PLEISTOCENE PLANTS FROM ALABAMA[1]

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In the course of the cooperative study of the Atlantic coastal plain from the Potomac river southward during the past season, plant-bearing beds of Pleistocene age have been discovered at various localities, more particularly in Virginia, North Carolina and Alabama. A rather interesting and highly fossiliferous deposit of this character occurs along the Chattahoochee river in Russell County, Alabama, where the collections upon which the following brief communication is based were made by Dr. L. W. Stephenson of the Federal Survey, who also very kindly furnished the sections here given. The locality is a few hundred yards below Abercrombies Landing on the Alabama side of the Chattahoochee river, and about seven and one-half miles below Columbus, Georgia.

The recognizable leaf-remains have been found at two levels: they occur in an upper layer of hard, dark drab, rather pure clay which dries to an ash color, and in a lower layer of very dark impure peat. The leaf-remains found in the clay are fairly permanent, but those in the peat are very perishable and have been saved and identified by allowing the material to become thoroughly macerated in water and then carefully floating out the larger fragments; from these, sun-prints giving the exact outline are made before the specimens become thoroughly dry. If allowed to become too dry they crumble to powder. After the prints have been made the specimens are mounted on small cards and coated with glue, but even in this condition they are extremely fragile and liable to destruction.

The following two diagrammatical sections were taken about 100 yards apart; No. 1 shows the leaf-bearing horizons, the lower of which is partially concealed by land slips, and No. 2 shows a complete section to the water's edge. From the way in which the base of the exposure is concealed in section No. 1, it is impossible

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to be certain that the peat is in place in the section and does not represent more recent drift material; however, the opinion of the collector and all of the circumstantial evidence are strongly in favor of the view that it is a true Pleistocene deposit, somewhat older than the overlying beds. The argument for this interpretation may be briefly stated as follows:—The peat which was uncovered over an area two by ten feet had every appearance of forming an integral part of the section. The material itself is very similar to the somewhat more argillaceous material occurring at the same level, and in place, in section No. 2. Seven species have been detected both in the peat and in the overlying clay, the latter unquestionably Pleistocene. These forms are *Quercus virginiana* Mill, *Quercus prinus* Linné, *Quercus nigra* Linné, *Betula nigra* Linné, *Platanus occidentalis* Linné, *Carpinus caroliniana* Walt., and *Ulmus alata* Michx.

The deposits record progressive changes in the conditions of deposition which may be recast somewhat as follows:—The lower gravel bed probably represents material deposited near the mouth of a stream with considerable current, during the brief erosion interval immediately preceding the deposition of the peat. With the subsequent subsidence of the land the lower stream valleys were transformed into estuaries and a barrier beach was built by wave action, which impounded the stream or lagoon, forming a swamp where the peaty material was accumulated. With the continued sinking of the land the advancing shore line spread a mantle of gravel (the upper gravel bed) over the swamp and with the still greater depression of the region, the overlying clays were deposited in quiet estuary waters.

With regard to the exact stage of Pleistocene represented, it is very probable that these Chattahoochee materials are to be correlated with those late Pleistocene beds which have been called the Talbot formation in Maryland and Virginia, and which contain numerous similar swamp deposits. The species of plants represented are all forms which occur in the recent flora of Alabama, although the present range of some of them is considerably different. For example, the northern limit of the live oak is about one hundred miles due south while the southern limit of the chestnut oak is about forty miles due north of Abercrombies Landing.

The willow oak is also rare as far south as this point although it is abundant a few miles to the northward.

The flora as a whole furnishes no evidence of climatic conditions appreciably different from those which exist at the present time in this region, although the grouping of species was quite different from that which obtains along the present Gulf coast.

The presence of *Tsuga canadensis* (Linné) Carr., and *Betula*

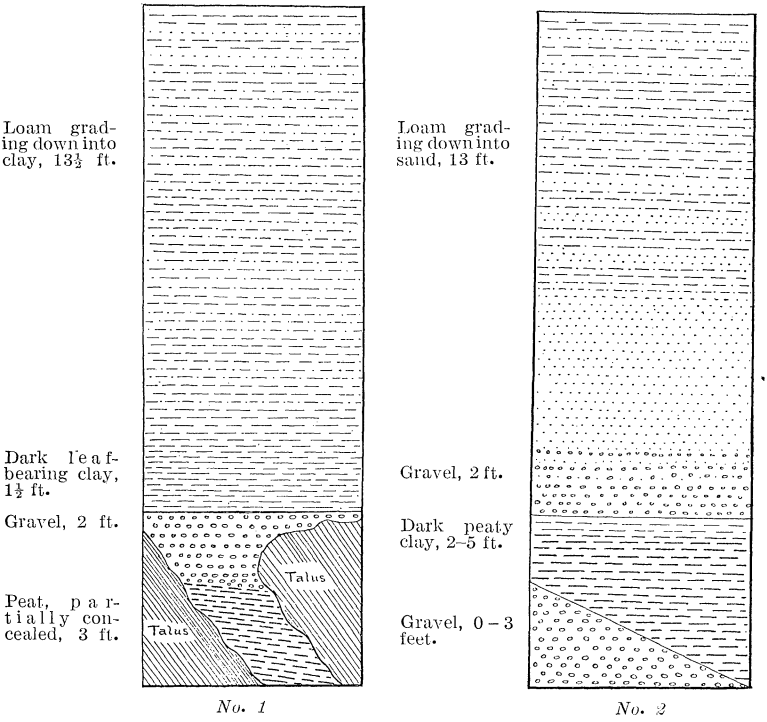

FIG. 1. Pleistocene sections along the Chattahoochee river in Alabama. *No. 1* is about three hundred feet north of *No. 2*.

lenta Linné in the existing flora of Alabama at an isolated locality in Winston county, miles south of their usual range, coupled with the presence of the larch in the Pleistocene of Georgia, would seem to indicate cooler conditions at some time in the Pleistocene, presumably at an earlier time than is represented by the fossils from near Abercrombies Landing.

In addition to the species enumerated below, there are a con-

siderable variety of small seeds, husks of Hicoria, and the cone scales and needles of Pinus, which it has seemed best not to determine positively at the present time. Remains of the cypress (Taxodium) and the gum (Nyssa) which are usually present in deposits of this age have not been detected.

FAGALES

Carpinus caroliniana Walt., *Fl. Car.*, p. 236, 1788.
Pl. 1, Figs. 8, 9.
Berry, *Journ. Geol.*, vol. 15, p. 340, 1907.

A species of low rich woods which ranges from Canada to Florida and Texas and is common throughout Alabama. The fossil leaves are present in both the peat and the overlying clays. Recently recorded by the writer from the Pleistocene of North Carolina.

Betula nigra Linné, *Sp. Pl.*, p. 982, 1753.
Pl. 2, Figs. 2–4.
Knowlton, *Amer. Geol.*, vol. 18, p. 371, 1896.
Berry, *Journ. Geol.*, vol. 15, p. 341, 1907.

A species which in the modern flora ranges from New England to Texas and which is common throughout Alabama, especially along the stream banks. Several leaves occur in both the peat and the clays and a small fragment of the characteristic bark was also detected in the peat. This species has been previously recorded from the Pleistocene of North Carolina and West Virginia.

Fagus americana Sweet, *Hort. Brit.*, p. 370, 1826.
Pl. 2, Fig. 7.
Berry, *Torreya*, vol. 6, p. 88, 1906; *Journ. Geol.*, vol. 15, p. 341, 1907.
Hollick, Maryland Geological Survey, *Pliocene and Pleistocene*, p. 226, 1906.

Fagus ferruginea Michx., Lesquereux, *Amer. Journ. Sci.*, vol. 27, p. 363, 1859; *Geol. of Tenn.*, p. 427, pl. 7 (K), fig. 11, 1869.

Fagus ferruginea Ait., Knowlton, *Amer. Geol.*, vol. 18, p. 371, 1896.

Mercer, *Journ. Phila. Acad.*, (ii), vol. 11, pp. 277, 281, fig. 8 (15), 1899.

In the modern flora the beech is a prominent element in the mesophile valley forests of the Alleghenian, Carolinian and Louisianian zones. It was also a very prominent Pleistocene type and has been recorded from the Pleistocene of Pennsylvania, Maryland, Virginia, West Virginia, North Carolina and Tennessee. Near Abercrombies Landing it is represented in the peat by four or five of the characteristic husks, two nuts and one imperfect leaf.

Quercus nigra Linné, *Sp. Pl.*, p. 995, 1753.

Pl. 1, Figs. 3, 4.

Berry, *Journ. Geol.*, vol. 15, p. 342, 1907.

This species ranges in the Recent from the Louisianian zone northward as far as Delaware and is common throughout Alabama where it inhabits low rich woods and sandy pine-barren swamps. It is by far the most abundant leaf in the peat deposits, possibly due to its ability to resist decay; in the clays a single impression was found, showing the basal two thirds of a leaf. This species has recently been recorded by the writer from the Pleistocene of North Carolina.

Quercus virginiana Mill, *Gard. Dict.*, Ed. 8, No. 16, 1768.

Pl. 1, Fig. 2.

The live oak is a tree of the sea-coast, and in Alabama rarely occurs north of latitude 31°. Thus its northern limit in this state is about one hundred miles due south of Abercrombies Landing,—collateral evidence, if such were necessary, that the Pleistocene sea or estuaries of it reached as far north as this point in the late Pleistocene. The species is present in both the peat and in the overlying clays, and so far as I am aware has not previously been recorded in the fossil state.

Quercus prinus Linné, *Sp. Pl.*, p. 996, 1753.

Pl. 1, Fig. 5.

Berry, *Journ. Geol.*, vol. 15, p. 342, 1907.

The chestnut oak is a tree of the rocky woods and hillsides and makes its best growth in Alabama on elevations exceeding eight hundred feet. Its present southern limit coincides approximately with the isothermal line of 60° F., which also serves to mark the boundary between the Carolinian and the Louisianian zones. This line crosses the Chattahoochee river near West Point, Ga., or about forty miles due north of Abercrombies Landing. Two leaves were found in the peat, and one fragmentary specimen showing venation but not marginal characters is from the overlying clays. It was recently recorded by the writer from the Pleistocene of North Carolina where it is present in considerable abundance.

Quercus phellos Linné, *Sp. Pl.*, p. 994, 1753.
Pl. 1, Fig. 1.
Berry, *Journ. Geol.*, vol. 15, p. 342, 1907.

The willow oak is a common element in the mesophile forests of the northern part of Alabama; it becomes rare, however, south of the long-leaf pine belt which stretches across the central part of the state, its southern boundary crossing the Chattahoochee river just north of Abercrombies Landing. The fossil leaves are a common element in the peat but have not been detected in the overlying clays. It was recently recorded by the writer from the Pleistocene of North Carolina where it is very common.

Ulmus alata Michx., *Fl. Am. Bor.*, vol. 1, p. 173, 1803.
Pl. 1, Figs. 6, 7.
Berry, *Journ. Geol.*, vol. 15, p. 343, 1907.

The water elm is common throughout Alabama and ranges northward as far as southern Illinois and Virginia. The Pleistocene material from Abercrombies Landing contained two fragmentary specimens, one from the peat and the other from the overlying clays. These leaves show the characteristic serrated margin of this genus. They are smaller and narrower than the leaves of *Ulmus pseudo-racemosa* Hollick from the Pleistocene of Maryland and the character of the marginal teeth is also somewhat different. The state of preservation indicates that the surface was roughened or somewhat pubescent in life. They are identical with the more perfect leaves which I have referred to this species from

the Pleistocene of North Carolina, and also agree admirably with leaves from the existing tree, so that the identification is reasonably sure in spite of the meager materials.

Ranales.

Liriodendron tulipifera Linné, *Sp. Pl.*, p. 535, 1753.

The tulip tree is a common mesophile type of the Alleghenian, Carolinian and Louisianian zones, its southern limit in Alabama being about latitude 31°. Material from Abercrombies Landing contained two positively identified winged carpels and several more doubtfully determined fragments all of which came from the peat. The genus Liriodendron, which has such an extremely interesting geological history,[1] has furnished a large number of American Cretaceous species ranging from the mid-Cretaceous onward, but none have been found in the American Tertiary. In Europe and the Arctic regions, however, a number of Tertiary forms have been described, especially from the Pliocene,— the leaves of *Liriodendron procaccinii* Unger from France and Italy being scarcely distinguishable from those of the existing species. The material from Alabama is, so far as I am aware, the first Pleistocene record of Liriodendron, although Schmalhausen records leaves which he has identified as this species from the Altai Mountains of Central Asia in strata which he refers doubtfully to the Pliocene.[2]

Rosales.

Platanus occidentalis Linné, *Sp. Pl.*, p. 999, 1753.

Pl. 2, Fig. 5.

Knowlton, *Amer. Geol.*, vol. 18, p. 371, 1896.

Penhallow, *Trans. Roy. Soc. Can.*, (ii), vol. 2, sec. 4, pp. 68, 72, 1896; *Amer. Nat.*, vol. 41, p. 448, 1907.

Mercer, *Journ. Phila. Acad.*, (ii), vol. 11, p. 277, 1899.

Berry, *Journ. Geol.*, vol. 15, p. 344, 1907.

[1] Berry, Notes on the Phylogeny of Liriodendron, *Bot. Gaz.*, vol. 34, pp. 44–63, 1902.

[2] Schmalhausen, Ueber tert. Pflanzen aus dem Thale des Flusses Buchtormia am Fusse des Altaigebirges. *Palacontographica*, vol. 33, 1887.

Platanus aceroides Göpp., Hollick, Maryland Geological Survey, *Pliocene and Pleistocene*, p. 231, pl. 73, 74, 1906.

In the modern flora this species inhabits low woods and banks from Canada to Florida and Texas. In Alabama it frequents the bottom lands of the central part of the state and is infrequent in the southern part. It is an abundant Pleistocene type and has been previously recorded from Canada, Pennsylvania, Maryland, West Virginia and North Carolina. The Abercrombies Landing remains include the fragment of a central part of a leaf shown in the figure, which has the characteristic venation but none of the marginal characters and which comes from the clays; and a still smaller fragment from the underlying peat which shows one of the marginal points.

SAPINDALES.

Ilex opaca Ait., *Hort. Kew.*, vol. 1, p. 169, 1789.
Pl. 2, Fig. 1.
Hollick, *Bull. Torrey Club*, vol. 19, p. 331, 1892.
Berry, *Journ. Geol.*, vol. 15, p. 345, 1907.

The holly frequents damp banks and hammock lands in Alabama and ranges northward to New York and southeastern Massachusetts. It has been recorded by Hollick from the supposed Miocene at Bridgeton, N. J., and by the writer from the North Carolina Pleistocene. A single specimen was found at Abercrombies Landing in the peat.

ERICALES.

Xolisma ligustrina (Linné) Britton, *Mem. Torrey Club*, vol. 4, p. 135, 1894. Pl. 2, Fig. 6.
Hollick, Maryland Geological Survey, *Pliocene and Pleistocene*, p. 236, pl. 69, fig. 6, 1906.
Berry, *Journ. Geol.*, vol. 15, p. 346, 1907.

In the present Alabama flora the typical forms of this species inhabit the damp banks of small streams in the mountainous portion of the state. It is of a generally more northern distribution, having its southern limit along the southern edge of the metamor-

phic hills in Lee county, and is not a member of the Louisianian flora. In a fossil state it has been previously recorded from Maryland and North Carolina. At Abercrombies Landing it is confined to the peat. *Xolisma foliosiflora* (Michx.) Small which Mohr[1] considers to be only a variety of this species, and which is common in the Alabama coastal plain and on lowlands westward into Louisiana and northward as far as Virginia, is apt to have leathery leaves which are usually distinctly serrulate. It may be considered to be the coastal plain descendant of the more ancient *Xolisma ligustrina*.

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[1] Mohr, *Bull. Torrey Club*, vol. 24, p. 24, 1897.

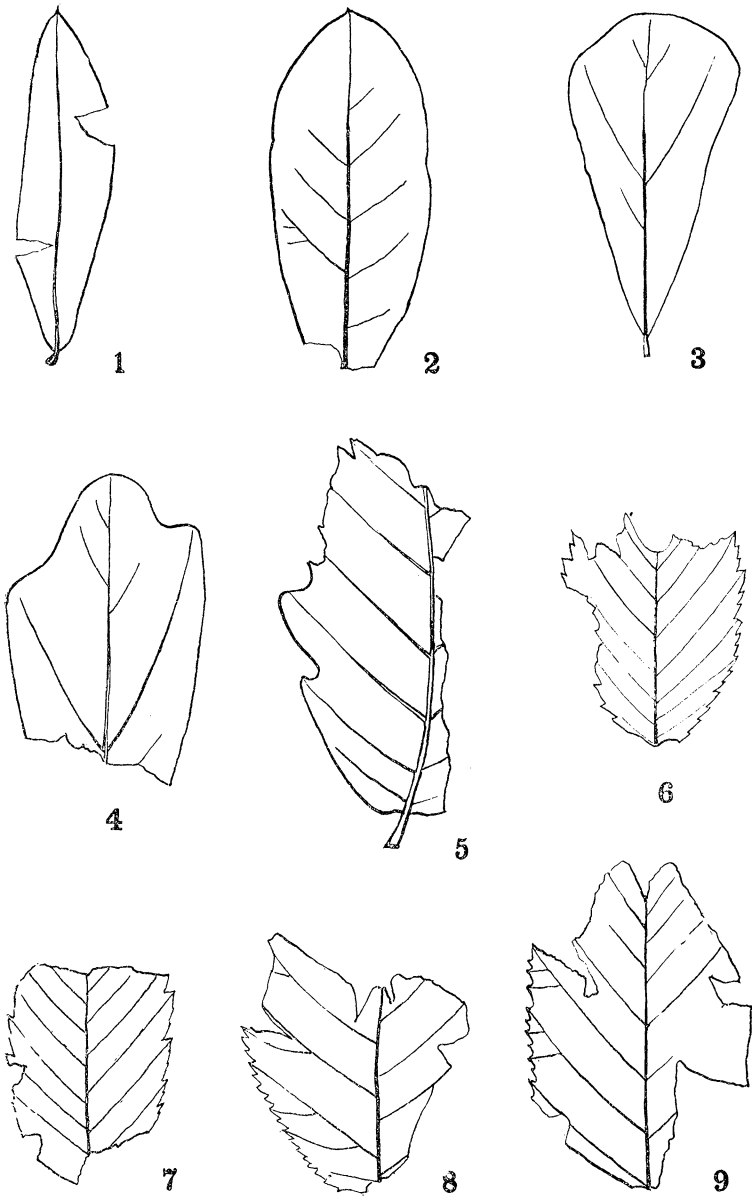
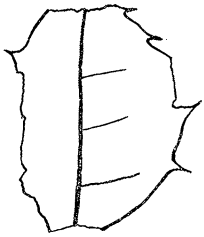


PLATE I

Fig. 1.—*Quercus phellos* Linné . . peat.
Fig. 2.—*Quercus virginiana* Mill . clay.
Figs. 3, 4.—*Quercus nigra* Linné . peat.
Fig. 5.—*Quercus prinus* Linné . . peat.
Fig. 6.—*Ulmus alata* Michx. . . peat.
Fig. 7.—*Ulmus alata* Michx. . . clay.
Fig. 8.—*Carpinus caroliniana* Walt. peat.
Fig. 9.—*Carpinus caroliniana* Walt. clay.



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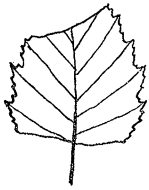

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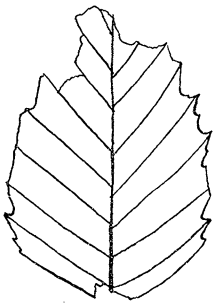

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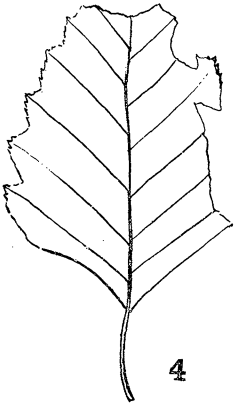

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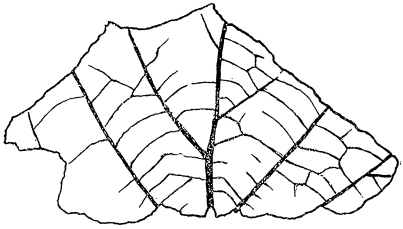

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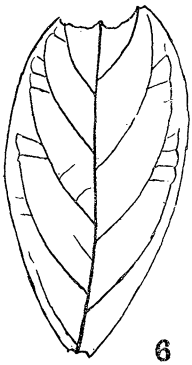

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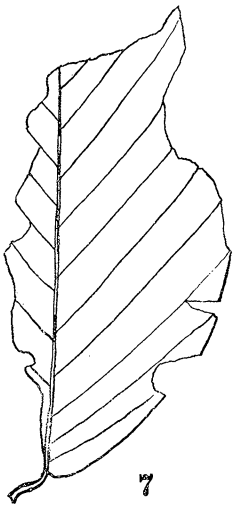

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PLATE 2

Fig. 1.—*Ilex opaca* Ait . . . . peat. Fig. 5.—*Platanus occidentalis* Linné peat.
Figs. 2, 3.—*Betula nigra* Linné . . clay. Fig. 6.—*Xolisma ligustrina* (Linné) Britton . . . . . peat.
Fig. 4.—*Betula nigra* Linné . . . peat.
Fig. 7.—*Fagus americana* Sweet . peat.