick but appears to have been stiff. Midvein stout. Secondaries thin, seen only from the upper side of the leaf, but probably not prominent on the under side. About 10 pairs diverge from the midvein at wide angles, prevailingly camptodrome well within the margins; the tertiary branches from the superjacent secondaries, with which the camptodrome arches connect, are oblique, sometimes sufficiently so to give the secondary a forked appearance. In the basal half of the leaf two adjacent secondaries may unite in a loop halfway between the midvein and the margin and give off two curved branches, neither of which is coincident with the basal half. Tertiary veins indistinct, the main nervilles thin, mostly oblique percurrent, the areolation open.

This leaf is referred to *Magnolia* with some hesitation and after comparison with a large number of recent genera. It has the general proportions of a number of extinct leaves which have been referred to this genus and also a venation of several of these—for example, *Magnolia longifolia* Newberry. I have seen no recent species exactly similar. On the other hand, the fossil is more like the recent leaves in this genus than it is like the recent leaves of such genera as *Anona*, *Nyssa*, *Ficus*, and *Aristolochia*, to which paleobotanists have referred similar leaves and an enumeration of which would serve no useful purpose.

Order RHAMNALES

Family VITACEAE

Genus VITIS Linné

Vitis dakotana Berry, n. sp.

Plate 26, figures 4–6; plate 27

Leaves showing wide variation in size, outline, and marginal characters. Slightly trilobate or entire, with an abrupt or extended tip and a deeply cordate base,

Margins with prominent serrate, abruptly pointed teeth, directed outward and small or large: these may be essentially of one size all around the margin, or some may be much larger than others. Some of the leaves are almost orbicular or elliptical cordate; others are slightly sublobate by the greater prominence of the teeth at the ends of the lateral primaries or at the ends of some of the secondaries; others have distinct sinuses dividing the leaf into a terminal and two lateral lobes, but the sinuses are never deep and are as a rule unequally developed on the two sides. The texture is subcoriaceous, and the manner of preservation suggests that the under surfaces were tomentose. Length 8 to 19 centimeters; maximum width 6 to 15 centimeters. Petiole frequently broken away, very stout and presumably long, preserved for a length of 5 centimeters in one specimen. Midvein stout and prominent. Lateral primaries diverging from the midvein at the top of the petiole at angles of 45 or less, stout. Secondaries stout, prominent, craspedodrome. Tertiaries relatively stout, as shown in the accompanying illustrations.

This is one of the commonest species at this outcrop and, I believe, represents a single botanic species, although several might be described from the material, as no two leaves are exactly alike. They all have the same facies, however, and are unmistakably grapes and not *Ampelopsis* or any of the related genera of the Vitaceae. It has also been found in some abundance in the white mud formation of the Cypress Hills region in western Canada.

Many of the leaves show leaf galls greatly resembling those produced by *Phylloxera*, and figure 4 illustrates such a specimen. These galls are approximately circular, about 2 millimeters in diameter and located away from the veins. Professor Cockerell, to whom Mr. Lee sent some specimens, is much impressed with the similarity of the fossils and the work of the modern *Phylloxera* and thinks he can distinguish the ostioles. He also calls attention to certain of the grape leaves with roundish perforations 2 to 4 millimeters in diameter which greatly resemble the work of the larvae of *Incurvaria*, one of the Lepidoptera.

Over 40 fossil species of *Vitis* have been described, but many of them probably represent *Ampelopsis* or *Platanus*. The earliest of these is a very questionable identification from the late Cretaceous Vermejo formation of New Mexico, which is certainly too doubtful to establish the presence of *Vitis* in that region at that time. Eocene species to the number of about 12 have been described. Among these are seeds from England and the Arctic which appear characteristic. No species are recorded from the Laramie, Denver, Lance, or Fort Union, the species from Fort Union described by Ward having been subsequently referred to *Ampelopsis*. One species was based on seeds from Black Buttes, Wyo., but it is not especially convincing. Knowlton recorded 4 species from the Raton formation, but these also are not conclusive. The known Oligocene species are all European, and the genus was evidently widespread and abundant throughout the later Tertiary and the Pleistocene.

The existing species are numerous and are confined to the Northern Hemisphere. Many might be mentioned as showing points of resemblance to the present fossil species, but their leaves are in general so variable that such comparisons lack any significance. The Asiatic species *Vitis amurensis* and *V. thunbergi* impress me as being similar, but this resemblance probably lacks any genetic significance.

Family RHAMNACEAE

Genus RHAMNITES Forbes

Rhamnites knowltoni Berry

Plate 26, figure 1

Cornus studeri Lesquereux, U.S. Geol. and Geog. Survey Terr. Rept. for 1871, p. 293, 1872; U.S. Geol. Survey Terr. Rept., vol. 7, p. 244, pl. 42, figs. 4, 5, 1878. [Not Heer.]
Knowlton, U.S. Geol. Survey Prof. Paper 101, p. 342, pl. 109, fig. 2, 1918; U.S. Geol. Survey Prof. Paper 134, p. 94, pl. 13, fig. 2; pl. 15, fig. 1, 1924.
Berry, U.S. Geol. Survey Prof. Paper 91, p. 331, pl. 68, fig. 3, 1916; Nat. Mus. Canada Bull. 63, p. 25, 1930.
Rhamnites knowltoni Berry, U.S. Geol. Survey Prof. Paper 131, p. 16, pl. 12, fig. 7, 1924.

The fossil leaves from American early Tertiary localities represented by the citations given above were long confused with the European Miocene species *Cornus studeri* Heer. They appear to me to be more closely allied to *Rhamnus* than to *Cornus* and are not uncommon in the Animas, Denver, and Raton formations of the western United States and in the Ravenscrag formation of western Canada. The species occurs also in the Wilcox of the Gulf Coastal Plain. Fragmentary specimens are not at all uncommon in the lower Lance of Harding County, S.Dak. These are not very distant from the Paskapoo and Livingston leaves and those from Point of Rocks, Wyo., which have been referred (wrongly) by Lesquereux and Penhallow to the European species *Cornus rhamnifolia* O. Weber.

Order LAURALES

Family LAURACEAE

Genus LAURUS of authors

Laurus wardiana Knowlton

Plate 26, figure 3

Laurus ocoteoides Lesquereux, U.S.Geol. Survey Terr. Rept., vol. 7, p. 215, pl. 36, fig. 10, 1878. [Not Massalongo, 1858.]

Laurus wardiana Knowlton, U.S.Geol. Survey Bull. 152, p. 129, 1898; U.S.Geol. Survey Bull. 696, p. 350, 1919; U.S.Geol. Survey Prof. Paper 130, p. 144, pl. 16, fig. 1, 1922.
Berry, U.S.Geol. Survey Prof. Paper 91, p. 13, 1916.

This species was described by Lesquereux from the typical Laramie at Golden, Colo., where it does not seem to have been especially common. It was redescribed by me in a description of Eocene floras published in 1916, to which the reader is referred for details. Broken specimens are not uncommon in the Midway or early Wilcox of Bexar County, Tex. It was recorded by Knowlton in 1919 from the Dawson arkose near Mosley, Colo., but the name does not appear in Knowlton's posthumous account of the Denver flora,[9] and what disposition he finally made of the Dawson material is unknown, although I surmise that it may be included in what is called "*Laurus primigenia*" in that work.

As commonly used by paleobotanists the genus *Laurus* is not applied to the existing species but is treated as a form genus for members of the Lauraceae about which there is some doubt as to genus. With abundant material it is often possible to refer such specimens to an existing genus. In the present case *Laurus wardiana* cannot be certainly distinguished from the leaves of a number of existing genera such as *Nectandra*, *Oreodaphne*, and *Mespilodaphne*.

Order GENTIANALES

Family OLEACEAE

Genus FRAXINUS Linné

Fraxinus leii Berry, n. sp.

Plate 25, figures 1–5

Leaflets relatively narrow and elongated, often falcate, lanceolate, slightly inequilateral, with acuminate tips and rounded-cuneate bases, petiolulate. Margins entire at base; above with somewhat variable and irregularly spaced serrate teeth directed upward, often so finely pointed and extended as almost to deserve the term spinous-serrate, though not thickened like true spines. Texture subcoriaceous. Length 5.5 to 13 centimeters; maximum width 1.25 to 3.25 centimeters. Petiolule usually not preserved, short and stout, not over 7 millimeters in length. Midvein stout and prominent. Secondaries relatively thin, subparallel, camptodrome. Tertiaries obscure except for the tertiary veinlets entering the marginal teeth. The species is named for the collector, Henry E. Lee, of Rapid City, S.Dak. It has subsequently been detected in the Ravenscrag formation of the Cypress Hills region of western Canada.

Leaves or leaflets similar to these have frequently been referred to *Rhus*, *Myrica*, or some proteaceous genus, but their features are, in my opinion, those of *Fraxinus*. They are much like the leaflets of the existing Old World *Fraxinus tamariscifolia*. Eocene fossil species in North America comprise 2 from the Denver formation, 1 from the Fort Union, and an Arctic species found in the Wilcox. Characteristic fruits also occur in the Wilcox, so there is no question that the genus was in existence during Eocene time—in fact, it has been recorded from the late Upper Cretaceous. Many Tertiary species have been described, and there are about two score existing species of the North Temperate Zone which reach their southern limit on the islands of Cuba and Java.

Genus CARPITES Schimper

Carpites lakesi Knowlton

Plate 26, figure 2

Carpites lakesii Knowlton, U.S.Geol. Survey Prof. Paper 130, p. 164, pl. 19, figs. 6–8, 1922.

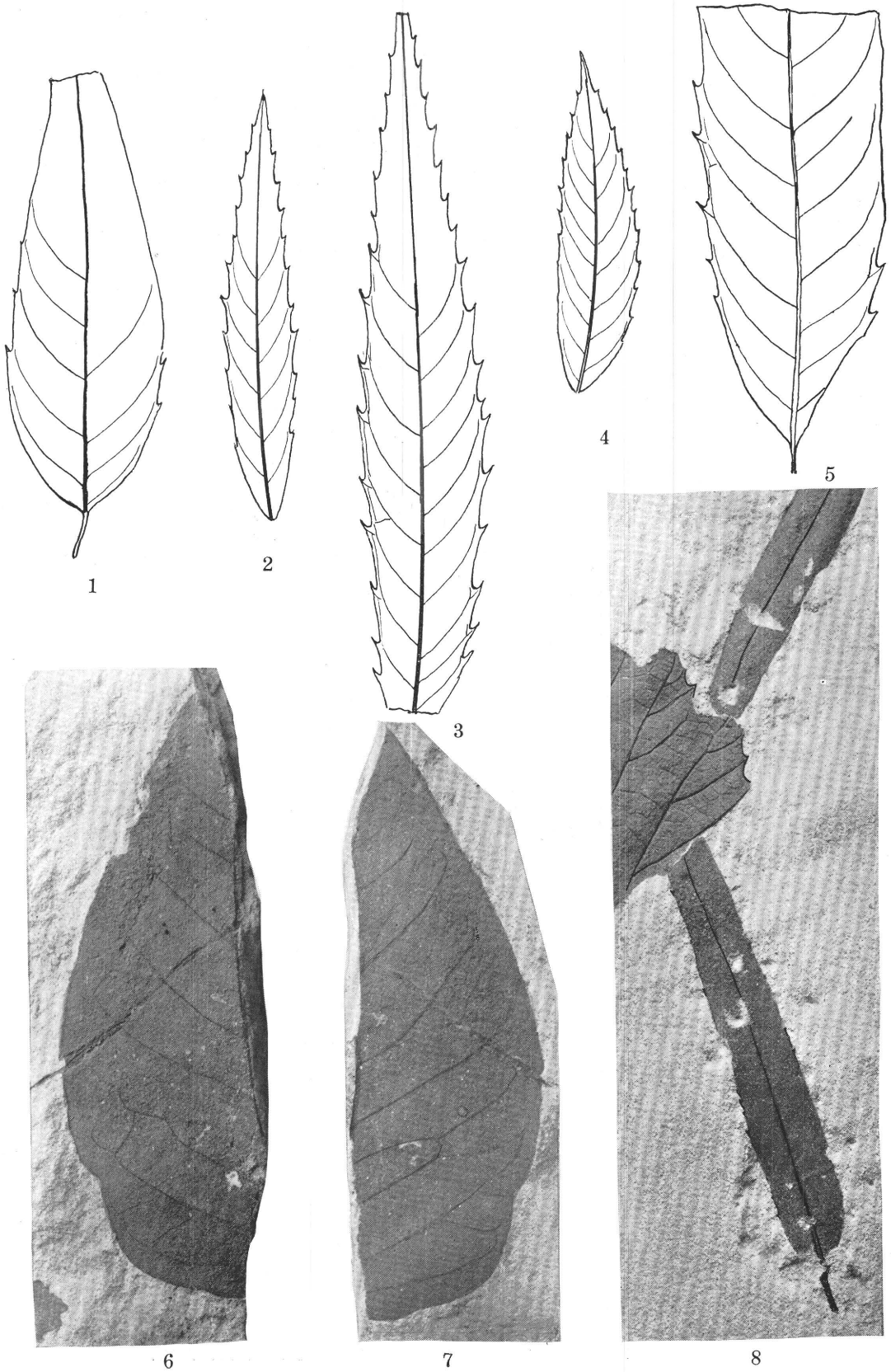
A single specimen of fruit from the lower Lance appears to be identical with this Laramie species though slightly larger. Its botanic nature is wholly conjectural, but as was suggested by Knowlton it greatly resembles the stones of various drupaceous fruits, particularly those of some species of *Prunus*, a genus which would not be at all out of place in a plant assemblage like that of the Lance.

It shows some resemblance also to a fossil fruit described by Knowlton[10] from the Dawson arkose as *Carpites coryloides*.

[9] Knowlton, F. H., The flora of the Denver and associated formations of Colorado: U.S.Geol, Survey Prof. Paper 155, 1930.

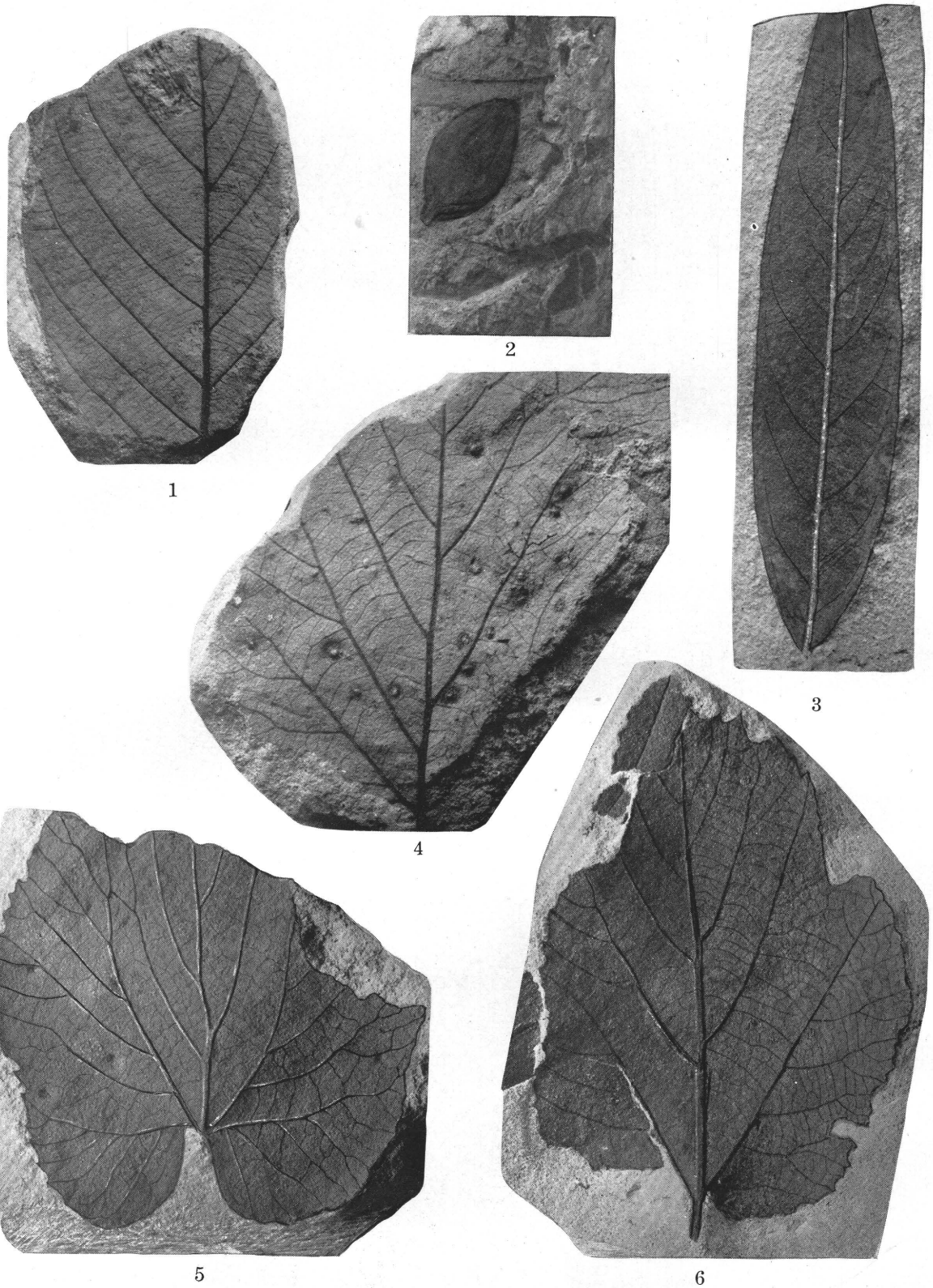
[10] Knowlton, F. H., The flora of the Denver and associated formations of Colorado: U.S.Geol. Survey Prof. Paper 155, p. 132, pl. 58, figs. 3, 4, 6, 1930.

PLATES 25–27



FOSSIL PLANTS FROM THE LOWER LANCE OF HARDING COUNTY, S.DAK.

1–5, *Fraxinus leii* Berry; 6, 7, *Magnolia dakolana* Berry; 8, *Salix lancensis* Berry.



FOSSIL PLANTS FROM THE LOWER LANCE OF HARDING COUNTY, S.DAK.

1, *Rhamnites knowltoni* Berry; 2, *Carpites lakesi* Knowlton; 3, *Laurus wardiana* Knowlton; 4–6, *Vitis dakotana* Berry. Figure 4 shows the galls supposed to have been produced by *Phyllozera*.

FOSSIL PLANTS FROM THE LOWER LANCE OF HARDING COUNTY, S.DAK.

Vitis dakotana Berry. Three-fourths natural size.