THE PALEONTOLOGIC HISTORY OF THE GENUS PLATANUS.

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(With Plates XVII–XXII.)

The paleontologic history of the horse and that of a number of other animals has been worked out to considerable satisfaction by zoologists, who have traced the lines of descent far back through geologic time and discovered their remote ancestors and many of the intermediate links in the phylogenetic chain. But in the vegetable kingdom few examples have presented themselves in which similar studies could be successfully undertaken. The fossil remains are too meager and imperfect and the affinities too doubtful, as a rule, to warrant any very wide generalizations relative to the genealogical history of plants. The case of the ginkgo tree presents a partial exception, and I once collected some of the evidence of the great antiquity of that singular and now nearly extinct form of plant life.* Our great trees of the Pacific coast (*Sequoia*) have also begun to attract attention from this point of view, since it has become known that their ancestral remains are abundant throughout the Tertiary and Upper Cretaceous strata of both hemispheres.†

With dicotyledonous plants the cases are still more rare, in consequence of the relatively recent appearance and brief geological history of this class. Baron von Ettingshausen has attempted to trace the chestnut tree back to an early ancestor in the Tertiary formation,‡ and more recently Dr. J. S. Newberry has introduced us to the ancestors of the tulip tree in the Cretaceous clays of New Jersey.§

Equally interesting with this latter, and, as we shall see, possibly allied to it, is the plane tree, or genus *Platanus*, of which only seven species survive in the present flora of the globe. Five of these seven species are comparatively rare and little known, only two of them being found within the limits of the United States in New Mexico and California. The two well-known species are the oriental plane tree (*Platanus orientalis*), and our abundant sycamore (*P. occidentalis*).

Few as are the living representatives of this type of vegetation, it is now known to have played a prominent part in the Tertiary history of the earth, and no less than twenty fossil species have been recognized. The greater part of these are from North American or Arctic strata, but

* See Science, Vol. V, June 19, 1885, p. 495.

† See Dr. Asa Gray's address as retiring president of the American Association for the Advancement of Science at Dubuque, August, 1872.

‡ Sitzb. d. Akad. d. Wiss., Bd. LXV, Abth. I, Wien, 1872, p. 147.

§ Bulletin of the Torrey Botanical Club, New York, Vol. XIV, January, 1887, p. 1.

several are found in the European Miocene. The Laramie group of the Rocky Mountain region, a formation which occupies a disputed position between the Cretaceous and Tertiary, and seems to span the boundary of Mesozoic and Cenozoic time, furnishes about half the known fossil forms. The species from this formation are all founded on the impressions of leaves, no inflorescence nor fruit having thus far been discovered. Among these leaves are some that deviate widely from those of living plane trees and seem to resemble those of *Aralia*. The most remarkable of these is the noble plane (*Platanus nobilis*) of Newberry, from the Upper Missouri country, or Fort Union group. This tree had a very large leaf, sometimes with a breadth of 2 feet, bearing a number of lobes, palmately disposed, and a considerable portion of the margin of the leaf was destitute of indentations or teeth. Smaller leaves having essentially the same form and nervation, but usually somewhat smoother on the margins, have been referred to *Aralia*. I have, however, collected great numbers of these leaves from beds on the Lower Yellowstone, where all the intermediate forms and sizes occurred in immediate association, so as to leave no doubt in my mind that they all belonged to the same type of plants. Fig. 1, Pl. XVII, represents one of these smaller forms, natural size.

This leaf has the usual form at the base for both the large and the small specimens, but others occurred having a remarkable expansion at the base of the blade, projecting backward on the leaf stalk and having from 2 to 5 lobes or points, as shown in figs. 2–5, Pls. XVII–XIX.

These expansions are to be interpreted as evidence that the leaves all belong to *Platanus* or to some extinct ancestral type of that genus, since something quite analogous to them is found in our American plane tree. The ordinary leaves of this tree are, it is true, destitute of basilar expansions, but those on young shoots, and sometimes those on the lower or non-fruit-bearing branches of trees, exhibit this peculiarity. Fig. 6, Pl. XIX, which represents a leaf from a small tree, shows it with considerable distinctness. Though less prominent, its resemblance to that of the fossil leaves is quite close.

In place of this backward expansion of the blade many sycamore leaves have an appendage similar in shape at the base of the leaf stalk, as though the once basilar appendage had been separated from the blade and crowded down the petiole to its point of insertion. This is very clearly shown in fig. 7, Pl. XX, from a young shoot with wedge-shaped leaves and very short petioles. More frequently these miniature blades are forced entirely off the petiole and are found grown together around the stem above the attachment of the leaf, so as not even to constitute true stipules. The constriction seen in the fossil forms between the blade of the leaf and the appendage would seem to represent the beginning of this process of detachment of the latter, and there is another fossil form (*Platanus appendiculata* LX., fig. 8, Pl. XX) found in the much more recent auriferous gravels of California, which corresponds precisely in this respect with the living specimen last figured.

The history of this character in the leaf of the sycamore is thus quite satisfactorily traced as far back as the close of the Mesozoic age, but the type is much older. The next series below the Laramie at which an abundance of vegetable remains is found in the western portions of the United States is the Dakota group of Kansas and Nebraska, which is usually regarded as Middle Cretaceous, and is about the equivalent of those beds in Europe in which the most ancient dicotyledonous plants occur. Throughout this series there are found large-lobed leaves variously referred to *Platanus*, *Aralia*, *Liquidambar*, *Sassafras*, *Liriodendron*, and *Aspidiophyllum*. The most abundant of these forms has been called *Sassafras*, or *Araliopsis*, the latter designation having, however, been generally dropped. It would, of course, be wrong to say that all these forms belong to *Platanus;* but to predict that they will one day be recognized as interrelated, and as representing the remote ancestry of the plane and the sycamore, can, in the light of our present knowledge, scarcely be considered rash. It seems very doubtful whether *Liquidambar* and *Platanus* of the living flora are as dissimilar as would appear from their wide separation in the so-called natural system of classification. That *Aralia*, *Sassafras*, and *Liriodendron* represent branches of a common trunk from which the former genera have also descended, is much less probable, but not impossible. As regards *Sassafras*, however, to which genus the greater part of the fossil leaves are supposed to belong, there is no need, I think, of resorting to so violent an assumption, since it is extremely doubtful that the Dakota leaves belong to that type.

It is a common mistake to look upon the *Sassafras* as possessing primarily a three-lobed leaf. Even those who know that non-lobate leaves occur are apt to regard them as abnormal and the lobed ones as normal. It is a fact well known to botanists that, in the oaks and many other trees, only the leaves on fruit-bearing branches can be depended upon for the determination of species, and most modern botanists now regard the varying forms of leaf seen on young shoots and near the base of trees as valuable hints at the probable stages through which the final forms have passed in the history of their development.

In the *Sassafras*, after it has attained any considerable size, the greater part of the leaves are elongate and without lobes. These are almost the only leaves found on flowering or fruiting branches of the larger trees. The lobed leaves occur almost entirely on the lower, barren branches of such trees. Fig. 9, Pl. XX, represents a nearly typical leaf from a tree 18 inches in diameter, on which at least nine-tenths of the leaves were without lobes. Fig. 10, Pl. XXI, shows a lobed leaf from the lower portion of the same tree.

Returning to the nervation, it will be instructive to compare that of the lobed leaf of *Sassafras* with that of the so-called Sassafras leaves of the Dakota group. Fig. 11, Pl. XXI, represents the *Sassafras cretaceum* of Lesquereux.

The disposition of the nerves proceeding from the midrib to the sinuses is remarkably uniform in all *Sassafras* leaves, as any one can prove by observation; yet it is here that the widest difference is seen in the fossil forms. These, however, bear some resemblance to the fossil forms of *Platanus* and to those called *Aralia*, which are probably of the same type.

None of the supposed *Sassafras* or *Liquidambar* leaves of the Dakota group show the basilar expansions that occur in some of the species of *Platanus* of later age, but in the anomalous form which has been called *Aspidiophyllum* something analogous to them is seen. Figs. 12 and 13, Pl. XXII, represent the *Aspidiophyllum trilobatum* Lx., the first of which shows the three lobes and nervation, while in the second the expansion at the base is somewhat lobed.

It is remarkable that certain of the remote ancestors of our familiar tulip tree are found to approach this same type, at least in general form, and one species formerly referred by Professor Lesquereux to that genus (*Liriodendron*), but finally classed as an *Aspidiophyllum*, has the enlarged base of blade with narrow neck in singular imitation of the *Platanus* leaves of the Lower Yellowstone Valley.

As regards *Aralia*, none of the Cretaceous forms thus far found possess this feature, but one of the species which I have myself called by that name, the beautiful *Aralia digitata* from the Fort Union deposits (fig. 15, Pl. XXII), shows a decided tendency in this direction, and though small and deeply lobed into five narrow digits curiously like fingers of the human hand, I can see nothing in the general nervation, dentation, or form that differs essentially from those of the largest leaves of *Platanus nobilis* from rocks of the same age.

The American origin of our sycamore was long denied by Willdenovius and other European botanists, and was only rendered certain by its discovery in a fossil state by Professor Lesquereux in a late deposit of the Mississippi Valley. Specimens were sent to that great authority on these subjects, Dr. Oswald Heer, of Zürich, who could find no characters by which to distinguish the fossil from the living form and who regarded this as a final settlement of the question.* But we have now learned that not only this most abundant species, not only the greater number of the living species are American, but that the genus itself, the entire type of vegetation to which the planes belong, is American, and that numerous and strange archaic forms of this type not only formed the umbrageous forests on the shores of the great inland Laramie sea where the Rocky Mountains now stand, but also those of the ocean at a time when it still pushed its arms northward across what are now the great plains of Texas, Colorado, and Wyoming.

*Bulletin de la société Vaudoise, Tome V, Lausanne, 1858, p. 144.

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FIG. 1. *Aralia notata* LX. (red. ½). (Page 40.) FIG. 4. *Platanus basilobata* Ward (red. ½). (Page 40.)

FIGS. 2, 3. *Platanus basilobata* Ward. (Page 40.)

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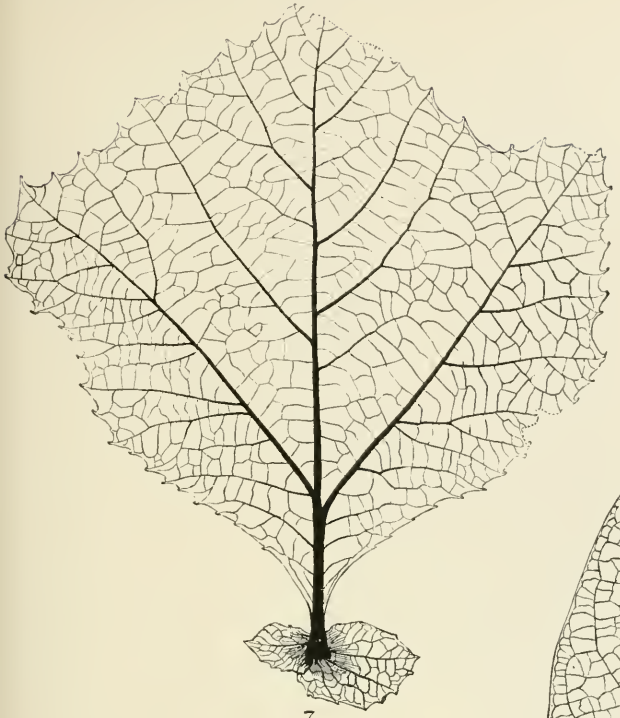
FIG. 5. *Platanus basilobata* Ward. (Page 40.) FIG. 6. *Platanus occidentalis* L. (red. 4 diam.). (Page 40.)



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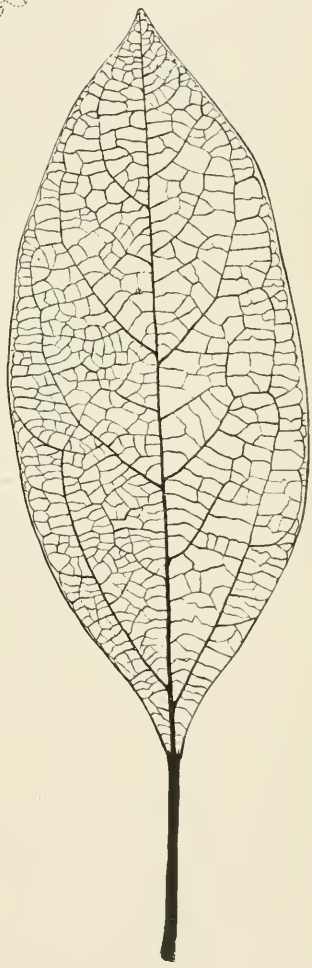

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FIG. 7. *Platanus occidentalis* L. (red. $\frac{1}{4}$). (Page 40.)
FIG. 8. *Platanus appendiculata* LX. (red. $\frac{1}{4}$). (Page 40.)

FIG. 9. *Sassafras officinale* Nees (red.). (Page 41

FIG. 10. *Sassafras officinale* Nees (red.). (Page 41.) FIG. 11. *Sassafras cretaceum* Lx. (Page 41.)

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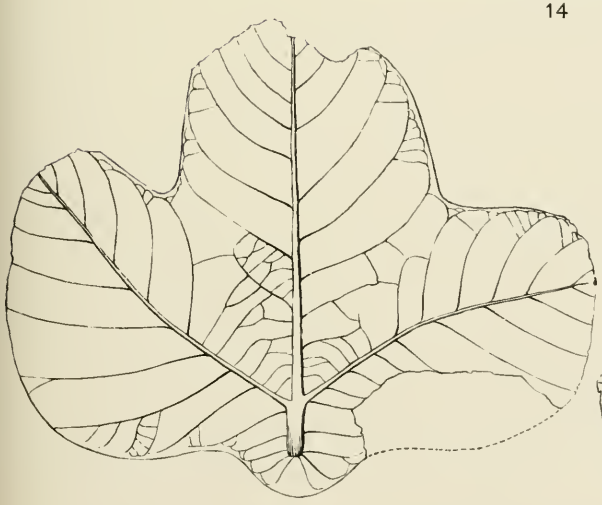

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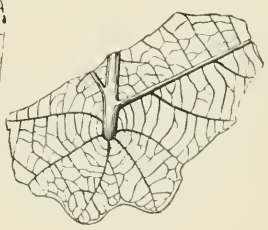

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FIGS. 12, 13. *Aspidiophyllum trilobatum* LX. (red. ⅓). (Page 42.)

FIG. 14. *Aspidiophyllum dentatum* LX., sp. ined. (red. ⅓). (Page 42.)

FIG. 15. *Aralia digitata* Ward. (Page 42.)