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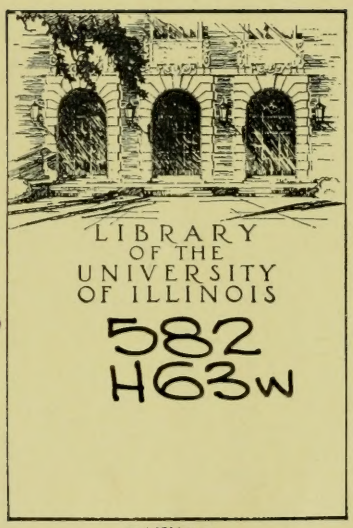
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THE

WOODY PLANTS

OF MANHATTAN

IN THEIR WINTER CONDITION

BY

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INTRODUCTION.

The following descriptions were written for the use of the students of the Kansas State Agricultural College, there being no work available for the determination of woody plants in their winter condition.

The nomenclature is that adopted recently by the Botanical Club of the A. A. A. S., and the sequence of species is that of Gray's Manual, sixth edition.

The characters given under a genus are not necessarily generic but are those which are common to the species under consideration. The specific descriptions apply to the species as observed in this locality and may not always hold good over a wider range. A few definitions will be necessary for a correct understanding of the descriptions. The pith though usually circular, may be rhomboidal as in wahoo, or five angled as in the oaks. It is understood to be cylindrical unless otherwise stated. Homogeneous pith is the same density throughout the twig and is the usual condition, but occasionally it consists of a series of thin transverse diaphragms a short distance apart as in the walnut, or is continuous except at the nodes where there is a woody cross-partition as in the grapes. By twig is meant the growth of the previous season, all older being called branchlets or branches. The color of the twigs of most species is subject to considerable variation and some allowance must be made in applying the description. The lenticels or small corky eruptions which roughen the epidermis are only occasionally of sufficient diagnostic value to be included in the descriptions. The shape of the leaf-scar may vary considerably in the same twig especially toward the base or apex. In procuring a twig for identification it is best to select one which has made the ordinary healthy growth, avoiding those which are stunted and also the abnormally vigorous sprouts The description of the leaf-scar applies to those of normal shape which occur over the middle portion of the twig. Most of the terms applied to the shape are self-explanatory. Arcuate is the same width throughout, but slightly curved. The exposed ends of the fibrovascular bundles are aggregated in more or less definite groups known as bundle-scars. At the angles of the leaf-scars will be found the stipule-scars, in plants provided with stipules. When the leaf-scars are oblique, the stipule-scars, if present, are unequal, the longer being on the side toward which the bud is placed.

The arrangement (phyllotaxy) of alternate leaves on the twig is usually two-ranked, five-ranked, or eight-ranked. In the first or one-half

phyllotaxy, the third leaf-scar, starting at any point, is directly over the first; in the second, or two-fifths phyllotaxy, the sixth leaf-scar is over the first; while in three-eighths phyllotaxy, the ninth is directly over the first, that is, there are eight leaves in a cycle, which consists of a spiral passing three times around the stem. The phyllotaxy may vary from two-fifths to three-eighths in the same species or even in different twigs on the same plant.

The lateral buds are usually single but there may be two or more in the same axil, one above another, when they are superposed. The terminal bud in many cases is not present, the upper lateral bud taking its place and pushing aside a terminal scar, which may be caused by the falling off of an inflorescence, but usually (according to Foerste, Bot. Gaz. xvii. No. 6,) is due to the casting off of the green terminal portion of the twig earlier in the season.

Since it has not been necessary, except in a few cases, to discriminate between closely allied species, the descriptions do not include the finer details but are confined to what seemed sufficient to identify the species.

The list includes sixty-three native species and four that are in common cultivation and have escaped in places. The four not native are Tree of Heaven, Black Locust, Catalpa and Osage Orange.

The fruit or leaves are often obtainable and will aid in the identification, in which case the student should refer to Gray's Manual.

Thanks are due to Dr. William Trelease, Director of the Missouri Botanical Garden, and Prof. S.C. Mason, of this College, for various favors.

KEY TO GENERA.

A. Leaf-scars more than one at each node.
  a. Buds pubescent.
    Twigs glaucous.....Acer. 15
    Twigs gray, buds brown-felty.....Fraxinus. 33
    Twigs very small, yellow, scales 2-3 pairs...Symphoricarpos. 31
    Twigs red, scales one pair.....Cornus. 29
  b. Buds glabrous.
    1. Evergreen.....Juniperus. 48
    2. Deciduous.
      Leaf-scars circular or oval.....Catalpa. 34
      Leaf-scars U-shaped.....Acer. 15
      Leaf-scars more or less semicircular.
        Pith rhomboidal, twigs 4-angled.....Evonymus. 7
        Pith cylindrical, twigs not angled.
          Stipule-scars present.
            Joining the leaf-scars.....Cephalanthus. 32
            Not meeting.....Staphylea. 16
          Stipule-scars absent.
            Leaf-scars meeting.....Sambucus. 30
            Leaf-scars not meeting.....Æsculus. 13

B. Leaf-scars one at each node.
  a. Plants armed with prickles or thorns.
    1. Thorns representing branches.
      Bearing leaf-scars below, thorn-like at apex.
        Leaf-scars V-shaped.....Pyrus. 26
        Leaf-scars oval.....Prunus. 23
      Typical thorns, bearing no leaf-scars.
        Simple; buds globose, single.
          Color ashy.....Ioxylon. 37
          Color red or brown.....Cratægus. 27
        Branched; buds superposed.....Gleditsia. 22

2. Prickles not representing branches.
In position of stipules.
Buds hidden by leaf-scar.....Robinia. 19
Buds exposed, red pubescent.....Zanthoxylum. 4
Scattered.
Plant provided with tendrils.....Smilax. 47
No tendrils.
A triple spine below leaf-scar.....Ribes. 28
Twigs strongly glaucous or else 5-ridged..Rubus. 24
Twigs cylindrical and at most only slightly glaucous.....Rosa. 25

b. Plants unarmed.
1. Buds naked.
Dark brown, silky.....Asimina. 1
Pubescence buff or gray.
Bundle-scar one.....Ceanothus. 9
Bundle-scars several.....Rhus. 17
2. Buds scaly.
*Vines.
Provided with tendrils.
Woody partitions at nodes.....Vitis. 10
No partitions at nodes.
Aerial rootlets on old parts; tendrils irregularly branching.....Ampelopsis. 12
No aerial rootlets; tendrils forked....Cissus. 11
No tendrils.
Leaf-scars semicircular.....Celastrus. 6
Leaf-scars circular.....Menispermum. 2
**Not vines.
†Leaf-scars two-ranked.
Buds glabrous.
Superposed.....Cercis. 20
Single.
Scales two or three.....Tilia. 3
Scales several.
Twigs brown.....Ulmus. 35
Twigs light colored.....Morus. 38
Buds pubescent.
Pith diaphragmed.....Celtis. 36
Pith homogeneous.
Buds dark brown, silky.....Ulmus. 35
Buds light brown, sparingly pubescent.
Conical, pointed.....Ostrya. 43
Flattened, rounded.....Corylus. 42
††Leaf-scars more than two-ranked.
Pith 5-angled.
Upper buds clustered at apex of twig....Quercus. 44

Buds not clustered.
Scales gummy; stipule-scars present.
..... Populus. 46
Scales not gummy; no stipule-scars.
.....Hicoria. 41
Pith cylindrical.
§Twigs pubescent, at least at apex.
Pith diaphragmed.....Juglans. 40
Pith homogeneous.
Brown.....Ailanthus. 5
White.
Leaf-scars V-shaped.....Pyrus. 26
Leaf-scars heart-shaped....Sapindus. 14
Leaf-scars small, semi-oval.
Scales obscure, cottony-villous.
.....Ceanothus. 9
Scales apparent, glabrescent.
.....Amorpha. 18
§§Twigs glabrous.
¶Stipule-scars present.
Extending around twig.....Platanus. 39
Not extending around twig.
Buds superposed.
Leaf-scars semi-oval.....Amorpha. 18
Leaf-scars U-shaped.....Gleditsia. 22
Buds single.
Scale one.....Salix. 45
Scales several.
Bundle-scar 1; twigs gray..Rhamnus. 8
Bundle-scars 3; twigs dark.
Leaf-scars V-shaped.....Pyrus. 26
Leaf-scars oval.....Prunus. 23
¶¶Stipule-scars absent.
Terminal bud absent.....Gymnocladus. 21
Terminal bud present..... Hicoria. 41

DESCRIPTIVE LIST.

1 ASIMINA, Adans. Fam. 1763.

A. TRILOBA, (L.) Dunal, Mon. Anon. 1817. *Anona triloba*, L. Spec. 1753. Papaw.

A small tree with white pith, brown twigs, glabrous, or pubescent at apex, two-ranked, rather broadly U-shaped leaf-scars and five bundle scars. The dark brown, silky buds are naked, the compressed terminal one being about 1 cm. long with conduplicate leaves, while the lateral leaf-buds are appressed and only about 4 mm. long, and the flower-buds globose and diverging. Usually occurs in groves in rich lowland soil.

2 MENISPERMUM, Tourn. Act. Acad. Paris, 1705; L. Spec. 1753.

M. CANADENSE, L. Spec. 1753. Moonseed.

A greenish brown, glabrous, twining vine with white pith, circular, concave leaf-scars, and about five bundle-scars. The uppermost of the two to four low, rounded, villous, superposed buds is largest and placed above the leaf-scar, the others being hidden. The bud scales are not easily distinguished. Twines opposite to the hands of a watch. Common.

3 TILIA, Tourn. Inst. 1700; L. Spec, 1753.

T. AMERICANA, L. Spec. 1753. Basswood.

A medium sized tree with smooth gray bark, white pith, drab, red or light brown, glabrous twigs, two-ranked, semi-oval, oblique leaf-scars with three to several bundle-scars, unequal stipule-scars, and no terminal buds. The ovoid lateral buds have two or rarely three scales which are glabrous or sometimes slightly pubescent at apex. Along moist bluffs. Not common.

4 ZANTHOXYLUM, L. Gen. 1737; Spec. 1753.

Z. AMERICANUM, Mill. Dict. 1768. Prickly Ash.

A shrub, four to eight feet high, with white pith, pubescent, dark brown or dark gray twigs, armed with prickles, or rarely unarmed. The short, stout, flattened prickles are in the position of stipules or occasionally scattered. The five-ranked leaf-scars are triangular heart-shaped, containing three separate or more or less coallescing bundle-scars. The buds are low and densely reddish, felty-pubescent, with obscure scales. Not common.

5 AILANTHUS, Desf. Act. Acad. Paris, 1786.

A. GLANDULOSA, Desf. l. c. Tree of Heaven.

A tree cultivated for shade and escaped in places. Pith large, chocolate-brown, twigs very large, light brown, pubescent and glaucous; large leaf-scars five-ranked, from V-shaped to triangular heart-shaped; bundle-scars numerous, frequently aggregated in about five areas; buds single, low, scarcely raised above the epidermis; scales about two, rounded and pubescent; terminal buds none. Native of China.

6 CELASTRUS, L. Gen. 1737; Spec. 1753.

C. SCANDENS, L. Spec. 1753. Bitter-sweet.

A twining vine with white pith, smooth light gray twigs, eight-ranked, semicircular leaf-scars, with bundle-scars aggregated in a central mass. The almost horizontally diverging buds are 1 to 2 mm. long, with the two outer, keeled, brownish scales enclosing several smaller ones. Scarlet fruit persistent. Common.

7 EVONYMUS, Tourn. Inst. 1700; L. Spec. 1753.

E. ATROPURPUREUS, Jacq. Hort. Vind. 1772. Wahoo.

A rather tall shrub with whitish, rhomboidal pith, smooth, green, four-angled twigs and white, semicircular, opposite leaf-scars with one bundle-scar. Terminal bud with two or three pairs of glabrous scales; lateral very small and appressed with one pair of scales. Fruit persistent. Not common.

8 RHAMNUS, Tourn. Inst. 1700; L. Spec. 1753.

R. LANCEOLATA, Pursh, Fl. 1814. Buckthorn.

A shrub with white pith, glabrous, gray twigs, small oval or arcuate, four-ranked leaf-scars, with one bundle-scar, and stipule-scars just above the angles of the leaf-scar. Buds pointed, appressed, about 3 mm. long, with several brown, glabrous scales. The phyllotaxy can be compared to that of decussate leaves in which one leaf of each pair is some distance above the other. Rare.

9 CEANOTHUS, L. Act. Soc. Ups. 1741; Spec. 1753.

C. OVATUS, Desf. Arb. ii, 1809. Red-root.

A low shrub with pubescent, gray or red-brown twigs, small, eight-ranked, semi-oval leaf-scars, one horizontal bundle-scar, and frequently persistent awl-shaped stipules. The scales of the globose, densely cottony-villous buds can not be easily distinguished. Common in upland woods and rocky hills.

10 VITIS, Tourn. Inst. 1700; L. Spec. 1753.

Woody vines climbing by forked tendrils placed opposite the leaf scars. Twigs brown and striate, the bark on the older portions becoming shreddy. Leaf-scars semicircular to crescent-shaped, the surface irregular, and the bundle-scars obscure. Buds obtuse, the two or three smooth brown scales frequently exposing the densely pubescent young leaves.

The pith is homogeneous, except at the nodes, where there is a woody cross partition.

Twigs cylindrical, glabrous.
Partition ½ to 1 mm. wide..... *V. riparia.*
Partition about 1½ mm. wide..... *V. cordifolia.*
Twigs angled, cottony..... *V. cinerea.*

V. CINEREA, (Engelm.) Engelm. Bushberg Cat. 1883, *V. æstivalis*, var. *cinerea*, Engelm. in Gray, Man. Ed. 5, 1868. Downy Grape.
Common along the Blue and lowlands of the Kansas rivers.

V. CORDIFOLIA, Michx. Fl. 1803. Frost Grape.
Rare along Kansas river from Manhatttan to St. George.

V. RIPARIA, Michx. Fl. 1803. Summer Grape.
Common.

11 CISSUS, L. Fl. Zeyl. 1747; Spec. 1753.

C. AMPELOPSIS, Pers. Syn. i, 1805. Cissus.
A vine climbing by once or twice forked tendrils, placed opposite the leaf-scars, with white pith becoming diaphragmed in the older canes, no partitions at the nodes, light gray-brown, glabrous, somewhat angled twigs, irregularly circular, two-ranked, raised leaf-scars and low buds, surrounded by the ruptured epidermis, with one scale almost enclosing the bud. Frequent.

12 AMPELOPSIS, Michx. Fl. 1803.

A. QUINQUEFOLIA, Michx. l. c. Virginia Creeper.
A vine climbing by irregularly branching tendrils opposite the leaf-scars and also aerial rootlets on the older parts. Twigs brownish gray to light buff, rather sparsely hirsute or glabrescent, leaf-scars cylindrical, concave, two-ranked, with several bundle-scars in an irregular circle; stipule-scars conspicuous, curved downward; buds low and rounded, with few glabrous or slightly rusty scales. Common.

13 ÆSCULUS, L. Syst. 1740; Spec. 1753.

Æ. ARGUTA, Buckley, Proc. Am. Acad. 1860. Buckeye.
A shrub or low tree with white pith, which quickly cracks leaving radiating cavities; large buff or reddish brown, glabrous or minutely pubescent twigs; large heart shaped, opposite leaf-scars, with three areas of bundle-scars; and large lanceolate, acute terminal buds, with numerous, acute, striate, often glaucous scales. The terminal bud is sometimes absent, when the upper pair of lateral buds are much larger than usual. Frequent.

14 SAPINDUS, Tourn. Inst. 1700; L. Spec. 1753.

S. MARGINATUS, Willd. Enum. 1809. Soap-berry.
A small tree with white pith, light gray twigs, glabrescent below, pubescent above, and frequently ridged; five-ranked, heart-shaped leaf-

scars, the raised borders of which form at the lower angles small protuberances; bundle-scars in three areas; terminal buds none; lateral buds two or three superposed, contiguous (or single), low, densely pubescent. Rare, on dry hills.

15 ACER, Tourn. Inst. 1700; L. Spec. 1753.

A. SACCHARINUM, L. Spec. 1753. Soft Maple.

A large tree, with reddish or yellowish-brown, glabrous twigs, V-shaped, opposite leaf-scars not quite meeting, but joined by a line, and three bundle-scars. Terminal buds with two or three pairs, the appressed lateral with one or two pairs of smooth, ovate, obtuse scales. Common along the Blue, and the Kansas river below the mouth of the Blue.

A. NEGUNDO, L. Spec. 1753. Box Elder.

A small or medium tree with yellow-green or dark red-brown, glabrous and glaucous twigs, above the nodes of which is an impression, marking the position of the bases of the petiole during the previous season. The leaf-scars are narrow, V-shaped, opposite, the lateral angles meeting and extending upwards into a free appendage. Bundle-scars are three, or the lateral double. Buds pubescent, gray, the scales about two pairs, ovate, obtuse. Frequent in lowland woods.

16 STAPHYLEA, L. Gen. 1737; Spec. 1753.

S. TRIFOLIA, L. Spec. 1753. Bladder-nut.

A shrub with brownish gray or mottled yellow, glabrous twigs, white-streaked branches and trunks, semicircular or crescent, opposite leaf-scars, with about three bundle-scars, and stipule-scars at the angles but not meeting. Terminal bud absent; lateral buds with two pairs of glabrous scales. Infrequent along bluffs.

17 RHUS, L. Gen. 1737; Spec. 1753.

Twigs glabrous.....*R. glabra.*
Twigs pubescent.
Buds hidden by leaf-scar.....*R. Canadensis.*
Buds not hidden.....*R. radicans.*

R. GLABRA, L. Spec. 1753. Smooth Sumac.

A shrub with large yellow-brown pith, large, reddish, glabrous and glaucous twigs, compressed toward the apex by ridges decurrent from the leaf-scars, which are five-ranked, narrow, horse-shoe shaped and nearly surrounding the bud. Bundle-scars numerous. Terminal buds none; lateral low, naked and densely brown-woolly. Common on dry hills, thickets, etc.

R. RADICANS, L. Spec. 1753. Poison Ivy. Poison Oak.

An erect shrub or a vine climbing by aerial rootlets. Pith white; twigs light brown, striate, minutely pubescent; leaf-scars two-ranked, heart, crescent or V-shaped, with raised border; bundle-scars five or six;

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buds naked, rusty pubescent. Very common in woods, along fences, and stone walls.

R. CANADENSIS, Marsh. Arb. 1785. Canada Sumac.

A small shrub with white pith, brown twigs finely pubescent above, glabrescent below, five or eight-ranked, circular leaf-scars raised on a broad base, with several scattered bundle-scars. Pubescent buds naked, entirely hidden by the over-arching leaf-scar. The next year's catkins conspicuous. Infrequent on rocky hills.

18 AMORPHA, L. Gen. 1737; Spec. 1753.

Twigs pubescent ..... *A. canescens.*
Twigs glabrous ..... *A. fruticosa.*

A. CANESCENS, Nutt. in Fraser's Cat. 1813. Lead plant.

A low shrub one or two feet high or occasionally as much as four feet. Twigs light brown or ashy, glabrescent below, pubescent above. The small leaf-scars eight-ranked, with three bundle-scars usually coalescent, and minute or obsolete stipule-scars. Buds single, flattened and closely appressed. Just above the bud there is a protuberance of the bark. Scales about four, brown, glabrescent. Common on prairie and in upland woods.

A. FRUTICOSA, L. Spec. 1753. False Indigo.

A shrub with gray, glabrous, sulcate twigs which die back at the summit, semi-oval, five-ranked leaf-scars, three closely aggregated bundle-scars, small stipules, usually persistent at the angles of the leaf-scars. Buds two superposed, the upper closely appressed; scales four or five, dark-brown, glabrous. Common in moist places.

19 ROBINIA, L. Gen. 1737; Spec. 1753.

R. PSEUDO-ACACIA, L. Spec. 1753. Black Locust.

Twigs light brown, glabrous, somewhat ridged. Leaf-scars triangular three-lobed, raised in the centre; bundle-scars three; stipular spines present or obsolete. Buds entirely hidden by leaf-scars, the cavity beneath lined with dense ferruginous pubescence. Introduced as a shade tree and escaped in places.

20 CERCIS, L. Gen. 1737; Spec. 1753.

C. CANADENSIS, L. Spec. 1753. Red bud.

A small tree with twisted and scaly bark; dark red-brown, glabrous, shining, slightly ridged twigs, two-ranked, triangular three-lobed leaf-scars, three bundle-scars and stipule-scars or persistent stipules adjacent above the leaf-scar. Terminal buds none; lateral small, flattened, appressed, two or three superposed. Flower buds larger, oval, spreading. Scales two or three. Common.

21 GYMNOCLADUS, Lam. Dict. i, 1783.

G. DIOICA, (L.) Koch, Dend. 1869-73. *Gailandina dioica*, L. Spec. 1753. *Gymnocladus Canadensis*, Lam. l. c.

Kentucky Coffee Tree.

A medium tree with reticulately roughened bark, chocolate pith, large, light drab twigs, glabrous, but roughened by numerous prominent lenticels. The large, V-shaped leaf-scars, five-ranked, with three or five bundle-scars, and obsolete stipule-scars. Terminal bud none; lateral two or three superposed, the upper a short distance above the others, all dark pubescent, low and circular, surrounded by an incurved rim of the bark. Infrequent in lowland woods.

22 GLEDITSIA, L. Gen. Ed. 2, 1742; Spec. 1753. *Gleditschia*, Scop. 1777.

G. TRIACANTHOS, L. Spec. 1753. Honey Locust.

A large tree with close dark bark, green or light gray, glabrous, sulcate twigs flattened at the nodes, five-ranked, horse-shoe shaped, usually somewhat three-lobed, prominent leaf-scars, three bundle-scars and minute or obsolete stipule-scars. Terminal buds none; lateral several superposed, the lower minute and seen only in longitudinal sections through node, the uppermost low and rounded A short distance above the buds there is a smooth red or brown more or less branched thorn, the branches in the axils of minute scales. Much branched thorns usually occur in fascicles on the trunk or not infrequently the tree is entirely unarmed. The branchlets are often nodulose from the developement of very short rounded twigs which bore fascicled leaves. Common in lowland woods.

23 PRUNUS, Tourn. Inst. 1700; L. Spec. 1753.

Shrubs or small trees with glabrous twigs, five-ranked leaf-scars, three bundle-scars and small stipule scars

Twigs and buds dark steel-gray, dull.....*P. Virginiana.*
Twigs and buds red brown, shining.
These medium.....*P. Americana.*
Small.....*P. angustifolia.*

P. AMERICANA, Marsh. Arb. 1785. Wild Plum.

The branches usually bear stunted thorn-like twigs or branchlets which are provided with leaf-scars. These semi-oval or arcuate. Terminal buds none; lateral appressed, acute, single or with two additional, collateral, diverging flower buds. Scales several, ovate, obtuse. Infrequent in thickets, along fences, etc.

P. ANGUSTIFOLIA, Marsh. Arb. 1785. *P. Chicasa*, Michx. Fl. 1803.

Chicasaw Plum.

Differs from P. Americana in having more slender twigs, smaller triangular-pointed buds with scales glabrous or somewhat pubescent. A shrub common on sand hills south of Manhattan.

P. VIRGINIANA, L Spec. 1753. Choke-Cherry.

Twigs rather large; leaf-scars more or less triangular, comparatively small, sometimes with only one bundle-scar. Buds pointed; scales five or six, glabrous, obtuse. A shrub or small tree rare in thickets.

24 RUBUS, Tourn. Inst. 1700; L Spec. 1753.

Declining suffruticose plants, with biennial or short lived perennial canes, armed with recurved prickles, five-ranked leaf-scars and three bundle-scars.

Twigs glaucous, cylindrical.... .....*R. occidentalis.*
Twigs not glaucous, five-ridged.....*R villosus.*

R. OCCIDENTALIS, L. Spec. 1753. Black Raspberry.

Pith yellow, cylindrical: twigs red-brown: leaf-scars crescent or semicircular, considerably raised, the leaf frequently breaking away irregularly, leaving a long stump without a distinct scar. Buds oblong with several acutish scales, more or less pubescent at apex. Common in upland woods, along fences, etc.

R. VILLOSUS, Ait. Hort. Kew. 1789. Blackberry.

Pith greenish, five-rayed; twigs purple, glabrous; prickles from a flattened base, sometimes straight: leaf-scars V-shaped, base of petiole often persistent: buds conical, strongly divergent, single or two or three superposed, scales few, somewhat pubescent. Infrequent.

25 ROSA, Tourn. Inst. 1700; L. Spec. 1753.

Prickly shrubs with white pith, V-shaped leaf-scars and three bundle scars.

Twigs green; climbing.....*R. setigera.*
Twigs red; a low shrub.....*R. Arkansana.*

R. SETIGERA, Michx Fl. 1803. Climbing Rose.

Twigs green; prickles flattened, recurved above an oval, white, well defined base; buds strongly divergent, oblong, obtuse, pink, scales two or three. Rare.

R. ARKANSANA, Porter, Fl. Colorado, 1874. Wild Rose.

A low shrub, usually not more than two feet high, with slightly glaucous twigs, armed with straight prickles from an elliptical base; leaf-scars very narrow, nearly half encircling the stem. Bud about 2 mm. above the leaf-scar, with three or four red or black scales, pubescent at tip. Common on prairie and open woods.

26 PYRUS, Tourn. Inst. 1700; Spec. 1753.

P. CORONARIA, L. Spec. 1753. Wild Crab-apple.

A small tree with red, glabrous twigs or in vigorous sprouts pubescent at apex, five-ranked, very narrow, open V-shaped leaf-scars, three bundle-scars and obsolete stipule-scars. Buds flattened, appressed, acutish;

scales several, glabrous but disclosing some pubescence at summit of bud. Along bluffs of Kansas river below Manhattan. *P. Iocusis*, Bailey, of eastern Kansas, is easily distinguished by its densely pubescent twigs.

27 CRATÆGUS, Tourn. Inst. 1700; L. Spec. 1753.

C. COCCINEA, L. Spec. 1753. Scarlet Haw.

A small tree with smooth and shining, dark red twigs, armed with slender, sharp pointed, slightly curved axillary thorns, one to two inches long and same color as twig. The base of the thorn is enlarged and bears a leaf-scar with bud on one side and a few fainter leaf-scars above. The arcuate or semi-oval leaf-scars are five-ranked with three bundle scars. Buds globose; scales several, rounded, glabrous. Rare in upland woods.

Var. MOLLIS, Torr & Gray, Fl. i, 1840.

Distinguished by the twigs being a duller brown and twigs and buds being usually sparsely villous, and by the buds being larger and the scales more open and spreading. Rare.

28 RIBES, L. Gen. 1737; Spec. 1753.

R. GRACILE, Michx. Fl. 1803. Wild Gooseberry.

A declining shrub with light-brown, glabrous, sulcate twigs, armed with brown triple spines below the leaf-scars, and on at least part of the old wood with scattered prickles. Leaf-scars five-ranked, narrow, U-shaped, almost hidden by the spines. Bundle-scars three. Buds conical, brownish, with numerous ovate scales, keeled at apex. Scales persistent at base of twig. Frequent in lowland woods.

29 CORNUS, Tourn. Inst. 1700; L. Spec. 1753.

Shrubs with hexagonal pith, red, pubescent twigs, crescent-shaped, opposite leaf-scars, with three bundle-scars. Terminal buds compressed, pointed; lateral, smaller, closely appressed. Scales two.

Branchlets bright red; pubescence soft.....*C. sericea*.
Branchlets gray; pubescence appresssed....*C. asperifolia*.

C. SERICEA, L. Mant. ii, 1771. Downy Dogwood.

Twigs and branchlets dark red, the former softly cinereous-pubescent, which hides the color. A small shrub three or four feet high, often with elongated stoloniferous branches. Infrequent in moist, rocky places.

C. ASPERIFOLIA, Michx. Fl. 1803. Gray Dogwood.

Twigs pale, dull red, the pubescence appressed and not hiding color of twig, the branchlets becoming gray-brown and finally gray. A shrub or sometimes almost a tree, very common in woods, thickets and along fences. This species is best distinguished from the previous by the color of the second and third year wood.

30 SAMBUCUS, Tourn. Inst. 1700; L. Spec. 1753.

S. CANADENSIS, L. Spec. 1753. Elderberry.

A shrub with large pith, light gray, glabrous, slightly angled twigs, large, triangular heart-shaped, opposite leaf-scars meeting around the stem and five bundle-scars. Terminal portion of twig dies back; lateral buds usually two, superposed, or if more, clustered; scales two or three pairs, glabrous, abruptly pointed. Not common.

31 SYMPHORICARPOS, Dill. Hort. Elth. 1732; Adans. Fam. 1763. *Symphoricarpus*, HBK. Nov. Gen. iii, 1818.

S. VULGARIS, Michx. Fl. 1803. Buck-bush.

A low shrub with extensive stolons, very slender, light brown, pubescent twigs, very small, triangular or shield-shaped, opposite leaf-scars connected by a ridge, and one bundle-scar. Frequently the base of the petiole persists as a withered stump without leaving a distinct scar. Buds very small, usually three collateral; scales two or three pairs, pubescent. Berries persistent. Common on prairie and upland woods.

32 CEPHALANTHUS, L. Gen. 1737; Spec. 1753.

C. OCCIDENTALIS, L. Spec. 1753. Button-bush.

A shrub with green or brown twigs, semicircular, opposite or whorled leaf-scars, central semicircular bundle-scars, stipule-scars or persistent stipules encircling the stem and very small, low buds, single or two superposed. Frequent in wet places.

33 FRAXINUS, Tourn. Inst. 1700; L. Spec. 1753.

F. VIRIDIS, Michx. f. Hist. Arb. Am. iii, 1813. Green Ash.

A small or medium tree with smooth, gray twigs, flattened at the nodes, semicircular or shield-shaped, opposite leaf-scars and central semicircular bundle-scars. Terminal buds obtuse, with two pairs of dark brown, felty pubescent scales; lateral single or two superposed. Frequent in lowland woods.

Var. PUBESCENS, Hitchcock, Cat. Ames, 1891.

Distinguished by its pubescent twigs. Rocky bluffs and thickets.

34 CATALPA, Scop. Introd. 1777.

C. SPECIOSA, Warder in Engelm. in Bot. Gaz. v. 1880. Catalpa.

A small tree, with smooth, gray twigs, opposite or whorled, circular or oval leaf scars with a concentric row of bundle-scars, and low buds with several, short, loose scales. Cultivated and escaped in places.

35 ULMUS, Tourn. Inst. 1700; L Spec. 1753.

Large trees with two ranked, oval, oblique leaf-scars, and unequal stipule-scars.

Twigs gray; buds densely pubescent..... *U. fulva.*
Twigs brown; buds glabrous ..... *U. Americana.*

U. FULVA, Michx. Fl. 1803. Red Elm.

Twigs scabrous or hirsutely pubescent, buds ovate, 5 to 6 mm. long, dark brown, divergent, scales two-ranked, four to six pairs; flower buds swelling considerably. Common in lowland woods.

U. AMERICANA, L. Spec. 1753. White Elm.

Twigs slender, glabrous, softly pubescent or even somewhat scabrous but not hispid; buds 3 to 4 mm. long, the lateral appressed, pointed; scales three or four pairs. Common.

36 CELTIS, Tourn. Inst. 1700; L. Spec 1753.

C. OCCIDENTALIS, L. Spec. 1753. Hackberry.

A small or medium tree with light, corky-ridged bark, white pith diaphragmed in the region of the nodes, dark gray-brown, glabrous or sparsely villous twigs, two-ranked, semi-oval or obtusely triangular, oblique leaf-scars, three bundle-scars and rather obscure stipule-scars. Terminal buds none; latteral flattened, appressed, pointed; scales about one pair, somewhat villous. Frequent in lowland woods.

37 IOXYLON, Raf. Am Monthly Mag 1817. *Maclura*, Nutt. Gen. 1818.

I. POMIFERUM, Rafin. l. c. *Maclura aurantiaca*, Nutt, l. c.

Osage Orange.

Twigs light yellowish-drab, glabrous, at least some of them armed with axillary thorns of the same color. Thorns simple bearing a bud at base. Leaf-scars five or eight-ranked, obtusely triangular, with a central bundle-scar. Buds low, depressed-globose. Scales few, brownish, ciliate-fringed. Introduced for hedges and escaped in places.

38 MORUS, Tourn. Inst. 1700; L. Spec. 1753.

M. RUBRA, L. Spec. 1753. Mulberry.

A small tree with light brown or greenish-drab, glabrous twigs, two-ranked, oval, oblique, concave leaf-scars, and unequal stipule-scars. Termial buds none; lateral appressed, pointed; scales several, two-ranked, rounded, glabrous. Infrequent in lowland woods.

39 PLATANUS, Tourn. Inst. 1700; L. Spec. 1753.

P. OCCIDENTALIS, L. Spec. 1753. Sycamore.

A large tree with smooth or slightly pubescent, light-brown, sulcate twigs, narrow, five-ranked leaf-scars, about half encircling the twig, five prominent bundle-scars, and encircling stipule-scars. Buds conical, smooth and shining as if sticky, scale one, entirely enclosing the bud. Frequent along streams. Bark white and smooth, scaling off in patches.

40 JUGLANS, L. Gen. 1737; Spec. 1753.

J. NIGRA, L. Spec. 1753. Black Walnut.

A large tree with diaphragmed pith, dark brown, clammy pubescent twigs; and three-lobed, five-ranked leaf-scars with three U-shaped bundle-scars. Terminal bud 10 mm. long or shorter; lateral two, superposed,

upper globose, 2 or 3 mm. long; scales downy. Common in lowland woods.

41 HICORIA, Rafin. Fl. Ludov. 1817. *Carya*, Nutt. Gen. 1818.

Bud scales two, valvate, yellow..... ....*H. minima*.
Bud scales several, brown.....*H. ovata*.

H. OVATA, (Mill.) Britt. Bull. Torr. Club, xv, 1888. *Juglans ovata*, Mill. Dict 1768. *Carya alba*, Nutt. l. c. 1818. Shellbark Hickory.

A large tree with rather large, dark chocolate, glabrous twigs, large, eight-ranked, circular to heart-shaped leaf-scars, three areas of bundle-scars and large terminal buds. Lateral buds single, small, obtuse, strongly divergent; terminal elliptical or lanceolate; scales acuminate, the inner pubescent above. Along the bluffs below Manhattan, on the south side of the Kansas river.

H. MINIMA, (Marsh.) Britt. l. c. *Juglans alba minima*, Marsh. Arb. 1785. *Carya amara*, Nutt. Gen. 1818. Pignut Hickory.

A small tree with yellowish-gray, smooth twigs, sprinkled with waxy atoms, especially above, as are the bud scales; five-ranked, heart-shaped leaf-scars, bundle-scars aggregated in about three areas and narrow, acute, curved terminal buds with waxy-yellow scales. Lateral buds two or three superposed, the upper frequently long stalked. Common.

42 CORYLUS, Tourn. Inst. 1700; L. Spec. 1753.

C. AMERICANA, Walt. Fl. 1788. Hazel-nut.

A shrub with light brown or yellowish-drab, pubescent or glabrescent twigs, two-ranked, crescent or oval leaf-scars, scattered bundle-scars and conspicuous stipule-scars. Buds flattened, rounded, scales several, rounded, upper pubescent. Next year's catkins conspicuous. Said to occur ten miles northeast of Manhattan (S. C. Mason.)

43 OSTRYA, Mich. Nov. Gen. 1722; Scop. Carn. ii. 1772.

O. VIRGINIANA, (Mill.) Koch, Dendr. ii. 2. 1869 73. *Carpinus Virginiana*, Mill. Dict. 1768. Iron-wood.

A small tree with twisted bark, brown or gray, softly pubescent or glabrescent twigs, small semi-oval or arcuate, slightly oblique, two-ranked leaf-scars, three bundle-scars and unequal stipule-scars. Buds conical, pointed, divergent, 5 or 6 mm. long; scales several, pubescent. Next year's catkins usually present. Frequent in upland woods.

44 QUERCUS, Tourn. Inst. 1700; L. Spec. 1753.

Pith five-angled; twigs five-ridged from the angles of the semicircular, five-ranked leaf-scars; bundle-scars several, scattered; stipule-scars small, often inconspicuous; upper lateral buds clustered at apex of twig.

Buds rounded, about as high as wide.

Glabrous..... .. ....*Q. prinoides*.
Pubescent .....*Q. macrocarpa*.

Buds pointed, about twice as high as wide.
Twigs glabrous and buds nearly so.....*Q. rubra.*
Buds pubescent.
Twigs pubescent.....*Q. nigra.*
Twigs glabrous.....*Q. tinctoria.*

Q. MACROCARPA, Michx. Hist. Chenes. 1801. Bur Oak.
A large tree with rough, light colored bark, branchlets, and often the light brown, glabrous or minutely pubescent twigs corky ridged, and frequently persistent stipules. Leaf-scars sometimes triangular-heart-shaped. Common.

Q. PRINOIDES, Willd. N. Schr. Ges. Berlin, iii, 1803; Spec. iv. 1805. *Q. Muhlenbergii*, Engelm. Trans. St. L. Acad. iii, 1877. Chinquapin Oak.
A shrub or tree with light, scaly bark, red or light brown glabrous twigs and terminal buds not more than 4 mm. long. Very common in upland woods.

Q. RUBRA, L. Spec. 1753. Red Oak.
A large tree with dark, close and quite smooth bark, red-brown or gray-brown twigs and terminal buds 5 or 6 mm. long with close scales. Frequent in upland woods.

Q TINCTORIA, Bartram, Trav. Ed. 2, 1794. Black Oak.
A large tree with close, rough, dark bark, brown, glabrous twigs and distinctly five-sided buds about 8 mm. long. Frequent in upland wood.

Q. NIGRA, L. Spec. 1753. Black Jack.
A medium tree with close, rough, dark bark, red-brown or gray-brown. pubescent twigs and buds much as in Q. tinctoria. The twigs on vigorous shoots are frequently glabrescent. Common in upland woods.

45 SALIX, Tourn. Inst. 1700; L. Spec. 1753.

Leaf-scars five-ranked; bundle-scars three: stipule-scars present; buds appressed, pointed; scale one.
Twigs and buds soft-pubescent; leaf-scars U-shaped.
.....*S. cordata.*
Twigs and buds glabrous or appressed-pubescent: leaf-scars crescent or arcuate.....*S. longifolia.*
Twigs and buds glabrous; leaf-scars U-shaped..*S amygdaloides.*

S AMYGDALOIDES, (Anders.) Anders. Ofv. Vet. Akad. Forh. 1858. *S. nigra*, var. *amygdaloides*, Anders. Kœnig. sven. Akad. Handl. vi.
Twigs light yellowish-brown: A low or tall tree common in moist places.

S. LONGIFOLIA, Muhl. in N. Schr. Ges. Nat. Fr. Berlin, iv. 1802. Sandbar Willow.
A shrub with slender, red-brown twigs and obtuse buds not more than 4 mm. in length. Common in moist places

S. CORDATA, Muhl. l. c. Downy Willow.

A large straggling shrub with camparatively large cinereous pubescent or glabrescent twigs and rectangular, U-shaped leaf-scars, the latter sometimes eight-ranked. Stipule-scars conspicuous, oval with one to three bundle-scars. Flower buds as much as 10 mm. long. Along rocky streamlets, not common.

46 POPULUS, Tourn. Inst. 1700; L. Spec. 1753.

P. MONILIFERA, Ait. Hort. Kew. 1789. Cottonwood.

A large tree with five-angled pith, light yellowish-drab, smooth and glossy, cylindrical or on vigorous shoots, angled twigs, five-ranked, elliptical, arcuate or shield-shaped leaf-scars with three bundle-scars and narrow stipule-scars. Terminal bud large, conical, curved, with a few brownish, ovate, smooth and shining, gummy scales. The lateral flower buds are very large, as much as 2 cm long. Frequent in lowland woods.

47 SMILAX, Tourn. Inst. 1700; L. Spec. 1753.

S. HISPIDA, Muhl. Cat. Ed. 2, 1818. Greenbrier.

An endogenous vine climbing by stipular tendrils. Twigs dark green, glabrous, at least the lower part armed with straight, polished, dark brown prickles. The base of the petiole with the two tendrils attached, persists after the leaf has fallen, leaving no distinct scar. Buds single, horizontally divergent, conical, two-ranked, showing but one scale. Common in low woods.

48 JUNIPERUS, Tourn. Inst. 1700; L. Spec 1753.

J. VIRGINIANA, L. Spec. 1753. Red Cedar.

Evergreen trees with two kinds of leaves, awl-shaped and divergent in whorls of three, and opposite, appressed, scale-like, with a gland on the back. Rocky bluffs.

THE OPENING OF THE BUDS OF SOME WOODY PLANTS.

A. S. Hitchcock.

Some notes were taken during the spring of 1892 on the opening buds of our native shrubs and trees. The drawings of the buds and leaves are mostly natural size and were made as the leaves appeared. The nomenclature and arrangement is that of Gray's Manual.

I have been unable to find any literature bearing directly upon the subject. Vernation is usually given in monographs and systematic notes, as that of *Quercus* by Engelmann, "About the Oaks of the United States," Trans. St. Louis Acad. Sci. iii., p. 375. The following are some of the references treating of bud-scales, stipules, and glands on young leaves: Goebel, Beiträge zur Morphologie und Physiologie des Blattes, 1. Die Niederblätter (Bot. Zeit. xxx, p. 753, 769, 785, 801, 817, 833; Just, viii. 1, p. 114); Schumann, Anatomische Studien über die Knospenschuppen von Coniferen und Dicotylen Holzgewächsen (Bibl. Botan. Heft. 15, 1889; Bot. Centr. xlii, 1890, No. 22, p. 275; Just, xvii. 1, p. 673); Mikosch, Beiträge zur Anatomie und Morphologie der Knospendecken Dicotylen Holzgewächse (Sietzungsb. d. kais. Akad. Wiss. Wien, B. 74, 1 Abth. 1876; Just iv, p. 453); Areschong, Beiträge zur Biologie der Holzgewächse (Lund, 1877; Just, v, p. 358); Velenovsky, Ueber die Achselsprosse einiger Smilax Arten (Flora, 68, p. 2–4; Just, xiii. 1, p. 612); C. Hilburg's Dissertation: Ueber den Bau und die Funktion der Nebenblätter, mit Zusätzen von F. Hildebrand (Flora, 1878, No. 11; Just, vi. 1, p. 105); Clos, Stipules considerées au point de vue morphologique (Bull. Soc. Bot. France, 2d Ser. i, No. 1, 1879, p. 151; Just. vii. 1, p. 69.) Reinke, Ueber die Funktion der Blattzähne und die Morphologische Werthigkeit einiger Laubblattnectarien

(Bot. Zeit. 1874, p. 47; Just, ii, p. 548). There is considerable literature relating to twigs but this is outside the subject treated in this paper.

Asimina triloba, Dunal. Buds naked, protected by the two outer, boat-shaped, dark ferruginous, silky leaves which increase but slightly in size as the bud opens, and never assume the typical shape. Inner leaves conspicuously 2-ranked, each successively inclosing the remainder of the bud. The flower buds are lateral, globose. May 3d.

Menispermum Canadense, L. Scales about 5, rounded to elliptical, smooth. Internodes above these elongating; young stem and leaves gray-villous. First leaf undeveloped, several cleft at apex, others normal. Vernation straight. Leaf-scars circular, concave. Buds 2 or 3 superposed, the upper just above the scar, the others bursting through a V-shaped crack in the leaf scar. May 6th.

Tilia Americana, L. Bud scales 2, the inner larger. Leaves well developed, each covered by its two large stipular scales. Vernation conduplicate. Apr. 30th.

Xanthoxylum Americanum, Mill. Buds low; scales two pairs, the outer pair short and dark brown, the bases of the scales joined by a circle of reddish brown fuzz; inner pair longer and their tips reddish brown with a similar pubescence. First leaf usually abnormal or abortive with two or three leaflets of unequal development, the later leaves successively better developed. Vernation of leaflets revolute, the leaf wrapping around the central cone. Apr. 29th.

Celastrus scandens, L. Buds perpendicular to axis of plant. Scales numerous, the two outer gray, like the bark, with a ridge on the back at the apex; the inner with brown tips and green bases gradually passing into leaves. Vernation involute. Apr. 29th.

Euonymus atropurpureus, Jacq. Scales opposite, two pairs. First pair of leaves small and deciduous. Vernation involute. Apr. 20th.

Ceanothus Americanus, L. Scales two to four, being rudimentary leaves with the stipules broadened and adnate to the much reduced blade. First leaf typical in form with two narrow hairy stipules. Vernation involute. Apr. 23d.

Vitis riparia, Mx. Buds rupturing the bark sometimes two superposed. Each leaf protected by its two hairy stipular scales. Vernation straight but inclosing the remainder of the bud. Apr. 1st.

Cissus Ampelopsis, Pers. Much as in *V. riparia*, but stipules and young leaves thinner and nearly smooth. May 3d.

Ampelopsis quinquefolia, Mx. Buds one to three, rupturing the epidermis. Scales four. Leaves enclosed by their enlarged stipules. First leaf perfect, 5-divided, lobes conduplicate, arranged almost in a circle. Apr. 30th.

Æsculus arguta, Buckley. Buds swelling considerably before opening. Scales opposite, six to ten pairs, the inner successively larger and thinner, but no transition to leaves. First leaves with five leaflets. Leaflets involute. Apr. 9th.

Acer dasycarpum, Ehrh. Scales opposite, four pairs; the inner pairs ciliate-margined. Vernation plicate. Apr. 21st.

Negundo aceroides, Moench. One of the first of the woody plants to show signs of pushing out leaves in spring. Scales opposite, four pairs. First pair with a roundish point; second pair about twice as long, apiculate; third pair about twice as long as the second, roundish at apex; fourth pair somewhat longer than the third, three-lobed at apex. First pair of leaves with three leaflets. Leaflets conduplicate, side by side, the margins of opposite leaves touching. Apr. 8th.

Staphylea trifolia, L. Scales opposite, two pairs. First set of stipules more than half as long as leaf, succeeding ones shorter. Leaflets involute, side by side. Apr. 22d.

Rhus Toxicodendron, L. Buds naked or occasionally with one or two scales. Leaflets conduplicate. May 5th.

Rhus Canadensis, Marsh. Buds naked, the first leaf becoming normal in size and shape. As all the internodes elongate there is but one ring separating the growth of successive years. (*R. glabra* also has naked buds, with the first leaves very felty-pubescent.) Leaves plicate. May 5th.

Amorpha fruticosa, L. Buds two, superposed, either or both developing. Scales several. First leaf pinnate, sometimes imperfect. Stipules lanceolate, acuminate. Leaflets conduplicate, side by side. May 6th.

Cercis Canadensis, L. Scales two. First leaf well-formed,

conduplicate, at first somewhat inflexed. Stipules prominent, outside of their leaf. May 2d.

Gymnocladus Canadensis, Lam. Buds at first scarcely raised above the bark; superposed, two or three, one or sometimes any two of the three developing. Scales three, enlarging greatly. First leaves with narrow stipules, pinnate below, twice pinnate above, the pinnæ ending in a bristle. Leaflets and pinnæ conduplicate. May 6th.

Gleditschia triacanthos, L. Buds superposed, usually two (one to three) both developing. Scales several, brownish, thin and soon deciduous. First leaf pinnate with several leaflets, downy beneath, smooth above; later ones twice pinnate. Stipules minute; petiole jointed with stem. Leaflets conduplicate as is the whole leaf, thus bringing the edge against the bud. May 5th.

Prunus Americana, Marsh. Scales numerous, the inner gradually increasing in length and showing a transition to the leaves. The first leaf has a pair of slender elongated stipules. Young leaves enclosing the flattened bud, the edges not overlapping, under surface silky pubescent and reticulately veined. Margin of leaf ciliate, serrations sharp and not glandular. Apr. 21st.

Prunus Chicasa, Mx. Scales as in *P. Americana*. Leaves smooth and shining, the serrations with a conspicuous gland. Young leaves enwrapping the terete bud, the edges considerable overlapping. May 4th.

Rubus occidentalis, L. Scales about six, first two rounded, with buds in their axils; next two, three pointed, the buds in their axils having well formed leaves nearly as long as scales; the inner scales are three-cleft, the lateral lobes apparently corresponding to stipules. Vernation plicate. Apr. 20th.

Rubus villosus, Ait. Scales about five, outer hard and red, pointed; inner gradually longer, rounded, hairy; fourth, 3-cleft; fifth, more deeply cleft; sixth, a small leaf. Vernation plicate. Apr. 29th.

Rosa Arkansana, Porter. Scales about seven. Outer ovate and pointed, inner becoming rounded and erose-dentate, while the innermost form a transition to leaves. Leaflets conduplicate, side by side. Apr. 20th.

Cratægus coccinea, L. Scales numerous, the inner showing a transition to leaves. The inner scales and stipules glandular ciliate, the latter being nearly as large as their leaves. Vernation conduplicate-plicate. May 14th.

Ribes gracile, Mx. Scales numerous, all but innermost scarcely enlarging. First leaf nearly normal in appearance. Vernation plicate. Apr. 11th.

Cornus asperifolia, Mx. Scales one pair, opposite, developing a small blade at the opening of the bud. Vernation slightly involute. Apr. 9th.

Sambucus Canadensis, L. Usually four buds in an axil, the central being the strongest. Scales opposite, about four pairs, showing transition to leaves. Leaflets involute, side by side. Apr. 20th.

Symphoricarpos vulgaris, Mx. Scales opposite, three pairs, increasing but little during the opening of the bud. Young leaves oval-oblong. Vernation involute. Apr. 9th.

Fraxinus viridis, Mx. f. Buds usually two, superposed. Scales opposite, one pair or if two pairs the inner hidden before the expansion of the bud. Leaflets conduplicate, side by side. Apr. 22d.

Ulmus fulva, Mx. Scales two-ranked, three or four pairs; outer dark brown and somewhat pubescent; inner silky-ferruginous above. First leaf very minute with two large stipules. Following leaves perfect, each covered by one large stipule and covering the other. Vernation conduplicate. Apr. 30th.

Ulmus Americana, L. Scales two-ranked, first three pairs empty, scarcely enlarging and soon falling off. Within these are about three pairs of stipular scales, without leaves, that is, the scales are in pairs on each side of the bud and attached at base. The next two pairs of stipules have a minute and abortive leaf between them. The inner leaves increase in size, and are imbricated with their stipules as in *U. fulva*. Vernation conduplicate. May 4th.

Celtis occidentalis, L. Scales two-ranked, three pairs. Young flowering branches bear flowers below and leaves above. Leaf branches bear above the scales two or three enlarged early deciduous stipules. First leaves normal; each enclosing its two stipules. Vernation straight. Apr. 23d.

Morus rubra, L. Scales two-ranked, six or seven. First leaf usually ovate, sometimes slightly lobed; inner ones lobed or entire. Vernation and arrangement of narrow stipules as in *Celtis occidentalis*. May 2d.

Platanus occidentalis, L. Bud conical; scales two, each covering the bud, the outer smooth, the inner covered by a gummy secretion, and usually having a bud in its axil. First leaf well formed, its stipule covering the remainder of the bud. Vernation revolute. May 2d.

Juglans nigra, L. Scales two to four, the outer oblong and obtuse, the inner increasing in length and passing by a series of clefts and lobes into a few-divided leaf. Flower buds from the lower part of the previous year's growth, usually two catkins superposed, each bearing two or three small scales at base. Leaflets conduplicate, the edges toward the rhachis and the sides pressed against the bud. May 4th.

Carya amara, Nutt. Scales two, valvate, covered with yellowish resinous dots, usually elongating and developing a few lobes at the apex. The first leaf, and sometimes the second also, is imperfectly developed. Leaflets conduplicate, side by side as shown in the drawing. May 3d.

Ostrya Virginica, Willd. Scales several, the first two are empty, the next pair are stipular with its leaf reduced to a mere appendage. The third pair is attached to a normal leaf. Vernation straight but the leaf clasping the bud. Apr. 22d.

Quercus macrocarpa, Mx. Scales stipular as in *Q. tinctoria*. The gradation is rather gradual from large stipules to narrow and from small leaves to large. Vernation conduplicate but the bend to one side of the midrib (Fig. 107). May 3d.

Quercus Muhlenbergii, Engelm. Scales numerous, five-ranked, much as in *Q. tinctoria*, but the change from broad scales to narrow ones at the base of the perfect leaves is more abrupt; thus the leaves appear to come from the top of the bud. Vernation conduplicate. May 3d.

Quercus tinctoria, Bartram. Scales very numerous, five-ranked, lower short, upper increasing in length. Several at the base are empty, above these each pair has a minute leaf in the angle between and inside, thus being stipular. The inner

leaves are successively larger and the stipules narrower. Vernation straight but the leaves are considerably corrugated. The five-ranked stipules correspond to the $\frac{2}{5}$ phyllotoxy. Young leaves very silky, purplish or pinkish. May 3d.

Salix amygdaloides, Anders. Scales two, usually splitting at the apex, the inner thin and membranous. Stipules hairy, vernation straight. Apr. 21st.

Salix cordata, Muhl. Bud is covered by one outer scale, on the inner side of which is attached the two stipular membranes which encircle the opening leaves at their base. Vernation convolute. Apr. 21st.

Populus monilifera, Ait. Scales mostly four, shining and usually gummy, outer short and rounded, inner becoming longer and more acute. First leaf normal, with two narrow stipules, purplish tinged. Vernation involute. Apr. 25th.

Smilax hispida, Muhl. Scales two, both next to the stem, that is, in the axil of the young branch and probably homologous with the sheathing stipules. Leaves involute, the first leaf bearing stipular tendrils. May 5th.

EXPLANATION OF PLATES.

1. *Asimina triloba.* Swelling lateral bud. 2. Terminal bud further advanced. 3. Cross section of bud with the two outer leaves removed.
4. *Menispermum Canadense.* Three superposed buds, the upper having developed into a branch. 5. Three buds, side view, the two upper having developed. 6. Swelling bud. 7. Young branch. 8. One of the first leaves. 9. Leaf-scar and bud before swelling.
10. *Tilia Americana.* Swelling bud. 11. Bud further advanced.
12. *Xanthoxylum Americanum.* Lateral bud developing. 13. Terminal bud further advanced.
14. *Celastrus scandens.* Lateral bud developing.
15. *Euonymus atropurpureus.* Two young lateral branches.
16. *Ceanothus Americanus.* An outer scale. 17. An inner scale. 18. A young leaf.
19. *Vitis riparia.* Swelling bud. 20. Young branch with bud below.
21. *Cissus Ampelopsis.* Young branch.
22. *Ampelopsis quinquefolia.* Swelling bud. 23. Young branch with bud below.
24. *Aesculus arguta.* Developing terminal bud.
25. *Acer dasycarpum.* Developing terminal bud.
26. *Negundo aceroides.* Developing terminal bud. 27-30. Scales showing transition to, 31. First leaf.
32. *Staphylea trifolia.* Two lateral buds developing. 33. Bud further developed, inner pair of scales removed; side view, showing two young leaves with their stipules. 34. Same, showing back of leaf.
35-36. *Rhus Toxicodendron.* Buds in different stages of development.
37. *Rhus Canadensis.* Swelling bud. 38. Developing bud. 39. Young leaf.
40. *Amorpha fruticosa.* Developing bud.
41. *Cercis Canadensis.* Developing bud. 42. Young branch.
43. *Gymnocladus Canadensis.* Swelling bud. 44. Bud further developed. 45. Young leaf.
46. *Gleditschia triacanthos.* Base of petiole of young leaf showing minute stipule. 47. Developing bud, leaves cut off above the base. 48. Young leaf.
49. *Prunus Chicasa.* Developing bud. 50-52. Young leaves. 53. Glandular serration $\times$ 125.
54. *Prunus Americana.* Developing bud. 55. Scale. 56. Inner scale or young leaf. 57. Stipule of developed leaf. 58. Serration of leaf $\times$ 125.
59. *Rubus occidentalis.* Young leaf. 60. Developing bud. 61-63. Scales.
64. *Rubus villosus.* Developing bud. 65. Young leaf. 66-68. Scales and outer leaf.
69. *Rosa Arkansana.* Developing bud. 70. Young leaf.
71. *Cratægus coccinea.* Young branch, some of the scales at base having fallen off. 72-73. Two forms of stipules on young leaves.
74. *Ribes gracile.* Developing bud.

75. *Cornus asperifolia.* Terminal bud developing. 76. Outer scale or leaf.
77. *Sambucus Canadensis.* Supernumerary buds, the uppermost developing. 78-79. Scales.
80. *Symphoricarpos vulgaris.* Developing bud.
81. *Fraxinus viridis.* Terminal bud with one pair of scales developing. 82. Bud with two pairs of scales.
84. *Ulmus fulva.* Swelling bud. 83. Bud further developed. 85. First pair of scale-like stipules.
86. *Ulmus Americana.* Swelling bud. 87. Young leaf and stipules.
88. *Celtis occidentalis.* Two young flowering branches. 89. Young leaf branch with one row of scales removed.
90. *Morus rubra.* Developing bud. 91-93. Young leaves. 94. Stipule.
95. *Platanus occidentalis.* Developing bud. 96-97. Scales. 98. Stipules of young leaf, partially unfolded.
99. *Juglans nigra.* Two flower buds with the catkins removed, showing two or three scales at base. 100. Developing leaf bud. 101. Scales and young leaf.
102-103. *Carya amara.* Buds developing.
104. *Ostrya Virginica.* Developing bud, with one leaf removed. 105 Swelling bud.
106. *Quercus macrocarpa.* Developing bud. 107. Cross section of leaf showing vernation. 108. Part of young branch showing young leaf and stipules. 109-110. Young leaves.
111. *Quercus Muhlenbergii.* Developing bud. 112. Young leaf.
113. *Quercus tinctoria.* Swelling bud. 114. Bud with outer scales removed, showing young leaf. 115. Young leaf with stipules.
116. *Salix amygdaloides.* Developing bud.
117. *Salix cordata.* Developing bud. 118. Outer scale with inner thin one attached at base, two views.
119. *Populus monilifera.* Developing bud. 120. Scales and young leaf.
121. *Smilax hispida.* Young branch. 122. Young leaf with its stipules.

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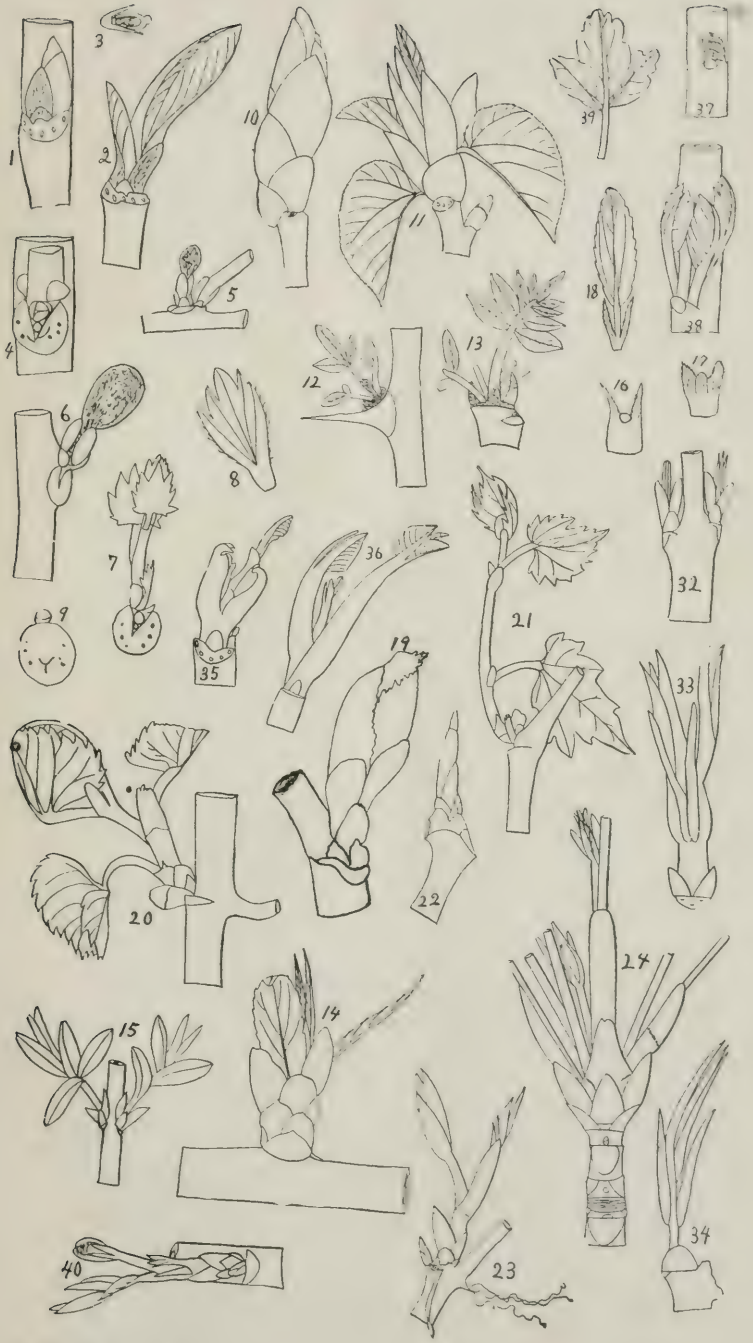

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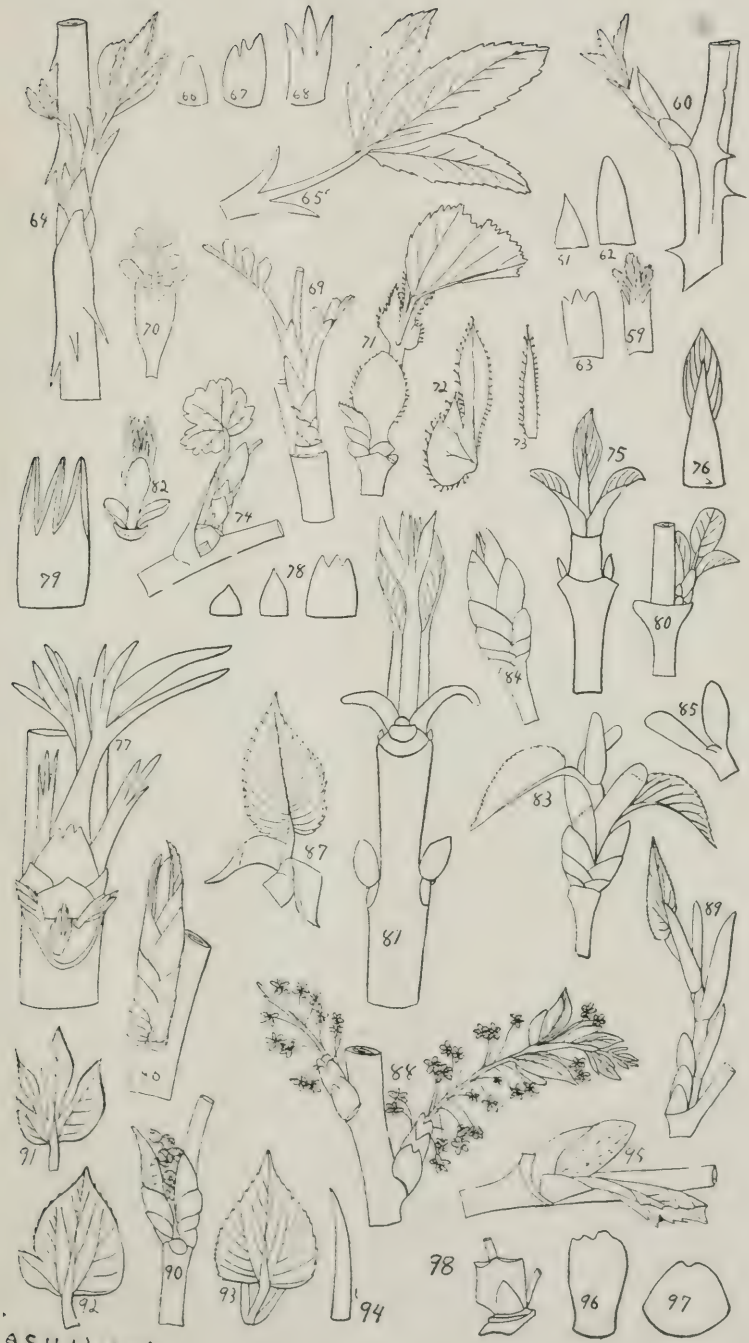
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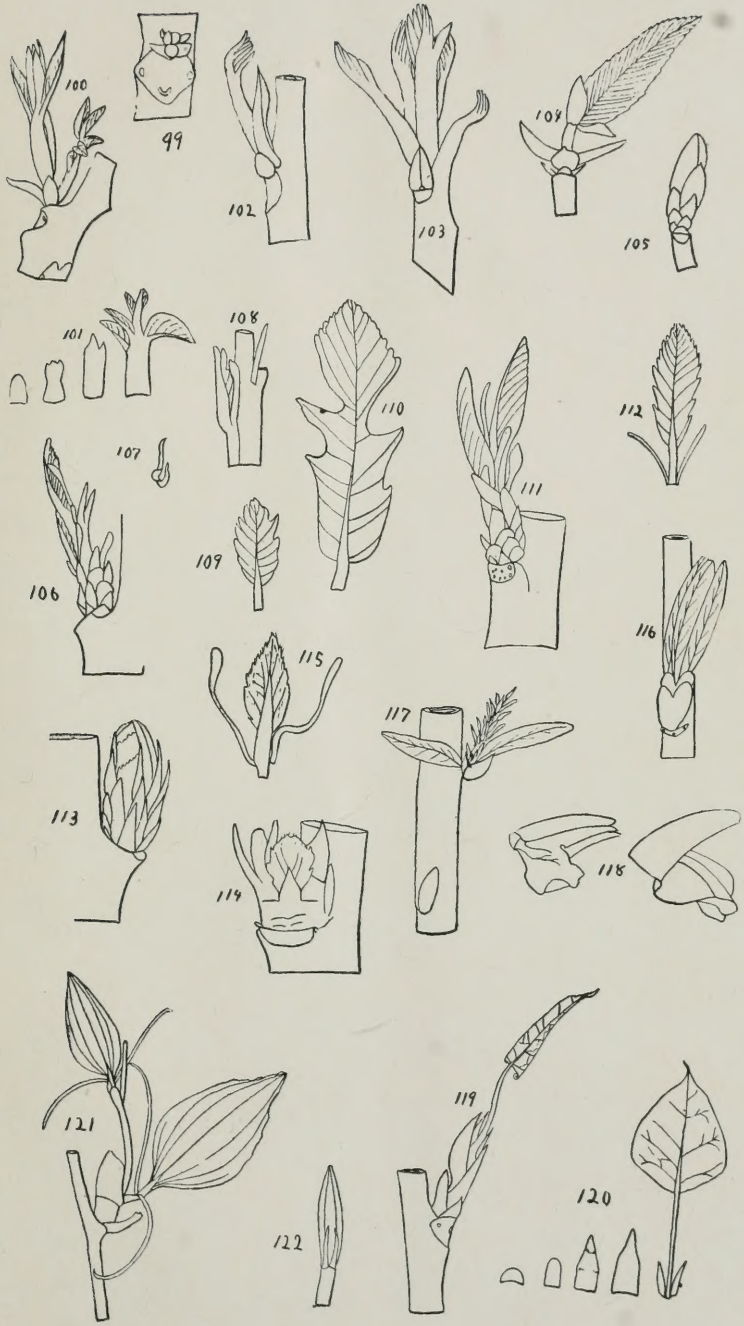
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