56.1(78.8)

Article IV.— THE FOSSIL FLORA OF FLORISSANT, COLORADO.

By T. D. A. Cockerell.

Plates VI–X.

The flora of the Florissant shales, as enumerated below, includes about 106 genera. The material obtained by the expedition of 1906 includes many genera and species not now reported, and it is probable that still others exist in various collections. In working over the new forms, I have selected for description and illustration those which seemed most characteristic, or which could be certainly referred to the vicinity of known living species, and have put aside for later study those which were either very imperfect, uncharacteristic, or of quite doubtful affinities. Some belonging to the last category, but well preserved, have been transmitted to Dr. Hollick, who has kindly promised to describe them if he can determine their systematic position.

So many mistakes in classification have been made by the most eminent palæobotanists, that those who follow in their footsteps may well regard error as inevitable. The precision which is possible in working up certain groups of fossil insects (*e. g.*, the dragonflies) or vertebrata, is quite out of the question in palæobotany, except in comparatively rare cases. On the other hand, however, plant remains are preserved in many more localities than those of land animals, and the specimens of the several species are frequently numerous and easily recognizable, so that for geological purposes they are exceedingly serviceable. It is probable, also, that the continued study of fossil plants, especially in comparison with living forms, will gradually yield results much more accurate than those yet attained. This will especially be the case if sufficient coöperation can be secured, so that the placing of difficult forms may not rest wholly on the opinions of single individuals. Fossils cannot be run down in the ordinary botanical keys, and it is almost impossible for any single man to have such a knowledge of the form and structure of leaves as to place all the members of an extinct flora, or determine certainly whether they belong to living genera. The relative abundance of the different species in the vicinity of Lake Florissant cannot be determined from the frequency of their occurrence in the shales. *Fagus longifolia, Populus lesquereuxi,* etc., which occur in great numbers, evidently grew on the very margin of the lake. Other species, represented by few or single specimens, may have been common enough on the sur-

rounding hills, but so far from the water that their leaves were rarely carried to it. The accidental character of the occurrence of various species in the lake, and consequently in the shale, makes it practically impossible to exhaust the possibilities of the locality, and a fine leaf of some hitherto unknown plant may be uncovered at any moment. At Station 14, where so many new species were found, there was some evidence that a small stream had flowed into the lake, perhaps carrying debris from the uplands. Of the 106 genera, 45 occur in Colorado to-day, namely: —

Chara (?)	Pinus.	Betula.	Amelanchier.	Aralia (?)
Fontinalis.	Sabina.	Alnus.	Cratægus.	Oxypolis.
Hypnum.	Typha.	Quercus.	Sorbus.	Vaccinium.
Phegopteris.	Potamogeton(?)	Celtis.	Ptelea.	Fraxinus.
Dryopteris.	Stipa.	Persicaria.	Rhus.	Mimulus.
Pellæa.	Acorus.	Odostemon.	Schmaltzia.	Aster.
Isoetes (?) [1]	Juncus	Saxifraga (?)	Pachistima (?)	Carduus.
	Populus.	Philadelphus.	Acer.	Parthenocissus.
	Salix.	Ribes.	Rhamnus.	
		Rosa.	Vitis.	
			Malvastrum.	

The apparent absence of *Picea*, *Pseudotsuga* and *Abies* is to be noted. Of the genera not found in Colorado, the following 36 occur in our eastern and southern states, about eleven being exclusively southern: —

Onoclea.	Planera.	Fagara (?)	Osmanthus.
Woodwardia.	Morus.	Cotinus.	Sicyos (?)
Spirodela.	Ficus.	Ilex.	Melothria (?).
Hicoria.	Aristolochia.	Celastrus.	Aneimia (sens. latiss.)
Juglans.	Persea.	Staphylea.	Myrsine (sens. latiss.)
Comptonia.	Hydrangea (?)	Sapindus.	— Florida.
Morella.	Liquidambar.	Tilia.	Dalbergia — Florida.
Carpinus.	Leucœna.	Andromeda (?)	
Castanea.	Cercis.	Bumelia.	
Ulmus.	Acacia.	Diospyros.	

It is thus evident that a flora similar to that of the Carolinian region occupied the Rocky Mountains during the Miocene; whether it persisted into the Pliocene we do not know. The increasing cold and aridity is of course quite sufficient explanation for its disappearance.

While some of the genera are to-day decidedly southern, we do not know that they may not have possessed a few hardier species in Miocene times. In any case, the flora certainly cannot be described as a tropical one. Two of the genera, *Weinmannia* and *Myrica*, exist to-day in the *mountains* of Jamaica and other tropical localities. *Sequoia*, as is well known, has retreated to California. *Zizyphus* is common in Texas and New Mexico.

[1] The (?) indicates that the generic identity of the fossil plant is in doubt, usually because of imperfect material.

The following seven generic names are applied to fossils of which the general relationships only are known, and have no great significance as members of the Florissant flora:—

Najadopsis *Heer.*
Celastrinites *Saporta* (?)
Apocynophyllum *Unger* (?).
Mimosites *Bowerbank* (?).
Palmocarpon *Lx.* (?).
Lomatites *Saporta.*
Banksites *Saporta* (?).

Of those marked with a query, one is very doubtfully from Florissant, and the others are probably not correctly assigned even to the "blanket genera" in which they are placed.

Podogonium Heer, is a well-known genus of the European Miocene, but the Florissant material is very incomplete, and may not be truly congeneric. Another American *Podogonium, P. americanum* Lx., is described from the Laramie and Montana formations of Wyoming, but the evidence as to generic identity is if anything even more unsatisfactory.

The remaining twelve Florissant genera exist to-day in distant parts of the world, as follows:—

Tmesipteris *Bernh.* Australian Region, and Mts. of Philippines. The generic position of the Florissant fossil is perhaps not beyond question.

Engelhardtia *Leschen.* East Indies, Indian Archipelago and S. China.

Lomatia *R. Brown.* Australia, Tasmania, Chile.

Pterocarya *Kunth.* Asia, including Japan.

Melia *L.* Africa and Asia, including Japan.

Santalum *L.* E. Indies and Australia. Generic position of Florissant plant doubtful.

Amygdalus *L.* Asia. One American species.

Paliurus *Juss.* Asia, including Japan.

Buettneria *L.* Mainly tropical America, but also in East Indies and Madagascar.

Sterculia *L.* Tropics of both hemispheres.

Hedera *L.* Palæarctic, to Japan. Florissant plant doubtfully of this genus.

Porana *Burm.* E. Indies. Miocene of Europe.

It will be remarked that there is *no strictly Neotropical element whatever.* Of the known localities for fossil plants, the one presenting a flora most like that of Florissant is Elko Station, Nevada. Unfortunately this locality is either poor in species, or has not been well worked, and has yielded only the following:—

Diospyros.
Fagus.
Ficus.
Lycopodium.
Myrica (4).
Planera.
Populus.
Salix (2)
Sapindus.
Sequoia (2).
Thuja.

Most of these genera, however, are also found at Florissant; and the species are said to include the highly characteristic Florissant fossils *Planera*

longifolia, Myrica drymeja and *Sequoia affinis.* It is therefore probable that the Elko Station beds are Miocene, and later than the true Green River formation.

The Green River formation, excluding Florissant and Elko Station, includes the following localities and genera:

(1). *Green River and mouth of White River.*

Acer.*	Ficus.*	Musophyllum (? locality)	Sapindus.*
Acrostichum.	Hemitelites.	Myrica.*	Sphærites.
Ampelopsis.	Ilex (2).*	Phragmites (in Colo.)	Zizyphus.*
Aralia.*	Juglans (4).*	Planera (2)*	Cyperus.
Arundo (2).	Juncus.*	Quercus,*	Ulmus(White R.)*
Brasenia.	Leguminosites (Z).	Rhus (in Colo.)*	
Equisetum.	Lomatia.*	Sabal.	
Eucalyptus (?).	Manicaria.	Salix (?)*	

In this and the following lists the asterisk indicates a Florissant genus.

(2.) *Uinta County, Wyoming.*

Acer.*	Cyperacites.
Alianthus.	Euonymus.
Amygdalus.*	Flabellaria.
Andromeda.*	Quercus.*
Antholithes.	Typha.*
Celtis.*	

Not one genus is common to Uinta Co. and Elko Station.

(3.) *Alkali Station, Wyoming.*

Alnus.*	Ilex.*
Apocynophyllum.*	Myrica (2)*
Ficus (2)*	Juglans.*

(4.) *Barrell Springs, Wyoming (? Green River group).*

Equisetum.	Lygodium.
Geonomites.	Poacites.

(5.) *Washakie Station, Wyoming.*

Rhamnus washakiensis* Ckll. (*intermedius* Lx., not S. & H.); species said to extend down to the Laramie Group.

(6.) *Sage Creek, Montana.*

Ilex.*
Sequoia.*

The Green River beds, if we include Elko Station and exclude Florissant, have yielded about 75 species of plants, of which 23 are supposed to be

identical with species described by European authors. The combined series is far inferior to that of Florissant, and most of the 24 genera common to both are widespread and of little significance as proofs of contemporaneity. The presence of palms in the Green River beds deserves note.

Characeæ.

Chara (?) **glomerata** *Lx.* A doubtful plant, which Lesquereux himself says "may represent flower-bearing pedicels of *Platanus*."

Diatoms and desmids must occur in the shale, but so far we have not been able to detect them.

In 1907 Mrs. Cockerell and Mr. Geo. N. Rohwer obtained an excellent "fruit" or sporostegium of *Chara* in a bed containing *Sphærium*, etc. The species will be figured in a later report, but in the meanwhile it may be named **Chara peritula**, sp. nov. and separated from other American fossil species known from sporostegia as follows: —

Sporostegium broader than long, strongly depressed, with 10 spirals *C. compressa* Kn.

Sporostegium spherical, about as broad as long, with six distinct spirals and signs of a seventh . . . . . *C. peritula* sp. nov.

Sporostegium ovoid or elliptical, longer than broad.

8 or 9 spirals . . . . . *C. stantoni* Kn.

12 or 13 spirals . . . . . *C. springeræ* Kn.

Fungi (Pyrenomycetes).

Pleosporeæ.

Didymosphæria betheli sp. nov.

Scattered, punctiform, perfectly black perithecia, slightly inclined to be in rows longitudinally, but not at all massed, on fragment of leaf of *Typha lesquereuxi* Ckll. The perithecia are circular to suboval, very well defined, with an average diameter of about 170 μ, some reaching about 220 μ.

Station 14. *Tmesipteris alleni* occurs on the same slab.

The small, definite black spots appear to indicate a Pyrenomycetous fungus, and agree quite closely with the recent *Didymosphæria typhæ* Peck.

Mr. E. Bethel has very kindly sent me, for comparison, *Leptosphæria typharum* (Desm.) Karst., found on *Typha latifolia* at Fort Collins, Colo. (*Crandall*); but I think the fossil is not closely allied to this, the general appearance being very different.

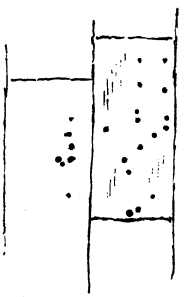


Fig 1. *Didymosphæria betheli* Ckll. Florissant, Sta. 14. On *Typha lesquereuxi* Ckll.

I have named the fungus after Mr. Bethel, in recognition of his important labors on the fungi of Colorado.

MUSCI.

Leaves linear, long-pointed . . . . . *Fontinalis pristina* Lx.
Leaves lanceolate or broader, not greatly elongated; plant branching.
Branches short, somewhat claviform . . . *Hypnum haydenii* Lx.[1]
Branches numerous, longer and more slender . *Hypnum brownii* Kirch.

These are all sterile. A fruiting moss, representing a new species, has been described by Mrs. Britton and Dr. Hollick as *Glyphomitrium cockerelleæ*.

SCHIZEACEÆ.

Aneimia (?) **gracillima** (*Lx.*). The *Adiantites gracillimus* Lx., Cret. and Tert. Floras, pl. xxi, p. 8, appears to be an *Aneimia* of the type of *A. aurita* Sw.

POLYPODIACEÆ.

Onoclea reducta sp. nov.

PLATE VI, FIG. 4.

Station 9 (T. D. A. Cockerell). Lower part of sterile frond.

Petiole about 34 mm. long; first segments about 21 mm., second over 30, the whole shaped as in the living *O. sensibilis*, but none of the marginal teeth large or elongated, the intervals between them also apparently greater than in the living species. Venation not preserved.

Much smaller and less strongly dentate than *O. sensibilis fossilis* Newberry.

Phegopteris guyottii (*Lx.*).

Sphenopteris guyottii Lx., Cret. and Tert. Floras, p. 137.

This common fern is much better referred to *Phegopteris* than to the mesozoic genus *Sphenopteris*. The specimens differ greatly among themselves, but so do different pinnæ of the recent *P. dryopteris*, and it does not seem practicable to establish a second species. Perhaps the best material is from Station 13.

Dryopteris scansa sp. nov.

PLATE VI, FIG. 9; PLATE X, FIG. 38.

Station 13. Part of a frond, about 3 cm. long, with ten pinnæ, which project at right angles. Pinnæ 6–13 mm. long, alternate, 4 to 6 mm. apart, very narrow,

[1] This so called moss proves to be a piece of the *Sequoia*, which takes the name *Sequoia haydenii*.

broadest basally (2–3 mm.); the margins deeply lobed, the lobes obtuse, about three in 6 to 7 mm.; venation very distinct. The general form is somewhat suggestive of *Pellæa atropurpurea*, but that has the pinnæ entire, or lobed at the base, with the veins obscure.

A specimen in the British Museum (v. 2574) is fertile, and shows the sori to be round, and placed at or near the ends of the short lobes of the pinnæ, one to each lobe. The uppermost (terminal) pinnæ (at least 5 or 6) are cuneiform, bluntish, and sterile, as is usual in the genus. The extreme end of the frond is lost, so it cannot be seen whether it is produced. The fertile pinnæ are about 9 mm. long. This specimen, being more complete, and also fertile, should be taken as the type of the species.

Woodwardia florissantia sp. nov.

PLATE VI, FIG. 2.

Station 13. Fertile fronds with long linear pinnæ, over 40 mm. long, and about 4 broad, in all respects formed as in *W. areolata* (L.) Moore.

It is possible that the species ought not to be separated from the modern one. The margins of the pinnæ are entire; no venation can be made out. *Woodwardia preareolata*, Knowlton, is also evidently allied.

Pellæa antiquella sp. nov.

PLATE VIII, FIG. 20.

Station 14. The end of a sterile frond, with its reverse. Similar to *P. stelleri* (S. G. Gmel.) Watt; apical lobe about 17 mm. long and 9 broad, with rounded lateral lobules; at the base of the apical lobe, on one side, a rounded lobe is attached, and below this, after an interval of about 3 mm., is a symmetrical pair of lobes, each over 10 mm. long and about 4½ broad; below these, after another interval, is another pair of smaller lobes.

PSILOTACEÆ.

Tmesipteris alleni (*Lx.*) *Hollick.* Stations 11, 12, etc.; a common fossil at Florissant.

ISOETACEÆ.

Isoetes (?) **brevifolius** *Lx.* Unfigured. There is an *Isoetes* of this name in Europe, but it is considered only a form of *I. velatum* A. Br.

PINACEÆ.

Pinus wheeleri sp. nov.

PLATE X, FIGS. 5, 11.

Station 14. Leaves in clusters of five, 12 cm. or more long, about 1 mm. broad. A cone attributed to this species was found by Dr. W. M. Wheeler at Station 11, at the top of the exposure. It is brown black, with large broad scales in the manner of *P. flexilis*, James. The diameter of the cone is about 30 mm.

Pinus florissanti *Lx.* Stations 9 and 13. Leaves in clusters of three. *P. hambachi* Kirch., is presumably the same.

Sequoia haydeni (*Lx.*) *Ckll.* (= *affinis* Lx). Plate X, Fig. 48. Station 14, etc., abundant. Foliage of two forms, and cones short, subglobular; allied to the modern *S. sempervirens*. After examining a large amount of material, and reading what J. S. Gardner has to say in his *British Eocene Flora, 2*: 29–42, I believe that only one species is represented at Florissant, and that the so called *Glyptostrobus* of that locality must be included in it. The fossil stumps must also be referred here.

In 1907 Mr. S. A. Rohwer found at Station 14 an additional conifer, represented by a beautifully preserved twig with about ten branchlets, which are an inch or less long. It may be named **Heyderia coloradensis** sp. nov. and compared with the recent *Heyderia decurrens* (Torrey) K. Koch, of California, with which it almost exactly agrees. The larger leaves are about 5½ mm. long, and perhaps less acutely pointed than in the living plant. The foliage is in general better developed than in most specimens of *H. decurrens*, but scarcely more so than in a plant in the herbarium of the New York Botanical Garden, which was collected by Torrey in 1865 in the grove of *Sequoia gigantea* in California. It is of much interest, as showing the persistence of a plant association through a long period, to note that the fossil *Heyderia* also occurred in a *Sequoia* grove, a piece of *Sequoia haydeni* being actually preserved on the same slab, and touching the *Heyderia*.

Heyderia is the American *Libocedrus*, or Incense Cedar. The genus is to-day represented by two species, *H. decurrens* of our Pacific coast, and the *Libocedrus macrolepis* B. & H. of Asia. The segregation of *Heyderia* from the true Libocedrus (of the southern Hemisphere) is here made in accordance with the views of Dr. N. L. Britton, as indicated in conversation and on the sheets at the N. Y. Botanical Garden. I was able to examine material of the true *Libocedrus* also, and since the fossil is obviously *Heyderia*, having the distinctive characters well-marked, it affords an additional argument for the segregation.

JUNIPERACEÆ.

Sabina linguæfolia (*Lx.*) *Ckll.* Station 14. Beautifully preserved. Lesquereux describes a var. *gracilis,* but I have not seen more than one form.

TYPHACEÆ.

Typha lesquereuxi *Ckll.* Plate X, Fig. 46. Station 13, etc.; very common.

ZANICHELLIACEÆ.

Potamogeton (?) **verticillatus** *Lx.* A plant of doubtful relationships. Another Florissant plant, not figured, is referred by Lesquereux to the European *P. geniculatus* Al. Br.

NAIADACEÆ.

Najadopsis rugulosa *Lx.* A problematical plant.

POACEÆ.

Stipa laminarum sp. nov.

PLATE VI, FIGS. 1, 3.

Station 14. Common. The specimens consist of the long-awned grains similar to those of the living *S. comata.* Grain 10–11 mm. long and about 2 broad, its awn quite 60 mm.

ARACEÆ.

Acorus affinis *Lx.*

LEMNACEÆ.

Spirodela penicillata (*Lx.*) *Ckll.*

JUNCACEÆ.

Juncus crassulus sp. nov.

PLATE X, FIGS. 44, 45.

Station 14; common, represented by single flowers. Capsule when well-developed globular, about 3 mm. long, and nearly or quite as broad, dark colored; perianth

about 5 mm. long, far exceeding capsule, very pale; style about 2 mm. long, perfectly straight; stigmas less than half length of style.

Probably allied to *Juncus setaceus* Rostk. The large flowers are suggestive of the South American genus *Rostkovia*.

Palmaceæ. (?)

Palmocarpon (?) *globosum* Lx. A problematical fruit, probably not a palm.

Juglandaceæ.

Based on an involucre . . . . *Engelhardtia oxyptera*, Saporta, Lx.
Based on nuts . . . . . 1.
Based on leaves, all with dentate or denticulate borders . . . . . 3.
1. Nut oval, the apex produced . . . *Hicoria rostrata* (Goepp.) Knowlt.
   Nut nearly circular, apex not produced . . . . . 2.
2. Nut small, scarcely over 1 cm. long . . . *Hicoria princetonia* n. n.
   Nut larger, about 17½ mm. long . . . . *Juglans* (?) *sepultus* n. sp.
3. Leaflet large, 11 cm. long, base rounded, inequilateral . *Juglans florissanti* Lx.
   Leaflet about 9½ cm. long, base broad cuneate, equilateral *Juglans affinis* Kirchner.
   Leaflets broad-cuneate basally, 6 to 9½ cm. long, base equilateral in terminal one, very inequilateral in lateral ones . *Hicoria juglandiformis* (Sternb.) Knowlt.
   Leaflets narrowed to base, but there rounded, obtuse, nearly equilateral in lateral leaflets . . . . . *Juglans crossii*, Knowlt., Kirchner.

Pterocarya americana Lx. described from Middle Park, is probably not a member of the Florissant flora; it is, moreover, quite uncertain generically; Lesquereux's figure shows neither the apex nor the base. **Hicoria princetonia** is the doubtful *Carya bruckmanni* Heer, of Lesquereux (Cret. and Tert. Floras, pl. xxxix, p. 6.) It is not quite clear to me that *Juglans affinis* is not a large terminal leaflet of *Hicoria juglandiformis*; in that case I should be inclined to use Kircher's specific name, regarding the identity of our plant with that of Sternberg (from Bohemia and Galicia) as doubtful.

Juglans (?) **sepultus** sp. nov.

Plate VI, Fig. 8.

Station 3, in soft red rock (W. P. Cockerell). Fruit globose, about 17½ mm. long and 16 broad, not beaked; apparently thin-shelled, with the seed deeply lobed.

This is the organism published by Lesquereux (Cret. and Tert. Flora, pl. xxxix, f. 5) as *Juglans costata* Unger. Schenk, in Zittel's 'Handbuch,'

refers it to *Carya ventricosa*; that is to say *Hicoria ventricosa* (*Juglandites ventricosus* Sternb.) from Central Europe. This latter is said by Unger to have the fruit very like that of *Hicoria alba*; it can scarcely be identical with the Florissant plant, which is probably a *Juglans*, as Lesquereux held. *Juglans costata* (Sternb.) Ung. (from Bohemia) is also a *Carya* (*Hicoria*) according to Unger and Schenk, and should be called *Hicoria costata*.

Myricaceæ.

Leaves deeply incised . . . . . 1.
Leaves merely dentate or denticulate . . . . . 2.

1. Large, tapering to base and apex, nearly 4 cm. broad in middle; reticulate veined (Station 11.) . . . . . *Comptonia insignis* (Lx.) Ckll.
   Smaller, apparently not reticulate veined; doubtfully distinct from the last *C. acutiloba* (Lx.) Ckll.
2. Leaves not or little tapering apically, the sparing dentation only beyond the middle . . . . . 3.
   Leaves usually narrow, more tapering, dentate to below the middle . . 4.
3. Leaves more obtuse and parallel sided, the teeth only near the apex (? Florissant) . . . . . *Morella bolanderi* (Lx.) Ckll.
   Leaves less obtuse, the sides more convex, the teeth not only near the apex *Morella hendersoni* Ckll.
4. Leaves large and broad, with sharp teeth of different sizes (Station 9L, W. P. Ckll.) . . . . . *Myrica copeana* Lx.
   Leaves narrower and more tapering, the teeth not, or not obviously, of two sizes . . . . . 5.
5. Leaves distinctly inequilateral at base . *Myrica drymeja* (Lx.) Knowlton. (I include here *fallax*, *obscura* and *rigida* of Lesquereux.)
   Leaves tapering (long-cuneate) and not obviously inequilateral at base . 6.
6. Teeth very strong and sharp, not very numerous . . *Myrica scotti* Lx.
   Teeth smaller, weaker, or more irregular . . . . *Myrica* sp.?

Myrica sp.?, at the end of the table, includes the leaves referred by Lesquereux to *M. acuminata* Unger, *M. amygdalina* Saporta, *M. zachariensis* Saporta and *M. polymorpha* Schimper. How many, or what, species these really represent seems to me doubtful.

M. drymeja is one of the commonest species at Florissant.

Salicaceæ.

Based on the calyces . . . . . *Populus crassa* (Lx.) Ckll.
Based on leaves . . . . . 1.

1. Leaves very broad, often with a more or less cordate base . . . . 2.
   Leaves pyriform or subpyriform, base broad and rounded . . . 3.
   Leaves lanceolate . . . . . 4.

2. Leaf very large, base cordate, blade about 12 cm. long and 14 broad toward base; margin feebly crenulate . . . . . *Populus scudderi* Ckll.
   Leaf not so large, not or hardly cordate; 5 nerved from base *P. arctica decipiens* (Lx.) Ckll.
3. Leaf long-oval, not strictly pyriform, the margins with a gentle even curve above; three nerves from base . . . . . *P. zaddachi* Heer, var., Lx.
   Leaf strictly pyriform, the margin beyond middle straight or a little concave; five-nerved from base . . . . . *P. pyrifolia* Kirch.
4. Margins entire . . . . . 5.
   Margins crenulate or dentate . . . . . 6.
5. Broadest part of leaf considerably beyond the middle; leaf 8 cm. long *Salix libbeyi* Lx.
   Leaf more tapering, broadest point not beyond middle . . *Salix sp.?*
6. Marginal teeth short or obtuse; venation conspicuously camptodrome *Populus lesquereuxi* Ckll.
   Marginal teeth fine and acute; venation semi-craspedodrome . . . 7.
7. Leaf less tapering apically, but with a more narrowly cuneate base *Salix ramaleyi* Ckll.
   Leaf more tapering apically, but with a broader base *S. ramaleyi rohweri* Ckll.

In addition to the above, the *Populus* (?) *pseudocredneria* is distinguished by the broad leaf with very large marginal teeth, quite unlike those of any of the other species. *Populus crassa* should doubtless be associated with one of the species known from the leaves, but which one we do not yet know. *P. zaddachi* is not, I believe, the species of Heer, but is probably merely a small short leaf of *P. lesquereuxi*, such as we have found on the same branch with normal leaves. *P. oxyphylla* Saporta, Lx., is a leaf similar to *P. pyrifolia*, but small and with remote denticulations. I believe that it is the same species, but that it is probably not Saporta's plant, so the name *pyrifolia* should be preferred. *Salix amygdalæfolia* Lx., will run in the above table to *Populus lesquereuxi* (Plate VIII, Fig. 23), and I strongly suspect that it is founded on small narrow leaves of that species. In any event, the name is unavailable, because of *S. amygdalifolia* Gilib. *Salix* sp.? in the table is merely to leave a place for the possible occurrence of such species as *S. integra* and *S. media*, which Kirchner lists, but I believe erroneously.

Salix ramaleyi rohweri n. var. (Plate IX, Fig. 34) is from Station 14, which I believe is not of the same age as the locality of typical *ramaleyi*. This leaf, as well as *ramaleyi* proper, differ from the more usual type of *Salix* (and conspicuously from "*S. amygdalæfolia*" Lx.) in the semicraspedodrome venation, the secondaries bending upwards apically, but terminating on the margin, nowhere forming perfect festoons. The secondaries in the variety are a little more divergent and a little more numerous. The length of the blade is 11 cm., its greatest width 24 mm.; its width 4 cm. from apex, 15 mm. The teeth are sharp, 6 to a cm.

Populus arctica decipiens (*Lx.*). This leaf, from Station 14, appears to be identical with *Populus decipiens* Lx., 1873, now considered a variety of *P. arctica* Heer. The base, however, is broadly rounded, not cuneate; the apex is also rounded; the blade of the leaf is 31 mm. long and 33 broad. There is a *Populus*-like petiole.

Populus crassa (Lx.).

PLATE VIII, FIG. 22; PLATE V, FIG. 42.

Macreightia crassa LX. Cret. and Tert. Floras, p. 175, pl. XXXIV f. 16, 17. (3-lobed or parted.)

Diospyros cuspidata KIRCHNER, Trans. Acad. St. Louis, VIII (1898), p. 185, pl. xii, p. 1. (4-lobed.)

These calyces are abundant in the Florissant shales at Station 14. They undoubtedly belong to *Populus*, being almost exactly like those of some of the modern species. In the living species, they vary from three to four parted. *P. crassa* should doubtless be associated with some of the fossil leaves, but until they are found connected, such association with any particular species can hardly be made.

Populus (?) pseudocredneria sp. nov.

PLATE VIII, FIG. 28.

Station 14; apical part of leaf, more than half. *Planera longifolia* is on the same slab. Type in Am. Mus. Nat. Hist.

Width 48 mm.; probable length of blade about 55 mm.; similar to *Populus* (?) *daturæfolia* (*Credneria* (?) *daturæfolia*, Ward. Types of the Laramie Flora, 1887), and especially to Ward's pl. xliv, f. 1, but marginal teeth not so numerous, being about the same size, though the leaf is so much smaller. The teeth seem to begin about the middle, and to be about three on each side, each about 10 mm. long, the breadth at base 9½ mm. or less, the margins slightly convex for the most part, not so generally concave as in *daturæfolia*. The apical and subapical teeth are notched laterally, producing a small accessory tooth. The venation, so far as preserved, is similar to that of Ward's species. The leaf gives the impression of having been rather thin. Ward himself admits that the reference of his *daturæfolia* (from the Fort Union Group, Montana) to *Credneria* is quite hypothetical. He compares the leaves also with *Ilex*, *Quercus*, *Platanus*, etc., but curiously enough, does not allude to *Populus*, although his pl. xliv, f. 2, could be believed conspecific with *P. subrotundata* Lx., Tert. Flora, pl. xxiv, f. 8. I have compared the venation with that of recent *Populus* leaves and do not find any such differences as seem to forbid generic association. The teeth, which Ward considers especially interesting, are very variable. When least developed (in *daturæfolia*) they recall some of our western cottonwoods; when highly developed (as in some *daturæfolia*, and in our *pseudocredneria*) they remind one of *Populus bolleana* Lauche, from Turkestan, which is usually regarded as a variety of *P. alba*.

The lobes or teeth of *P. pseudocredneria* rather recall those of *Acer indivisum* Lx., but they are more numerous, and the venation is pinnate instead of palmate as in *indivisum*. There is also some resemblances to *Platanus dissecta* Lx., but the leaf of *pseudocredneria* is much smaller, with larger lobes. *P. dissecta* has the venation nearly as in *pseudocredneria*, and looks as though it could possibly be congeneric. There is some resemblance to *Platanus rhomboidea* Lx., from Golden, but the venation is markedly different.

Betulaceæ.

Carpinus (?) **attenuata** *Lx.* Station 14, on the same slab with, and almost touching, a leaf of *Planera longifolia*. A well-preserved leaf, showing the details of the venation, which do not seem to accord perfectly with *Carpinus* or *Corylus*. In outline, the leaf is like a *Corylus*, such as *C. rostrata*; and I do not believe it is correctly referred to *Carpinus*.

Lesquereux has figured (Cret. and Tert. Floras, pl. xxxix, f. 3) what he calls flowers of *Alnus*, but they seem to me to belong to *Quercus*. On the other hand, we have an excellent pistillate ament of *Alnus* from Station 13. It is ovoid, about 11 mm. long and 7 broad.

Alnus cordata Lx. (Cret. and Tert. Floras, p. 151) is a homonym of *A. cordata* Desp.; it may be called *A.* **præcordata**, n. n.

The following table separates the Florissant species of this family:—

Leaf large, with double serration; tapering (wedge-shaped) at either end, and very broad in the middle . . . . . *Carpinus* (?) *attenuata* Lx.
Leaf with the sides more or less evenly convex, or nearly parallel, as is usual in the family . . . . . 1.
1. Leaf elongate, more or less lanceolate, with double serration . . . 2.
Leaf oval or subcordate . . . . . 3.
2. Teeth conspicuously of two sizes, large sharp ones terminating the lateral veins, and little ones in the intervals; laterals not very numerous *Betula florissanti* Lx.
Teeth sharp, but not obviously of two sizes; laterals very numerous; sides often nearly parallel (Stations 50 and 14) . . . . . *Carpinus fraterna* Lx. (incl. "*grandis* Ung." Lx.)
3. Leaf doubly serrate; about 6 cm. long; base cordate; laterals eight pairs, opposite . . . . . *Alnus præcordata* Ckll.
Leaf simply serrate; base truncate . . . . . 4.
4. Leaf larger, laterals fewer and more regular (Station 5) *Alnus kefersteinii* (Goepp.) Ung., Lx.
Leaf smaller, laterals closer and more irregular . . *Betula truncata* Lx.

Our *Alnus* from Station 5 is evidently that figured by Lesquereux as *kepersteinii* from Florissant, but its identity with the plant figured by Unger

is questionable, the latter having the laterals or secondaries still fewer and wider apart.

It is a singular thing, that the leaves of the common *Planera longifolia* of Florissant are almost exactly like those of *Betula pumila*, as figured in Britton and Brown's 'Illustrated Flora' (Vol. I, p. 511); but they are not at all like those of *B. pumila* as represented in the herbarium of the University of Colorado!

FAGACEÆ.

Leaf lanceolate, margin entire
species doubtfully referred to *Quercus elæna* Ung. and *Q. neriifolia* Al. Br.
Leaf serrate or dentate or lobed . . . . . 1.
1. Leaf lobed . . . . . 2.
Leaf dentate (often coarsely) or serrate . . . . . 4.
2. Lobes few and more or less rectangular . . *Quercus balaninorum* Ckll.
Lobes more numerous, rounded . . . . . 3.
3. Lobes longer; base very narrowly cuneate . . *Quercus lyratiformis* Ckll.
Lobes shorter; base more obtuse . . . . *Quercus ramaleyi* Ckll.
4. Apex abruptly produced, tongue-like, teeth irregular . *Quercus osbornii* Lx.
Apex not thus produced . . . . . 5.
5. Leaf oval, with a long petiole; serrations weak
Quercus (?) *florissantensis* Ckll. (*Q. pyrifolia* Lx., not Blume)
Leaf long-oval or longer; marginal teeth strong . . . . . 6.
6. Leaf long-oval; teeth irregular *Quercus peritula* n. n. (*Quercus mediterranea* Lx).
Leaf much elongated, approximately parallel sided . . . . . 7.
7. Base very narrowly cuneate, tapering to the petiole; teeth large and regular
Quercus drymeja Unger, Lx.
Leaf large, probably over 12 cm. long; lateral nervures more numerous than in the last; marginal teeth more numerous . . *Castanea intermedia* Lx.
Leaf large; teeth fewer and more irregular than in the last; base broad
Castanea dolichophylla Ckll.

Quercus serra, Unger, is reported by Lesquereux, without a figure. According to Unger's figures, it resembles *Q. florissantensis*, but is more prominently toothed.

Quercus mediterranea Unger, of Lesquereux (Cret. and Tert. Floras, pl. xxviii, f. 9) is certainly not the species originally described by Unger in 'Chloris Protogaea'; it may take the name *Q. peritula*.

Quercus lyratiformis sp. nov.

PLATE VII, FIG. 17.

Station 14; four leaves on twig. Type in Am. Mus. Nat. Hist.; reverse at University of Colorado.

Leaf similar to *Q. lyrata* Walt., and agreeing with that species and differing from

Q. alba in the very acute basal angle. Probable length of leaf 65–70 mm., the petiole 7 mm., the blade comparatively narrow, its breadth about 18 mm., deeply lobed, the lobes about 5 mm. long, and formed as in *lyrata*, except that none have a secondary lobule, and the sinuses are more acutely pointed.

There is a certain resemblance to *Comptonia insignis* (Lx.) Ckll., but the leaves are much narrower, with more obtuse lobes.

Quercus balaninorum sp. nov.

PLATE VIII, FIG. 21.

Station 14. A leaf, lacking the base; as preserved light ferruginous. Form lanceolate, tapering to base and apex, with one or two large rectangular lateral lobes, and some irregular small dentations. Secondary nervures few, near middle of leaf more than 10 mm. apart. Greatest breadth of leaf 28 mm.; breadth 11 mm. from apex 17 mm.; apex not produced.

Much like *Quercus lesquereuxiana* Kn., as figured by Knowlton (1900), but different from Lesquereux's original figures (as *Q. acrodon*), which have sharp teeth, numerous and not far apart. There is very strong resemblance to *Q. emoryi* Torrey, as figured by Sargent (Trees of North America, p. 286), except that in *emoryi* the apex is more tapering. Rydberg's *Q. emoryi* (Bull. N. Y. Bot. Gard., 1901, pl. 32) shows the apex as in the fossil, but the lobes are a little more pointed. There is also a slight resemblance to *Q. prinoides* Willd.

The name is derived from the beetles of the genus *Balaninus*, which doubtless infested the acorns. Scudder has described six species of this genus from the Florissant shales.

Castanea intermedia *Lx.* This was described from "Middle Park," but no doubt really came from Florissant. The so called *Quercus drymeja* Ung., from Bridge Creek, Oregon (Miocene), as figured by Lesquereux (Cret. and Tert. Floras, pl. liv, f. 4) appears to be the same species; it certainly is not Unger's plant. Knowlton has referred it to his *C. pulchella*, a species closely resembling the so-called *C. ungeri*.

Lesquereux recognized three species of *Castanea* from the American Tertiaries; they may be separated as follows:—

Leaf broader, more inclined to ovate, the teeth strong and sharp (Miocene, John Day Valley, Oreg.) . . . . . *atavia* "Unger." Lx.
Leaf longer in proportion to its breadth, more parallel-sided . . . . 1.
1. Leaf large, the teeth short and not very close together (California) *ungeri* "Heer." Lx.
Leaf smaller, the teeth larger and closer together (Florissant) *intermedia* Lx.

Knowlton, applies to the *C. ungeri* the name *C. castaneæfolia* (Unger)

Knowlton, based on the *Fagus castaneæfolia* of Unger. Unger's figure of the latter, however, is almost exactly like the leaf which Lesquereux calls *C. atavia*, and is distinctly different from the leaves figured as *C. ungeri*. According to Knowlton, the *C. atavia* of Lesquereux is identical with "*Quercus*" *horniana* Lx.

Castanea dolichophylla sp. nov.

Station 14 (Rohwer) a single well-preserved leaf; type in Amer. Mus. N. Hist., reverse at University of Colorado. Leaf about 165 mm. long and 25 broad, elongate, the basal half parallel-sided, the apical gradually tapering (about 60 mm. from apex the leaf is about 17 mm. broad, about 40 mm. from apex, 12 mm.); base obtuse, rounded, inequilateral; teeth of the usual form, but rather irregular, and not close together (near middle of leaf about 1 tooth in 10 mm.); petiole about 10 mm. long, somewhat twisted. The base of the leaf is as in the common chestnut.

Distinguished from *C. intermedia* by the teeth being only half as numerous, and in form more like those of the living *C. dentata* (Marsh) Borkh. (*C. intermedia* is more like *C. pumila*). The elongate form and strong teeth distinguish it from *C. ungeri*. The leaf is much like certain species of *Quercus* (e. g., *Quercus drymeja* Ung.), but the base is entirely different. The teeth are not unlike those of *Castanea kubinyi* Kov., especially in their remoteness and comparative irregularity.

ULMACEÆ.

Ulmus tenuinervis *Lx.* (Plate VIII, Fig. 26.) Station 14. A good leaf, with reverse.

Ulmus hilliæ *Lx.* Station 14. Distinguished from *U. tenuinervis* by the broad simple teeth, and very inequilateral base. I am convinced that *Fraxinus libbeyi* Lx., is a synonym; and so also, I believe, is *Ulmus brownellii* Lx.

Planera myricæfolia (Lx.). *Planera longifolia myricæfolia* Lx. 1883 (Station 13) appears to me to be a distinct species, notwithstanding the statements of Lesquereux, and the fact that *P. longifolia* is extremely variable.

The following table separates the Florissant Ulmaceæ: —

Base of leaf equilateral or nearly so . . . . . 1.
Base of leaf conspicuously inequilateral . . . . . 4.
1. Leaf long-pyriform, feebly dentate, lateral nervures irregular *Celtis mccoshii* Lx.
Leaf oval or lanceolate or oblong, with very strong simple teeth, laterals regular . . . . . 2.

2. Leaf oval or oblong . . . . . 3.
   Leaf lanceolate, laterals forming a very acute angle with midrib, base very narrowly long-cuneate . . . . . *Planera myricæfolia* (Lx.) Ckll.
3. Leaf with only about the apical half toothed; broad, but with cuneate base *P. ungeri* Ett., Lx.
   Leaf with much more than apical half toothed; oval or oblong, the broad leaves with obtuse base . . . . *Planera longifolia* Lx. Pl. IX, Fig. 30.[1]
4. Teeth broad and simple . . . . . *Ulmus hilliæ* Lx.
   Teeth more or less double . . . . . 5.
5. Apex tapering, elongated . . . . . *U. tenuinervis* Lx.
   Apex not so tapering; leaf usually larger . . *U. braunii* Heer. Lx.
   Fruits have been found, and referred hypothetically to *U. braunii*.

MORACEÆ.

Morus symmetrica sp. nov.

PLATE VII, FIG. 19.

A single well-preserved leaf, with reverse. The leaf is almost exactly the color of the shale, with the veins standing out very prominently, dark brown. Length about 57 mm., breadth 38; equilateral; the base truncate, broad; apex not produced; marginal teeth very low, rounded, little developed; venation normal, the lateral veins (5 or 6 on each side) failing just before reaching the margin, or reaching it by very feeble terminations; delicate cross-veins developed at right angles to midrib and lateral veins; first lateral with five veins leaving its lower margin and running to (or nearly to) edge of leaf.

This is much like a *Celtis*, but distinguished by its symmetrical form. I am not positive that it belongs to *Morus*, but it may well do so. There is quite a strong resemblance to *Tilia populifolia* Lx., as figured in Cret. and Tertiary Floras, pl. xxxiv, f. 9; but this figure appears to represent a different species from fig. 8, which is to be regarded as the type-figure of *T. populifolia*.

Ficus florissantella sp. nov.

PLATE IV, FIG. 33.

Station 14. A single well-preserved leaf, 49 mm. long, 34½ broad; entire, broad-oval, pointed apically, the base subtruncate and oblique (inequilateral); secondary nervures about six pairs, joined by fine nervures on lateral margin, as usual in the genus. Leaf moderately thick.

Almost exactly like *F. haydenii* Lx., except that the base is conspicuously inequilateral, and the tip is not prolonged; the lateral nervures at the base are as in *F. haydenii*, and different from those of the otherwise very similar *F. tiliæfolia* Heer. The apex, on the other hand, is as in *F. tiliæfolia*.

[1] In 1907 we got fruiting material of *Planera longifolia*, proving that it is no *Planera* but a beech. It takes the name *Fagus longifolia* (Lx.) Hollick & Cockerell.

Ficus arenaceæformis sp. nov.

PLATE VIII, FIG. 24.

Station 14, several specimens. Elongate entire leaves, with inequilateral base, and in good examples showing prominent lateral veins diverging from the midrib at an angle of not less than 60°. The leaves are quite like those of *F. arenacea* Lx. (Tertiary Flora, pl. xxix, f. 1), except that they narrower and more elongate; it is quite possible that they represent only a variety of *F. arenacea*, which is described from the Green River beds in Wyoming. The leaves appear to have exceeded 100 mm. in length, with a breadth near the base of 18–23 mm. A specimen showing only the basal part is taken as the type, as it has the venation more distinctly preserved than the others. In the field, some of these leaves were taken for *Quercus neriifolia*, but that has a quite different base.

There seems to be some confusion about the species of *Ficus* allied to *F. lanceolata*. Knowlton refers *F. arenacea* Lx. in part to *lanceolata* and in part to *F. uncata*. The typical *arenacea* appears however to be a distinct species, differing from *F. lanceolata* by its much broader and strongly inequilateral base. *F. arenacea brevipetiolata* Lx. may well be *F. uncata* Lx., as Knowlton states; but in this case the prior name is *F. gaudini* Lx., 1872, not *uncata* Lx., 1878.

Ficus lanceolata Heer, 1856, is a homonym of the much earlier *F. lanceolata* Buch. Ham. in Roxb. (a living oriental species), and may take the name *Ficus* **navicularis.**

Ficus jynx Unger, is recorded by Lesquereux from Elko Station, Nevada, but his figure shows a leaf with the base much more acute than in Ettinghausen's figures of *jynx*, which he cites. The base of *F. jynx*, as figured by Ettinghausen, is like that of *F. arenacea*.

Ficus trinervis *Knowlton.* Here may belong a *Cinnamomum*-like leaf found by Messrs. Henderson and Ramaley; *cf.* Univ. of Colo. Studies, III, p. 172.

PROTEACEÆ.

Lomatites Saporta, 1873.

Lomatites hakeæfolia (*Lomatia hakeæfolia* Lx. 1883) and *Lomatites spinosa* (*Lomatia spinosa* Lx. 1883) appear to be closely related to *Lomatites berendtianus* (Goepp.) Conw., from European amber. I am indebted to Professor Sargent for a number of species of recent *Lomatia*, and it seems very unlikely that the Florissant plants are truly congeneric with them, while they may apparently be referred with safety to Saporta's genus.

The nominal species from Florissant are as follows:—

Based on a fruit resembling that of *Pinus* . . *Banksites lineatus* Lx.
Based on leaves . . . . . 1.
1. Leaves with three subequal lobes . . . . *Lomatia tripartita* Lx.
Leaves elongate, with lateral teeth or lobes . . . . . 2.
2. Little lobules between the obtuse lobes, as in some Rosaceæ *L. interrupta* Lx.
No lobules between the lobes or teeth . . . . . 3.
3. Lobes rounded, obtuse, very regular . . . . . *L. abbreviata* Lx.
Lobes pointed, or when rather obtuse, then irregular . . . . . 4.
4. Lobes elongated, more or less parallel-sided . . . . . 5.
Lobes triangular . . . . . 6.
5. Apex broad, not lobulate or dentate; lobes very irregular . *L. terminalis* Lx.
Apex narrow, lobulate nearly to point; lobes nearly regular . *L. acutiloba* Lx.
6. Leaf elongate, with a long linear apex . . *Lomatites spinosa* (Lx.) Ckll.
Leaf shorter, with broad base, apex less produced *Lomatites hakeæfolia* (Lx.) Ckll.

L. acutiloba was found at Stations 4, 11 and 14; *L. terminalis* at 4 and 11; *L. tripartita* at 14. It is exceedingly probable that *L. terminalis* and *tripartita* are forms of the same thing.

Santalaceæ.

Santalum americanum Lx. is based on a *Lepargyræa*-like leaf, lanceolate with entire margins, and no venation visible except the midrib. Its affinities must be considered doubtful.

Polygonaceæ.

Persicaria tertiaria (*Polygonum tertiarium* Small) was described by Dr. Small in his revision of the North American species of *Polygonum* and allies. I saw the type when in New York in 1904. The leaf is comparatively broad, with a broad base, approaching the modern *Persicaria amphibia* (*Polygonum amphibium*, L.). There is a strong resemblance to the smaller leaves of *Populus lesquereuxi*.

Aristolochiaceæ.

Aristolochia mortua sp. nov.

Plate VIII, Fig. 25.

Station 14. A leaf, on same slab with *Planera longifolia*.

Leaf evidently thin, similar in form to that of *A. clematitis*, with a more or less acute apex, broadly cordate base, and entire margins. The venation is similar in type to that of *A. crassifolia*. (*A. cordifolia* Newberry, Later Extinct Floras, pl. LX, f. 4 not of Mutis.), but the veins do not unite on the lateral margins. There are about six pairs of lateral veins, diverging at an angle of about 45°, the lowest giving off branches as in *A. crassifolia*. Total length of leaf about 105 mm., breadth about

70. It is more deeply cordate, smaller than and not so broad as in *A. crassifolia*; the margins are much more convex and rounded out than in *A. aurantiaca* (as figured in Zittel).

There is a close resemblance in both form and venation to some species of *Ficus*, such as *F. catalpæfolia* Fzl., but the leaf was evidently thin, and the marginal venation does not agree with *Ficus*.

With regard to the name *A. cordifolia* Mutis, it is to be remarked that while it is so given in Steudel, the 'Index Kewensis' has it "*cordiflora*." I suspect that the latter name is a mistake, but cannot now consult the original work of Mutis. In any event, the name *crassifolia* (*Catalpa crassifolia* Newb.) has page-priority over *cordifolia* Newberry.

Berberidaceæ.

Odostemon florissantensis sp. nov.

Station 14. Lateral leaflets resembling those of *Odostemon simplex* (*Berberis simplex* Newberry, Later Extinct Floras, pl. lvi, f. 2) from the Miocene of Bridge Creek, Oregon, but the inferior basal angle is produced into a tooth, so that the truncate base of the leaf is greatly broadened. The teeth, as in *O. simplex*, are three on each side, not counting the base. Length of leaf along midrib 42 mm.; extreme length 48 mm.; breadth of the oblique base 25 mm.; length of the tooth-like lobes about 8 mm. The venation, very well preserved, agrees with that of the recent *Odostemon repens* (*Berberis repens* Lindley), but that has many more teeth, which are strongly spinose. Perhaps the greatest affinity is with the Californian species *Odostemon dictyota* (*Berberis dictyota* Jopson). I follow Rydberg in recognizing the genus *Odostemon*, which seems quite sufficiently distinct from *Berberis*.

A smaller and less well preserved leaf is from the same place as the type.

Lauraceæ.

Persea coloradica sp. nov.

Plate II, Figs. 12, 13.

Station 14. Leaf about 76 mm. long, and 19 broad, with entire margins. Lanceolate, with the base practically equilateral, midrib strong, especially basally, where it continues into the thick (2 mm. diam.) petiole; secondaries arched, leaving the midrib at an angle of nearly 70°, but not at all prominent. Not unlike *Laurus princeps*, but much smaller, with the sides a little less parallel.

Another specimen, from Station 11, is about 67 mm. long and 23 broad; it is thus noticeably broader than the type, but it appears to be certainly conspecific.

SAXIFRAGACEÆ.

Saxifraga (?) **peritula** sp. nov.

PLATE X, FIG. 41.

Station 14. Leaf oblique-oval, the base being inequilateral, broadly rounded on one side, slightly concave for about 4 mm. on the other; petiole about 1 mm. diameter, not winged; apex only slightly pointed; margin with regular triangular teeth, sharp but with a broad base, 4 to 4½ in 5 mm.; no venation visible.

This puzzling little leaf is doubtfully referred to *Saxifraga*, because it appears to have been thick and perhaps rather succulent, with weak venation of a character which would be readily obliterated; and the marginal teeth are also exactly as in certain species of that genus.

HYDRANGEACEÆ.

Philadelphus palæophilus sp. nov.

PLATE X, FIG. 37.

Station 13. Leaf ovate-elliptic, similar to that of *P. coronarius* L., about 48 mm. long and 25 broad, sparingly dentate beyond the middle; venation as in *P. inodorus* L., with a pair of prominent laterals arising opposite each other near the base, giving the leaf a trinerved aspect; other laterals few, with few nervilles.

The leaf resembles certain of the narrower ones ascribed by Lesquereux to *Populus arctica* Heer; it also recalls species of *Cinnamomum*. The smaller angles formed by the laterals (especially the upper ones) will distinguish it from *Celtis mccoshii* Lx.

Hydrangea (?) **subincerta**, sp. nov.

PLATE IX, FIG. 32.

Station 14 (W. P. Cockerell). Sterile flower, with 4-lobed calyx, in the manner of *H. radiata*, Walt. Lobes long-oval, about 5½ mm. long, and 3½ broad, as preserved ferruginous brown with light mottling; no conspicuous venation. Total diameter about 13 mm. The lobes as not quite equal in size.

This may not belong to *Hydrangea*, but it accords with that genus in superficial appearance, at least. It is not at all similar to *H. bendirei* (Ward) Knowlton, from Oregon: it recalls rather certain of the recent species, as *H. hortensis*.

GROSSULARIACEÆ.

Ribes protomelænum sp. nov.

PLATE II, FIG. 15.

Station 6 S D; a leaf with its reverse. Leaf about 46 mm. long (apex to beginning of petiole) and fully 60 broad; base deeply cordate, the sides of the basal portion rounded, without lobes; the large lateral lobes as in *R. nigrum*, as also the apical part; margin crenulate-dentate; venation normal. This appears to be quite close to the living *R. nigrum* and *R. hudsonianum*.

CUNONIACEÆ.

Weinmannia phenacophylla sp. nov.

Station 13. Leaflets narrow, about 27 mm. long and 6–6½ broad, coarsely crenate-dentate on the upper edge; wings abruptly enlarged beneath the insertion of the leaflets.

This is the species figured by Lesquereux, Cret. and Tert. Floras, pl. xlii, as *W. haydenii* (*Rhus haydenii* Lx.), but the true *haydenii* is the plant figured on the same plate as *W. integrifolia*, especially fig. 10.

Weinmannia haydenii (*Lx.*). *Weinmannia integrifolia* Lx.; *Rhus haydenii* Lx.

The British Museum collection, now in my hands, contains an excellent specimen of this species, very like that figured by Lesquereux (Tertiary Flora, pl. lviii, f. 12), but rather more perfect, and with the second pair of leaflets (counting from the apex) strictly opposite. It was obtained at Florissant by the Princeton expedition of 1877; the locality "Middle Park," cited by Lesquereux, is erroneous. The leaflets are entire, and the plant seems distinct from *W. phenacophylla*, but it is not impossible that the latter may eventually be found to deserve only varietal rank.

Weinmannia obtusifolia *Lx.* Station 13. A very characteristic specimen.

Weinmannia lesquereuxi sp. nov.

Station 14. Type in Amer. Mus. Nat. Hist.; reverse at Univ. of Colorado. Leaflets about 31 mm. long and 11 broad, the apex acuminate, the upper edge coarsely serrate-dentate with five or six teeth, the lower edge serrate with two or three teeth beyond the middle. The leaflets are larger, further apart (15–16 mm.) and much more coarsely serrate than in *W. phenacophylla*; they are fully twice as broad, though little longer. The wings are similar to those of *phenacophylla*, but broader.

No doubt it is this species which Lesquereux figures (Cret. and Tert.

Floras, pl. xlii, figs. 15, 16, 17) as *Rhus acuminata* Lx. The original *Rhus acuminata* Lx., 1872. from Green River, must be considered doubtful. The name *acuminata* was much earlier used in *Rhus* by DeCandolle. Another specimen of *W. lesquereuxi* was found at Station 13 (W. P. Cockerell). It exhibits six pairs of leaflets, the distance from the first to the last about 118 mm. The terminal leaflet is 13 mm. broad; the leaflets of the second pair from the end are 43 mm. long. As in the type, the leaflets are sessile.

A single leaflet of *W. lesquereuxi*, obtained by the Princeton Expedition of 1877, is in the British Museum (No. V. 2784). It is labelled *Rhus incisa* Heer.

Weinmannia (?) **dubiosa** n. n.

Weinmannia rosæfolia Lx., 1874; not A. Cunn. 1839.
Rhus rosæfolia Lx., 1878; not Hoffmsgg.

This may remain in *Weinmannia*, as it resembles one of the New Zealand species (*W. sylvicola*), and does not appear to be a *Rhus*.

HAMAMELIDACEÆ.

Liquidambar convexum sp. nov.

PLATE VII, FIG. 16.

Station 14 (*S. A. Rohwer*). A leaf, with reverse.

Leaf large, the blade at least 10 cm. long; middle lobe about 7 cm. long (the apex is missing), and 36 mm. broad in the middle, but only 26 at base, its sides being strongly convex; second lobes much more slender, the greatest width about 22 mm., the apex tapering; serrations rather feeble and obtuse, about four in 10 mm.

Apparently distinct by the convex margins of the lobes; perhaps nearer to the living *L. styraciflua* than to the fossil *L. europæum*, though the tapering tips suggest the latter, as figured by Heer from Œningen.

ROSACEÆ.

Rosa wilmattæ sp. nov.

PLATE VII, FIG. 14.

Type in Am. Mus. Nat. Hist.

A species of the *R. sayi* type, the leaves with five leaflets; stipules very narrow, not apparent in the fossil; leaf 55 mm. long, of which 21 mm. is petiole; first pair of leaflets small, oval, 10 mm. long, about 6½ broad, nearly sessile; second pair about 7½ mm. from first pair, long-oval, about 16 mm. long and 7½ broad; apical leaflet 5 mm. beyond second pair, long-oval, with a cuneate base, length 21 mm., breadth 10; serrations of leaflets coarse and simple.

Another specimen (in Univ. of Colo.) has larger and broader leaflets; the second pair about 10½ mm. broad.

The other American Tertiary rose (also from Florissant), *R. hilliæ* Lx., represents the modern *R. setigera*, and has only three leaflets, and very distinct stipules. *R. wilmattæ* has a slight superficial resemblance to *Weinmannia rosæfolia* Lx. This latter species was later referred by Lesquereux to *Rhus*, but it may as well remain in *Weinmannia*, on account of its resemblance to the New Zealand *W. sylvicola*. If retained in *Rhus*, the name would have to be changed, having been earlier used in that genus.

Malaceæ.

Amelanchier peritula sp. nov.

Plate VI, Fig. 6.

Station 13 (T. D. A. Cockerell). A single well-preserved leaf, coffee brown in color. Broad oval, the apex and base forming about equal angles (of about 100°); marginal teeth broad and not sharp, about 12 in number on each side, extending to within about 5 mm. of the base; the largest (upper) teeth are about three in 6 mm.; principal lateral veins 3½–4 mm. apart. Length of leaf about 26 mm., breadth about 17½.

Differs from *A. scudderi* Ckll., by its narrower form, with the serrations much more numerous, and beginning near the base. It is a little like the living *A. rotundifolia* (Mx.), but is much narrower, with fewer lateral veins. It has no resemblance to *A. typica* Lx.

A. scudderi Ckll. is from the railroad cut east of Florissant.

Cratægus (?) **lesquereuxi** Ckll. (*Cratægus acerifolia* Lx.) Station 14. A good leaf, lacking the base, but having the long pointed apex, wanting in Lesquereux's type. I do not think the plant is a *Cratægus*; it looks to me like some member of the Malvaceæ, perhaps *Althæa*.

The following species is also recorded from Florissant:

Cratægus newberryi n. n. *Cratægus flavescens* Newberry (not of Bosc, in DC.); *Myrica diversifolia* Lx., not *Cratægus diversifolia* Steud.

Sorbus megaphylla sp. nov.

Plate IX, Fig. 29.

Station 14. The end of a leaf, with six leaflets preserved.

Leaf large, the leaflets narrow and elongated, those of third pair from end about 70 mm. long and 12½ wide, with only a few coarse distant teeth near the middle; distance between second and third pair of leaflets (from end) 15 mm.; apical leaflets about 56 mm. long and 10½ wide.

This looks at first sight like a *Rhus*, but the leaflets are rounded (not tapering) at the base, a character which accords better with *Sorbus*. In any case, the plant is quite distinct from *Rhus coriarioides* Lx., by the rounded bases of the leaflets and their almost straight lower edge.

AMYGDALACEÆ.

Amygdalus gracilis *Lx.*

MIMOSACEÆ.

Leucæna coloradensis sp. nov.

Legume similar in form to that of *L. greggii* Watson, about 75 mm. long, 7 broad, the margins even, both ends tapering. The pod is only slightly curved. Station 7 (*S. Rohwer*).

With this I associate a fragment of a leaf from Station 13, apparently identical with Lesquereux's Cret. and Tert. Flora, pl. xxxvii, f. 13, referred there to *Mimosites linearifolius*; but my leaf is certainly different from that originally described under that name, as the leaflets are only 9 mm. long, and scarcely 1½ broad, while there are five leaflets on each side in 10 mm. (7 in 25 mm. in *linearifolius*). The leaflets are sessile, with a truncate or subtruncate base, and parallel sides. The midrib is not distinctly visible. The pinnæ have more than 20 pairs of leaflets. The leaf (pinna) has a strong superficial resemblance to a branchlet of *Taxodium*.

The genus *Mimosites* was founded by Bowerbank in 1840 on a fruit (legume) from the cement-stone of Ossington, Suffolk, England. This fruit, according to Unger, is very like that of *Acacia farnesiana*, and there is no particular reason for supposing it congeneric with the so-called *Mimosites* of Florissant. The name *Mimosites*, however, has been applied in a general sense to fossil plants resembling *Mimosa* or *Acacia*.

The following table separates the Florissant Leguminosæ recorded by Lesquereux:—

Leaves bipinnate, leaflets entire . . . *Mimosites linearis* (Lx.) Knowlton.
Leaves not bipinnate . . . . . 1.

1. Leaves broad, nearly circular or obtusely subtriangular, entire *Cercis parvifolia* Lx.
Leaflets ovate-lanceolate, acuminate (compare the modern *Cassia occidentalis*) *Cassia fischeri* Heer, Lx.
Leaflets long-cordiform, deeply emarginate at apex, margins entire (compare the modern *Dalbergia melanoxylon*) . . . . *Dalbergia cuneifolia* Heer, Lx.
Leaflets lanceolate . . . . . 2.

2. Leaves trifoliate, leaflets serrulate (compare *Melilotus*)
Leguminosites serrulatus Lx.
Leaflets entire . . . . . 3.
3. Leaves trifoliate . . . . . 4.
Leaves presumably pinnate . . . . . 5.
4. Lateral leaflets equilateral at base . . . . *Cytisus modestus* Lx.
Lateral leaflets very inequilateral at base . . *Cytisus florissantianus* Lx.
5. Leaflet broadest beyond the middle, lateral veins nearly parallel with midrib
Acacia septentrionalis Lx.
Leaflet broadest in middle or below, lateral veins subtransverse
Podogonium acuminatum Lx.

The evidence for the existence of the beautiful genus *Podogonium* at Florissant is at present somewhat inadequate, but certainly the leaflet figured by Lesquereux might almost belong to *P. knorii* (A. Br.), from Œningen.[1] Lesquereux also refers to a fragment of a seed. The generic position of the fossil *Dalbergia* is a little doubtful; notwithstanding the great superficial resemblance to the modern *D. melanoxylon*, the venation is not quite the same. The species referred to *Cytisus* cannot be supposed to belong to that genus. They are discussed below under the head of *Ptelea*.

Viborquia *Ortega.*

Viborquia ORTEGA, Hort Matr. Dec. 66 (1798) = *Eysenhardtia* H. B. K., 1823.

The prior name for this genus has been suppressed, I suppose because of the still earlier *Viborgia* Moench, 1794; a synonym of *Cytisus*. It appears to me that the names are quite distinct, and so I adopt the earlier one. The known living species are few, as follows:

(1.) *Viborquia polystachya* Ortega = *Eysenhardtia amorphoides* H. B. K. Mexico and southwestern U. S.

(2.) *Viborquia spinosa* = *Eysenhardtia spinosa* Engelm. 1850. Texas and northern Mexico.

(3.) *Viborquia orthocarpa* = *Eysenhardtia orthocarpa* (A. Gray) Watson Mexico and New Mexico.

(4.) *Viborquia adenostylis* = *Eysenhardtia adenostylis* Baill., 1870. Guatemala.

To these must be added a fifth species, from the Miocene shales of Florissant:—

Viborquia nigrostipellata sp. nov.

Represented by a portion of a leaf, about 26 mm. long, rachis straight and very slender, still bearing four long-oval leaflets, three on one side and one on the other;

[1] There is a superficial resemblance, at least, between *Podogonium* and our *Gleditsia aquatica* Marsh, of the Southern States.

these leaflets with the blade about 5⅓ mm. long and 2⅔ broad, with petiolule about ⅔ mm., the whole almost exactly as in the living *V. orthocarpa*. The little pairs of sharply pointed stipels are black, and except that they are a little broader and shorter, exactly resemble those of *V. spinosa*. The distance from the insertion of one pair of leaflets to another is 3 mm. Florissant (*Princeton Expedition*); type in the British Museum (No. V. 2579).

RUTACEÆ.

Fagara (?) **delicatula** sp. nov.

Station 14 (W. P. Cockerell). Type in Amer. Mus. Nat. Hist.; reverse at Univ. of Colorado. A single well-preserved leaf.

Leaf about 63 mm. long, of which 20 mm. is petiole; five pairs of leaflets, and a terminal one, the leaflets of the pairs opposite; leaflets lanceolate, entire, apparently very thin; leaflet of second pair from base about 23 mm. long and nearly 7 broad, with a very short petiole; leaflets of last pair about 10 mm. long, and apical leaflet also narrow.

Very distinct from *Fagara spireæfolia* (*Zanthoxylum spireæfolium* Lx., 1883), described from Florissant, by the much narrower leaflets. In both the leaflets are symmetrical at the base, differently from the common modern species. A third species, *Fagara diversifolia* (*Zanthoxylum diversifolium* Lx. 1878), is recorded from the Miocene of California.

Ptelea modesta (sp. nov.?).

Station 14 (W. P. Cockerell). A branch with three leaves; leaves trifoliate, with three sessile lanceolate-acuminate leaflets, the largest 10 mm. broad and over 40 long, their margins sparingly serrate, the serrations sharply pointed. This appears to be the *Cytisus modestus* and *Leguminosites serrulatus* of Lesquereux (Cret. and Tert. Floras), the *Cytisus* having priority of place.

The smaller leaves agree exactly with the *Cytisus*, the larger with the *Leguminosites*, and it cannot well be doubted that they and the plant before me all represent a single species, which appears to be a *Ptelea*. I will also venture to suggest that the supposed fruit of *Dodonæa* figured in Cret. and Tert. Floras, pl. xxxvi, f. 5, may belong to *Ptelea modesta*.

The *Cytisus florissantianus* Lx. is no doubt really leguminous; it may belong to *Rhynchosia*.

MELIACEÆ.

Melia (?) **expulsa** sp. nov.

Station 14. Type in Amer. Mus. Nat. Hist.; reverse at University of Colorado. Apparently similar to *M. azedarach* L., though smaller, with the terminal leaflets

more decidedly though very irregularly lobed, and its basal part very slender; length of terminal leaflets about 35 mm., its breadth about 12, with two large lobes on each side; lateral leaflets next to the terminal one about 23 mm. long, slender basally, but sessile; leaflets opposite.

Melia is an Asiatic genus; *M. azedarach* can endure a temperate climate, and is commonly planted by roadsides in southern New Mexico. The fossil may not belong here, but the general resemblance is very close, and I do not know where else it can be placed.

ANACARDIACEÆ.

Rhua hilliæ *Lx.* Station 14, common. Also in the British Museum, No. 11043. The leaves are compound and odd-pinnate, as Lesquereux surmised; the leaflets are very variable; the broader and shorter ones are suggestive of *Cratægus*. One occurs on the same slab as *Tmesipteris alleni*.

Cotinus fraterna (*Lx.*) *Ckll.* This was obtained in excellent condition at Station 14. Also found at Station 11.

For *Rhus acuminata* Lx. and *R. rosæfolia* Lx., see *Weinmannia*.

The Florissant species of this family may be separated thus:—

Leaves oval, pointed at each end, entire, long-petioled *Cotinus fraterna* (Lx.) Ckll.
Leaves trifoliate . . . . . 1.
Leaves pinnate . . . . . 2.
Structure of leaves uncertain, but leaflets subovate, acuminate, with one or two pointed lobes or very large teeth on each side . *Rhus subrhomboidalis* Lx.
Leaflets ovate-acuminate, denticulate (probably not at Florissant) *Rhus evansii* Lx.

1. Leaves long-petioled, leaflets cuneiform, lobed, not acuminate *Schmaltzia vexans* (Lx.) Ckll.
Leaflets long-ovate, entire, apical one much larger than the lateral ones *Rhus cassioides* Lx.
Leaflets orbiculate . . . . . *Rhus rotundifolia* Kirch.
Leaflets oval, apiculate and dentate to middle . . *R. trifolioides* Lx.
2. Leaflets lanceolate, serrate (like *Rhus hirta*) . . . *R. corarioides* Lx.
Leaflets ovate-acuminate, coarsely and irregularly serrate, or lobed *R. hilliæ* Lx.

Of all these, only *R. coriarioides* is a perfectly typical *Rhus* in the restricted sense.

AQUIFOLIACEÆ.

Ilex knightiæfolia *Lx.* Station 14, not rare. The leaves are variable in size. *I. rigida* Kirch. appears to be a synonym. The leaves are parallel-sided, with large teeth, and remind one of the dandelion.

Ilex leonis *Ckll.* V. 2584, in the British Museum, is a sparsely dentic-

ulate leaf of this species. *Ilex microphylla* Lx. is not figured, but it is said to very closely resemble *Ilex subambigua* (*Ilex ambigua* Unger, Chloris Protogæa, 1847, not of Elliott, 1824, or Torrey, 1843). Unger's figure shows a species not unlike *I. leonis*, and I strongly suspect that *I. microphylla* Lx. is only a small leaf of *leonis*. The name *microphylla* is not available for the Florissant species, having been much earlier used by Hooker and Sprengel.

Ilex subdenticulata *Lx.* A rather ambiguous species; Lesquereux's figures 5 and 6 do not appear to be conspecific.

Ilex grandifolia *Lx.* Based on a fragment of a very large leaf, 5 cm. broad, the margins dentate.

Ilex pseudostenophylla *Lx.* Not figured. Leaf small, obovate or oblanceolate, obtuse, entire. It is said to be like *I. stenophylla* Unger, and is therefore of the type of the modern *Ilex cassine* L.

Celastraceæ.

Pachistima (?) **integra** sp. nov.

Plate VIII, Fig. 27.

Station 14 (S. A. Rohwer). A piece of a twig with six leaves, which as preserved are dark brown. The opposite leaves with parallel margins are entirely as in *P. canbyi*, but the petioles are a little longer (2–3 mm.), and the margins of the leaves are entire. Length of blade 25 mm.; breadth about 6½; distance from one pair of leaves to next about 4 mm.

The Florissant Celastraceæ may be separated thus:—

Margins of leaves entire . . . . . 1.
Margins of leaves crenate, serrate or dentate . . . . . 2.

1. Leaves long and narrow, with parallel sides . . *Pachistima integra* Ckll.
Leaves small, broadly oval, obtuse, abruptly narrowed to petiole *Celastrus greithianus* Heer, Lx.

2. Leaves orbicular or suborbicular, crenate . . . *Celastrinites elegans* Lx.
Leaves obovate or spatulate, rounded and dentate at apex *Celastrus lacoei* Lx.
Leaves broad lanceolate, serrate, decurrent to petiole . *C. fraxinifolius* Lx.

The two leaves figured by Lesquereux as *Celastrinites elegans* appear to be doubtfully conspecific, and they so little resemble Saporta's various species of this genus that their generic position may well be considered uncertain. In true *Celastrinites* the margins are not crenate, but undulate to short-toothed, the points being usually more or less sharp, and the broad sinuses between them gently and evenly concave. This just reverses the condition found in *C. elegans*.

STAPHYLEACEÆ.

Staphylea acuminata *Lx.* Station 14, Station 11 (*W. P. Cockerell*) and Station 5). The last mentioned locality is the *Corixa*-zone in the railroad cut east of Florissant station. There appears to be no reason for questioning the generic reference, although the genus is not otherwise known from the American tertiaries. The locality "Middle Park" is erroneous; all the material described by Lesquereux came from Florissant. (*Cf.* Whitman Cross, Proc. Colorado Scientific Soc., Oct. 1892, pp. 21–24.)

ACERACEÆ.

Acer florissanti *Kirch.* was found at Stations 5 and 13. A fruit, supposed to be *A. mysticum* Kirch. is from Station 11.

SAPINDACEÆ.

Sapindus stellariæfolius *Lx.* Station 14 (W. P. Cockerell); also in the British Museum, from the Princeton Expedition of 1877. The latter specimen shows the terminal leaflet, which is 28½ mm. long, and nearly 7 broad, similar to the lateral ones, but equilateral. These specimens belong to Lesquereux's smaller form of *S. angustifolius* (*e. g.*, Cret. and Tert. Fl., pl. xxxvii, f. 4), but they appear to me to be conspecific with *S. stellariæfolius*, and the name *angustifolius* was much earlier used in *Sapindus* by Wallich. The large leaflets which Lesquereux refers to *S. angustifolius* belong to a different plant, described below.

Sapindus coloradensis sp. nov.

PLATE IV, FIG. 31.

Station 14 (W. P. Cockerell). A beautifully-preserved specimen, ferruginous in color, the leaves very distinct, but the secondary venation practically obsolete. Closely allied to *S. drummondi* Hook. & Arn., of our Southern States, but the leaflets are hardly so broad in proportion to their length. Leaflets in 9 pairs (no odd terminal one), inequilateral as usual in the genus, entire, acuminate, about 47 mm. long and 12 broad, the apical pair broader and shorter, with the broadest part near the middle instead of at the base; the leaflets are very short-petiolulate. Length of rachis 123 mm.; leaflets usually but not always opposite.

This is part of Lesquereux's *S. angustifolius* (not Blume, not Wall); *e. g.*, his fig. 3, pl. xxxvii, in Cret. and Tert. Floras, and fig. 2 in Tertiary Flora, pl. xlix.

Sapindus leonis sp. nov.

I had supposed that all the large leaves referred by Lesquereux to *Sapindus angustifolius* might be placed with *S. coloradensis* Ckll., the type of which is a very beautiful specimen figured herewith. I find, however, in the British Museum collection a very good leaf, on which five leaflets still remain, agreeing with Lesquereux's Pl. XXXVII, fig. 7, in the "Cretaceous and Tertiary Floras." This was obtained by the Princeton Expedition, and is numbered V. 2569; it may be taken as the type of a species *S. leonis*, described as follows:—

Leaflets opposite, sessile or practically so, lanceolate, entire, with the base gibbous at one side, even perhaps a little more than is shown in Lesquereux's figure just cited. Length of leaflets about 64 mm., breadth near base 15 mm., breadth about 30 mm. from tip 12 mm., 15 mm. from tip 7½ mm.; insertions of pairs of leaflets 19 mm. apart. Venation as in figure cited.

From *S. coloradensis* this is readily known by the larger leaflets, which are sessile, and taper much more gradually.

Lesquereux describes two other species from Florissant; *S. inflexus* Lx. and *S. lancifolius* Lx.

RHAMNACEÆ.

Leaf orbicular . . *Paliurus* **haydeni** n. n. (*P. orbiculatus* Lx., not Saporta.)
Leaf ovate . . . . . *Zizyphus obtusa* Kirch.
Leaf lanceolate or broad-lanceolate . . . . . 1.
1. Leaf small, broadest below the middle, with lateral nervures arising near the base, and running parallel to the margin (*Z. obtusa* has similar laterals) *Paliurus florissanti* Lx.
Leaf larger, narrower basally; margin entire . . . . . 2.
2. Leaf broader and shorter . . . . . *Rhamnus kirchneri* Ckll.
Leaf longer and narrower *Rhamnus florissantensis* n. n. (*R. oleæfolius* Lx., not *oleifolia* Hook.)

The venation of *Paliurus* is much like that of *Ceanothus*; *P. haydeni* is curiously similar to some of the leaves referred to varieties of *Populus arctica*. I separate *P. haydeni* from *P. orbiculatus*, as the latter (European) species has the leaf less precisely orbicular, with the base subemarginate instead of truncate. *Rhamnus kirchneri* may be compared with *R. frangula*, but the leaves are hardly so broad. *R. florissantensis* is like *R. caroliniana*, but that has the margins usually more or less serrate.

VITACEÆ.

Vitis florissantella sp. nov.

PLATE VII, FIG. 18.

Station 13 (W. P. Cockerell). Type in Amer. Mus. Nat. Hist.
Leaf small, of the general type of *V. vinifera*. Length about 27 mm. (apex

wanting, length of leaf as preserved 22 mm.); breadth about 26; trilobate, the apical lobe broad-ovate, separated from the lateral lobes by broad claviform sinuses, about 7 mm. deep; base strongly cordate, with a sinus about 4 mm. deep; serrations coarse, about 2⅓ mm. long, not sharply pointed; three principal veins, one to each lobe.

When working out this species, I took occasion to review the fossil American species referred to *Vitis*, with the following result:—

(1.) The four species described by Ward in Bull. 37, U. S. Geol. Surv., belong to *Ampelopsis*. This agrees with Ward's own opinion; he did not consider *Ampelopsis* a distinct genus, and hence used the name *Vitis*. They are separated as follows:—

Leaves large, over 70 mm. long.

Apical projection sharply pointed, longer than a serration; serrations stronger . . . . . *Ampelopsis bruneri* (Ward).

Apical projection no more prominent than a lateral serration; serrations weaker . . . . *Ampelopsis bruneri carbonensis* (Ward).

Leaves small, less than 40 mm. long.

Base truncate . . . . . *A. xantholithensis* (Ward).

Base tapering to petiole; serrations sharp *A. montanensis* Ckll. (*Vitis cuspidata* Ward).

The non-cordate base readily separates all these from the Florissant plants.

(2.) *Vitis olriki*, Heer, Lx., is a true *Vitis*; a large leaf, of the general type of *V. cinerea*, Engelm., without lateral sinuses. The last character and the size separate it at once from *V. florissantella*.

(3.) *V. sparsa* Lx. is based on seeds, from a place where leaves of *Cissus tricuspidata* (Heer) Lx. are abundant.

(4.) *Vitis* **alaskana** n. n. (*V. rotundifolia*, Newberry, 1882, not of Mx., 1803), from Alaska, is three-nerved, cordate at base, with no lateral sinuses. It is similar in general to *V. rupestris*.

Parthenocissus osborni sp. nov.

Station 14 (W. M. Wheeler). A single leaflet, about 75 mm. long (without petiole) and 28 broad, the apex long-acuminate, the margin with large teeth, all formed practically as in the modern Virginia Creeper.

It is named *P. osborni* because, except for the larger and sharper teeth, it is exceedingly like the *Quercus osborni* Lx., as figured in Cret. and Tert. Floras, pl. xxxviii. It does not look at all like a *Quercus*, and I am by no means prepared to assume that Lesquereux's plant is identical with mine; but in view of the possibility, I provide mine with a name which can remain whether it is the same or not.

TILIACEÆ.

Tilia populifolia *Lx.*

STERCULIACEÆ.

Buettneria (?) perplexans, sp. nov.

PLATE X, FIG. 39.

Station 14 (Rohwer). Calyx divided nearly to the base into five equal and symmetrical lanceolate lobes, as in *B. catalpifolia*. Lobes about 9½ mm. long and 3 broad, pointed, constricted basally, with a prominent median nervure, from which numerous lateral nervures diverge at an angle of 45 to 50°, the nervures appearing dark on a light ground.

The reference of this to *Buettneria* is necessarily problematical; in some ways it is suggestive of *Sabbatia*. There is a strong superficial resemblance to *Getonia floribunda* (Combretaceæ), but that has three longitudinal nervures of equal strength, instead of only one. There is also some resemblance to *Petræa volubilis* (Verbenaceæ), but that has the ends of the lobes much less pointed.

It may be added that certain fossil leaves referred to *Ficus*, of the *F. haydenii* type, could very well belong to *Buettneria*.

Sterculia rigida *Lx.* Station 11. *S. engleri* Kirch. is doubtfully distinct.

MALVACEÆ.

Malvastrum exhumatum *Ckll.*

ARALIACEÆ.

Hedera marginata Lx. is probably not a true *Hedera*; it is somewhat suggestive of Berberidaceæ. *Aralia dissecta* Lx. is based on a splendid large palmately-lobed leaf, certainly not a true *Aralia*, but of doubtful generic position. It is said to be very close to *A. multifida* Saporta, both being similar to the living *A. elegans*, a cultivated species from New Grenada. Unfortunately, *A. elegans* is not in the Index Kewensis, nor in Bailey's Cyclopædia of Horticulture, or any other work to which I have access. There is a cultivated species *A. elegantissima* Veitch, but that is quite different, and is from the New Hebrides. *A. dissecta* is also strikingly similar to *Cussonia polydrys* Unger, from the European Miocene, but that does not appear to be a genuine *Cussonia*. The plants seem to be related to *Panax*, and it may be impossible to place them generically from the leaves alone.

UMBELLIFERÆ.

Oxypolis destructus sp. nov.

Station 13. A fruiting umbel; when first found nearly perfect, but on thin papery shale, and much injured on the journey home. Umbel small (about 2 cm. diameter). simple; fruit with the outline of an apple, similar to that of *O. rigidus*, but rather broader, length and breadth each about 3½ mm.

ERICACEÆ.

Andromeda scudderiana n. n. (*A. rhomboidalis* Lx., not Vieill.) has rhomboidal leaves, "narrowed downward to a long slender petiole, and equally so upward to an obtuse apex." It is only an *Andromeda* in the old, broad sense.

VACCINIACEÆ.

Vaccinium retigerum Ckll. (*V. reticulatum* "Al. Br.," Lx., not Sm.). Similar to the living *V. ovalifolium* J. E. Smith.

MYRSINACEÆ.

Myrsine laminarum n. n. (*M. latifolia* Lx., not Spreng.) has the leaves broadly oval or nearly round, entire. It is said to be allied to the European *M. antiqua* Unger. These plants are probably not true *Myrsine*.

SAPOTACEÆ.

Bumelia florissanti *Lx.* Broad subovate leaves, with a cuneiform base, and the apex obtuse, or even slightly emarginate. There is a general resemblance to *B. angustifolia* Nuttall, living in Florida and Texas.

EBENACEÆ.

Diospyros princetonia, sp. nov.

PLATE X, FIG. 36.

Leaf about 62 mm. long, and 25½ broad, long-ovate, pointed at each end, quite entire. Secondaries leaving midrib at an angle of about 45°; apex forming an angle of 50° or more, base a little more narrowed.

Differs from *D. copeana* Lx. by the more pointed apex, narrower form, and the maximum breadth about the middle instead of above it. Both apex and base are more pointed than in normal *D. brachysepala*; the basal 20 mm. of the margin of our leaf is not convex, but straight,— even faintly concave. In the base, *D. princetonia* is more like *D. myosotis* Unger, from Radoboj, but that is a proportionately narrower leaf, with a much less convex (in outline) margin, and the acumination of the apex abrupt instead of gradual. Type in British Museum, no. 655 = v. 2783; collected at Florissant by the Princeton Scientific Expedition of 1877. The specimen was examined by Lesquereux in 1879, and marked *'Diospyros.'*

Oleaceæ.

Fraxinus palæophila sp. nov. (Oleaceæ).

Station 14. A leaf showing five leaflets. Similar to *F. caroliniana* Mill, the Water Ash of our Southern States, but the obscure crenulation of the leaflets coarser, and the lateral leaflets somewhat broader, and strongly inequilateral. The following measurements are in mm.; length of terminal leaflet (apex gone) about 35, its breadth about 16, its base from origin of upper lateral leaflets 22; petioles of lateral leaflets 6; length of upper lateral leaflets about 33, of lower about 25, their breadth 13–14; crenulations occupying about 2 mm.; venation as in the living species.

Eight species of *Fraxinus* have already been reported from Florissant: it seems absurd to add a ninth, but the plant now described agrees with none of them, and it is very probable that they do not all belong to the genus. *F. heerii* and *F. prædicta* have entirely different venation; *F. mespilifolia* has a much more obtuse base to the leaflets, with a short twisted petiole; *F. libbeyi* has large "leaflets" looking like *Ulmus braunii*; *F. myricæfolia* has much narrower leaflets, which are sessile; *F. abbreviata* has short broad leaflets.

Osmanthus præmissa (*Lx.*) *Ckll.* Plate VI, Fig. 7. Station 14. The end of a branch, about 20 cm. long, with 15 or 16 leaves, but no flowers. The leaves are slightly inequilateral (variably so), perfectly entire, and with no discernible secondary nervures. Their petioles are longer than Lesquereux's figure shows. The plant could be mistaken for a willow.

The Florissant Oleaceæ recorded by Lesquereux may be separated thus:

	Leaves simple, lanceolate, entire	*Osmanthus praemissa* (Lx.) Ckll.
	Leaves compound	1.
1.	Leaflets with entire margins	*Fraxinus heerii* Lx.
	Leaflets with margins dentate, denticulate or serrate	2.
2.	Leaflets lanceolate	3.
	Leaflets broader, ovate or oblong	4.

3. Leaflets sessile and opposite, feebly dentate . *Fraxinus* (?) *myricæfolia* Lx.
   Leaflets somewhat broader, with lateral veins strongly arched (probably not at Florissant) . . . . . *Fraxinus prædicta* Heer, Lx.
4. Apex attenuate (leaves suggesting *Populus lesquereuxi*, but easily separated by the short twisted petiole) . . . . . *F. mespilifolia* Lx.
   Apex not attenuate . . . . . *F. albreviata* Lx.

F. libbeyi is referred to *Ulmus*. *F. brownellii* Lx. has not been figured.

Apocynaceæ.

Apocynophyllum scudderi *Lx.* is reported by Kirchner, but needs confirmation.

Convolvulaceæ.

Porana tenuis *Lx.* (Plate I, Fig. 10.) A very good example was found, lacking only one of the sepals. As Lesquereux states, it is closely similar to *P. macrantha*, Ludwig, differing however in the very obtuse, almost truncate sepals. The venation, which is very distinct, is practically as in *P. œningensis* (A. Br.) Heer, and since this latter has been obtained with characteristic fruit, the reference to *Porana* is fortified. It must be said, however, that the venation is entirely different from that of the recent *Porana* (*Dinetus*) *racemosa*, Roxb.

Porana speirii Lx. is also from Florissant.

Scrophulariaceæ.

Mimulus saxorum, sp. nov.

Plate X, Fig. 47.

Station 4 (T. D. A. Cockerell). A well-preserved calyx, about 18 mm. long and 8 high, formed approximately as in *M. guttatus*, but the middle and lower teeth, like the upper, are long and sharply pointed. Length of upper teeth about 6 mm., of middle about 5, of lower about six. The peduncle, 6½ mm. long, is preserved. There is some indication of a mediolateral longitudinal rib or fold.

The genus is new to the American Tertiaries.

Cucurbitaceæ.

Sicyos (?) **florissantia** sp. nov.

Plate X, Fig. 43.

Station 14. A corolla showing two lobes and part of a third, shaped as in *S. angulatus*. The broad lobes, 3 mm. broad and about 3⅓ long, are characteristic;

their shape is broader than long, were it not for the small apical projection. The venation is not visible. The throat is quite wide, about 3 mm. in diameter.

I am not sure that this is a *Sicyos*, but the resemblance is certainly very close, and it can go in this genus for the present.

Melothria (?) **coloradensis** sp. nov.

PLATE X, FIG. 40.

Station 9 K (W. P. Cockerell). A flower, showing the ovary shaped as usual in the genus, and constricted below the corolla. Corolla large, about 25 mm. diameter, the lobes broad (10½ mm.) but not very long (6–7 mm.), with pointed tip, their margins entire. Length of ovary 15 mm., breadth a little over 6, the broadest part not toward the base.

Except for the larger flowers, this resembles *M. hirsuta*. It is very distinct from *M. pendula*.

COMPOSITÆ.

Aster florissantia sp. nov.

PLATE IX, FIG. 35.

Station 5 J. A well-preserved leaf, dark brown in color.

Blade about 42 mm. long and a little over 25 broad, ovate-acuminate, cordate at base, distinctly but not very strongly dentate; teeth about 3 to 6 mm. long (i. e. from notch to notch); cordate base also dentate; structure throughout essentially as in *A. divaricatus* L., but the teeth feebler; venation as in *divaricatus*, with strongly arched laterals, and enclosed spaces basally.

Carduus florissantensis *Ckll.*

RELATIONSHIPS UNKNOWN.

Phyllites cyclophyllus (Lx.) Hollick.
Carpites gemmaceus Lx.
Carpites milioides Lx.
Carpites pealei Lx.
Antholithes amœnus Lx.
Antholithes obtusilobus Lx.
Phenanthera petalifera Hollick.

POSTSCRIPT.

Jan., 1908.

The collection of 1907 contains good material of *Myrica obscura* Lx., which proves to be a perfectly valid species, probably referable to *Comptonia*. The new material also throws doubt on the affinities of *Onoclea reducta*, which may not be a fern. Some remarkable new species were obtained, as well as many beautiful specimens throwing fresh light on the described species.

EXPLANATION OF PLATES.

PLATE VI.

Fig. 1. *Stipa laminarum* sp. nov. Cotype.
Fig. 2. *Woodwardia florissantia* sp. nov. Type.
Fig. 3. *Stipa laminarum* (germinating).
Fig. 4. *Onoclea reducta* sp. nov. Type.
Fig. 5. *Pinus wheeleri* (cone) sp. nov. Type.
Fig. 6. *Amelanchier peritula* sp. nov. Type.
Fig. 7. *Osmanthus præmissa* (Lx.) Ckll.
Fig. 8. *Juglans* (?) *sepultus* sp. nov. Type.
Fig. 9. *Dryopteris scansa* sp. nov. Type.
Fig. 10. *Porana tenuis*. Lx.
Fig. 11. *Pinus wheeleri* sp. nov. Type.

PLATE VII.

Fig. 12. *Persea coloradica* sp. nov. Type.
Fig. 13. *Persea coloradica* sp. nov.
Fig. 14. *Rosa wilmattæ* sp. nov. Type.
Fig. 15. *Ribes protomelænum* sp. nov. Type.
Fig. 16. *Liquidambar convexum* sp. nov. Type.
Fig. 17. *Quercus lyratiformis* sp. nov. Type.
Fig. 18. *Vitis florissantella* sp. nov. Type.
Fig. 19. *Morus symmetrica* sp. nov. Type.

PLATE VIII.

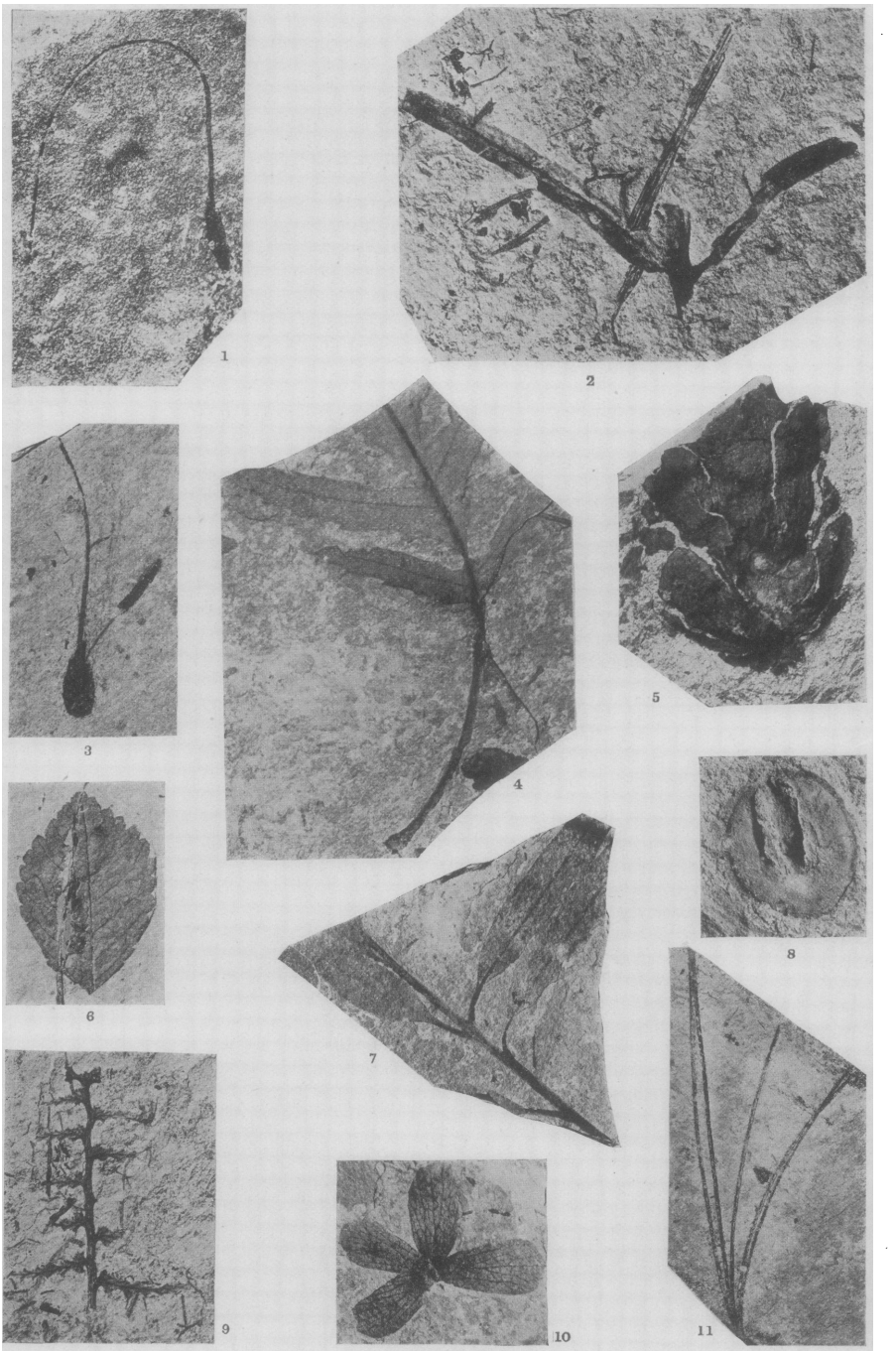
Fig. 20. *Pellæa antiquella* sp. nov. Type.
Fig. 21. *Quercus balaninorum* sp. nov. Type.
Fig. 22. *Populus crassa* (Lx.).
Fig. 23. *Populus lesquereuxi* Ckll. Greatly reduced.
Fig. 24. *Ficus arenaceæformis* sp. nov. Type.
Fig. 25. *Aristolochia mortua* sp. nov. Type.
Fig. 26. *Ulmus tenuinervis* Lx.
Fig. 27. *Pachistima integra* sp. nov. Type.
Fig. 28. *Populus* (?) *pseudocredneria* sp. nov. Type.

PLATE IX.

Fig. 29. *Sorbus megaphylla* sp. nov. Type.
Fig. 30. *Planera longifolia* Lx.
Fig. 31. *Sapindus coloradensis* sp. nov. Type.
Fig. 32. *Hydrangea* (?) *subincerta* sp. nov. Type.
Fig. 33. *Ficus florissantella* sp. nov. Type.
Fig. 34. *Salix ramaleyi rohweri* var. nov. Type.
Fig. 35. *Aster florissantia* sp. nov. Type.

PLATE X.

Fig. 36. *Diospyros princetonia* sp. nov. Type.
Fig. 37. *Philadelphus palæophilus* sp. nov. Type.
Fig. 38. *Dryopteris scansa* sp. nov.
Fig. 39. *Buettneria* (?) *perplexans* sp. nov. Type.
Fig. 40. *Melothria* (?) *coloradensis* sp. nov. Type.
Fig. 41. *Saxifraga peritula* sp. nov. Type.
Fig. 42. *Populus crassa* (Lx.).
Fig. 43. *Sicyos* (?) *florissantia* sp. nov. Type.
Fig. 44. *Juncus crassulus* sp. nov.
Fig. 45. *Juncus crassulus* sp. nov. Type.
Fig. 46. *Typha lesquereuxi* Ckll.
Fig. 47. *Mimulus saxorum* sp. nov. Type.
Fig. 48. *Sequoia haydeni* (Lx.) Ckll.



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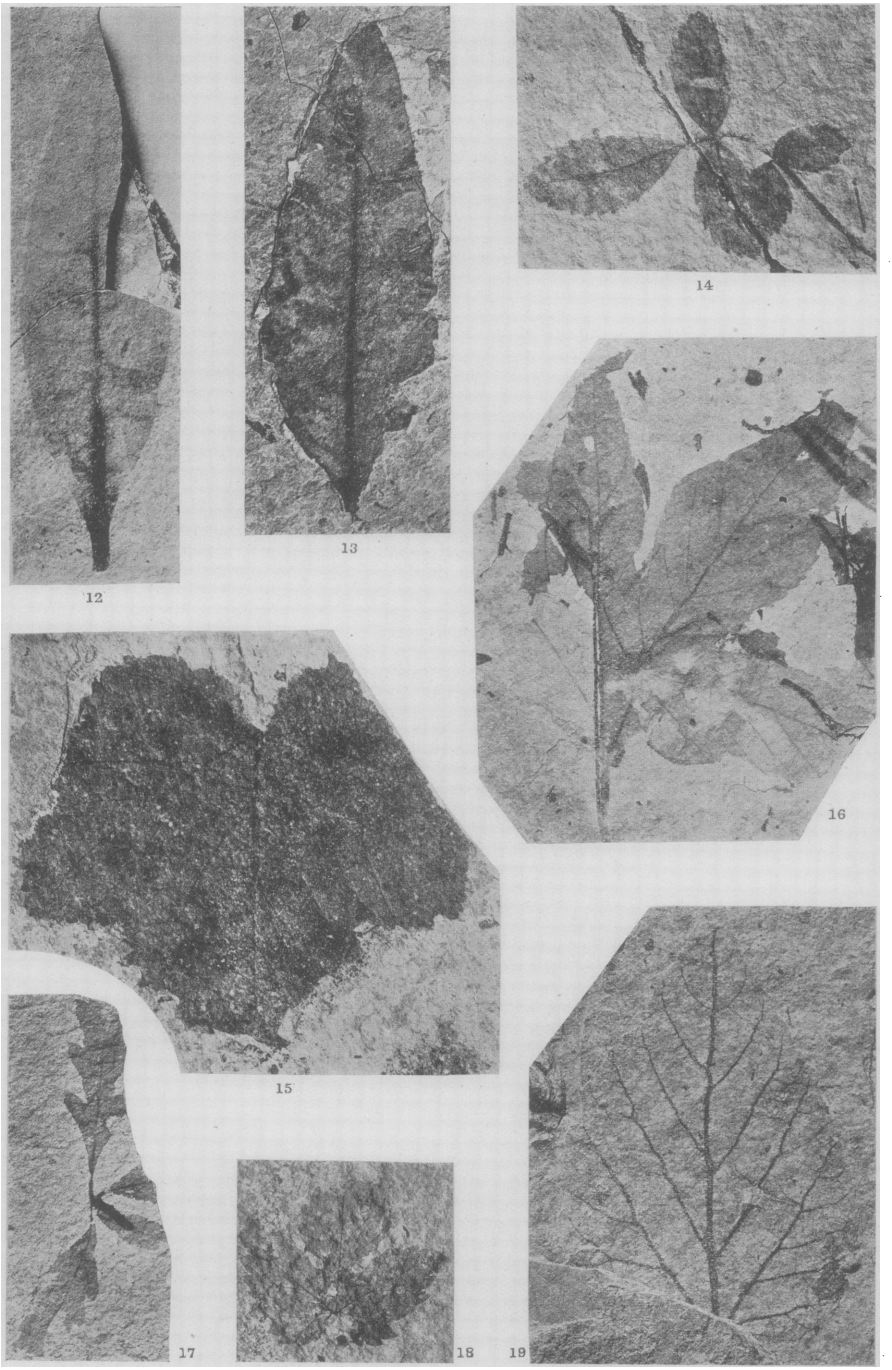
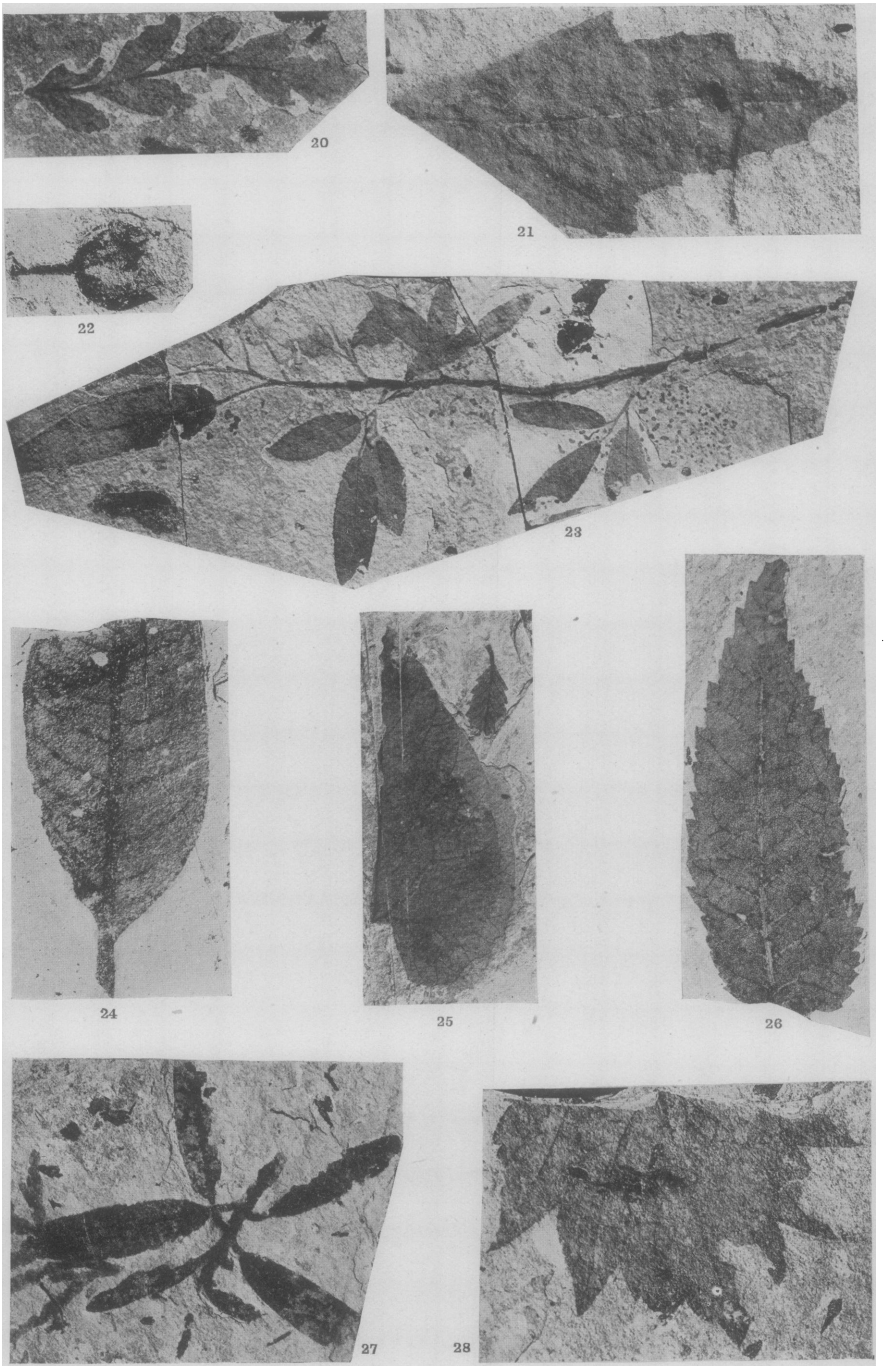
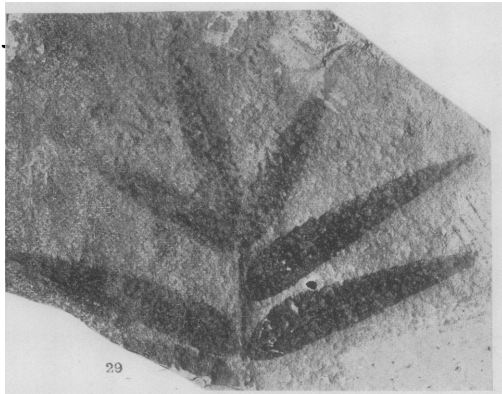


FOSSIL PLANTS, FLORISSANT, COL.



Fossil Plants, Florissant, Col.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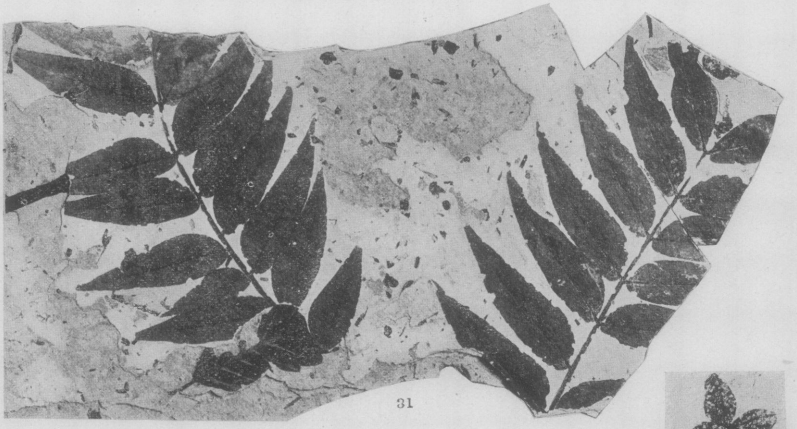
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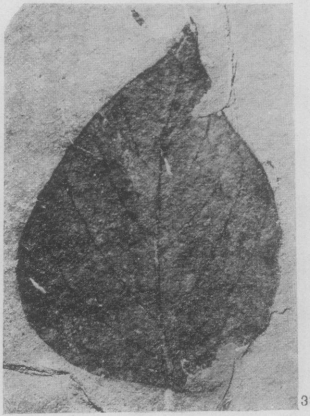
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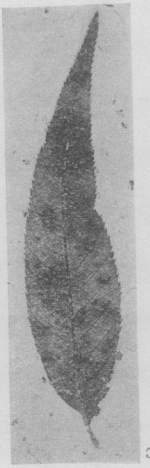
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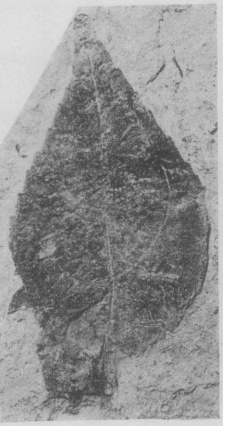
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FOSSIL PLANTS, FLORISSANT, COL.


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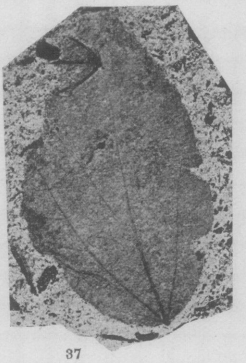
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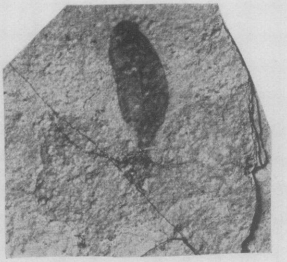
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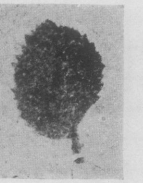
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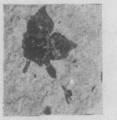
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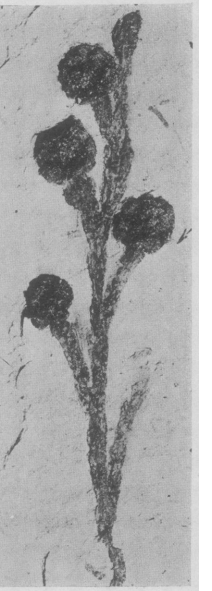
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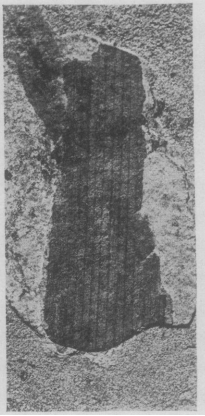
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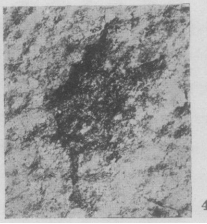
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Fossil Plants, Florissant, Col.