

\$B 001788

A BUD AND TWIG KEY

To the More Important Broadleaf Deciduous
Trees in the United States

REVISED

BY

O. L. SPONSLER

ASSOCIATE PROFESSOR OF FORESTRY
UNIVERSITY OF MICHIGAN

GEORGE WAHR, PUBLISHER
ANN ARBOR, MICHIGAN
1916

COPYRIGHT, 1916

GEO. WAHR.

A BUD AND TWIG KEY.

The Key was first published in 1911 in the Nebraska Forest Club Annual, and reprints were made and used in the class room in Forest Botany. That edition is exhausted and there seems still to be a demand sufficiently large to warrant a revised edition. In the revision however only a few species have been added and a few changes made in the context.

About 85 species of broadleaf deciduous trees are included in the Key, among them are the most important forest trees and a few of the more common exotics, also a few of the small trees that occur on the border line between trees and shrubs. The Key was worked out originally for use in a course in Forest Botany and in order to give the student a hint of the broadleaf trees in other than the Hardwood Region of the eastern United States, a few of the western and several of the southern species were included.

In most cases the descriptions have been carefully checked up with live material and are considered fairly accurate; a few however were made from dried specimens; and some were taken from the literature and not verified owing to a lack of material.

The key is based upon features that are visible either to the naked eye or with the aid of a hand-lens. The larger divisions are based upon those characteristics which first attract the eye; and the subdivisions, upon less and less prominent features, until in the final divisions the distinctions are, in a few instances, often variable to the extent of becoming more or less unreliable. The uncertainty introduced here is not of any great importance and can be ignored in most cases.

In a few instances the characteristics are given for the genus only. For such genera as *Crataegus*, *Salix*, *Cornus*, *Magnolia*, where the species are either so numerous and indefinite or occur rather rarely throughout the Hardwood Region, it did not seem advisable to carry the distinctions beyond those of the genus.

The terms used throughout the Key are common to systematic botany or are self-explanatory, with the exception of a few that might be readily misconstrued, among which are the following:

Tip-scar, a term used to designate the scar left when the tip of the twig is deciduous and has dropped off. A few genera have formed the habit of casting the end of the twig in early summer and allowing the growth of the next season to be continued through the uppermost lateral bud.*

Twig, a term used to designate the part of the branch that made its elongation growth during the last growing season.

Terminal bud, the bud at the end of the twig on those twigs which do not have a deciduous tip.

DECIDUOUS BROAD-LEAF TREES.

I. Leaf-scars whorled, three (rarely two) at each node, oval with many bundle-scars in a line forming an ellipse, no stipule-scars, no terminal bud, tip-scar prominent, twig large, buds small globular partially sunk in bark. Plate I.

**Catalpa* Scop.

II. Leaf-scars opposite, two at each node.

aI. Bundle-scars three forming a lunate line.

bI. Stipule-scars represented by a line connecting leaf-scars.

cI. Terminal bud one-eighth to one-fourth inch long, two or more pair of scales visible, stipular line always present, leaf-scars narrow lunate.

Acer Linn. (Except *A. macrophyllum*. See page 6.)

dI. Terminal bud acuminate dark brown, conical with five or six pair of scales visible, twigs brown glabrous, stipular line straight. Plate I.

A. saccharum Marsh.

d2. Terminal bud red or greenish with two pair of scales visible, buds obtuse or globular.

* "Twigs of Woody Plants," A. S. Hitchcock, *The Plant World*, Vol. 9, No. 1, January, 1909.

* It is not possible to distinguish the species of *Catalpa* by the twig and bud.

- e1.* Thick milky juice exudes from freshly cut bud, twigs glabrous red brown, bud dark red or slightly greenish, scales smooth and shiny. Stipular line between leaf scars straight or slightly angled. *A. platanoides* Linn.
- e2.* Juice of bud watery.
- f1.* Stipular line between leaf-scars straight, twigs glabrous, usually red or reddish brown, scales glabrous. Plate I. †*A. saccharinum* Linn.
‡*A. rubrum* Linn.
- f2.* Stipular line between leaf-scars usually broad and sharp-angled, twigs change from green through several shades of purple and red during winter, often with white bloom, buds changing color with twigs, bud-scales often apiculate, outer pair slightly pubescent, inner scales silky tomentose. Plate I. *A. negundo* Linn.
- c2.* Terminal bud long-lanceolate or flattened, one pair of scales visible, stipular line usually present, bundle-scars three often united or indistinct, leaf-scars narrow lunate, especially those near base of twig. Plate I. *Cornus* Linn.
- b2.* Stipule-scars and stipular line absent. *Cornus* (see above).
- a2.* Bundle-scars five to many, often nearly united, forming a U-shaped line.
- b1.* Terminal buds one-half inch or longer and half as broad, coated with wax, many light brown scales, bundle-scars five to seven prominent, no stipule-scars, twig large, leaf-scar large shield-shaped, pith large. *Aesculus* Linn.

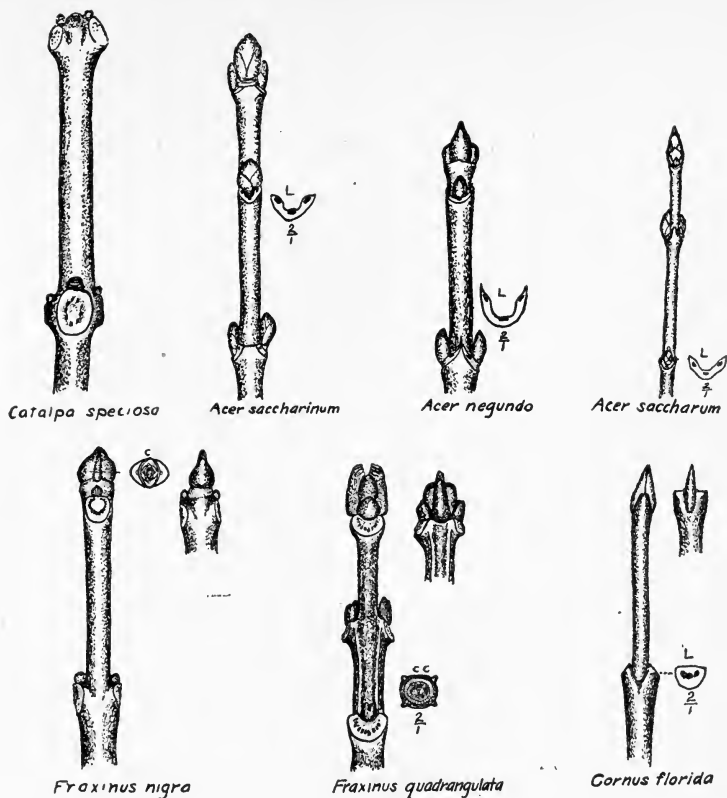
† It is difficult to distinguish between these two species without leaves or fruit. *A. saccharinum* often has apiculate bud-scales and rather long, narrow buds while *A. rubrum* rarely has apiculate scales and usually quite globular buds.

- b2. Terminal buds one-quarter inch or shorter and nearly as broad, one or two pair of scales visible, light or dark brown felty, many bundle-scars form nearly a solid U-shaped line, twigs large, no stipule-scars, lateral buds small globose, leaf-scars semi-orbicular or lunate.
Fraxinus Linn.
- c1. Twigs four-angled or -winged, buds light brown, outer pair of scales with pinnate apex. Plate I.
F. quadrangulata Michx.
- c2. Twigs cylindrical, pubescent or glabrous, buds dark brown, scales broad ovate, apex acute. Plate I.
 * *F. americana* Linn.
 * *F. pennsylvanica* Marsh.
 * *F. lanceolata* Borkh.
 * *F. oregona* Nutt.
 * *F. nigra* Marsh.
- b3. Terminal bud one-quarter inch long, several smooth red scales, distinct stipular line connects leaf-scars, bundle-scars five to seven distinct, twig large glabrous green changing to red during winter, leaf-scars crescent-shaped.
Acer macrophyllum Pursh.
- a3. Bundle-scars many forming an ellipse.
Catalpa (see above, page 4).

III. Leaf-scars alternate, one at each node.

- a1. Bud at end of twig entirely or partially sunk in bark.
- b1. Twigs armed with two stipular prickles, bundle-scars three, buds white silky hidden beneath shield-shaped leaf-scar, no terminal bud, tip-scar or dead tip of the twig prominent, twig reddish brown.
Robinia pseudacacia Linn.

* It is difficult to distinguish between these species without leaves and fruit. A cross-section of the terminal bud of *F. nigra* is usually elliptical and shows three pair of bud-scales, while in the case of the other four species of the cross-section is more or less four-lobed and usually shows four scales. In the East the twigs of *F. pennsylvanica* are pubescent and the buds small, while *F. americana* and *F. lanceolata* are glabrous and the buds large, but near the Mississippi River and west of it there is much confusion of these three species. The twig of *F. oregona* is often light woolly.



• PLATE I.

L—Leaf-scar magnified.
 C—Cross-section of bud.
 CC—Cross-section of twig.

- b2. Twigs armed with simple or branched thorns above the buds, several buds superposed, the lower ones hidden beneath the V-shaped leaf-scar, see Plate II. Bundle-scars three prominent, no stipule-scars, no terminal bud, tip-scar distinct, twig light yellowish brown glabrous. Plate II. *Gleditsia triacanthos* Linn.

b3. Twigs without thorns or prickles.

c1. Pith salmon colored, twigs very large, buds small two superposed covered with brown hairs, no terminal bud, tip-scar prominent, no stipule-scars, leaf-scar large shield-shaped with three to five large protruding bundle-scars in a U-line, twig reddish brown or light gray. Plate II.

Gymnocladus dioicus (Linn.) Koch.

c2. Pith white to yellow.

d1. Twigs very large, bundle-scars six to eight.

e1. Pith large cream color, twig greenish brown smooth with slight bloom, bud reddish silky half surrounded by large shield-shaped leaf-scar, no terminal bud, tip-scar prominent, no stipule-scars.

Ailanthus glandulosa Desf.

e2. Pith large yellow, twig hairy, bud densely silky grayish nearly surrounded by U-shaped leaf-scar, juice milky resinous, no stipule-scars, no terminal bud, tip-scar or dead tip of twig prominent. Plate II. * *Rhus hirta* (Linn.) Sudworth.

d2. Twigs small and glabrous, bundle-scars three or rarely five.

e1. One bud in axil of each leaf, only white silky top visible, nearly surrounded by U-shaped leaf-scar, no stipule-scars, no terminal bud, tip-scar prominent, twig dark red brown. Plate II.

Ptelea trifoliata Linn.

e2. Several superposed buds in axil of each leaf, glabrous, hidden beneath leaf-scar; twig light yellow brown, glabrous.

Gleditsia triacanthos (see above, page 7).

a2. Bud at end of twig not sunk in bark.

b1. Bud at end of twig irregular in outline, unsymmetrical in form, scales felty.

* *Rhus glabra* differs from *Rhus hirta* only in having smooth instead of densely hairy twigs.

c1. Terminal bud pedicelled, scales with pinnate apex, buds densely tomentose light brown, stipule-scars small, twigs small dull gray-brown slightly pubescent, leaf-scars small broadly crescent-shaped, three or four bundle-scars often united in a single line. Plate II. *Hamamelis virginiana* Linn.

c2. Terminal bud sessile, no stipule-scars.

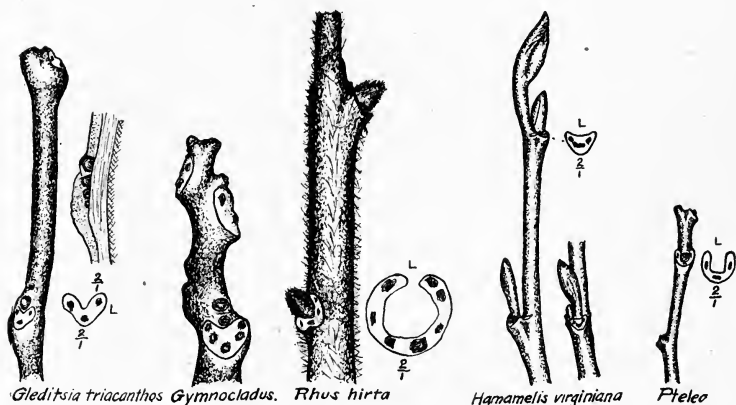


PLATE II.

L—Leaf-scar magnified.

LC—Longitudinal section showing buds beneath leaf-scar.

d1. Pith brown chambered, bundle-scars three, often two to four small superposed axillary buds, twigs large, leaf-scars three-lobed, three bundle-scars one in each lobe, the lowest bundle-scar U-shaped, terminal buds large gray-brown with three or four irregular scales indistinctly visible.

Juglans Linn.

e1. Band of pale tomentum elevated between leaf-scar and axillary buds, terminal bud one-half to three-fourths inch long often with pinnate apex, pith usually dark brown, twig greenish brown slightly pubescent. Plate III. *J. cinerea* Linn.

- e2. Without band of tomentum between leaf-scar and buds, terminal bud about one-fourth inch long, pith usually light brown, twig reddish brown slightly pubescent. Plate III.

* *J. nigra* Linn.

* *J. rupestris* Engelm.

- d2. Pith nearly white solid, bundle-scars many scattered, axillary buds small quite regular and symmetrical, leaf-scars obscurely three-lobed, terminal buds one-half inch long compressed, usually two scales visible.

- e1. Terminal bud bright yellow, leaf-scar small.

Hicoria minima (Marsh) Britton.

- e2. Terminal bud covered with a dark brown glandular pubescence,† leaf-scar large with thin membranaceous border around it.

Hicoria pecan Britton.

- d3. Pith white solid often with woody transverse partitions, bundle-scars about five in a U-line, axillary buds small oval, leaf-scars crescent-shaped narrow, terminal buds very narrow about one-fourth inch long, no scales distinct, very dark brown densely silky, twigs small, branchlets with longitudinal shallow grooves.

Asimina triloba (Linn.) Dunal.

- b2. Bud at end of twig quite regular in outline but unsymmetrical in form, scales not felty.

* Distinction between these two species is rather difficult from twigs alone. *J. rupestris* has larger terminal buds, usually between one-fourth and one-half inch long, pubescence on twigs remains until the second year, branches in their fourth year are nearly white. *J. nigra* has terminal buds usually a little less than one-fourth inch long, the branchlets in the second year are glabrous.

† United States Forest Service Bulletin 80.

- c1. Buds pedicelled, terminal bud scurfy or slightly tomentose dark red, stipule-scars distinct but small, two bud-scales visible valvate, bundle-scars three, leaf-scars rounded crescent-shaped. Plate III.

Alnus Ehrh.

- c2. Buds sessile, scales glabrous bright red or greenish, one large scale makes bud unsymmetrical, usually three scales visible, bundle-scars about eight scattered through the broadly crescent-shaped leaf-scar, stipule-scars distinct, one broad the other linear, no terminal bud, tip-scar prominent, twigs medium size, buds nut-ciliginous pleasant tasting. Plate III.

Tilia americana Linn.

- b3. Buds at end of twig regular and symmetrical.

- c1. Stipule-scars extend half way around twig or farther.

- d1. Terminal bud large ovate covered with long white hairs, one scale visible, leaf scar large and oval or lunate, bundle-scars about eight in a U-line or scattered, stipule-scars extending completely around twig join to form a narrow continuous line, twig large. Plate III.

Magnolia Linn.

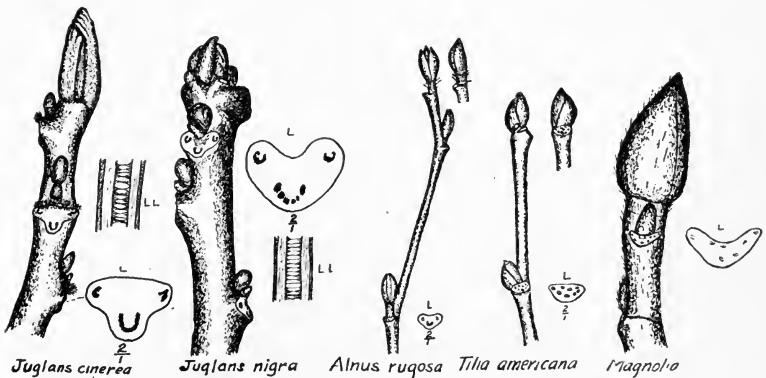


PLATE III.

L—Leaf-scar magnified.

LL—Longitudinal section showing chambered pith.

- d2. Bud at end of twig small nearly conical glabrous red or greenish, leaf-scar encircles bud, one scale visible, stipule-scar extends completely around twig as one continuous line, bundle-scars about eight in a U-line, twig medium size, no terminal bud, tip-scar distinct. Plate IV.

Platanus occidentalis Linn.

- d3. Terminal bud spatulate glabrous greenish red, leaf-scar orbicular, two valvate bud-scales; stipule-scars, encircling twig as a continuous line, meet forming a notch; bundle-scars ten scattered, twig medium size. Plate IV.

Liriodendron tulipifera Linn.

- d4. Terminal bud long lanceolate sharp pointed, many scales light brown glabrous or pubescent at apex, leaf-scar somewhat crescent-shaped or elliptical, stipule-scars not a continuous line, one ends above the other, bundle-scars about six scattered, twig small glabrous reddish-brown. Plate IV.

Fagus atropunicea (Marsh.) Sudworth.

- c2. Stipule-scars distinct but small.

- d1. Pith white chambered, buds small brown slightly pubescent flattened against twig, stipule-scars minute, bundle-scars three, often united into one line, twigs small glabrous or pubescent, no terminal bud, tip scar not prominent. Plate IV.

* *Celtis occidentalis* Linn.

- d2. Pith solid.

- e1. Buds ovate clustered at end of twig, bud-scales many chestnut brown, bundle-scars many scattered, pith somewhat five-angled, terminal bud present, stipule-scars distinct.

† *Quercus* Linn.

* Compare *Morus rubra*.

† The descriptions of the Oak twigs given here are taken from Sargent, "Silva of North America."

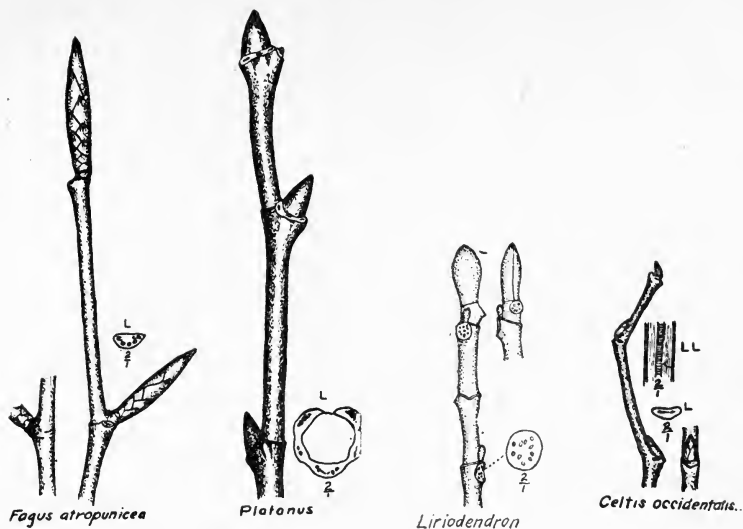


PLATE IV.

L.—Leaf-scar magnified.

LL—Longisection showing chambered pith.

f1. Bud-scales loosely imbricated.

g1. Twigs glabrous slender, dull red, becoming grayish brown the second year, buds acute strongly angled, scales dark brown minutely pubescent scarious margins.

Q. nigra Linn.

g2. Twigs coated with tomentum, stout becoming dark brown often with glaucous bloom, buds obtuse tomentose one-fourth to one-third inch long, outer scales linear lanceolate, inner scales wider and rounded at apex.

Q. densiflora Hooker & Arn.

f2. Bud-scales firmly imbricated.

g1. Buds less than one-fourth inch long.

h1. Buds covered with pubescence.

A Bud and Twig Key

- i7.* Branchlets two years old covered with soft pale pubescence, twigs stout light brown becoming darker the second year, buds brown broadly ovate obtuse about one-eighth inch long.

Q. minor (Marsh.) Sargent.

- i2.* Branchlets two years old glabrous.

- j1.* Twigs slender light yellowish brown slightly pubescent becoming lighter colored in second year, buds acute scarcely one-fourth inch long.

Q. lobata Née.

- j2.* Twigs slender light yellowish-brown, or minutely pubescent growing darker or ashy gray in second year, buds obtuse or acute one-eighth inch long light brown.

Q. gambelii Nutt.

- j3.* Twigs stout light yellowish glabrous becoming ashy gray or light brown in second year, corky wings on branchlet usually appear second or third year, buds broadly ovate, acute or obtuse one-eighth to one-quarter inch long.

Q. macrocarpa Michx.

- h2.* Buds glabrous or slightly or partially pubescent.

- i1.* Buds obtuse.

- j1.* Bark on branches one inch in diameter breaks into stiff papery sheets, twigs stout light brown glabrous growing darker in second year, buds one-eighth inch long, scales light brown with pale scattered hairs near apex.

Q. platanoides (Lam.) Sudworth.

j2. Bark not forming papery plates.

k1. Buds glabrous dark red-brown one-eighth inch long, broadly ovate obtuse, twigs slender red and lustrous or coated with glaucous bloom becoming ashy gray in second year.
Plate V. *Q. alba* Linn.

k2. Buds tomentose near margin of scales, light brown obtuse, twigs slender glabrous grayish brown becoming ashy gray or light brown, buds one-eighth inch long.

Q. lyrata Walt.

i2. Buds acute.

j1. Bud-scales with scarious margins.

k1. Scales erose light brown lustrous, buds acute one-eighth inch long, twigs slender glabrous light brown growing darker in second year.

Q. imbricaria Michx.

k2. Bud-scales entire brown, margin light, bud acute one-eighth inch to nearly one-fourth inch long, twigs slender glabrous light brown becoming darker in second year.

Q. acuminata (Michx.) Houba.

j2. Bud-scales without scarious margins.

k1. Twig stout pubescent dark brown becoming brown or gray in second year, buds acute one-eighth to one-fourth inch long bright brown scales minutely pubescent.

Q. digitata (Marsh.) Sudworth.

A Bud and Twig Key

k2. Twigs slender glabrous lustrous brown growing darker in second year, buds one-eighth inch long gradually tapered to acute apex light brown glabrous or often minutely pubescent.

Q. palustris Muenchh.

g2. Buds one-fourth inch or longer.

h1. Twig conspicuously densely hairy light brown stout, becoming glabrous bright reddish in the second year, buds acute one-third to one-half inch long covered with a dense coat of light rusty tomentum.

Q. garryana Dougl.

h2. Twigs glabrous.

i1. Buds prominently angled acute one-fourth inch long covered with rusty brown hairs, twigs stout light to dark brown becoming darker or ashy gray the second year.

Q. marilandica Muenchh.

i2. Buds covered with light gray pubescence, one-fourth to one-half inch long, gradually taper to obtuse apex, strongly angled, twigs stout dull red-brown becoming darker in second year, pith yellow. Plate V.

Q. velutna Lam.

i3. Buds glabrous or only partially pubescent.

j1. Bud-scales with scarious margins, minutely pubescent, scales of inner ranks tomentose on outer surface, buds broadly ovate or oval acute one-fourth inch long, twigs bright red or yellowish brown becoming ashy gray in the second year.

Q. michauxii Nutt.

j2. Bud-scales without scarious margins.

k1. Twig light brown stout becoming dark gray or brown in the second year, buds acute or acuminate one-fourth to one-half inch long and narrow in proportion, scales light brown with ciliate margins.

Q. prinus Linn.

k2. Twig dark red brown slender remaining about the same the second year, buds taper gradually to acute apex, one-fourth inch long light brown glabrous. Plate V.

Q. rubra Linn.

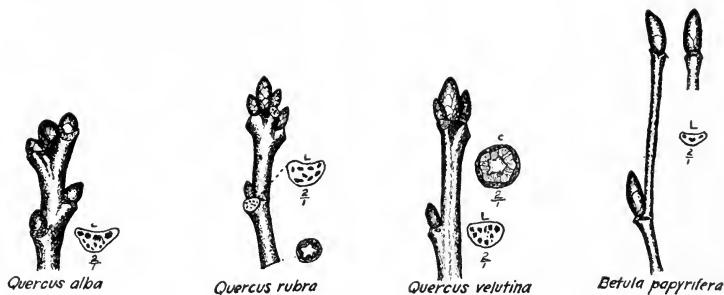


PLATE V.

L.—Leaf-scar magnified.

C.—Cross-section of twig.

e2. Buds solitary at end of twig.

f1. Buds long narrow appressed, one cap-like scale glabrous or pubescent, bundle-scars three in a narrow lunate leaf-scar, stipule-scars usually distinct, twigs slender, no terminal bud, tip-scar often prominent. *Salix* Linn.

A Bud and Twig Key

- f2. Bud globular very small, three scales visible, a one-fourth inch thorn accompanying the axillary bud, leaf-scar small round with one bundle-scar or several clustered in the center, stipule-scars very small, twigs small, sap milky, pith of the older branchlets often yellow, no terminal bud, tip-scar indistinct.

Toxylon pomiferum Raf.

- f3. Buds ovate or long oval, apex acute, two to four scales visible.

- g1. Bundle-scars three, dwarf shoots common, buds long oval about one-fourth inch long, twigs small, no terminal bud, tip-scar distinct.

* *Betula* Linn.

- h1. Twigs dull red, becoming shiny dark yellowish brown the second year, buds slightly resinous. Plate V.

B. papyrifera Marsh.

- h2. Twigs light yellowish brown, becoming shiny yellowish brown.

B. lutea Michx.

- h3. Twigs very dark red shiny becoming dull reddish brown the second year.

B. nigra Linn.

- h4. Twigs bright red brown shiny becoming dull brown, have wintergreen flavor.

B. lenta Linn.

- g2. Bundle-scars four to six or more scattered, no dwarf shoots, stipule-scars small but distinct, no terminal bud, tip-scar distinct.

- h1. Pith five-angled, buds glabrous dark brown ovate or oval scarcely one-fourth inch long, twig glabrous brown.

Castanea dentata (Marsh.) Borkh.

* Distinction between the species is difficult from twigs alone.

- h2. Pith round, buds broadly ovate, one-fourth inch long light brown glabrous, flattened against twig, twig glabrous light brown. * *Morus rubra* Linn.
- f4. Buds ovate acute, more than four scales visible.
- g1. Bundle-scars about six to ten scattered, bud appressed, not more than five scales visible. *Morus rubra* (see above).
- g2. Bundle-scars three to six arranged in a lunate line.
- h1. Pith five-angled, terminal bud ovate long pointed, leaf-scar broad, outermost bud-scale directly above leaf-scar, middle one of the three bundle-scars often double, branchlet roughened by elevated leaf-scars. *Populus* Linn.
- i1. Terminal bud one-half to three-fourths inch long, resinous.
- j1. Buds fragrant very resinous, three-fourths inch long and one-fourth inch broad, lateral buds often flattened against twig, twigs stout light or dark orange color lustrous, bud scales slightly pubescent at base, scarious margins. *P. trichocarpa* Torr. & Gr.
- j2. Buds not fragrant, one-half inch long, resinous, flattened, slightly pubescent at base, leaf-scar three-lobed truncate or emarginate above, twigs stout often with ridge extending downward from each side of leaf scar. *P. deltoides* Marsh.

* Compare *Celtis occidentalis*.

A Bud and Twig Key

i2. Terminal buds about one-fourth inch long slightly or not at all resinous.

j1. Stipule-scars very faint lines or usually none, bud not resinous, axillary buds about one-fourth inch long, terminal bud a little longer, scales slightly pubescent, leaf-scars rounded triangular, twig and bud brown, buds spread wide from twig, not flattened. Plate VI.

P. grandidentata Michx.

j2. Stipule-scars distinct, buds slightly resinous.

k1. Pith orange color, buds broadly ovate, scales slightly pubescent towards base, leaf-buds one-fourth inch, flower-buds one-half inch long, bright red brown, twigs light yellowish stout becoming darker in second year rough with large leaf-scars. *P. heterophylla* Linn.

k2. Pith white, buds narrow conical sharp-pointed, scales glabrous shiny, scarious margin, leaf-scars lunate, terminal buds usually about one-fourth inch, lateral buds about one-eighth inch long, twigs and buds red-brown lustrous, outermost bud-scale emarginate, twigs slender. Plate VI.

P. tremuloides Michx.

h2. Pith round, terminal bud one-eighth inch long, twig has bitter aromatic taste, leaf-scars lunate five ranked on twig, bundle-scars three, many bud-scales glabrous, first pair lateral, stipule-scars distinct but small. * *Prunus serotina* Ehrh.

* Compare *Ulmus americana* and *Ulmus racemosa*.

- h3. Pith round, no terminal bud, leaf-scars two-ranked on the twig, many bud-scales.
- i1. Pith-rays in a one-sixteenth inch diameter branchlet distinctly visible with hand lens, twigs about one-thirty-second inch in diameter, leaf-scars very small, stipule-scars minute, bud about one-eighth inch long, twig dark red lustrous becoming when about one-half inch diameter dull gray, tip-scar very small, often dead tip of twig extends past the end bud, bundle-scars three. Plate VI.

* *Carpinus caroliniana* Walt.

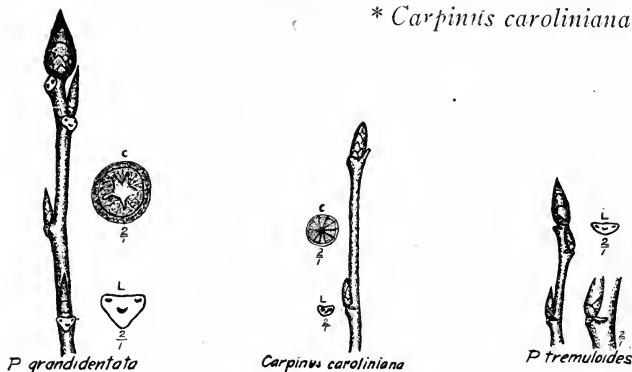


PLATE VI.

C—Cross-section of twig.

L—Leaf-scar magnified.

- i2. Pith-rays in small branchlet scarcely or not at all visible with hand lens, twigs one-sixteenth inch or larger.
- j1. Bundle-scars three to six depressed in corky layer of leaf-scar, tip-scar distinct, stipule-scars small, twigs zig-zag usually larger than one-sixteenth inch, light brown, bud scales with rounded apex. * *Ulmus* Linn.

* Compare *Ostrya virginiana*, *Ulmus americana*, *Carpinus caroliniana* and *Prunus serotina*.

A Bud and Twig Key

- k1.* Buds broadly ovate obtuse dark brown, outer scales with rusty brown hairs, next scales within covered with thick rusty tomentum, buds one-fourth inch long, oval leaf-scars, twig light grayish or brownish slightly roughened, becoming darker second year, bundle-scars three, tip-scar not prominent.
U. pubescens Walt.
- k2.* Buds ovate acute slightly flattened one-eighth inch long, scales glabrous bright chestnut brown, leaf-scars oval or semi-orbicular, bundle-scars three rarely four, twig reddish brown. Plate VII.
 * *U. americana* Linn.
- k3.* Buds ovate one-fourth inch long, scales brown slightly pubescent, margin ciliate with soft white hairs, bundle-scars three or four to six in rather irregular line, leaf-scars orbicular or semi-orbicular or triangular, twig light brown glabrous or minutely pubescent. Plate VII.
U. racemosa Thomas.
- j2.* Bundle-scars three raised slightly above surface of very small lunate leaf-scar, stipule-scars minute, twigs one-sixteenth inch rarely larger, buds about one-fourth inch long, bud-scales light brown with obtuse apex, twigs red-brown lustrous becoming when about one-half inch diameter dull brown. Plate VII.
 * *Ostrya virginiana* (Mill.) Koch.

* Compare *Carpinus caroliniana*, *Ulmus americana*, and *Ostrya virginiana*.

c3. Stipule-scars none.

d1. Bud-scales felty, bundle-scars many scattered, pith angled, twigs very tough, terminal buds broadly ovate, four or more scales or scars left by early deciduous scales. † *Hicoria* Raf.

e1. Outer scales deciduous in autumn or early winter.

f1. Bud-scales two exposed, leaf-scars small more or less obscurely lobed, terminal bud about one-fourth inch long dome-shaped with acute apex. Plate VII. *H. glabra* (Mill.) Britton.

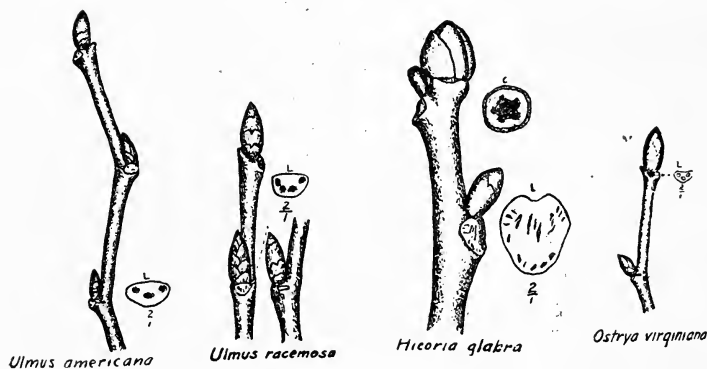


PLATE VII.

C—Cross-section of twig.

L—Leaf-scar magnified.

f2. Terminal buds one-half to three-fourths inch long, three or four outer scales deciduous in autumn, exposed scales densely tomentose or silky, leaf-scars more or less obscurely lobed.

H. alba (Linn.) Britton.

H. ovata (Mill.) Britton.

† It is difficult to distinguish between the species of this group of Hickories even when all characteristics, leaf, fruit, bark, etc., are at hand, for there seem to be a great many intermediate forms. *Hicoria alba* and *Hicoria ovata* are especially hard to separate definitely.

A Bud and Twig Key

- e2. Outer scales remain until spring, terminal bud three-fourths to one inch long, leaf-scar three-lobed, twigs orange yellow stout, outer scales eleven or twelve, leaf-stocks of previous year often persist. *H. laciniosa* (Michx.) Sargent.
- d2. Bud-scales glabrous or slightly pubescent, bundle-scars one or three, pith round.
- e1. One prominent bundle-scar transversely elongated.
- f1. Terminal bud one-fourth inch or longer, broadly ovate, obtuse apex, four to six greenish red scales visible each with rounded apex, glabrous, leaf-scar semi-orbicular or broadly crescent-shaped, twig bright green lustrous brittle, spicy aromatic taste, pith mucilaginous one-half diameter of twig. Plate VIII.

Sassafras sassafras (Linn.) Karst.

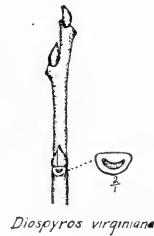


PLATE VIII.

L.—Leaf-scar magnified.

- f2. No terminal bud, tip-scar distinct, buds one-eighth inch long broadly ovate flattened against twig, acuminate apex, scales two dark brown lustrous, leaf-scars semi-orbicular, twigs slender light brown or gray becoming darker in second year. Plate VIII.

Diospyros virginiana Linn.

e2. Bundle-scars three.

- f1. No terminal bud, tip-scar distinct; buds two superposed the larger one scarcely one-sixteenth inch long, appressed, nearly hemispherical; scales two rarely three visible dark brown, smaller bud nearly hidden between upper one and the rounded triangular leaf-scar, twig brown speckled with gray, glabrous.

Cercis canadensis Linn.

- f2. Terminal bud one-eighth to one-fourth inch, more than four scales visible.

- g1. Pith solid with woody transverse plates about one-eighth inch apart visible with hand-lens, terminal bud one-fourth inch long obtuse, scales six or seven visible, dark reddish slightly pubescent, leaf-scar lunate, twig glabrous or nearly so, light brown becoming darker the second year.

Nyssa sylvatica Marsh.

g2. Pith homogeneous.

- h1. Leaf-scars broadly lunate or semi-orbicular, terminal bud acute about one-fourth inch long, scales polished ciliate margin, bundle-scars large annular, pith large in twigs, branchlets often winged after second year.

Liquidambar styraciflua Linn.

- h2. Leaf-scars narrowly lunate, buds nearly globular, numerous scales rounded or obtuse at apex, chestnut brown lustrous, twigs glabrous, usually armed with thorns.

Crataegus Linn.

A Bud and Twig Key

- d3. Bud-scales slightly pubescent, inner ones silky tomentose, bundle-scars five, terminal bud about one-half inch long ovate acute, scales three or four visible dark red, leaf-scar narrow lunate, lateral buds small, two scales visible, twig stout red-brown glabrous becoming darker in second year, on branchlets outer papery layer of bark easily separable from green layer beneath.

Pyrus americana (Marsh.) de. C.

