

NOTES ON NORTH AMERICAN TREES. II. CARYA

C. S. SARGENT

Conspectus of the species of the United States

Bud-scales valvate, the inner strap-shaped and only occasionally slightly accrescent; fruit more or less broadly winged at the sutures (*Apocarya* C. DC.).

Shell of the nut thin and brittle; leaflets more or less falcate.

Aments of staminate flowers nearly sessile, usually on branches of the previous year; lobes of the seed entire or slightly notched at apex.

Leaflets 13-15; nut ovoid-oblong, cylindrical; seed sweet...1. *C. pecan*

Leaflets 7-11; nut oblong, compressed; seed bitter.....2. *C. texana*

Aments of staminate flowers pedunculate, on branches of the year or of the previous year; lobes of the bitter seed deeply 2-lobed.

Leaflets 7-11; nut cylindrical or slightly compressed...3. *C. cordiformis*

Leaflets 7-13; nut compressed, usually conspicuously wrinkled

4. *C. aquatica*

Shell of the ellipsoidal nut thick and hard; lobes of the sweet seed deeply 2-lobed; leaflets 7-9, occasionally 5, rarely slightly falcate; aments of staminate flowers long-pedunculate at the base of branches of the year.....5. *C. myristicaeformis*

Bud-scales imbricated, the inner becoming much enlarged and often highly colored; aments of staminate flowers on peduncles from the base of branches of the year, rarely from the axils of leaves; fruit usually without wings; seed sweet, its lobes deeply 2-lobed (*Eucarya* C. DC.).

Branchlets usually stout, slender in no. 7; involucre 6-12 mm. in thickness, opening freely to the base.

Bark on old trunks separating into long, broad, loosely attached scales; nuts pale.

Branchlets light red-brown; shell of the nut thin.

Leaflets 5 or rarely 7, obovate to ovate, acute or acuminate; nut much compressed, often long-pointed at apex; branchlets glabrous or pubescent.....6. *C. ovata*

Leaflets 5, lanceolate, acuminate; nut little compressed, acute at apex; branchlets slender, glabrous...7. *C. carolinae-septentrionalis*

Branchlets pale orange color, pubescent; leaflets usually 7-9; shell of the nut thick.....8. *C. laciniosa*

Bark not scaly, on old trunks dark, deeply ridged; leaflets 7-9, often subcoriaceous, pubescent below; nut reddish brown, often long-pointed, thick-shelled; branchlets pubescent.....9. *C. alba*

Branchlets slender; leaves 5-7-foliolate; involucre of the fruit tardily dehiscent to the middle, indehiscent or opening freely to the base; shell of the nut thick, bark close or sometimes scaly in no. 13.

Branchlets and leaves not covered when they first appear with rusty brown pubescence.

Involucre of the fruit 3-5.5 mm. in thickness, opening freely to the base; leaves usually 7-foliolate; winter-buds pubescent.

Leaflets hoary tomentose below in early spring, slightly pubescent at maturity; petioles and rachis glabrous; fruit broad obovoid; branchlets glabrous.....10. *C. leiodermis*

Leaflets covered in early spring with silvery scales, pale and pubescent below during the season; petioles and rachis more or less thickly covered with fascicled hairs; fruit ellipsoidal to obovoid or globose; branchlets glabrous or slightly pubescent.....11. *C. pallida*

Involucre of the fruit 1-3 mm. in thickness; winter-buds glabrous or puberulous.

Leaves 5-, rarely 7-foliolate, glabrous or rarely slightly pubescent; fruit obovoid, often narrowed below into a stipitate base, the involucre indehiscent or tardily dehiscent.....12. *C. glabra*

Leaves generally 7-foliolate, glabrous or rarely pubescent; fruit short-oblong, subglobose or obovoid, the involucre opening freely to the base; bark often more or less scaly.....13. *C. ovalis*

Branchlets and leaves densely covered when they first appear with rusty brown pubescence; leaflets usually 5-7; winter-buds rusty pubescent.

Fruit obovoid; the involucre 2-3 mm. in thickness; peduncles of the aments of staminate flowers often from the axils of leaves; branchlets soon becoming glabrous.....14. *C. floridana*

Fruit subglobose to broadly obovoid, ellipsoidal or pyriform, the involucre on the different varieties 2-13 mm. in thickness; branchlets pubescent through their first season.....15. *C. Buckleyi*

1. *CARYA PECAN* Engl. and Graeb.—The pecan was evidently planted by the Indians in the Mississippi Valley, and it is sometimes difficult to determine the natural distribution of this tree. It is probably indigenous in western Mississippi and in West Feliciana Parish, Louisiana, but the statement in my *Silva of North America* that the pecan extended to central Mississippi and Alabama must, I think, be taken to refer to planted or possibly naturalized trees; and it is possible that some of the pecan trees in southern Indiana, especially those toward the Ohio border, were planted by the Indians or are descendants of their trees. Westward in the United States the pecan ranges to the valley of the south fork of the

Arkansas River in Woods County and to Comanche County, Oklahoma, and in Texas to the valley of the Devil's River and to Hardiman County.

2. *CARYA TEXANA* C. DC.—In addition to the stations in Texas and Arkansas (see *Trees and Shrubs* 2:206) the bitter pecan has been found near Lake Charles in Calcasieu Parish, and near Laurel Hill, West Feliciana Parish, Louisiana, and near Natchez, Adams County, Mississippi.

3. *CARYA CORDIFORMIS* Schn.—This is perhaps the most widely distributed although not the commonest of all the species of *Carya*, as it ranges from southern Maine to the valley of the St. Lawrence River near Montreal and to that of the Ottawa at Hull in the Province of Quebec, and westward to northeastern Nebraska and eastern Oklahoma, and southward to western Florida, northern Alabama, western Mississippi, Louisiana, and eastern Texas. In New England it appears to grow farther north than the other species, but in the valley of the St. Lawrence River in Quebec and Ontario it is associated with *C. ovata*. It grows on the shores of the Straits of Mackinac, Michigan, and in southeastern Minnesota with *C. ovata*, but as it ranges much farther north than that species in Minnesota it must be considered the most northern representative of the genus. In the south Atlantic states from Virginia to southern Georgia it is found from the coast up to altitudes of about 700 m. on the Appalachian Mountains. I have no record of its occurrence in Florida outside the valley of the Apalachicola River or in the coast region of the Gulf states.

To persons who have not read books about trees *C. cordiformis* is generally known, at least in the southern states, as the pignut, and this name should be used for it rather than for *C. glabra* or *C. ovalis* and their varieties, which all have sweet and edible seeds. The first published account of *C. cordiformis* appeared in 1731 in CATESBY'S *Natural History of Carolina* (1:38. pl. 38), where it is called "*nux Juglans Carolinensis fructu minimis putamiene laevi*, the pignut." CATESBY describes the nuts "as not one-quarter part so big as those of the hickory, having both inner and outer shells very thin, so that they may easily be broken with one's fingers. The kernels are sweet, but being small and covered with a very

bitter skin, makes them worthless except for squirrels and other wild creatures." CATESBY's figure of a single nut is not a very good one, and at one time led me to suppose that he had figured a nut of some form of *C. ovalis*, but there can be no doubt that his description is that of *C. cordiformis*. In 1770 MUENCHHAUSEN (Hausv. 5:181) called *Juglans alba* of MILLER the pignut among other names. MARSHALL in 1785 described *C. cordiformis* as *Juglans alba minima* and called it the pignut; but in 1787 WANGENHEIM called the *Juglans glabra* of MILLER the pignut and *Juglans cordiformis* the bitternut, and these names appear to have been adopted by all later writers on these trees.

CARYA CORDIFORMIS var. LATIFOLIA Sargent, Trees and Shrubs 2:206. 1913.

New stations for this broad-leaved variety are Fayetteville, Washington County, Arkansas, *E. J. Palmer*, July 15, 1915 (no. 8219), Hannibal, Marion County, Missouri, *J. Davis* (no. 2068), Yellow River and Postville, Allamakee County, Iowa, *O. Schulz*, 1914 (nos. 95 and 30), Toledo, Lucas County, Ohio, *R. E. Horsey*, September 29, 1913.

4. CARYA AQUATICA Nutt.—The water hickory has usually been considered an inhabitant of deep, long inundated river swamps, but toward the southern limits of its range in Florida and Texas it sometimes grows on the high sandy banks of rivers which are only occasionally overflowed, and in dry sandy soil at a considerable distance from streams. The bark of trees in such situations is close, pale, and does not separate into the long, loosely attached scales which are characteristic of this tree when it grows in swamps, although the bark of very old trees growing on dry ground sometimes shows a tendency to flakiness. The trees growing on dry ground have narrower leaflets and usually nuts of a different shape, without the longitudinal wrinkles peculiar to the nut of the water hickory, although some narrower-leaved trees bear nuts of the ordinary size and shape. These southern narrow-leaved trees are so distinct that they may be distinguished as

CARYA AQUATICA var. **australis**, n. var.—Differing from the type in its narrower leaflets, in its smaller ellipsoidal fruit, pale red-brown nuts without longitudinal wrinkles, and in its close pale bark. Leaflets 9-11, lanceolate, acuminate, slightly falcate;

minutely glandular-serrate, the terminal raised on a stem 1–1.5 cm. in length, the lateral nearly sessile; when they unfold scurfy-pubescent above and hoary tomentose below, and in the autumn glabrous on the upper surface, pubescent and furnished on the lower surface with small conspicuous tufts of axillary hairs, 6–8 cm. long and 1–1.5 cm. wide. Fruit ellipsoidal, acute at apex, acute or rounded at base, compressed, covered with small scattered yellow scales, 2–2.5 cm. long, about 1 cm. wide and thick; involucre 1–1.5 mm. in thickness, the sutures only slightly winged, tardily dehiscent usually only to the middle; nut oblong to slightly obovoid or semiorbicular, rounded at the ends, compressed, slightly angled, smooth and without longitudinal wrinkles, the shell 1–1.5 mm. thick.

A large tree with close pale bark.

In dry sandy soil in the yard of a house at Alva, Lee County, Florida, C. S. Sargent, March 26, 1914, T. G. Harbison, September 16, 1914 (no. 2, type). Banks of the Caloosahatchee River near Alma, common, C. S. Sargent, March 26, 1916, T. G. Harbison, September 16, 1916. Banks of the St. Johns River, Florida, A. H. Curtiss, October (no. 2573), no date.

A tree with close bark growing 5 miles west of Jupiter, Palm Beach County, Florida, with leaflets from 1.5 to nearly 2.5 cm. wide (C. S. Sargent, March 19, 1914), is probably of this variety, but I have not seen the fruit. A number of trees with pale close bark on the high banks of the St. Johns River at San Mateo, Putnam County, Florida, seen by Mr. HARBISON and me in 1917, in their rather broader leaflets and larger nuts, resembling in shape the nuts of the typical water hickory but without their peculiar wrinkles, seem to connect the variety with the species. I have seen water hickories with close bark and narrow leaflets growing in dry sandy soil near Marshall, Harrison County, Texas, but the fruit of these trees has not been collected.

5. *CARYA MYRISTICAEFORMIS* Nutt.—The nutmeg hickory connects the two sections *Apocarya* and *Eucarya* of the genus which without this species might well have been considered distinct genera. The valvate bud-scales and the thin involucre of the fruit with prominently winged sutures show its relationship with *Apocarya*, but the thick shell of the nut and the small number of leaflets, 7–9 and occasionally 5, are characters of *Eucarya*. The lobes of the seed are deeply 2-lobed, like those of *Eucarya*, but this is true of two other species of *Apocarya*, *C. cordiformis* and *C. aquatica*. The seeds of these, however, are bitter, while those of

C. myristicaeformis are sweet and edible, like the seeds of *Eucarya*. Nowhere common and very local in distribution, the nutmeg hickory has recently been found on the bluffs of the Yazoo River near Yazoo City, Mississippi, in Richmond Parish in northern Louisiana, at Natchitoches on the Red River in western Louisiana, at Beaumont on the Nueces River in Texas, and at Hugo in Choctaw County, Oklahoma.

6. *CARYA OVATA* Koch.—The shagbark hickory shows that little reliance can be placed on pubescence as a specific character in this genus, for individual trees have glabrous or pubescent branchlets and glabrous or pubescent leaflets, the two forms often growing together, so that this variation is not dependent on soil or climate, although pubescent individuals are more common in the south than in the north. On some trees the anthers are red and on others yellow. As it is found from the neighborhood of Montreal in the Province of Quebec to southern Minnesota, *C. ovata* grows farther north than the other species of the genus with the exception of *C. cordiformis*. Westward it ranges to southeastern Nebraska, eastern Kansas, and eastern Oklahoma. In North and South Carolina it is confined to the Piedmont region, and on the mountains is replaced by *C. ovalis*. In Georgia I have seen it only on Shell Bluff on the Savannah River, below Augusta, near Eatonton, Putnam County, and at Rome, Floyd County. I have no reason to believe that this tree grows in Florida; and from Alabama I have seen specimens only from Valley Head, Dekalb County, and from the neighborhood of Selma, Dallas County, although MOHR credits it to the "Tennessee valley mountain region upper division of the Coast Pine belt." From Mississippi I have seen specimens only from the east central part of the state (Columbus, Starkville, and Brookville), where it is common in its most pubescent form. It has not been found in eastern Louisiana, but it is common in the western part of that state and in southern Arkansas, but is rare in eastern Texas to the valley of the Trinity River. The common form of the fruit is short-oblong to subglobose and depressed at apex, and the nut is then rounded, truncate, or slightly obcordate at apex. The fruit, however, varies considerably in size and shape, and a small-fruited form has been described as var. *Nuttallii*.

Sargent, Trees and Shrubs 2:207. 1913. More distinct is a form with oblong fruit and pointed nuts which may be described as

CARYA OVATA var. **ellipsoidalis**, n. var.—Differing from the type in its ellipsoidal fruit and slender branchlets. Fruit bluntly pointed at the ends, much compressed, slightly angled by winged sutures, rough, 3–3.5 cm. long, about 2.5 cm. wide, and 2 cm. thick; involucre opening to the base, 4–5 mm. thick. Nut ovoid to ellipsoidal, abruptly narrowed at apex into a long acuminate point, rounded at base, more or less compressed and prominently ridged.

Missouri, near Hannibal, Marion County, *J. Davis*, September 5, 1913 (no. 2071, type), Oakwood, Rolles County, *J. Davis*, September 13, 1913 (no. 2132). These trees have unusually slender glabrous reddish branchlets for *C. ovata*, but the foliage is of that species, and the white strongly angled nuts, in spite of their abruptly pointed apex, are clearly the nuts of *C. ovata*. To this variety may be referred a tree found by *James McHugh* at Indian River, Lewis County, New York, September 15, 1911 (no. 11), which differs from the Missouri trees only in its less compressed fruit with an involucre 5–6 mm. in thickness. Nuts of this species more or less pointed at apex are not uncommon, especially at the north, but I have not seen the ellipsoidal compressed fruit with its comparatively thin involucre of this variety except on the specimens from northeastern Missouri and Indian River, New York.

CARYA OVATA var. **complanata**, n. var.—Differing from the type in its broadly obovoid, much compressed, slightly angled nuts cuneate at base, and rounded truncate or slightly obcordate at apex, and in the oblong-obovoid fruit. Fruit 3 cm. long and about 2.5 cm. wide, with an involucre 5–6 mm. in thickness. Nut 2.2–2.5 cm. in length, 2–2.5 cm. in width, and 1.2–1.4 cm. in thickness, with a shell only 1 mm. thick.

A single tree believed to be 50 years old on the Drushel Farm 2 miles southeast of Mt. Hope in Holmes County, Ohio. For *C. ovata* this tree has unusually slender, sparingly villose branchlets and comparatively small villose buds. The leaves are those of the common form of the species. For the specimens of this tree I am indebted to Professor J. ANDREW DRUSHEL, instructor in nature study and geology in the Harris Teachers' College at St. Louis. In the shape of the nuts this is the most unusual form of *C. ovata* which I have seen, and nuts with such a thin shell are not often found in this species.

CARYA OVATA var. **FRAXINIFOLIA** Sargent, Trees and Shrubs 2:207. 1913.—This variety, distinguished by its narrow lanceolate leaflets and the rather thinner involucre of the fruit, was based on

specimens collected in western New York. This distinct looking tree is now known to occur in Ohio, Indiana, near Kingston, Ontario, at Keosauqua, Van Buren County, Iowa, and near Myers, Osage County, Oklahoma (*G. W. Stevens*, August 12, 1913, no. 2060).

CARYA OVATA var. **pubescens**, n. var.—Differing from the type in the dense pubescence of pale fascicled hairs on the young branches and on the petioles, rachis, and under surface of the leaflets.

A slight pubescence is not unusual on the branchlets and leaves of *C. ovata*, but this pubescence is sometimes so abundant on individual trees in the southern states that it seems desirable to give them varietal distinction. What I have taken as the type of this variety was collected on May 28, 1918, by *T. G. Harbison* on the bottom lands of the Savannah River at Calhoun Falls, Abbeville County, South Carolina (no. 53). It is a large tree with scaly bark and unusually slender branchlets. The buds are nearly fully grown and are acuminate with the outer scales thickly covered with fascicled hairs. Other specimens referred to this variety are *C. S. Sargent*, banks of Chattanooga Creek, Hamilton County, Tennessee; Valley Head, Dekalb County, Alabama, *T. G. Harbison*, January 26, 1912 (no. 54); *C. Mohr*, Columbus, Lowndes County, Mississippi, October 28, 1898; *T. G. Harbison*, Starkville, Oktibbeha County, and Brookville, Noxubee County, Mississippi, May 3, 1915 (no. 17), October 8, 1915 (nos. 7a, 17a, 26). These trees have slender branchlets and small buds for the species with the exception of those of 17a from Brookville. The pubescence of this tree is rusty brown, but the fruit, which is subglobose and 4.5 cm. in diameter, with an involucre 1.2 cm. in thickness, is clearly that of *C. ovata*.

7. *CARYA CAROLINAE-SEPTENTRIONALIS* Engl. and Graeb.—New stations for this species are Calhoun Falls, Abbeville County, South Carolina, Columbus, Lowndes County, and Brookville, Noxubee County, eastern Mississippi, and the neighborhood of Selma, Dallas County, Alabama.

8. *CARYA LACINIOSA* Engl. and Graeb.—The range of this species has been extended to southwestern Ontario, to the valley of the Alabama River near Selma, Dallas County, Alabama, and to West Feliciana Parish, Louisiana (*Cocks*).

9. *CARYA ALBA* Nutt.—Although this species varies in the size and shape of the fruit and nuts, in the thickness of the branchlets, which are densely covered with fascicled hairs when they first appear, and are pubescent or glabrous in their first winter, and in the size of the winter-buds, which are obtuse or acute, it can always

be recognized by the close slightly ridged dark bark which never becomes flaky, by the dense pubescence on the under surface of the leaflets and on the rachis and petioles, and by the conspicuous reticulate veinlets of the leaflets. The fruit varies from globose to short-oblong, obovoid or ovoid, and is rounded or pointed at apex. The involucre is always thick and usually opens freely nearly to the base by 3 or 4 sutures, the valves generally remaining connected below. The nut is more or less compressed, rounded or acute at base, rounded, acute, or acuminate at apex, slightly ridged usually to the base, and tinged with red; in drying the thick shell often cracks transversely.

This is the common hickory of the south Atlantic and eastern Gulf states, and is always called hickory by the inhabitants of that part of the country, descriptive names being used for the other species. It is less common at the north, and I have not seen specimens from any part of New England north of eastern Massachusetts, from eastern Canada, from Ontario except from the southwestern corner, or from New York west of the Hudson River. It is not rare in Ohio, southern Michigan, Indiana, and Illinois, and becomes very abundant in Missouri and Arkansas; in Florida it is rare except in the northern counties. It is one of the commonest species in Alabama, Mississippi, and Louisiana, and reaches eastern Oklahoma and eastern Texas.

The leaflets, which are usually 7, but occasionally 9, vary much in thickness, and a southern form with very large and thick leaflets has been described as var. *subcoriacea* Sargent, *Trees and Shrubs* 2:207. 1913. This is the common form of southern Arkansas and occurs occasionally from Virginia to Florida, through the Gulf states to eastern Texas, and through Arkansas to Missouri, and has been found in Posey County, Indiana (*C. C. Deam*).

A form of *C. alba* with obovoid fruit, narrowed and rounded above and narrowed below into a stipelike base and compressed nuts acuminate at the ends, has been described as var. *ficoides* Sargent (*l.c.* 206). The type of this variety is in a cemetery at Webb City, Jasper County, Missouri. The same form was collected in 1894 at Ocean Springs, Jackson County, Mississippi, by Josephine Skehan. Nuts of *C. alba* acute or acuminate at apex are not

rare, and trees producing such nuts occur in eastern Pennsylvania and are generally distributed through the southern states. Such pointed nuts are usually acute or acuminate at base and are inclosed in involucre which are oblong, gradually narrowed and rounded at base, and acute or acuminate at apex; but a tree at Noel, Missouri, produces ovoid fruit broad and rounded at base and gradually narrowed and rounded at apex, which is so different from that of other forms of this species which I have seen that it may be distinguished as

CARYA ALBA var. **ovoidea**, n. var.—Differing from the type in its ovoid fruit with a thinner tardily dehiscent involucre. Leaves small for the species, not more than 20 cm. long, with densely pubescent petioles and rachis, and 7 thin leaflets. Fruit smooth and lustrous, not at all compressed, 3.5–4.5 cm. long and 2.5–3 cm. in diameter; involucre not more than 4 mm. in thickness, remaining entirely closed or opening tardily by 2 or 3 of the sutures nearly to the middle. Nut rounded at base, gradually narrowed into a long acuminate apex, irregularly ridged to below the middle, much compressed.

A tree 15 m. high with rough ridged gray bark.

Noel, McDonald County, Missouri, *E. J. Palmer*, September 5, 1913 (no. 4119, fruit, type), October 23, 1910 (no. 3287, leaves).

On the grounds of the P. J. Berckmans Nursery Company, a few miles west of Augusta, Georgia, there is a hickory tree which bears the large oblong acute fruit and acuminate nuts rounded at base of one of those extreme forms of *C. alba* which produce pointed nuts. The bark of this tree is indistinguishable from that of a tree of *C. alba* which is growing close to it. It has glabrous branchlets, however, as slender as those of *C. ovalis*, and acute pubescent terminal winter-buds 8–10 mm. long. The leaves are 7-foliate with thin leaflets and are only slightly pubescent. *C. pallida* grows near this tree, and there are individuals of *C. glabra* not far off. I should have suspected that this tree might be a hybrid between *C. alba* and one of these species, but I can find no trace of either of them in the fruit which is distinctly that of *C. alba*. It may be described as

CARYA ALBA var. **anomala**, n. var.—Differing from the type in its nearly glabrous leaves with smaller leaflets, in its slender glabrous branchlets, and in its smaller winter-buds. Leaves 7-foliate; petioles and rachis only slightly pubescent; leaflets thin, acuminate, finely and remotely dentate, puberulous below and pubescent on

the lower side of the midribs, 14-20 cm. long and 4-6 cm. wide. Fruit oblong, rounded at base, acute at apex, 5 cm. in length; involucre 6 mm. in thickness; nut oblong, rounded at base, acute at apex, compressed, slightly angled to the middle or nearly to the base.

A tree with bark indistinguishable from that of *C. alba* with which it is growing, slender red-brown lustrous glabrous branchlets and acute pubescent terminal buds only 8-10 mm. in length. A single tree on the grounds of the P. J. Berckmans Nursery Company, a few miles west of Augusta, Georgia. This is one of the most abnormal hickory trees I have seen. Without the fruit it might easily be taken for one of the forms of *C. ovalis*, but the fruit and the nuts are clearly those of *C. alba*.

10. *Carya leiodermis*, n. sp.—Leaves 7-, rarely 5-foliolate, 30-35 cm. long with slender petioles and rachis slightly or densely pubescent with fascicled hairs, becoming glabrous or nearly glabrous; leaflets thin, finely serrate, long-pointed at apex, gradually narrowed, cuneate and unsymmetrical at base, the terminal oblong-obovate, raised on a slender pubescent petiolule 1-1.5 cm. in length or nearly sessile, of the same shape and often smaller than those of the upper pair of nearly sessile lateral leaflets; leaflets of the lower pairs lanceolate, petiolulate, much smaller; when they unfold densely covered on the lower surface with hoary tomentum, pubescent above and often ciliate on the margins; fully grown in April when the flowers open, and at maturity dark green and lustrous on the upper surface, pale and slightly pubescent on the lower surface, those of the upper pair 12-15 cm. long and 5-6 cm. wide, with stout midribs more or less densely pubescent on the lower side. Aments of staminate flowers 10-12 cm. long, on slender puberulous peduncles, their bracts lanceolate, puberulous; bracts of the flower ovate, lanceolate, furnished on the margins with long white hairs mixed with stipitate glands, one-third longer than the ciliate calyx lobes; anthers red, covered with long white rigid hairs. Pistillate flowers in short spikes, their involucre and bracts densely clothed with long white hairs. Fruit broadly obovoid, smooth, glabrous or slightly pubescent, sparingly covered with small white scales, 4-4.5 cm. long and 3.5-4 cm. in diameter; involucre 5-5.5 mm. in thickness, opening freely to the base usually by 2 sutures only;

nut oval to slightly obovoid, rounded at the ends, tinged with red, about 3 cm. long and broad and 2.5 cm. thick; shell 4–5 mm. in thickness; seed small and sweet.

A tree 20–25 m. high, with a trunk sometimes 50 cm. in diameter, covered with close only slightly ridged pale bark, and slender reddish brown lustrous branchlets puberulous or pubescent when they first appear, becoming glabrous or almost glabrous by the end of their first season. Terminal winter-buds acute, about 1 cm. long, the outer scales pubescent, the inner covered with appressed pale hairs and ciliate on the margins; axillary buds ovate and rounded at the apex or subglobose.

LOUISIANA: Low woods on Little Bayou Têche 4 miles east of Opelousas, Caddo Parish, *R. S. Cocks* and *C. S. Sargent*, October 11, 1913 (no. 5, type), *R. S. Cocks*, April 1914 (nos. 5, 9, 13, 14); Lake Charles, Calcasieu Parish, *C. S. Sargent*, March 23, 1917; Natchitoches, Natchitoches Parish, *R. S. Cocks*, September 1914 (no. 17), *E. J. Palmer*, April 27, 1915; Grand Ecore, Natchitoches Parish, *E. J. Palmer*, April 28, May 5, 1915 (nos. 7411, 7412, 7524), April 15, 1916 (no. 9452); dry woods, Winnfield, Winn Parish, *Cocks* and *Sargent*, April 6, 1913; Tangipahoa Parish, *Cocks* and *Sargent*, March 28, 1917, roadside between Springfield and Ponchatoula, *Sargent* and *Cocks*, March 29, 1917, Loranger, *Sargent* and *Cocks*, March 30, 1917.

ARKANSAS: Fulton, Hempstead County, *E. J. Palmer*, October 18, 1915 (no. 8953).

MISSISSIPPI: Bluffs, Yazoo City, Yazoo County, *T. G. Harbison*, May 1 and 30, 1915 (nos. 22, 36, 37), October 26 and 28, 1916 (nos. 46, 48).

The slender often glabrous branchlets of *C. leiodermis* show its relationship with *C. ovalis*; the close bark, the thick involucre of the fruit, the reddish nut, and the pale tomentum on the under surface of the young leaflets indicate a connection with *C. alba*, and its proper position seems to be between these two species.

CARYA LEIODERMIS, var. **callicoma**, n. var.—Differing from the type in the thinner involucre of the fruit and in the bright red color of the unfolding leaves. Leaves 7-foliate, the young leaflets coated below with hoary tomentum, ciliate on the margins and scurfy-pubescent above, bright red and very fragrant, and at maturity thin, dark green and lustrous on the upper surface and yellow-green and nearly glabrous on the lower surface. Fruit slightly obovoid, smooth, nearly glabrous, usually 3–3.5 cm. long or rarely not more than 2 cm. long; involucre 2.5–3 mm. in thickness, opening tardily nearly to the base by 2 or 3 sutures; nut rounded at the ends, compressed, only slightly angled, pale brown, 1.5–2.5 cm. long and wide, the shell 3.5 mm. in thickness.

A tree 25-30 m. in height, with a tall trunk sometimes 1 m. in diameter, covered with close gray-brown ridged but not scaly bark, ascending and spreading branches forming a narrow round-topped head, and slender glabrous red-brown branchlets marked by numerous pale lenticels.

LOUISIANA: Low woods, borders of streams and river banks often overflowed; Lake Charles, Calcasieu Parish, *C. S. Sargent*, April 2 and 3, 1913, April 12, 1914, *R. S. Cocks*, October 1913, September 1914, *R. S. Cocks* and *C. S. Sargent*, April 12, 1915; West Lake Charles, *R. S. Cocks* and *C. S. Sargent*, April 1913.

TEXAS: Low woods near Beaumont, *C. S. Sargent*, April 11, 1915, *E. J. Palmer*, April 22 and September 11, 1916 (nos. 9528, 9532, 10694, 10695).

MISSISSIPPI: Vicksburg, Warren County, *T. G. Harbison*, October 28, 1916 (no. 3); near Natchez, Adams County, *Miss C. C. Compton*, May 1915; Jackson, Hinds County, *T. G. Harbison*, April 29, 1915; Taylor, Lafayette County, *T. G. Harbison*, April 14, 1915 (no. 7); Rockport, Copiah County, *T. G. Harbison*, 1915, 1916, 1917 (nos. 2, 3, 15, 16, 17); Columbus, Lowndes County, *C. S. Sargent*, October 12, 1914; Starkville, Oktibbeha County, *T. G. Harbison*, April and October, 1913 (nos. 1059, 1283).

From other hickories this variety differs in the bright red color of the young foliage, which in early spring makes it one of the most distinct and beautiful trees in the forests in the neighborhood of Lake Charles, where it is common. It may be expected to occur generally in the region between Lake Charles and the valley of the lower Nueces River, Texas.

11. ***Carya pallida***, nov. comb.—*Hicoria pallida* Ashe, Notes on hickories. 1896.—This tree is closely related to *Carya ovalis* Sargent, but may be distinguished from all the forms of that species by the pale under surface of the leaflets, by the silvery scales on the young foliage, and by the prominent and persistent clusters of fascicled hairs on the petiole, rachis, and under side of the midrib. The leaves are 7-, rarely 9-foliate, and vary from 1.5 to 6 cm. in width. The fruit is pubescent and varies from ellipsoidal to obovoid or to broad-obovoid and to subglobose or depressed globose, and from 2 to 4 cm. in length, and is not easily distinguishable from that of some forms of *C. ovalis*. The involucre varies from 3 to 4 mm. in thickness and splits tardily to the base, usually by 2 or 3 of the sutures. The nut is white, rounded at the ends or occasionally slightly obcordate or obtusely pointed at apex, compressed and more or less prominently ridged nearly to the base. On a tree growing on the grounds of the Country Club at Summerville, near Augusta, Georgia, the fruits are pyriform, 5 cm. long, and contracted below into a stipelike base with an involucre 5 mm.

thick and oblong much compressed nuts narrowed at apex. The branchlets of *C. pallida* are slender, glabrous or pubescent, and the winter-buds are acute or obtuse, and are covered with yellow scales. When *C. pallida* grows in rich soil it sometimes attains a height of 30–35 m. and forms a trunk 6 m. in diameter. On such trees the bark is pale and only slightly furrowed. On dry stony ridges trees more than 10–15 m. tall are not common, and the bark of trees growing in such soil is sometimes nearly black, very rough with prominent ridges.

Carya pallida grows in New Jersey in sandy soil in the neighborhood of Cape May. It is common in sandy soil in southern Delaware and in the southern part of the Maryland peninsula. It is common in Gloucester and James City counties, Virginia, where it often grows in rich soil and attains its largest size. It occurs in Isle of Wight County, Virginia, and is common in the Piedmont region of North and South Carolina, and in the western parts of these states ascends into mountain valleys up to elevations of 700 m. above the sea-level. It is common in northern and central Georgia, and occasionally reaches the Georgia coast. It grows at Bainbridge, southwestern Georgia, and in Leon and Gadsden counties, Florida. In Alabama it is the common hickory on the dry gravelly and poor soil of the upland table lands and ridges of the central part of the states, and extends into the southwestern counties. The western stations from which I have seen specimens of this tree are Chattanooga, Tennessee, Yazoo City, Mississippi, where it is common on the bluffs of the Yazoo River, and northeastern Louisiana (near Kentwood, Tangipahoa Parish, Cocks).

Trees of this hickory can easily be recognized at a distance by the pale color of the under surface of the leaves, and southward by the dark, deeply fissured bark of the trunk, which is not found on other hickories in the southeastern states. Formerly I considered that *C. pallida* was the same as *C. villosa* from Allenton, Missouri, and other authors have adopted this view, but further observations show that it can be distinguished from that tree by the absence of the rusty brown pubescence from the unfolding leaves and young branchlets, by the silvery scales on the young leaves, by the pale color of the under surface of the leaflets, and by the thicker involucre of the larger often ellipsoidal or globose fruit.

12. *CARYA GLABRA* Sweet.—The name pignut, which should be confined to *Carya cordiformis*, has been generally applied to many trees with smooth or slightly scaly bark, slender branchlets, small winter-buds, and pear-shaped or globose fruit. The husk of the fruit of these trees varies in thickness; it remains closed or opens

only at the apex or splits to the base; it is puberulous and, like the involucre of the pistillate flower, is covered more or less thickly with yellow scales, which are usually found also on the lower surface of the 5 or more commonly 7 leaflets. The different forms of these trees intergrade, and it would be possible to consider them forms of one species; but as the trees with close bark usually produce pear-shaped fruits which remain closed or open tardily to the middle, and generally by only 1 or 2 sutures, and as the trees with scaly bark bear fruit which, although round or pear-shaped on different forms, always splits freely to the base, it seems convenient to group these different forms under two species, chiefly distinguished by the indehiscent or dehiscent involucre of the fruit. The earliest post-Linnaean name for any of these trees is *Juglans glabra* of MILLER, published in the eighth edition of his *Dictionary* in 1768. MILLER's species is based on CLAYTON's *Juglans alba fructu minori, cortice glabro*. Trees with close bark and indehiscent pear-shaped fruit and trees with slightly scaly bark and globose dehiscent fruit are common in Gloucester County, Virginia, where CLAYTON lived for many years and where he probably made most of his observations on trees, but the "cortice glabro" seems to point to the tree with close bark and pear-shaped indehiscent fruit. If this view is correct and the trees with indehiscent fruit are treated as representatives of a distinct species, this becomes

Carya glabra Sweet, Hort. Brit. 97. 1827; Torrey, Fl. N.Y. 2:182 (in part). *pl.* 101.

Juglans glabra Miller, Dict. ed. 8, no. 5. 1768.

Juglans porcina Michaux f., Hist. Arb. Am. Sept. 1:206 (in part). *pl.* 38. *figs.* 1, 2. 1910.

Carya porcina Nuttall, Gen. 2:222 (in part); Sargent, Trees and Shrubs 2:199. *pl.* 179. 1913.

The fruit of this tree is obovoid, compressed, rounded at apex, gradually narrowed below and often abruptly contracted into a short stipelike base; the involucre is 1.5–2.5 mm. in thickness and opens tardily generally by 1 or 2 sutures, or often remains closed. The nut is compressed, obovoid, slightly obcordate or acute at apex, gradually narrowed at base, not ridged, and light colored with a hard thick shell and small sweet seed. The leaves are usually 5-, rarely 7-foliolate, and more or less thickly covered with yellow scales. The bark is close and shows no tendency to become flaky. This is one of the least

common of the forms of the so-called pignut, but ranges from southwestern Vermont to western New York and southeastern Ontario (Queensland Heights), and southward to Delaware, the District of Columbia, eastern Virginia, and along the Appalachian Mountains to North Carolina; it occurs in northern, central, and eastern Georgia, northern Alabama, eastern Mississippi, and in southern Indiana, where it is common, and in southeastern Illinois (*H. A. Gleason* in *Herb. Gray*). *MICHAUX*'s figure on which *SWEET* based his *Carya glabra* represents a rather longer fruit than that of the common form of this tree and the involucre has opened by 4 sutures nearly to the middle of the fruit. *Carya glabra* passes into

CARYA GLABRA var. **megacarpa**, nov. comb.—*Carya megacarpa* Sargent, *Trees and Shrubs* 2:201. pl. 180. 1913; *Carya ovalis* var. *megacarpa* Ashe, *Torreyia* 18:74. 1918.—Differing from the type in its larger fruit with a thicker involucre and in its usually stouter branchlets and larger winter-buds.

This tree has larger fruit with a thicker involucre, usually stouter branches, larger buds, and close bark which shows little tendency to become flaky. The thickness of the branchlets, the size of the buds, and the size of the fruit, however, cannot always be depended upon to distinguish this form, for some of the southern trees which bear the largest fruit have branchlets as slender as the northern small-fruited trees; and trees with stout branchlets sometimes produce as small nuts as the small-fruited form of *C. glabra*. This variety is usually glabrous, but on a tree in Rochester, New York, and on one at Brunswick, Georgia, the leaves are distinctly pubescent. The fruit varies from 2.5 to 4.5 cm. in length, with an involucre 2.5–3 mm. in thickness and is occasionally entirely covered with bright yellow scales; it varies from oblong-obovate, with a distinctly stipelike base, to short-obovate and rounded at base, or to subglobose. The nut is rounded or acute at the ends. The leaves are 5–7-foliate.

In the north this form has been seen only near Rochester, New York, on the New Jersey Coast, in the District of Columbia, and in southern Illinois; it is one of the most abundant hickories in the coast region of the southeastern states from North Carolina to the Florida peninsula, and to Alabama, where it is a common tree on the shores of Mobile Bay, and Louisiana. It ranges occasionally inland to central and northern Georgia and to western Mississippi.

CARYA GLABRA var. *MEGACARPA* f. **angulata**, n. f.—Differing from the type in the striately angled nuts. The fruit of this form is broadly obovoid, depressed at apex, 2.5–3 cm. long, 2.8–3 cm. wide, and about 2.5 cm. thick; the involucre is 3–4 mm. in thickness and remains closed after the fruit is perfectly dry. The nut is

subglobose, but rather broader than high, and conspicuously angled to the base, with a shell 4-5 mm. in thickness. The leaves of this form are 5-7, usually 7-foliolate. It is a tree with wide spreading branches, pale gray shallowly grooved close bark, slender glabrous bright red-brown lustrous branchlets, and acute winter-buds, the terminal 5-8 mm. long, their outer scales covered with gray pubescence.

Borders of salt marshes, near Brunswick, Glynn County, Georgia, *T. G. Harbison*, March 26 and October 1, 1913, November 13, 1914 (nos. 1024 type, 1025, 1027, 1028).

13. *CARYA OVALIS* (Wangenheim). Sargent, *Trees and Shrubs* 2:207. 1913.—This is the oldest name which can be used for the small-fruited hickories with globose or pear-shaped fruit opening usually as soon as ripe to the base generally by the 4 sutures of the thin involucre, and often with slightly scaly bark. The type of this tree and its varieties have glabrous or rarely slightly pubescent leaves, with usually 7 thin leaflets. The type of the species, judging by WANGENHEIM'S figure, has short-oblong fruit rounded at base, acute at apex, 2.5-3 cm. long and about 1.5 cm. in diameter, with an involucre 2-2.5 mm. in thickness. This is one of the least common of the forms of this tree, and occurs from western New York and eastern Pennsylvania to Illinois, and southward to the mountains of North Carolina and Tennessee, and to central Georgia and Alabama. The following varieties can be distinguished:

CARYA OVALIS var. *OBCORDATA* Sargent, *l.c.* 208. 1913, with subglobose to short-oblong fruit 2-3 cm. in diameter. The bark often separates into narrow scales, but on some trees shows no tendency to become scaly.

This is the commonest and the most widely distributed of the northern forms of this tree and the *Carya* or *Hicoria microcarpa* of many recent authors. It is common in southern New England and ranges to Wisconsin, southwestern Missouri, western North Carolina, central and eastern Georgia, eastern Mississippi, and to central Alabama, where it is very common in the mountain districts. On the Carolina mountains this tree grows to a large size and is sometimes called scaly-barked hickory. On dry ridges in Macon County, North Carolina, and near Birmingham, Alabama, the bark is close and darker, and some of the trees look distinct from the red color of the petioles which they retain during the season.

CARYA OVALIS var. OBCORDATA, f. *vestita*, n. f.—Differing from the var. *obcordata* in the thick tomentose covering of the branchlets during their first year. The leaflets of this form are slightly pubescent in the autumn on the under surface of the midribs. Although the nuts are more compressed than those of the ordinary forms of var. *obcordata*, the fruit is of that variety. The branchlets are unusually stout for a form of *C. ovalis* and are covered with rusty tomentum during their first year and are more or less pubescent in their second and third seasons.

A large tree on the low border of Davis Pond 14.3 miles southwest of Decker, Knox County, Indiana, *C. C. Deam*, October 5, 1917 (no. 24, 144 type).

CARYA OVALIS var. ODORATA Sargent, *l.c.* 1913.—The fruit of this form shows less tendency to vary than that of the other forms and is subglobose or slightly longer than broad, much flattened and 1.3–1.5 cm. in diameter, with an involucre often not more than 1 mm. thick. The bark of old trees is often scaly.

This form is not common, but ranges from southern New England, eastern Pennsylvania, and the District of Columbia to western New York, Ohio, Indiana, southeastern Ontario, and southern Illinois. From the southern states I have seen specimens only from the neighborhood of Atlanta, Georgia, and from Starkville, Oktibbeha County, Mississippi.

CARYA OVALIS var. BOREALIS Sargent, *l.c.* 1913.—This variety differs from *C. ovalis* in its pubescent branchlets and winter-buds and in the pubescence on the leaves early in the season. It has ellipsoidal or ovoid flattened fruit with an involucre 3–3.5 mm. thick and an ovoid nut conspicuously ridged to the base. The bark is scaly.

This variety has only been noticed in southwestern Michigan.

CARYA OVALIS var. OBOVALIS Sargent, *l.c.* 1913.—This form has more or less obovoid fruit about 2.5 cm. long and 2 cm. in diameter. The fruit resembles in shape that of *Carya glabra*, but the involucre is thicker and splits easily to the base or nearly to the base.

This form is found from southern New England to Missouri and northern Arkansas, and occurs on the mountains of North Carolina, on the coast of Georgia, and in northern central Alabama, and is the common "pignut" in the middle western states.

CARYA OVALIS var. OBOVALIS f. **acuta**, nov. f.—*Carya porcina* var. *acuta* Sargent, Trees and Shrubs 2:200. *pl.* 179. *figs.* 9, 10. 1913.—In spite of its close bark this tree seems to belong with *C. ovalis* rather than with *C. glabra*. The bark and the nuts pointed at the ends afford the only characters by which it can be distinguished from *C. ovalis* var. *obovalis*.

CARYA OVALIS var. **hirsuta**, nov. comb.—*Hicoria glabra hirsuta* Ashe, Notes on hickories. 1896.—This is a common tree on the southern Appalachian Mountains of North Carolina at elevations of from 1200–1500 m. above the sea, and occasionally grows to a height of 20–25 m. with a trunk diameter of 6 m. The scaly bark of this tree shows its relationship with *Carya ovalis* rather than with *C. glabra*, and I have taken up ASHE's name, although the petioles and lower surface of the leaflets are not tomentose as he describes them, but pubescent, the fascicled hairs which are more or less abundant on different individuals being most numerous on the under side of the midribs. The fruit is pyriform, usually narrowed below into a short stipitate base, 3–4.5 cm. in length, more or less compressed, with an involucre tardily dehiscent, usually opening only to the middle, and 1.5–3 mm. in thickness. The nut is compressed, very slightly ridged, and rounded at the ends, with a thin shell and a sweet seed. The winter-buds are pubescent, acute or obtuse, the terminal varying from 7 to 14 mm. in length.

Highlands, Macon County, North Carolina, *T. G. Harbison*, 1913 and 1914 (no. 1). *Harbison* no. 1250, June and October 1914, with less pubescence and slightly obovoid fruit, with a thin involucre splitting freely to the base and a slightly obovoid nut, appears to be a form connecting the variety with the species.

14. CARYA FLORIDANA Sargent, Trees and Shrubs 2:193. *pl.* 177. 1913.—When I described this species I had not seen terminal winter-buds and I mistook it for an *Apocarya*. Collections made later show that the terminal winter-buds are ovate, acute or obtuse, and 5–7 mm. long, and that the scales are imbricated and covered with close rusty pubescence and more or less thickly with yellow or rarely silvery scales. The branchlets are glabrous or pubescent during their first winter. Later collections show that the fruit is obovoid, gradually narrowed, rounded, and sometimes slightly

depressed at apex, narrowed below into a short stipelike base, occasionally slightly winged at the sutures, sometimes roughened by prominent reticulate ridges, puberulous and covered with small yellow scales, 2-3.5 cm. long and 2-2.5 cm. in diameter; the involucre is 2-3 mm. in thickness, splitting to the base by usually 2 or 3 sutures. The nut is pale or reddish, subglobose, and not more than 1.5 cm. in diameter, or ovate, acute at base, narrowed and rounded at apex, slightly compressed, or rarely oblong and acute at base, rounded at apex, and 2.5-3 cm. long and 2 cm. wide; the shell varies from 2-3 mm. in thickness; the cotyledons are sweet.

Although the fruit and thin branchlets of *C. floridana* resemble those of the *glabra-ovoidea* group, the thick rusty pubescence on the young leaves and branchlets separates it from all the plants of this group. It differs from them also and from other hickories in the occasional appearance of the aments of staminate flowers from the axils of leaves, and in the fact that it is often shrubby in habit and produces large crops of fruit on stems not more than 2-3 m. high. The sessile, or nearly sessile, terminal leaflet is also unusual in the genus.

Carya floridana is common on the eastern coast of Florida, growing on dry sandy ridges and low hills from Valusia County southward to Jupiter Island, Palm Beach County. It is common, too, usually as a small shrub near Orlando in Orange County and southward to De Soto County, and occurs on the shore of Pensacola Bay.

THE TEXAS HICKORY.—In 1860 BUCKLEY described his *Carya texana* in Proc. Philad. Acad. As the name was otherwise occupied DURAND changed it to *C. Buckleyi*, and as BUCKLEY described the fruit as globose with a thin involucre *C. Buckleyi* has been adopted for a tree with globose fruit, a thin involucre, and pale red nearly globose nuts. This tree with the round nuts is common in the neighborhood of Denison, Grayson County; it grows also near Jacksonville in Cherokee County, at San Augustine, San Augustine County, and at North Pleasanton, Atascosa County, and in Oklahoma on dry sandy hills west of Muskogee, Muskogee County.

The hickory with obovoid or ovoid fruit, often with an involucre varying greatly in thickness, and with an oblong or slightly obovoid compressed slightly angled pale nut, which I described as *C. arkansana* (Trees and Shrubs 2:203. pl. 181), is much more common and more widely distributed in Texas, and it is probable that BUCKLEY

had the 2 trees in mind when he described his *C. texana*, for when they grow together in dry sterile soil, as in the neighborhood of Denison, they both have thick nearly black fissured bark and cannot be distinguished except by the shape of the fruit. Farther north and in better soil the bark of *C. arkansana* is thinner, lighter-colored, and is inclined to separate into small thin scales. The unfolding leaves and the young branchlets of both trees are thickly covered with tawny pubescence mixed on the under side of the leaflets with small silvery scales. This pubescence distinguishes them and *C. floridana* from all the other species of the United States. The size and shape of the fruit and the thickness of the involucre do not afford good specific characters in *Carya*, and the nature of the bark is so dependent within certain limits on the soil in which the individual grows that this cannot be depended upon for distinguishing species. The winter-buds on both trees are covered with brownish pubescence in which silvery scales are more or less scattered; and the long white hairs found at the apex of the scales of the former sometimes occur but are perhaps more often wanting from the scales of the latter. The thick tawny pubescence is the most distinct and constant character of all the forms of this tree. The form with obovoid fruit can perhaps best be treated as a variety which becomes

15. CARYA BUCKLEYI var. **arkansana**, nov. var.—*C. arkansana* Sargent, Trees and Shrubs 2:203. *pl.* 181. 1913.—Differing from the type in the obovoid to ellipsoidal or ovoid fruit with a usually thicker involucre, and in the oblong more compressed pale-colored nuts.

The type region of this tree is the valley of the Arkansas River at Van Buren, near Fort Smith, in the extreme western part of the state of Arkansas. It has been found growing in sandy soil near Vollmer, Knox County, Indiana (*C. C. Deam*, no. 18232, August 28, 1915), and it is common in northeastern Missouri, where it has been collected by the Reverend JOHN DAVIS at a number of stations near Hannibal. It is the common hickory on the Ozark Mountains in northwestern Arkansas, where it is very abundant on dry rocky ridges at elevations of 400–600 m., and occurs in several other parts of Missouri and in Arkansas and eastern Oklahoma. It is not rare in western Louisiana, where it has been collected in the neighborhood of Opelousas, at Winnfield, and near Alexandria. In Texas it is the common hickory from the coast to the base

of the Edwards Plateau and as far south as the valley of the Atascosa River in Atascosa County, where it was first collected by BUCKLEY in June 1881. From farther northwest I have seen specimens only from Fredericksburg in Gillespie County. As in other species of the genus, there is considerable variation in different individuals. The fruit is obovoid, rounded or gradually narrowed at the base or abruptly contracted into a more or less developed stipe, or ellipsoidal or ovoid and rounded at the ends; it varies from 2 cm. to 5 cm. in length and in diameter. The involucre varies from 2 mm. to 4 mm. in thickness, the largest fruit with the thickest involucre being found in southern Arkansas and western Louisiana, and the smallest in northern Missouri. The nuts are oblong to slightly obovoid, compressed and rounded at the ends and vary much in size but little in shape or in the thickness of the shell, which is unusually thick for a species of this group. The thickness of the branchlets, which are pubescent during the first year, and the size of the winter-buds vary on different trees. The leaflets as they unfold are covered above by small scattered yellow scales and on the lower surface are thickly clothed with thicker tawny scales mixed with silvery white scales, and are pubescent on the midribs and veins, traces of these fascicled hairs being persistent during the season. The scales and fascicled hairs are also found on the young petioles and rachis, which usually become quite glabrous before the end of the season. The yellow scales, sometimes mixed with short hairs, are more or less persistent on the fruit and on the winter-buds.

CARYA BUCKLEYI var. *ARKANSANA*, f. ***pachylemma***, n. f.—Differing from the var. *arkansana* in its larger fruit with a thicker involucre. The fruit of this form is 5–6 cm. long and 4–5 cm. in diameter with an involucre 1.2–1.3 cm. in thickness; the nut is rounded at the ends, slightly angled, compressed, from 3.2 to 3.5 cm. long and about 3 cm. wide.

A large tree with thick deeply fissured pale gray bark, small drooping unusually slender nearly glabrous branchlets and rusty pubescent winter-buds.

Rich woods, Fulton, Hempstead County, Arkansas, *E. J. Palmer*, April 27, 1914 (no. 5396), October 19, 1914 (no. 6878), April 10 and 12, 1915 (nos. 7172, 7184), June 17, 1915 (no. 8032), October 18, 1915 (no. 8952).

This tree, which in the size and thickness of the involucre produces remarkable fruit, long puzzled Mr. PALMER and me until the unfolding leaves showed its relationship with *Carya Buckleyi*.

A hickory tree which is common and widely distributed in Missouri and northwestern Arkansas has the peculiar rusty brown pubescence of the Texas hickory on its young leaves and branchlets and on its winter-buds, and although the fruit is smaller this tree

cannot be specifically distinguished from that species, and is here treated as

CARYA BUCKLEYI var. **villosa**, nov. comb.—*Hicoria glabra* var. *villosa* Sargent, Silva N. Am. 7:167. pl. 355. 1895; *Hicoria villosa* Ashe, Bull. Torr. Bot. Club 24:481. 1897; Sargent, Man. 145 (in part). 1903; *Carya villosa* Schneider, Ill. Handb. Laubholz. 1:803. 1906; *Carya glabra* var. *villosa* Robinson, Rhodora 10:32. 1908.—Differing from the type in its smaller obovoid or ellipsoidal fruit with a thinner often indehiscent involucre.

A single tree, the type of this variety, was found nearly 40 years ago by the late GEORGE W. LETTERMAN on a dry rocky hillside at Allenton, St. Louis County, Missouri, where it is still growing. LETTERMAN considered it a hybrid. Before the Texas hickory and its varieties were recognized it was considered a variety of *Carya glabra*, from which it differs in its pubescence and in its usually more dehiscent involucre. There would be more reason in following ASHE and treating it as a species did not trees occur with fruit which approaches in its larger size and thicker involucre that of the var. *arkansana* which occasionally grows with it in Missouri.

The Allenton tree has thick, rough, deeply furrowed, nearly black bark similar to that of *C. Buckleyi* as it grows near Denison, Texas. On trees growing in better soil in other parts of the state the bark is often paler and less deeply furrowed. The leaves of the typical tree are 5-7-foliolate, with pubescent petioles and rachis, becoming glabrous or nearly glabrous; the leaflets are lanceolate to oblanceolate, long-pointed, with prominent reticulate veinlets, the lateral nearly sessile, the terminal short-petiolulate, nearly glabrous above and early in the season covered below with rusty pubescence and small brownish scales, in the autumn glabrous or nearly glabrous with the exception of the fascicled hairs on the lower side of the midrib. The fruit of the Allenton tree is obovoid, cylindrical, sometimes slightly winged above the middle, about 2.5 cm. long and 1.8 cm. in diameter, rusty pubescent and covered with scattered yellow scales; the involucre is about 2 mm. in thickness and is indehiscent or splits tardily to the base usually only by 2 sutures. The nut is ovoid, rounded at base, pointed at apex, only slightly angled, thin-shelled, and faintly tinged with red. The

branchlets are slender, pubescent during their first year and puberulous in their second season. The winter-buds are covered with rusty brown pubescence and yellow scales, and often furnished near the apex with the tufts of white hairs, which are generally found on the buds of *Carya Buckleyi*. The fruits on trees in other parts of the state vary from obovoid to ellipsoidal, or are rarely subglobose; they vary from 1.5 to 3 cm. in length, and are nearly cylindrical or much compressed; the involucre varies from 1 to 4 mm. in thickness, and on some trees the fruit is completely covered by the yellow scales. On some trees the branchlets lose their pubescence early and by the end of September are glabrous, red, and lustrous.

I have seen specimens of this tree collected in Missouri by the Reverend *John Davis* in the neighborhood of Hannibal, Marion County (nos. 1361, 1630, 2028, 2032, 2078, 2089, 2156, 2160, 2162, 2163, 2166, 2182, 2188, 2190, 2237); in Grain Valley, Jackson County, *B. F. Bush*, May 24, 1913 (nos. 6981, 6991); at Jerome, Phelps County, *J. H. Kellogg*, May 7, 1913 (nos. 333, 339, 340, 341, 347, 348, 357); Allenton, St. Louis County, *G. W. Letterman*, June 20, 1880, May 15, 1881, May 1, 1882, April 1883, July 16, 1911, May 10, 1912, *J. H. Kellogg*, October 7, 1911, *E. J. Palmer*, August 13, 1917 (no. 12652); Des Arc, Iron County, *E. J. Palmer*, July 2, 1914 (no. 6165); Branson, Tenney County, *E. J. Palmer*, October 23, 1913 (no. 4707), June 18, 1914 (no. 5891); Willow Springs, Howell County, *E. J. Palmer*, July 8, 1914 (no. 6227); dry hillsides near Campbell, Osage County, *C. S. Sargent*, September 5, 1915; dry barren hills, Joplin, Jasper County, *E. J. Palmer*, October 1911 (no. 3494), May 17 and September 18, 1913 (nos. 3491, 3928, 4356, 4357, 4358, the last with ellipsoidal fruit on a long peduncle, 4359, 6890, 6891); Noel, McDonald County, *E. J. Palmer*, September 6 and 14, 1913 (nos. 4060, 4159, 4170, 4216, 4336, 4337, 5410).

ARKANSAS: Eureka Springs, Carroll County, *E. J. Palmer*, September 22 and 24, 1913 (nos. 4428, 4482), May 11, 1914 (no. 5548).

HYBRID HICKORIES.—The supposed hybrids between species of *Apocarya* are

CARYA BROWNII Sargent, *Trees and Shrubs* 2:195. *pl.* 178. 1913.—This tree grows on the bottom lands of the Arkansas River below Van Buren, Crawford County, Arkansas. In the Arboretum Collection are nuts of what is no doubt the same hybrid collected at Collinsville, Rogers County, Oklahoma. To this hybrid probably belongs the so-called Galloway hickory (see S. GALLOWAY in Gar-

dening 2:26. 1874; TRELEASE in Rep. Mo. Bot. Gard. 7:33. *pl.* 16. *figs.* 15, 16. *pl.* 20; Sargent, *l.c.* 196).

A tree evidently of the same parentage has been described as *CARYA BROWNII* var. *VARIANS* Sargent, *Trees and Shrubs* 2:196. 1913.—This tree grows on the banks of Sears Creek near the Pump House of the Van Buren Water Works, Crawford County, Arkansas. A tree with similar fruit has been found near Natchez, Adams County, Mississippi, by Miss C. C. COMPTON.

Three evident hybrids between species of *Apocarya* and *Eucarya* are known.

CARYA LANEYI Sargent, *Trees and Shrubs* 2:196. 1913.—This appears to be a hybrid of *C. cordiformis* and *C. ovata*. The original tree is in the Riverside Cemetery at Rochester, New York. In the Arboretum Collection there are nuts of a tree growing at Millersville, Lancaster County, Pennsylvania, which is known as the Beaver hybrid and appears to be of the same parentage. Trees of the same parentage but with the leaves of *C. cordiformis* and with larger fruits with thicker involucre than those of that species and nuts resembling those of *C. ovata* have been distinguished as

CARYA LANEYI var. *CHATEAUGAYENSIS* Sargent, *l.c.* 1913.—First discovered at Chateaugay near the mouth of the Chateaugay River in the Province of Quebec by Professor J. G. JACK, this tree was later found by him at Summertown, Ontario.

Carya Schneckii, n. hyb. (*C. alba* × *pecan*).—Leaves 7-9-foliolate, glabrous; leaflets thin, acuminate at apex, cuneate and unsymmetrical at base, falcate, short-petiolulate. Fruit oblong, acute at apex, rounded at base, pubescent, 5.5 cm. long, with an involucre splitting to the base and 6-7 mm. in thickness; nut oblong, gradually narrowed and rounded at base, acuminate at apex, slightly compressed, angled to the middle or to the base, reddish and conspicuously streaked with brown, 4-4.5 cm. long and about 2 cm. wide, with a shell 1-2 mm. in thickness and a sweet kernel.

A large tree with bark resembling that of the pecan, stout reddish brown puberulous branchlets, and winter-buds with imbricated scales, the outer dark red-brown and puberulous, the inner thickly covered with hoary tomentum; axillary buds solitary with usually valvate scales.

Lawrenceville, Lawrence County, Illinois, *Dr. J. Schneck*, October 15, 1895 (type) (see Sargent, *Silva N. Am.* 7:138). A tree believed to have been of the same parentage was found at about the same time by Mr. F. REPPERT near Muscatine, Muscatine County, Iowa (see TRELEASE in *Rep. Mo. Bot. Gard.* 7:39. *pl.* 23. *figs.* 2-5).

Carya Nussbaumerii, n. hyb. (*Carya laciniosa* × *pecan*).—Leaves 7-9-foliolate; petioles and rachis puberulous; leaflets lanceolate, long-pointed and acuminate at apex, rounded and unsymmetrical at base, pubescent on the lower surface, the terminal petiolulate, the lateral nearly sessile. Fruit oblong, narrowed and rounded at base, acute at apex, puberulous and more or less thickly covered with yellow scales, about 7 mm. long and 3.5-3.8 cm. in diameter; involucre splitting nearly to the base and 4 mm. in thickness. Nut oblong, compressed, only slightly angled, short-pointed at apex, rounded at base, 6 mm. long, 3.5 cm. wide, and 2.5 cm. thick, with a shell 1.5-2 mm. in thickness.

I suggest this name for the Nussbaumer hybrid (see SARGENT, *Silva N. Am.* 7:158. *pl.* 349. *fig.* 4; TRELEASE in *Rep. Mo. Bot. Gard.* 7:41. *pls.* 22, 23. *figs.* 7-9).

This tree was first found on the bottoms between Mascoutah and Fayetteville, St. Clair County, Illinois. A tree producing a similar nut which came originally from Illinois was cultivated before 1892 by Mr. R. M. FLOYD of Cedar Rapids, Iowa, and has been called the Floyd nut. In October 1895 Dr. SCHNECK found a tree producing similar fruit at Mt. Vernon, Posey County, Indiana. Grafted plants of this tree, which has been called the McCallister (see *Nut culture in the United States*, Bull. U.S. Dept. Agric., Div. of Pomology, 1896, 63. *pl.* 9. *fig.* 6), were sent to Washington, Georgia, whence this tree was distributed as the Washington nut, a name now abandoned by pomologists. Another of these trees has been reported from the neighborhood of Burlington, Des Moines County, Iowa, and another, known as the Rockville nut, from near Rockville, Bates County, Missouri. In its foliage and in the color of the branchlets this hybrid resembles *C. laciniosa*. The branchlets, however, are not as stout and are less pubescent than those of that species, and the buds are smaller and more acuminate. The fruit in shape resembles that of the pecan, but does not have the sutural wings of that species, and the nut is white or nearly white and only slightly streaked with brown.

Carya Dunbarii, n. hyb. (*C. laciniosa* × *ovata*).—I suggest this name for a number of trees found growing on the bottoms of the Genesee River at Golah, Monroe County, and Mount Morris,

Livingston County, New York, by JOHN DUNBAR, assistant superintendent of the parks of the city of Rochester, New York. These trees, which have at different times been considered both *C. laciniosa* and *C. ovata*, vary among themselves in the color and pubescence of the branchlets, in the size of the buds, and in the size and shape of the fruit and nuts. The leaves have the 7 or 9 leaflets of *C. laciniosa*, but the leaflets are usually narrower than those of that species and less pubescent. I have selected no. 68 *Dunbar*, September 19, 1911, as the type of this hybrid, as the tree is still standing and can easily be located.

Leaves 7-foliolate, the petioles and rachis slender, glabrous; leaflets acuminate, puberulous on the lower surface and pubescent on the under side of the midribs, the terminal oblong-obovate, cuneate, and gradually narrowed below into a slender petiolule 1.5 cm. in length, the lateral lanceolate to oblanceolate, nearly sessile. Fruit oblong, rounded at ends, glabrous, 4 cm. long, 3 cm. in diameter; involucre splitting to the base, 5 mm. in thickness; nut oblong, gradually narrowed and rounded at base, acute at apex, compressed, conspicuously ridged to below the middle, pale brown, 3 cm. long, 2.5 cm. wide, and 2 cm. thick.

A tree 80-90 ft. high, with light gray scaly bark, stout spreading branchlets puberulous early in the season, glabrous and pale red-brown in the autumn. Terminal buds, oblong, acute, 1.5-1.8 cm. long and 6-7 mm. in diameter, the outer scales dark red-brown and puberulous.

Golah, Monroe County, New York, *J. Dunbar*, September 19, 1911 (no. 68, type).

No. 71 Golah, collected by *J. Dunbar* September 19, 1911, has the leaves in the size and shape of the leaflets like those of *C. ovata*; the petioles and rachis are pubescent, and the leaflets are more pubescent than those of no. 68. The fruit is oblong-obovoid, compressed, rounded at base, abruptly acute at apex, 4 cm. long, 3 cm. wide, and 2 cm. thick, with an involucre splitting nearly to the base and 4 cm. thick. The nut is oblong-obovoid, acute at the ends, only slightly angled, and pale in color.

This tree, which is still standing, is 80 ft. high, with ashy gray bark divided into plates but not separating into loosely attached scales like that of its supposed parents, and stout reddish glabrous

branchlets. The terminal winter-buds are acute, 1.8 cm. long, the outer scales pale pubescent, the inner hoary tomentose. In the number of leaflets the leaves of this tree resemble those of *C. laciniosa*, but in the shape of the leaflets they resemble those of *C. ovata* var. *fraxinifolia*. In shape the fruit resembles a small fruit of *C. laciniosa*, but the involucre is thinner than that of *C. ovata* or *C. laciniosa*. The nut is more like that of *C. laciniosa*; the bark and color of the branchlets are unlike those of either of the supposed parents. The winter-buds are more like those of *C. laciniosa* than of *C. ovata*.

No. 61 Golah, *J. Dunbar*, September 29, 1911, has the leaves of *C. laciniosa*, short-oblong fruit 4 cm. long, depressed at the apex like that of *C. ovata*, with an involucre 6 mm. in thickness. The branchlets are red and glabrous and unlike those of either parent. Except in the branchlets this number resembles a small-fruited *C. laciniosa*.

No. 66 Golah, *J. Dunbar*, September 19, 1911, has the leaves of *C. laciniosa*, oblong slightly obovoid pubescent fruit only 3 cm. long, with an involucre 4 cm. in thickness, and a compressed slightly angled reddish nut. The branchlets are reddish, pubescent, and about as thick as those of the common form of *C. ovata*. The buds are acute and 7-8 mm. long, with puberulous outer scales.

No. 73 Golah, *J. Dunbar*, September 19, 1911, has the leaves of *C. laciniosa*, fruit similar to that of no. 66 and slender, densely pubescent brown branchlets resembling those of a pubescent form of *C. ovata*.

No. 207 Golah, *J. Dunbar*, September 19, 1911, has the leaves of no. 68, fruit like no. 61, stout glabrous red branchlets and terminal buds 1.5 cm. long, the outer scales covered with pale pubescence.

No. 208 Golah, *J. Dunbar*, September 19, 1911, has leaves resembling in shape those of *C. ovata*, fruit like that of no. 73 and 3 cm. long; branchlets somewhat stouter and less pubescent than those of no. 73, and the winter-buds of *C. ovata*.

No. 250 Golah, *J. Dunbar*, August 31, 1915, has the leaves of *C. laciniosa*, obovoid pubescent fruit 3-3.5 cm. long, with an involucre 5 mm. in thickness, and a slightly compressed angled

nut. The branchlets resemble those of the pubescent form of *C. ovata*.

No. 251 Golah, *J. Dunbar*, August 31, 1915, has only slightly pubescent leaves with leaflets resembling in shape those of *C. ovata* var. *fraxinifolia*. The fruit is pubescent, subglobose, 3 cm. long and rather broader than long, with an involucre 3 mm. in thickness; the nut, although less prominently ridged, resembles the nut of *C. ovata*. The branchlets are reddish brown and puberulous.

No. 252 Golah, *J. Dunbar*, August 31, 1915, has the leaves of *C. laciniosa*, oblong pubescent fruit 3 cm. long, with an involucre 5 mm. in thickness and conspicuously angled nuts. The branchlets are stout, dark red-brown, and densely pubescent. The terminal bud is about 1 cm. in length. Except in the color of the branchlets, the small size of the buds, and in the small size of the fruit, this number resembles *C. laciniosa*.

No. 253, *J. Dunbar*, August 31, 1915. Although only puberulous, the leaves otherwise generally resemble those of *C. laciniosa*. The fruit is similar to that of no. 73, but the involucre is 7 mm. in thickness; the nut is only slightly compressed and angled. The branchlets are reddish brown, pubescent, and as stout as those of the common form of *C. ovata*. The bud is 1 cm. long with pubescent outer scales.

No. 254 Golah, *J. Dunbar*, August 31, 1915, has leaves resembling those of no. 68, the fruit of *C. laciniosa*, and red nearly glabrous winter branchlets. The winter-buds are 1 cm. long with puberulous outer scales.

No. 59, Mount Morris, Livingston County, *J. Dunbar*. This has leaves like no. 68 from Golah; the fruit is that of *C. laciniosa* and 4 cm. long. The branchlets are slender, reddish, and glabrous; the winter-buds are about 1 cm. in length with pubescent outer scales.

There is so much variation in these trees that their hybrid origin seems probable. The most remarkable things about them are the red glabrous lustrous branchlets of some of the trees; these are entirely unlike those of either of the supposed parents and suggest that one of the forms of *C. ovalis* or *C. glabra* might have had some influence on them. If they are hybrids in large part between

C. laciniosa and *C. ovata*, as I believe, they are the only hybrids between two species of *Eucarya* which have been noticed, other hybrids of *Carya* having been produced by the crossing of 2 species of *Apocarya* or of a species of *Apocarya* with a species of *Eucarya*. In the case of other hybrids of *Carya* only a single tree or single trees in different locations have been noticed. The hickory trees in western New York, however, have been more carefully examined by Mr. DUNBAR and his associates than the hickories in any other part of the United States. When the trees in other parts of the country are as carefully and intelligently studied, it is possible that many hybrid hickories and many individuals of these hybrids will be found, just as in recent years many hybrid oaks often with numerous individuals have been found.

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