The Woody Flora of the Iowa State University Campus

by

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CHAPTER I. INTRODUCTION

Plant identification courses at Iowa State University are currently offered in botany, horticulture, and landscape architecture departments. Plants to be studied are usually selected from those found growing on the campus. Since there is no inventory available of all the trees, shrubs, and woody vines in existence on the campus, studies are often restricted to the more common or well known plants. In addition to the problem of no complete inventory there is also some confusion over the correct binomials for several members of the campus woody flora.

Statement of the Problem

The purpose of this study was to conduct a complete inventory of the woody flora of the Iowa State University Campus, provide a simple, convenient means of identifying the various species, and to help promote accuracy in botanical nomenclature in many of the plant identification courses offered at Iowa State University.

Review of Previous Work

In 1962 Eugene Brady submitted a thesis entitled "A Partial Woody Flora of the Iowa State University Campus." Initially Brady attempted to conduct a complete plant inventory but time limitations restricted his investigation to a partial study of the campus woody flora. The investigation resulted in the identification of forty families and 199 species of which ten were listed as tentative identifications. Keys were constructed for the identification of members of the campus flora included in the partial inventory. The keys, developed for the families,

genera, and species, were based primarily on floral characters.

"The Herbaceous Flora of the Iowa State University Campus" was published in 1960 as a thesis by Quency A. Wemple. Included is a system for plant location on the Iowa State University Campus. Wemple divided a map of the campus into ten thousand square yard quadrants, then assigned letters to the horizontal scale and numbers to the vertical scale. Plants were located in their respective quadrants with reference made to some nearby building or other permanent marker. A revised version of Wemple's method was employed in the location of species in this investigation.

"The Iowa Flora", a checklist by R. I. Cratty, was written in 1933. This study was used to provide some idea of chance seedlings that might be found on the campus.

Importance of the Study

Inventory of the woody flora

The campus flora of Iowa State University is constantly changing. The construction of new buildings and sidewalks often results in the removal of some members of the woody flora. The sometimes harsh Iowa climate, old age, disease, and other plant pests also cause the elimination of some species from the woody flora. New members are constantly added to the campus flora in the form of new plantings and chance seedlings. The complete, up-to-date inventory of the woody flora of the Iowa State University Campus provided in this study is designed to serve as a teaching aid for instructors of many of the plant identification courses offered at the university.

Vegetative key to the woody flora

Currently there are no plant manuals available that include a key to all members of the woody flora of the Iowa State University Campus. Most of the keys provided in the various plant manuals contain many technical terms and are based primarily on floral and fruit characters. This can create some difficulties since not all members of the campus woody flora can be found in flower and fruit. The fruiting and flowering periods of many plants are often very brief and seldom occur simultaneously. Also, as a result of environment or selection, several of the plants found on campus do not flower or produce fruit. In order to avoid the difficulties associated with keys based on reproductive characters, a key that is based solely on vegetative characters was constructed. The key is designed to enable one with no botanical training to identify any member of the woody flora to the species level, and in cases with significant morphological variation, to the subspecies level. Every effort has been made to minimize the technical jargon frequently used in keys. Certain more or less technical terms, however, are essential to accurate description. Those used are explained in the glossary following the key.

Herbarium specimens

To aid in identification and promote accuracy in nomenclature, herbarium specimens were collected and prepared. The specimens were placed in the Iowa State University Herbarium and are available for study. Whenever possible specimens were collected in fruit and flower in addition to foliage. Specimens were collected of all members of the woody flora and identified. The exact location of each

specimen is given on the herbarium label to further aid in identification.

Slides

To serve both as an identification and teaching aid, photographs were taken of all the species and developed into color slides. These included overall photographs of the plants in winter and summer condition. Close-ups were taken of the leaves, flowers, fruits, and bark whenever possible. Photographs depicting additional plant parts significant to identification were included in the slide series for some species. A metric ruler was included in most of the close-ups to provide some idea of the relative size of the plant parts photographed. A black felt cloth was usually used as a background. The slides were labeled with the name of the plant photographed and then arranged in alphabetical order according to genera in notebooks designed for that purpose. These have been placed on file at the Horticulture department at Iowa State University and are available for study and use as teaching aids for plant identification classes.

Botanical accuracy

Recent changes in plant nomenclature have affected the binomials of several members of the Iowa State University woody flora. These changes coupled with the use of common names can create confusion in both the identity and nomenclature of some individuals. Problems associated with the use of common names have been discussed at length (Porter, 1967; Solymosy, 1964) and will not be dealt with in this study. However, it is suggested that in order to avoid some confusion, instructors require students to learn at least the generic name for each plant studied. This

would not be very difficult. The author has observed that students learn botanical names as easily as common names. Also, in many cases the common names are synonymous with the generic names. Examples of these include: Viburnum, Forsythia, Ginkgo, etc.

CHAPTER II. SUMMARY OF FIELD WORK

Specimens were collected from all members of the woody flora to facilitate identification and to serve as permanent records. Specimens were collected from March 1977 extending to May 1978. Photographs of the specimens were taken simultaneously.

Location of Area of Study

The central campus of Iowa State University is included with the area of Range 24 W, Township 83 N. Certain arbitrary boundaries were used to delimit the central campus. These included Lincoln Way (Highway 30) as the southern boundary. The railroad tracks located immediately north of the campus were used as the northern boundary. A line projected straight north along Wallace Road extending to the railroad tracks, including the grounds surrounding Maple-Willow-Larch Halls, served as the eastern boundary. The western boundary was delimited by a straight line projected north along Hyland Avenue continuing to the railroad tracks.

Materials and Methods

Equipment

The collection, preparation, and identification of herbarium specimens required no special equipment other than that normally associated with the study of taxonomy. These included: several drying presses, drying heater, fumigator, field notebook, garden clippers, binocular microscope, and the keys available and necessary to identify the species.

The materials used in photographing the species included: 35mm camera, tripod, color film, black felt cloth, metric ruler, and record book.

Methods of location and identification

Identification of all members of the woody flora was not always easy. Currently there exists some confusion over the correct binomials for several of the plants found on campus. To eliminate some of the confusion associated with ornamental plant taxonomy, the author's name for each species has been placed in abbreviated form after each species listed in the inventory.

In many cases accurate identification depends on flower and fruit characters. Since several plants on campus do not flower or produce fruit, obviously ideal specimens could not be collected from all of the species. Planting records, maps, class lists from identification classes, "The Iowa Flora" checklist, and personal communications were used to obtain a survey of the probable species on campus. Each species was carefully studied with the aid of a binocular microscope. Descriptions of species from plant manuals along with herbarium specimens contained in the Iowa State University Herbarium were used to identify accurately the specimens collected. In a few instances where positive identification could not be accomplished by the author, advice was sought from several members of the Iowa State University Faculty.

To facilitate location of the various species, a map of the campus was secured. The map was divided into ten thousand square yard quadrats which were lettered on the horizontal scale and numbered on the vertical scale. Plants were located in their respective quadrats with some reference made to a building or other permanent marker. This method of plant

location is adapted from the method employed by Wemple in his study of the herbaceous flora of the Iowa State University Campus.

CHAPTER III. THE WOODY FLORA

Most individuals with little or no botanical training are reluctant to attempt identification of plants through the use of keys designed for that purpose. The technical terms usually found in keys are often discouraging to the beginner. To avoid this problem most of the technical terms often used are not employed in this key. Another problem is that in some keys, knowledge of fruit, flower, and leaf characters is necessary for identification. Since only a few plants can be found in this condition at a given time, there is often some difficulty associated with the use of such keys. To eliminate this problem the following key is based solely on vegetative characters; primarily leaf, twig, and bark morphology. These characters were selected simply because they are usually available for study for longer periods of time than fruit or flowers.

The following key was constructed from information obtained from personal observations made from herbarium specimens and plants in the field, descriptions given in several plant manuals and floras, and keys found in these publications. The key is designed to identify all members of the woody flora to the species level. In several instances plants can be identified to subspecies levels. These represent only morphological variance from the species in vegetative characters and not floral or fruit characters. Furthermore, the key is designed to identify only members of the woody flora found on the Iowa State University Campus and has little application outside of this area.

Vegetative Key to the Species

1a. Leaves needle-like or scale-like..... 2

1b. Leaves not needle-like or scale-like..... 28

2a. Leaves alternate or borne in dense clusters..... 3

2b. Leaves opposite or in whorls of 3..... 23

3a. Leaves all alternate..... 4

3b. Leaves, or some of them, borne in dense clusters, needle-like..... 12

4a. Leaves sessile..... 5

4b. Leaves petioled..... 9

5a. Leaves borne on small projections from the stem, ... 6

5b. Leaves not borne on small projections from the stem, ... 8

6a. Leaves stiff, bristle-pointed, bluish; buds with brownish-yellow usually reflexed scales..... *Picea pungens* var. *glauca*

6b. Leaves not bristle-pointed, green; bud scales not reflexed..... 7

7a. Leaves yellow-green, tending to be crowded on the upper surface of twigs, strong disagreeable odor when crushed..... *Picea glauca*

7b. Leaves dark green, not crowded on upper surface of twigs, no strong disagreeable odor when crushed..... *Picea abies*

8a. Leaves 4-6 cm long, bluish-green..... *Abies concolor*

8b. Leaves 1-1.5 cm long, yellowish-green..... *Taxodium distichum*

9a. Leaves borne on small projections from the twig, 2 white lines beneath..... *Tsuga canadensis*

9b. Leaves not borne on small projections from the twig, not striped beneath..... 10

10a. Leaves bluish-green, needle-like..... Pseudotsuga menziesii

10b. Leaves dark green above, light green beneath, linear-lanceolate..... 11

11a. Mature branchlets olive-green; scales of winter buds obtuse..... Taxus x media

11b. Mature branchlets reddish-brown; scales of winter buds acute, keeled..... Taxus cuspidata

12a. Needles deciduous, many in each cluster..... 13

12b. Needles persistent, 2-5 in each cluster..... 14

13a. Needles 1-2.5 cm long..... Larix laricina

13b. Needles 2.5-3 cm long..... Larix decidua

14a. Needles 5 per cluster..... 15

14b. Needles 2-3 per cluster..... 16

15a. Branches stout, extremely flexible; needles curved, stout and rigid, not scratchy..... Pinus flexilis

15b. Branches slender, not extremely flexible; needles straight, slender and soft, scratchy near the tip..... Pinus strobus

16a. Needles 2 per cluster..... 17

16b. Needles 3 per cluster..... 21

17a. Needles longer than 10 cm..... 18

17b. Needles less than 10 cm..... 19

18a. Needles brittle, easily breaking when bent double; terminal bud brown..... Pinus resinosa

18b. Needles flexible; terminal bud silvery-white..... Pinus nigra

19a. Needles 2-4 cm long..... Pinus banksiana

19b. Needles longer than 4 cm..... 20

20a. Needles twisted; bark reddish-brown above; tree.... Pinus sylvestris

20b. Needles not twisted; shrub, usually multistem..... Pinus mugo

21a. Bark peeling off in large scales leaving green and gray patches; twigs slender..... Pinus bungeana

21b. Bark not peeling off in large scales; twigs stout..... Pinus ponderosa

22a. Needles scale-like, appressed, imbricated in 4 rows on 2 edged branchlets; branchlets in planes..... Thuja occidentalis

22b. Needles scale-like or needle-like, not imbricated in 4 rows on 2 edged branchlets; branchlets not in planes..... 23

23a. Needles opposite..... 24

23b. Needles in whorls of 3..... 26

24a. Needles with a strong disagreeable odor when crushed..... Juniperus sabina

24b. Needles without a strong disagreeable odor when crushed..... 25

25a. Procumbent shrub with long trailing branches..... Juniperus horizontalis

25b. Erect shrub or tree-like..... Juniperus virginiana

26a. Leaves needle-like and jointed to the twig, broad white bands above; winter buds distinct..... Juniperus communis

26b. Leaves needle-like or scale-like, not banded; winter buds lacking..... Juniperus chinensis

27a. Plants without a stem; leaves erect and spreading, linear-lanceolate, acute, 25-75 cm long, 2-3 cm wide..... Yucca filamentosa

27b. Plants with a stem; leaves not as above..... 28

28a. Plant a tree..... 29

28b. Plant a shrub or vine.....153

29a. Leaves simple..... 30

29b. Leaves compound.....128

30a. Leaves lobed..... 31

30b. Leaves not lobed..... 57

31a. Leaves opposite..... 32

31b. Leaves alternate or borne in dense clusters..... 37

32a. Leaves silvery-white beneath..... 33

32b. Leaves green or purplish beneath..... 35

33a. Leaves moderately lobed, lobes broad at base..... *Acer rubrum*

33b. Leaves deeply lobed, lobes narrow at base..... 34

34a. Leaves with lobes divided into many slender segments..... *Acer saccharinum* var. *laciniatum*

34b. Leaves with lobes not divided into many slender segments..... *Acer saccharinum*

35a. Leaves purplish, reddish, or green, lustrous beneath, with distinct tufts of hairs in the axils of the veins.....149

35b. Leaves glabrous or when pubescent beneath, pubescence not restricted to tufts of hairs in the axils of the veins..... 36

36a. Leaves mostly 3-lobed, sides of blades drooping, pubescent beneath at least along prominent veins..... *Acer nigrum*

36b. Leaves mostly 5-lobed, sides of blade not drooping, glabrous beneath..... *Acer saccharum*

37a. Leaves 4-lobed, truncate or notched at apex; stipules large, encircling the bud.... *Liriodendron tulipifera*

37b. Leaves not as above; stipules not encircling the bud..... 38

38a. Leaves fan-shaped, many of them borne in dense clusters, 2-lobed; veins forked in pairs..... Ginkgo biloba

38b. Leaves not fan-shaped; veins not forked in pairs..... 39

39a. Plants thorny..... 40

39b. Plants not thorny..... 43

40a. Leaves distinctly lobed, with veins extending to the sinuses as well as to the points of lobes..... 41

40b. Leaves shallowly lobed or toothed, with veins extending only to teeth or points of lobes..... 42

41a. Leaves truncate to subcordate at base..... Crataegus phaenopyrum

41b. Leaves cuneate at base..... Crataegus laevigata

42a. Leaves truncate to subcordate at base..... Crataegus mollis

42b. Leaves cuneate at base..... Crataegus punctata

43a. Leaves palmately lobed..... 44

43b. Leaves pinnately lobed..... 46

44a. Leaves white tomentose beneath.....152

44b. Leaves glabrous or pubescent beneath..... 45

45a. Leaves coarsely toothed; bark peeling off in large scales..... Platanus occidentalis

45b. Leaves finely toothed; bark not peeling off in large scales..... Liquidambar styraciflua

46a. Leaf scars with many bundle scars..... 47

46b. Leaf scars with 3 bundle scars Malus ioensis 'Plena'

47a. Leaves with bristle-pointed lobes..... 48

47b. Leaves without bristle-pointed lobes; lobes sometimes mucronate..... 52

48a. Leaves pubescent beneath, at least when young; mature leaves often glabrous except for tufts of hairs in the axils of the veins..... Quercus velutina

48b. Leaves glabrous beneath, except for tufts of hairs in the axils of the veins..... 49

49a. Leaves with the longest lobes 2-6 times as long as the narrow middle portion, lustrous above..... 50

49b. Leaves with longest lobes almost equaling the width of the broadest middle portion of the leaves; leaves dull above..... Quercus borealis

50a. Leaves with conspicuous tufts of hairs in the axils of the veins below..... 51

50b. Leaves with small tufts of rusty hairs in the axils of the veins beneath..... Quercus coccinea

51a. Leaves mostly cuneate at base..... Quercus palustris

51b. Leaves mostly truncate at base..... Quercus ellipsoidalis

52a. Leaves shallowly lobed..... 53

52b. Leaves deeply lobed or cleft..... 54

53a. Leaves lanceolate, acuminate..... Quercus muhlenbergii

53b. Leaves oblong-obovate to oblong..... Quercus bicolor

54a. Branches glabrous or nearly so..... 55

54b. Branches pubescent or tomentose..... Quercus macrocarpa

55a. Petioles less than 1 cm long..... 56

55b. Petioles 1-2.5 cm long..... Quercus alba

56a. Plant with spreading branches..... Quercus robur

56b. Plant columnar..... Quercus robur var. fastigiata

57a. Leaves opposite or whorled..... 58

57b. Leaves alternate..... 63

58a. Leaves toothed..... 59

58b. Leaves entire..... 61

59a. Leaves doubly toothed..... *Acer tataricum*

59b. Leaves singly toothed..... 60

60a. Leaves elliptic to lanceolate, acuminate; branches slender, drooping..... *Euonymus bungeanus* 'Pendula'

60b. Leaves orbicular to ovate, obtuse; branches horizontal to upright..... *Cercidiphyllum japonicum*

61a. Leaves with lateral veins running parallel to margins, nearly meeting at apex..... *Cornus florida*

61b. Leaves with lateral veins not running parallel to margins..... 62

62a. Leaves pubescent beneath, often whorled..... *Catalpa speciosa*

62b. Leaves glabrous beneath, never whorled..... *Syringa reticulata*

63a. Leaves toothed..... 64

63b. Leaves entire.....117

64a. Leaves with 3-5 nearly equal main veins from near the base..... 65

64b. Leaves with 1 main vein from the base..... 75

65a. Sap milky..... 66

65b. Sap not milky..... 67

66a. Leaves glabrous beneath or pubescent only on the veins..... *Morus alba*

66b. Leaves pubescent beneath..... *Morus rubra*

67a. Leaves cordate at base, sometimes unequal; buds not sticky..... 68

67b. Leaves cuneate to truncate; buds sometimes sticky..... 73

68a. Leaves much longer than broad, sometimes entire or nearly so; bark with corky ridges..... *Celtis occidentalis*

68b. Leaves about as broad as long; bark without corky ridges..... 69

69a. Leaves glabrous beneath, except for tufts of hairs in the axils of the veins..... 70

69b. Leaves pubescent or tomentose beneath..... 72

70a. Leaves without tufts of hairs in the axils of the veins near the base..... Tilia americana

70b. Leaves with tufts of hairs in the axils of the veins near the base..... 71

71a. Leaves glaucous beneath; tertiary veins not prominent..... Tilia cordata

71b. Leaves light green beneath; tertiary veins prominent Tilia euchlora 'Redmondi'

72a. Leaves slightly pubescent beneath, tufts of hairs occurring in the axils of the veins..... Tilia platyphyllos 'Fastigiata'

72b. Leaves white tomentose beneath..... Tilia tomentosa

73a. Leaves ovate to orbicular; obtuse, acute, or abruptly short-acuminate..... 74

73b. Leaves triangular to ovate-triangular, with gradually tapering long-acuminate apex..... Populus deltoides

74a. Leaves finely toothed..... Populus tremuloides

74b. Leaves with large irregular teeth..... Populus grandidentata

75a. Leaves coarsely toothed and/or doubly toothed, or remotely denticulate or serrate..... 76

75b. Leaves finely toothed..... 98

76a. Leaves doubly toothed..... 77

76b. Leaves singly and coarsely toothed..... 94

77a. Plants thorny..... 78

77b. Plants not thorny..... 79

78a. Leaf base truncate to subcordate..... Crataegus mollis

78b. Leaf base cuneate..... Crataegus punctata

79a. Leaf base unequal..... 80

79b. Leaf base equal..... 86

80a. Twigs with prominent oval-shaped lenticels..... 81

80b. Twigs without prominent oval-shaped lenticels..... 82

81a. Bark of trunk broken into small shaggy plates..... Ostrya virginiana

81b. Bark of trunk smooth..... Carpinus caroliniana

82a. Leaves smooth above..... Ulmus carpinifolia

82b. Leaves rough above..... 83

83a. Leaves sometimes with 3 or 5 acuminate lobes at the apex; bark remaining smooth for many years..... Ulmus glabra

83b. Leaves never lobed; bark furrowed..... 84

84a. Leaves 5-7 cm, sometimes to 8 cm.....151

84b. Leaves 7-20 cm..... 85

85a. Buds with rusty hairs; leaves often folded upwards along the midrib, rough on both surfaces; bark of trunk dark red brown..... Ulmus rubra

85b. Buds nearly glabrous; leaves rough above, sometimes smooth, smooth below, rarely folded upwards along the midrib; bark of trunk with alternating gray and brown layers..... Ulmus americana

86a. Petioles and branchlets glandular pubescent..... 87

86b. Petioles and branchlets not glandular pubescent..... 89

87a. Branches twisted and curled..... *Corylus avellena* var. *contorta*

87b. Branches not abnormal in appearance..... 88

88a. Petioles 15-25 mm long; leaves often slightly lobed..... *Corylus avellena*

88b. Petioles 8-15 mm long..... *Corylus americana*

89a. Leaves orbicular to obovate, sticky when unfolding, leaf tip often emarginate..... *Alnus glutinosa*

89b. Leaves generally ovate, not sticky when unfolding, leaf tip never emarginate..... 90

90a. Leaves with 3-7 pairs of veins..... 91

90b. Leaves with 7-15 pairs of veins..... 92

91a. Leaves rhombic-ovate, glabrous beneath..... *Betula pendula*

91b. Leaves ovate, usually pubescent on veins beneath..... *Betula papyrifera*

92a. Leaves rhombic-ovate, cuneate at base..... *Betula nigra*

92b. Leaves ovate to oblong-ovate, rounded to subcordate at base, leaf base sometimes unequal..... 93

93a. Bark smooth..... *Carpinus caroliniana*

93b. Bark broken into small, shaggy plates..... *Ostrya virginiana*

94a. Leaves coarsely serrate..... 95

94b. Leaves remotely serrate or denticulate..... 97

95a. Leaves whitish-tomentose beneath..... *Quercus muhlenbergii*

95b. Leaves glabrous beneath or with tufts of hairs in the axils of the veins when young..... 96

96a. Leaves oblong-lanceolate, acuminate, cuneate at base; teeth sharp and glandular..... *Castanea dentata*

96b. Leaves obovate-oblong to oblong, acute, rounded or broad-cuneate at base; teeth bristle-tipped..... *Quercus acutissima*

97a. Leaves with 9-14 pairs of veins, margin serrate..... *Fagus grandifolia*

97b. Leaves with 5-9 pairs of veins, margin denticulate..... *Fagus sylvatica*

98a. Plants thorny.....355

98b. Plants without thorns..... 99

99a. Leaves 4 times longer than broad.....100

99b. Leaves less than 4 times as long as broad.....104

100a. Leaves glabrous beneath at maturity.....101

100b. Leaves pubescent beneath, at least along the midrib, at maturity.....102

101a. Branches ascending..... *Salix amygdaloides*

101b. Branches pendulous..... *Salix* x *blanda*

102a. Branches olive-brown..... *Salix alba*

102b. Branches yellow.....103

103a. Branches drooping; leaves green beneath.... *Salix alba* var. *tristis*

103b. Branches ascending; leaves bluish beneath, slightly pubescent..... *Salix alba* var. *vitellena*

104a. Petioles with glands near leaf blade.....105

104b. Petioles without glands.....107

105a. Leaves with appressed, incurved teeth..... *Prunus serotina*

105b. Leaves with spreading teeth.....106

106a. Leaves sharply serrate..... *Prunus padus* var. *commutata*

106b. Leaves serrulate; usually shrub-like, sometimes a small tree..... *Prunus virginiana*

107a. Twigs with strong wintergreen taste..... Betula lenta

107b. Twigs without a wintergreen taste 108

108a. Petioles less than 1 cm long.....109

108b. Petioles longer than 1 cm.....110

109a. Branchlets glabrous, sometimes slightly pubescent when very young..... Ulmus pumila

109b. Branchlets pubescent..... Ulmus parvifolia

110a. Leaves with margins crenately toothed or teeth bristle-pointed, glabrous beneath.....111

110b. Leaves with margins serrate; when bluntly serrate, pubescent beneath.....113

111a. Leaves with bristle-pointed teeth..... Pyrus ussuriensis

111b. Leaves with margins crenate or crenate-serrate.....112

112a. Leaves ovate to broadly ovate, rounded to broad cuneate at base; branchlets glabrous Pyrus calleryana 'Bradfordi'

112b. Leaves oval to oblong-ovate, subcordate to broad cuneate at base; branchlets glabrous..... Pyrus communis

113a. Young leaves and branches purple..... Malus purpurea

113b. Young leaves and branchlets green to brown.....114

114a. Leaves pubescent beneath at maturity.....115

114b. Leaves glabrous beneath at maturity.....116

115a. Leaves bluntly serrate..... Malus sylvestris

115b. Leaves coarsely or incisely serrate, sometimes shallowly lobed..... Malus ioensis 'Plena'

116a. Branchlets glabrous..... Malus baccata 'Columnaris'

116b. Branchlets slightly pubescent..... *Malus zumi* var. *calocarpa*

117a. Leaves and branchlets covered with silvery scales..... *Elaeagnus angustifolia*

117b. Leaves and branchlets not covered with silvery scales.....118

118a. Plants with thorns..... *Maclura pomifera*

118b. Plants without thorns.....119

119a. Leaves with lateral veins parallel to margins nearly meeting near apex..... *Cornus alternifolia*

119b. Leaves with lateral veins not parallel to margins.....120

120a. Bud scales large membranous stipules attached to the base of the petioles, deciduous with the unfolding of each successive leaf.....121

120b. Bud scales not large membranous stipules attached to the base of the petiole.....123

121a. Young branchlets densely pubescent..... *Magnolia stellata*

121b. Young branchlets lustrous.....122

122a. Leaves ovate to oblong-ovate..... *Magnolia acuminata*

122b. Leaves obovate..... *Magnolia* x *soulangeana*

123a. Leaves sharply contracted at base; stems with strong smelling juice.....124

123b. Leaves not sharply contracted at base; stem without a strong smelling juice.....125

124a. Leaves green..... *Cotinus coggygria*

124b. Leaves purplish..... *Cotinus coggygria* var. *purpureus*

125a. Leaf base unequal; leaves often serrate..... *Celtis occidentalis*

125b. Leaf base equal.....126

126a. Leaves cordate at base ..... Cercis canadensis

126b. Leaves cuneate to rounded at base.....127

127a. Leaves undulate..... Quercus imbricaria

127b. Leaves flat..... Nyssa sylvatica

128a. Leaves opposite.....129

128b. Leaves alternate.....137

129a. Leaves with 3 leaflets, sometimes 5.....130

129b. Leaves with 5 or more leaflets.....131

130a. Bark separating into thin papery layers..... Acer griseum

130b. Bark of trunk furrowed, tight and smooth on branches..... Acer negundo

131a. Leaves pinnately compound.....132

131b. Leaves palmately compound.....135

132a. Leaflets crenulate with ciliate margins..... Phellodendron amurense

132b. Leaflets entire or serrulate.....133

133a. Branchlets 4-angled and often winged..... Fraxinus quadrangulata

133b. Branchlets round, not winged.....134

134a. Leaflets crenulate to entire, glabrous beneath..... Fraxinus americana

134b. Leaflets sharply serrate at least above the middle, glabrous to pubescent beneath..... Fraxinus pennsylvanica

135a. Leaflets mostly obovate.....136

135b. Leaflets mostly elliptic..... Aesculus glabra

136a. Leaflets crenate-serrate, often doubly toothed..... Aesculus x carnea

136b. Leaflets obtusely-serrate, never doubly toothed..... Aesculus hippocastanum

137a. Leaves even pinnate.....138

137b. Leaves odd pinnate.....140

138a. Leaflets entire; leaves bipinnately compound, 15-35 cm long..... Gymnocladus dioica

138b. Leaflets remotely serrate; leaves mostly once pinnately compound, sometimes bipinnately compound, 14-20 cm long.....139

139a. Plants with thorns..... Gleditisia triacanthos

139b. Plants without thorns..... Gleditisia triacanthos var. inermis

140a. Leaflets entire.....141

140b. Leaflets toothed.....143

141a. Leaflets opposite..... Sophora japonica

141b. Leaflets alternate.....142

142a. Plants with stipular spines..... Robinia pseudoacacia

142b. Plants without spines..... Cladrastis lutea

143a. Leaflets mostly entire except for 2-4 coarse teeth near the base, each with a large gland beneath..... Ailanthus altissima

143b. Leaflets continuously toothed along margin.....144

144a. Leaflets sessile..... Sorbus aucuparia

144b. Leaflets stalked.....145

145a. Leaves with 11-23 leaflets.....146

145b. Leaves with 5-11 leaflets.....148

146a. Leaflets serrulate..... Juglans cathayensis

146b. Leaflets irregularly serrate.....147

147a. Leaflets ovate-lanceolate, glabrous above and hairy beneath; pith buff-colored; bark dark brown..... Juglans nigra

147b. Leaflets oblong-lanceolate, wrinkled above and hairy beneath; pith dark chocolate brown; bark gray..... Juglans cinerea

148a. Leaflets mostly 5, white-tufted along margins; bark shaggy..... Carya ovata

148b. Leaflets mostly 7, mature leaflets almost smooth along margins; bark furrowed..... Carya cordiformis

149a. Leaves reddish or purplish.....150

149b. Leaves green..... Acer platanoides

150a. Leaves dull red, turning green..... Acer platanoides 'Schwedleri'

150b. Leaves brownish-purple, lustrous above..... Acer platanoides 'Crimson King'

151a. Leaves usually folded upwards along midrib; branches without corky wings..... Ulmus carpinifolia 'Christine Buisman'

151b. Leaves usually flat; branches often with corky wings..... Ulmus procera

152a. Plant columnar in habit..... Populus alba var. pyramidalis

152b. Plant spreading in habit..... Populus alba

153a. Plant a shrub.....154

153b. Plant a vine.....329

154a. Leaves compound.....155

154b. Leaves simple.....172

155a. Leaves with 3 leaflets; branchlets without prickles or bristles.....156

155b. Leaves usually with more than 3 leaflets; branches sometimes with bristles.....158

156a. Leaves opposite..... Staphylea trifolia

156b. Leaves alternate.....157

157a. Leaflets entire or finely crenulate..... Ptelea trifoliata

157b. Leaflets coarsely toothed..... Rhus aromatica

158a. Leaves with 4 leaflets..... Caragana frutex

158b. Leaves with 5 or more leaflets, (sometimes 3).....159

159a. Leaves palmately compound, with 5-7 leaflets..... Acanthopanax sieboldianus

159b. Leaves pinnately compound.....160

160a. Petioles winged at base or with large membranous stipules 5-7 mm long.....161

160b. Petioles not winged at base; stipules not large and membranous.....166

161a. Leaflets sessile, entire..... Potentilla fruticosa

161b. Leaflets stalked, toothed.....162

162a. Leaves with 3 leaflets, rarely 5..... Rosa setigera

162b. Leaves with 5-11 leaflets.....163

163a. Leaflets 1-2 cm long..... Rosa spinossisima

163b. Leaflets 3-9 cm long.....164

164a. Bark green or brownish-green..... Rosa x 'Hybrid Teas, Floribunda, Grandiflora' hybrids

164b. Bark red, purple, or reddish-brown.....165

165a. Branches with prickles; branchlets with bristles..... Rosa virginiana

165b. Branches without prickles; branchlet usually without bristles..... Rosa blanda

166a. Leaves with odd number of leaflets.....167

166b. Leaves with even number of leaflets..... Caragana arborescens

167a. Leaflets 5-9, sometimes 11.....168

167b. Leaflets 11-31, sometimes 9.....169

168a. Branchlets with prickles up to 1 cm long..... *Xanthoxylum americanum*

168b. Branchlets without prickles.....353

169a. Leaflets 1.5-4 cm long..... *Amorpha fruticosa*

169b. Leaflets 4-12 cm long.....170

170a. Rachis of leaf winged..... *Rhus copallina*

170b. Rachis of leaf round, not winged.....171

171a. Branchlets glabrous..... *Rhus glabra*

171b. Branchlets densely pubescent.....354

172a. Leaves lobed.....173

172b. Leaves not lobed.....185

173a. Leaves opposite.....174

173b. Leaves alternate.....177

174a. Petioles with large disk-like glands near leaf blade.....175

174b. Petioles without glands.....176

175a. Leaves 5-10 cm long..... *Viburnum opulus*

175b. Leaves 3-5 cm long..... *Viburnum opulus* 'Nanum'

176a. Leaves entire, sinuately lobed..... *Symphoricarpos albus*

176b. Leaves doubly serrate, usually with 2 lobes near base..... *Acer ginnala*

177a. Branches glandular pubescent; leaves doubly serrate and often slightly lobed.....178

177b. Branches not glandular pubescent.....179

178a. Plants with spines..... *Ribes americanum*

178b. Plants without spines..... *Corylus avellena*

179a. Older bark separating in numerous thin strips..... *Physocarpus opulifolius* var. *nanus*

179b. Older bark close; not separating in thin strips.....130

180a. Leaves incisely serrate..... *Spiraea vanhoutei*

180b. Leaves coarsely dentate.....181

181a. Branches without spines or rarely with a pair of small prickles below the petiole.....182

181b. Branches with spines and prickles..... *Ribes missouriensis*

182a. Young branches glandular..... *Ribes americana*

182b. Young branches without glands.....183

183a. Young branches pubescent..... *Ribes odoratum*

183b. Young branches glabrous or nearly so.....184

184a. Bark flaking off freely..... *Ribes alpinum*

184b. Bark close, not flaking off freely..... *Ribes aureum*

185a. Leaves opposite or whorled.....186

185b. Leaves alternate or borne in dense clusters.....270

186a. Leaves entire.....187

186b. Leaves toothed, sometimes remotely toothed.....227

187a. Leaves 6-15 mm long..... *Buxus microphylla* var. *koreana*

187b. Leaves 1.5 to 20 cm long.....188

188a. Branchlets angled.....189

188b. Branches round or oval.....191

189a. Leaves dotted with tiny clear glands .... *Hypericum prolificum*

189b. Leaves without tiny glands..... 190

190a. Leaves alternate, whorled, and opposite, obtuse to acute, sometimes remotely denticulate.... *Euonymus nanus* var. *turkestanica*

190b. Leaves never alternate or whorled, acuminate..... *Fontanesia fortunei*

191a. Buds hidden by the base of the petiole.....192

191b. Buds not hidden by the base of the petiole.....198

192a. Bark of stems aromatic..... *Calycanthus floridus*

192b. Bark of stems not aromatic.....193

193a. Leaf base round.....194

193b. Leaf base cuneate.....196

194a. Leaves pubescent beneath.... *Philadelphus pubescens* var. *verrucosus*

194b. Leaves glabrous beneath except for veins and tufts of hairs in the axils of the veins..... 195

195a. Leaves glabrous and lustrous above, with the texture of coarse writing paper..... *Philadelphus inodorus*

195b. Leaves glabrous above, not lustrous, texture not similar to writing paper..... *Philadelphus coronarius*

196a. Leaves pubescent beneath.....197

196b. Leaves glabrous beneath except for veins and tufts of hairs in the axils of the veins..... Philadelphus lemoinei

197a. Leaves elliptic-ovate to oblong-lanceolate, usually pendulous and curved, with the texture of coarse writing paper..... Philadelphus laxus

197b. Leaves ovate, not pendulous, texture not similar to coarse writing paper..... Philadelphus virginalis

198a. Leaf base cordate, subcordate, or tips tapered at both ends.....199

198b. Leaves not with the above combination of characters.....204

199a. Petiole 5-11 mm long.....200

199b. Petioles 11-30 mm long.....201

200a. Leaves glabrous beneath..... Syringa persica

200b. Leaves pubescent beneath, at least on midrib and veins near base..... Syringa patula

201a. Leaves pubescent below, at least near midrib when young.....202

201b. Leaves glabrous below.....203

202a. Leaves broad-ovate to ovate, rounded to subcordate at base..... Syringa reticulata var. mandeschurica

202b. Leaves broad-elliptic to oblong, attenuate at base..... Syringa villosa

203a. Leaves truncate to subcordate at base, sometimes broad-cuneate..... Syringa vulgaris

203b. Leaves attenuate to cuneate..... Syringa chinensis

204a. Bark of stems loose, shredding in long pieces.....205

204b. Bark of stems and older branches smooth, not shedding.....208

205a. Leaf scar with 1 bundle scar.....206

205b. Leaf scar with 3 bundle scars.....221

206a. Stems solid..... Symphoricarpos orbiculatus

206b. Stems hollow.....207

207a. Leaves oval or ovate, entire or undulate-crenate..... Symphoricarpos occidentalis

207b. Leaves oval to elliptic-oblong, often sinuately lobed ..... Symphoricarpos albus

208a. Lateral veins running parallel to leaf margins, nearly meeting at apex.....209

208b. Lateral veins not parallel to leaf margins.....215

209a. Leaves or at least young branches with spreading or curling hairs..... Cornus amomum

209b. Leaves and young branches with appressed hairs or nearly glabrous.....210

210a. Mature branches gray or brown.....211

210b. Mature branches reddish, green, or yellow.....212

211a. Leaves bluish beneath; petioles 8-15 mm..... Cornus racemosa

211b. Leaves green on both sides, lustrous above; petioles 5-10 mm..... Cornus mas

212a. Shrub upright, not stoloniferous.....213

212b. Shrub with frequent prostrate or arching stoloniferous stems.....214

213a. Leaves green, not edged with white..... Cornus albus 'Siberica'

213b. Leaves green, edged with creamy-white..... Cornus albus 'Argento-marginatus'

214a. Bark dull green tinged with red..... Cornus sericea

214b. Bark yellow or green-yellow..... Cornus sericea 'Flaviramea'

215a. Leaf blade 1-6 cm long.....216

215b. Leaf blade 6-20 cm long.....218

216a. Leaves edged with golden-yellow..... Ligustrum x vicaryi

216b. Leaves green, not edged with yellow.....217

217a. Leaves pubescent beneath on midrib..... Ligustrum amurense

217b. Leaves glabrous beneath..... Ligustrum vulgare

218a. Leaves wrinkled above.....219

218b. Leaves smooth above.....220

219a. Leaves ovate-oblong to ovate-lanceolate, 7-18 cm long..... Viburnum rhytidophyllum

219b. Leaves elliptic-ovate or oblong-ovate, 8-20 cm long..... Viburnum x rhytidophylloides

220a. Stipules about 2 mm long..... Cephalanthus occidentalis

220b. Stipules absent..... Calycanthus florida

221a. Branches glabrous.....222

221b. Branches pubescent, at least when young.....224

222a. Midrib covered with bristle-like hairs beneath..... Lonicera fragrantissima

222b. Midrib not covered with bristle-like hairs.....223

223a. Leaves pubescent beneath.....Lonicera maximowiczii

223b. Leaves glabrous beneath..... Lonicera tatarica

224a. Leaves acuminate.....Lonicera mackii var. podocarpa

224b. Leaves acute to obtuse.....225

225a. Leaves rhombic-ovate..... Lonicera xylosteoides 'Clavey's Dwarf'

225b. Leaves oval or oblong-ovate.....226

226a. Leaves glabrous or slightly pubescent beneath..... Lonicera tatarica

226b. Leaves grayish-tomentose beneath..... Lonicera morrowii

227a. Leaves doubly toothed.....228

227b. Leaves singly toothed, sometimes remotely toothed.....229

228a. Petioles 1.5-5 cm long.....Acer tataricum

228b. Petioles 3-5 mm long..... Rhodotypos scandens

229a. Plants with some branches ending in spines..... *Rhamnus cathartica*

229b. Plants without spines.....230

230a. Leaves serrate or sometimes entire, occasionally trifoliate or lobed on vigorous shoots; branches hollow or with lamellate pith, usually with prominent lenticels.....231

230b. Plants not with the above combination of characters.....235

231a. Branches hollow, with solid pith at the nodes; leaves often trifoliate..... *Forsythia suspensa*

231b. Branches at least partly with lamellate pith.....232

232a. Mature branches greenish or brownish; leaves elliptic-ovate to lanceolate.....233

232b. Mature branches yellowish; leaves ovate or broad-ovate, rarely trifoliate..... *Forsythia ovata*

233a. Leaves sometimes trifoliate; branches erect or arching; pith usually solid at the nodes, lamellate or sometimes hollow between the nodes.....234

233b. Leaves rarely trifoliate; branches upright; pith lamellate throughout, sometimes hollow at the base of vigorous branches..... *Forsythia viridissima*

234a. Leaves 5-12 cm long..... *Forsythia* x *intermedia*

234b. Leaves 1-4 cm long..... *Forsythia* x *intermedia* 'Arnold's Dwarf'

235a. Branches hollow.....236

235b. Branches solid.....237

236a. Leaves obtuse, undulate-crenate or entire..... *Symphoricarpos occidentalis*

236b. Leaves long-acuminate, finely serrate to remotely serrate.....350

237a. Buds hidden by the base of the petioles.....238

237b. Buds visible.....243

238a. Leaves round at base.....239

238b. Leaves cuneate at base.....241

239a. Leaves pubescent beneath.... Philadelphus pubescens var. verrucosus

239b. Leaves glabrous beneath, except for veins and in the axils of the veins.....240

240a. Leaves glabrous and lustrous above, texture similar to coarse writing paper..... Philadelphus inodorus

240b. Leaves glabrous but not lustrous above, texture not similar to coarse writing paper..... Philadelphus coronarius

241a. Leaves pubescent beneath.....242

241b. Leaves glabrous beneath, except for veins and in the axils of the veins..... Philadelphus virginalis

242a. Leaves elliptic-ovate to oblong-lanceolate, usually drooping and curved, texture similar to coarse writing paper..... Philadelphus laxus

242b. Leaves ovate, not pendulous, texture not similar to coarse writing paper..... Philadelphus lemoinei

243a. Branches ridged.....244

243b. Branches round.....248

244a. Branches winged..... Euonymus alatus 'Compacta'

244b. Branches not winged.....245

245a. Leaves linear to linear-oblong, remotely denticulate to entire, sometimes alternate and whorled... Euonymus nanus var. turkestanica

245b. Leaves broader, all opposite.....246

246a. Leaves pubescent beneath..... Euonymus atropurpureus

246b. Leaves glabrous beneath, except sometimes pubescent on midrib.....247

247a. Leaves long-acuminate, finely serrate; branches drooping..... Euonymus bungeanus 'Pendula'

247b. Leaves acuminate, crenate-serrate branches spreading..... Euonymus europaeus

248a. Branches green, glabrous, extremely flexible.....249

248b. Branches brown, glabrous or pubescent, not extremely flexible.....250

249a. Leaf base rounded..... Euonymus fortunei 'Sarcoxie'

249b. Leaf base cuneate..... Euonymus fortunei 'Vegete'

250a. Petioles 3-6 cm long..... Hydrangea paniculata 'Grandiflora'

250b. Petioles less than 3 cm long.....251

251a. Petioles 1-4 mm long.....252

251b. Petioles 4 mm to 2.5 cm long.....253

252a. Leaves remotely serrate to entire..... Kolkwitzia amabilis

252b. Leaves coarsely serrate..... Weigela florida 'Pink Princess'

253a. Leaves finely toothed to almost entire.....254

253b. Leaves coarsely toothed.....260

254a. Leaves sharply and abruptly acuminate..... Viburnum lentago

254b. Leaves not abruptly sharp acuminate.....255

255a. Leaves wrinkled above.....256

255b. Leaves smooth above.....257

256a. Leaves ovate-oblong to ovate-lanceolate, 7-18 cm long..... Viburnum rhytidophyllum

256b. Leaves elliptic-ovate or oblong-ovate, 8-20 cm long..... *Viburnum rhytidophylloides*

257a. Leaves serrulate.....258

257b. Leaves slightly serrate, obscurely dentate, or denticulate.....259

258a. Branches glabrous..... *Viburnum prunifolium*

258b. Branches rusty pubescent..... *Viburnum rufidulum*

259a. Leaves glabrous below..... *Viburnum cassinoides*

259b. Leaves pubescent below..... *Viburnum x burkwoodii*

260a. Leaves coarsely dentate.....261

260b. Leaves not coarsely dentate.....263

261a. Leaves 3-8 cm long.....262

261b. Leaves 8-14 cm long..... *Viburnum wrightii*

262a. Leaves with mostly 3-4 veins on each side of midrib..... *Viburnum rafinesquianum*

262b. Leaves with mostly 5-8 veins on each side of midrib..... *Viburnum dentatum*

263a. Petioles densely covered with long hairs..... *Viburnum dilatatum*

263b. Petioles slightly pubescent.....264

264a. Petioles 5-10 mm long.....265

264b. Petioles longer than 1 cm.....267

265a. Leaves ovate to ovate-oblong..... *Viburnum x juddi*

265b. Leaves broad-ovate to elliptic.....266

266a. Leaves lustrous above..... *Viburnum x carlcephalum*

266b. Leaves not lustrous above..... *Viburnum carlesii*

267a. Branches scurfy pubescent or stellate tomentose when young.....268

267b. Branches glabrous or only slightly pubescent.....269

268a. Branches scurfy pubescent..... *Viburnum lantana*

268b. Branches stellate tomentose when young..... *Viburnum plicatum* f. *tomentosum*

269a. Leaves with 5-6 pairs of veins..... *Viburnum farreri*

269b. Leaves with 7-10 pairs of veins..... *Viburnum sieboldianus*

270a. Leaves entire.....271

270b. Leaves toothed, sometimes only near apex.....297

271a. Plants with thorns or spines.....272

271b. Plants without thorns or spines.....279

272a. Leaves and branchlets covered with silvery scales.....273

272b. Leaves and branchlets without silvery scales.....275

273a. Leaves elliptic to ovate-oblong..... *Elaeagnus umbellata*

273b. Leaves linear, lanceolate, or oblong-lanceolate.....274

274a. Leaves linear..... *Hippophae rhamnoides*

274b. Leaves lanceolate to oblong-lanceolate..... *Elaeagnus angustifolia*

275a. Branches with grooves.....276

275b. Branches round..... *Rhamnus cathartica*

276a. Leaves elliptic to ovate..... *Berberis* x *mentorensis*

276b. Leaves obovate or spatulate.....277

277a. Leaves green..... *Berberis thunbergii*

277b. Leaves purplish.....278

278a. Plants less than 22 cm in height..... *Berberis thunbergii* 'Crimson Pigmy'

278b. Plants more than 22 cm in height..... Berberis thunbergii var. atropurpurea

279a. Leaves with lateral veins parallel to margins, nearly touching at apex..... Cornus alternifolia

279b. Leaves with lateral veins not parallel to margins.....280

280a. Bud scales large membranous stipules attached to the base of the petioles, deciduous with the unfolding of each successive leaf.....281

280b. Bud scales not large membranous stipules attached to the base of the petiole.....282

281a. Young branchlets densely pubescent..... Magnolia stellata

281b. Young branches lustrous..... Magnolia soulangeana

282a. Leaves sharply contracted at base, stem with strong-smelling juice.....283

282b. Leaves not sharply contracted at base.....284

283a. Leaves green..... Cotinus coggygria

283b. Leaves purplish..... Cotinus coggygria var. purpurea

284a. Branchlets and leaves covered with brown and silvery scales.....285

284b. Branchlets and leaves not covered with brown and silvery scales.....286

285a. Branches often spiny; branchlets yellowish-brown..... Elaeagnus umbellata

285b. Branches without spines; branchlets reddish-brown..... Elaeagnus multiflora

286a. Leaves aromatic.....287

286b. Leaves not aromatic.....288

287a. Leaves pubescent and glandular dotted on both surfaces, often with a few blunt teeth at the apex..... Myrica pensylvanica

287b. Leaves glabrous..... Lindera benzoin

288a. Branches hollow.....289

288b. Branches solid.....290

289a. Leaves 8-15 cm long..... Polygonon cuspidatum

289b. Leaves 3-8 cm long..... Polygonon reynoutria

290a. Branches flexible, with very tough bark, having the appearance as if jointed..... Dirca palustris

290b. Branches not as above.....291

291a. Leaves leathery, glossy above, with many minute rust-colored scales beneath..... Rhododendron 'P J M hybrids'

291b. Leaves without rust-colored scales below.....292

292a. Leaves narrow elliptic to lanceolate, often obscurely crenulate, 3-7 cm long..... Rhododendron yedoense

292b. Leaves elliptic, ovate, or suborbicular, 8 mm-4 cm long, sometimes 5.....293

293a. Leaves pubescent above at maturity..... Cotoneaster racemiflorus var. soongoricus

293b. Leaves glabrous above at maturity or occasionally slightly pubescent.....294

294a. Leaves 8-20 mm long.....295

294b. Leaves 2-4 cm long, occasionally to 5.....296

295a. Leaves elliptic..... Cotoneaster divaricatus

295b. Leaves suborbicular to orbicular-ovate..... Cotoneaster apiculatus

296a. Leaves pubescent above when young, dull green..... Cotoneaster acutifolius

296b. Leaves glabrous and lustrous above..... *Cotoneaster lucidus*

297a. Leaves singly toothed.....298

297b. Leaves doubly toothed.....323

298a. Plants with spines or thorns.....299

298b. Plants without spines or thorns.....302

299a. Branchlets grooved; leaves 1-3 cm long..... *Berberis* x *mentorensis*

299b. Branchlets smooth; leaves 3-8 cm long.....300

300a. Petioles 1-3 cm long.....351

300b. Petioles 2-10 mm long.....301

301a. Leaves sharply serrate, acute; branchlets smooth..... *Chaenomeles speciosa*

301b. Leaves coarsely crenate-serrate, mostly obtuse; branchlets rough..... *Chaenomeles japonica*

302a. Leaves aromatic, almost entire except for few teeth at apex..... *Myrica pensylvanica*

302b. Leaves not aromatic.....303

303a. Leaves purplish or reddish.....304

303b. Leaves green.....305

304a. Inner bark purplish.....348

304b. Inner bark yellow..... *Prunus* x *cistena*

305a. Petioles or midribs with one or several glands.....306

305b. Petioles and midribs without glands.....307

306a. Petioles with glands..... *Prunus virginiana*

306b. Midribs with glands..... *Aronia melanocarpa*

307a. Leaves equal at base, not coarsely dentate.....308

307b. Leaves equal at base, not coarsely dentate.....309

308a. Leaves subcordate at base, rarely broad cuneate, coarsely crenate-dentate..... Hamamelis virginiana

308b. Leaves cuneate or truncate at base, rarely subcordate, coarsely sinuate-dentate above the middle..... Hamamelis vernalis

309a. Petioles more than 1 cm long.....310

309b. Petioles less than 1 cm long.....313

310a. Branches stout, often with thorn-like spurs; leaves sometimes lobed..... Malus sargentii

310b. Branches slender, not thorny; leaves not lobed.....311

311a. Leaves glabrous when young..... Amelanchier laevis

311b. Leaves pubescent when young.....312

312a. Mature leaves pubescent beneath on midrib; petioles and branchlets pubescent; twigs brown..... Amelanchier canadensis

312b. Mature leaves with glabrous to slightly pubescent petioles, midribs, and branchlets; twigs gray..... Amelanchier interior

313a. Leaves pubescent above..... Prunus tomentosa

313b. Leaves glabrous above.....314

314a. Leaves crenate-serrate to nearly entire.....315

314b. Leaves sharply toothed.....316

315a. Leaves crenate at apex, sometimes nearly entire.....Exochorda x macrantha 'Pearl'

315b. Leaves toothed all along margin, not only near apex..... Prunus glandulosa

316a. Branches with lenticels.....Ilex verticillata

316b. Branches without lenticels.....317

317a. Leaves toothed only near apex, sometimes lobed.....318

317b. Leaves toothed all along margins, not lobed.....320

318a. Leaves rhombic-ovate to rhombic-obovate, sometimes lobed..... *Spiraea* x *vanhoutei*

318b. Leaves oblanceolate or linear-lanceolate, not lobed.....319

319a. Leaves oblanceolate..... *Spiraea nipponica* var. *tosaensis*

319b. Leaves linear-lanceolate..... *Spiraea thunbergii*

320a. Leaves finely toothed.....349

320b. Leaves coarsely and occasionally doubly serrate.....321

321a. Teeth callus-tipped.....322

321b. Teeth smooth at apex..... *Spiraea* x *bumalda*

322a. Branches angled..... *Spiraea albiflora*

322b. Branches round..... *Spiraea japonica* var. *fortunei*

323a. Petioles and branchlets glandular pubescent.....324

323b. Petioles and branchlets not glandular pubescent.....326

324a. Branches twisted and curled..... *Corylus avellena* var. *contorta*

324b. Branches normal in appearance.....325

325a. Petioles 15-25 mm long; leaves often slightly lobed..... *Corylus columa*

325b. Petioles 8-15 mm long..... *Corylus americana*

326a. Petioles 1.5-2.5 cm long..... *Malus arnoldiana*

326b. Petioles 3-10 mm long.....327

327a. Branches angled..... *Spiraea chamaedrifolia*

327b. Branches round.....328

328a. Leaves 3-6 cm long..... Prunus triloba 'Multiplex'

328b. Leaves 6-10 cm long..... Prunus americana

329a. Leaves simple.....330

329b. Leaves compound.....341

330a. Leaves opposite.....331

330b. Leaves alternate.....335

331a. Leaves toothed.....332

331b. Leaves entire.....334

332a. Leaves 15-22 mm long..... Euonymus fortunei 'Minima'

332b. Leaves 2.2 to 7 cm long.....333

333a. Leaves round to acute..... Euonymus fortunei var. radicans

333b. Leaves acuminate..... Euonymus fortunei f. colorata

334a. Leaves pubescent beneath..... Lonicera japonica 'Halliana'

334b. Leaves glabrous beneath..... Vinca minor

335a. Leaves lobed.....336

335b. Leaves not lobed.....339

336a. Leaves with toothed lobes.....337

336b. Leaves with entire lobes.....338

337a. Plants climbing by means of long, coiled tendrils; tendrils without disc-like tips..... Vitis riparia

337b. Plants climbing by means of short, branched tendrils with disc-like tips..... Parthenocissus cuspidata

338a. Leaves 3-5 lobed; pubescence stellate..... Hedera helix var. baltica

338b. Leaves with 1-3 pairs of lobes at base; pubescence not stellate..... Solanum dulcamara

339a. Leaves entire.....340

339b. Leaves crenate-serrate..... *Celastrus orbiculatus*

340a. Leaves 3-8 cm long..... *Lycium chinense*

340b. Leaves 10-30 cm long..... *Aristolochia durior*

341a. Leaves opposite, sometimes simple.....342

341b. Leaves alternate.....346

342a. Leaves with 9-13 leaflets..... *Campsis radicans*

342b. Leaves with 3-7 leaflets, sometimes simple.....343

343a. Leaves with serrate leaflets..... *Clematis virginiana*

343b. Leaves with entire leaflets, sometimes lobed.....344

344a. Leaves glabrous beneath..... *Clematis paniculata*

344b. Leaves at least slightly pubescent beneath.....345

345a. Leaves with mostly 5 or 7 leaflets, occasionally simple..... *Clematis* x *jackmanii*

345b. Leaves with mostly 3 leaflets, occasionally simple..... *Clematis lanuginosa*

346a. Leaves with 3 leaflets..... *Toxicodendron radicans*

346b. Leaves with 5-7 leaflets.....347

347a. Leaves with serrate leaflets..... *Parthenocissus quinquefolia*

347b. Leaves with entire leaflets..... *Akebia quintata*

348a. Leaves purplish..... *Prunus cerasifera* 'Atropurpurea'

348b. Leaves reddish or green tinged with red..... *Prunus cerasifera* 'Newportii'

349a. Leaves serrulate..... *Prunus glandulosa* 'Alboplena'

349b. Leaves denticulate..... *Spiraea prunifolia* var. *plena*

350a. Leaves remotely serrate to nearly entire..... *Kolkwitzia amabilis*

350b. Leaves finely serrate..... *Deutzia gracilis*

351a. Leaves sharply serrate..... *Malus sargentii*

351b. Leaves crenate-serrulate or denticulate.....352

352a. Leaves subopposite, elliptic or ovate..... *Rhamnus cathartica*

352b. Leaves alternate, elliptic-lanceolate to lanceolate or oblanceolate..... *Rhamnus spathulaefolia*

353a. Leaves opposite..... *Sambucus canadensis*

353b. Leaves alternate..... *Mahonia aquifolium*

354a. Leaflets cut into narrow lobes..... *Rhus typhina* var. *laciniatum*

354b. Leaflets not lobed..... *Rhus typhina*

355a. Leaves obovate to oblong-obovate..... *Crataegus crus-galli*

355b. Leaves orbicular-ovate to ovate.....*Pyrus ussuriensis*

Glossary

1. Alternate. Not opposite to each other on the stem.
2. Axil. The angle formed by the branching of a vein.
3. Appressed. Lying close and flat against.
4. Blade. The expanded part of a leaf.
5. Branchlet. A young branch.
6. Bristle. A stiff, strong hair.
7. Ciliate. Bearing hairs on the margin.
8. Compound. Composed of two or more similar parts.
9. Crenulate. Finely crenate.
10. Denticulate. Finely or minutely dentate.
11. Glabrous. Without hairs.
12. Glandular. Bearing secreting organs.
13. Habit. The general mode of growth.
14. Imbricate. Overlapping, as shingles on a roof.
15. Incised. Slashed irregularly, more or less deeply and sharply.
16. Keeled. Ridged like the bottom of a boat.
17. Lamellate. Having thin, flat plates.
18. Leaflet. One part of a compound leaf.
19. Lenticels. Small wart-like dots or patches on the twig surface.
20. Margin. The edge of the leaf blade.
21. Mucronate. Terminated abruptly by a distinct point.
22. Obtuse. Blunt, rounded.
23. Opposite. Arranged opposite to one another on the stem.
24. Palmate. Lobed or divided in a palm-like or hand-like fashion.

25. Pinnate. With the leaflets of a compound leaf placed on either side of the axis.

26. Prickle. A small, weak spine-like body borne irregularly on the bark or epidermis.

27. Procumbent. Trailing or lying flat, but not rooting.

28. Pubescent. Covered with short, soft hairs.

29. Rhombic. Diamond-shaped.

30. Simple. Composed of a single part.

31. Spine. A strong, sharp-pointed, woody body mostly arising from the wood of the stem.

32. Stellate. Star-like.

33. Stoloniferous. Bearing stolons (shoots that bend to the ground and take root.

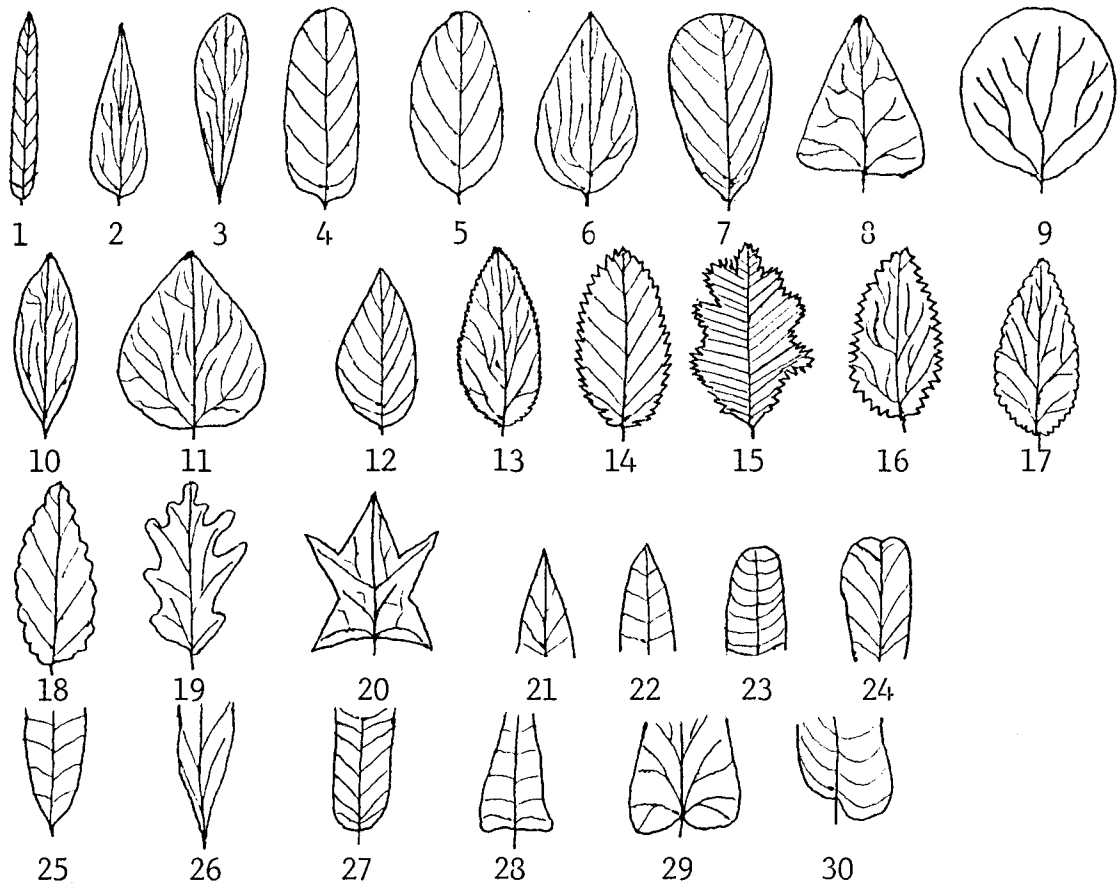
34. Sub. A prefix signifying somewhat or slightly.

35. Tomentose. With matted, soft, wool-like hairs.

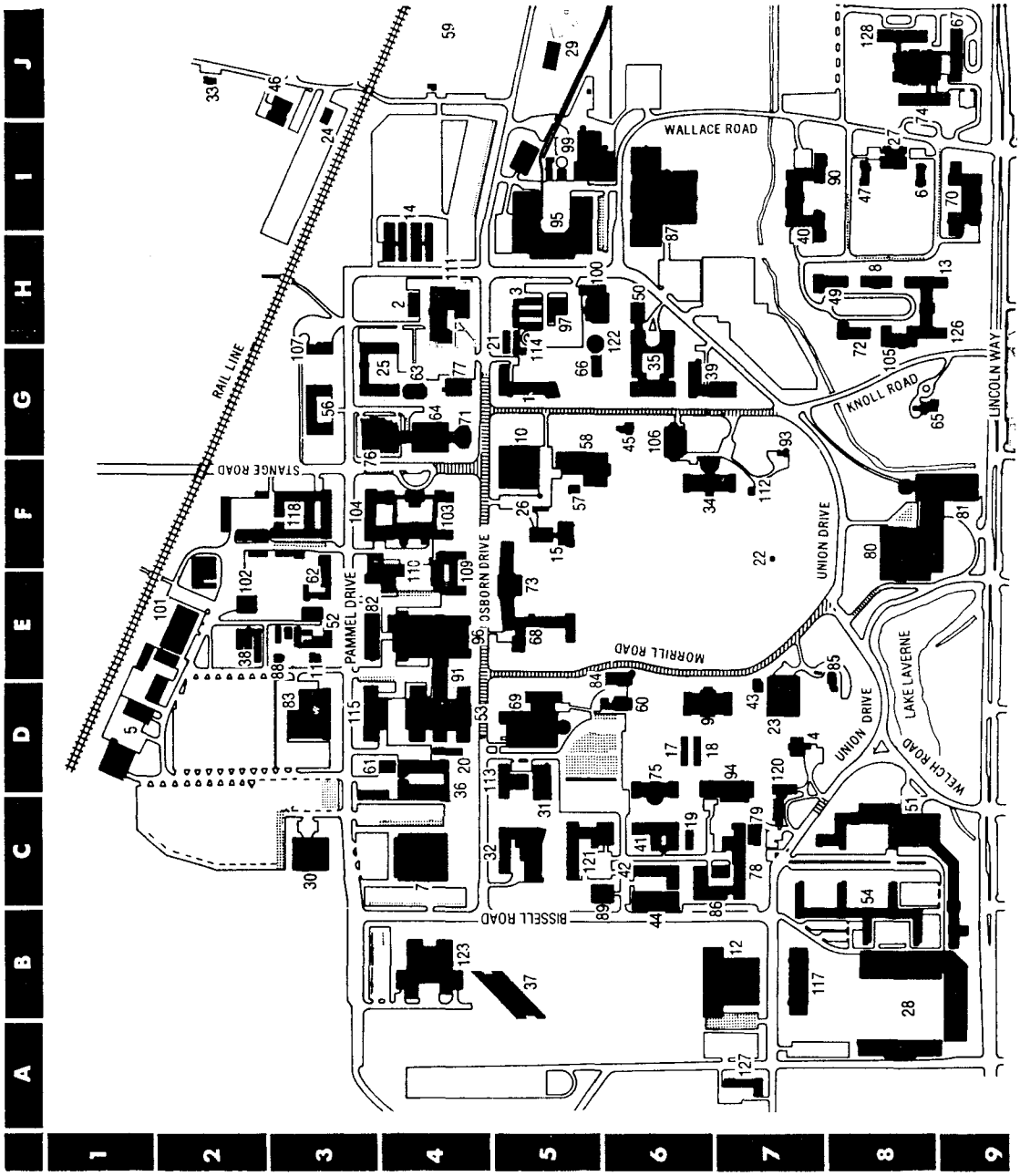
36. Toothed. With the edge of the leaf blade separated into sharp or blunt projections.

37. Undulate. Wavy (up and down, not in and out), as some leaf margins.

38. Whorled. Arranged about a common point on the stem.



1. Linear
2. Lanceolate
3. Oblanceolate
4. Oblong
5. Oval
6. Ovate
7. Obovate
8. Deltoid
9. Orbiculate
10. Elliptic
11. Cordate
12. Entire
13. Serrulate
14. Serrate
15. Doubly serrate
16. Dentate
17. Crenate
18. Sinuate
19. Pinnately lobed
20. Palmately lobed
21. Acuminate
22. Acute
23. Rounded
24. Emarginate
25. Cuneate
26. Attenuate
27. Rounded
28. Truncate
29. Cordate
30. Unequal


A
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WALLACE ROAD
RAIL LINE
STANGE ROAD
PAMMEL DRIVE
OSBORN DRIVE
MORRILL ROAD
BISSELL ROAD
UNION DRIVE
KNOLL ROAD
LINCOLN WAY
LAKE LAVERNE
WELCH ROAD

Inventory of the Species

Aceraceae

Acer ginnala Maxim.	
Acer griseum Pax	G-9
Acer negundo L.	
Acer nigrum Michx.	
Acer platanoides L.	
Acer platanoides L. 'Crimson King'	
Acer platanoides L. 'Schwedleri'	
Acer rubrum L.	
Acer saccharum Marsh.	
Acer saccharinum L.	
Acer saccharinum L. var. laciniatum Pax.	
Acer tataricum L.	

Anacardiaceae

Cotinus coggygria Scop.	
Cotinus coggygria Scop. var. purpurea Rehd.	
Rhus aromatica Ait.	
Rhus coppalina L.	
Rhus glabra L.	
Rhus typhina L.	
Rhus typhina L. var. laciniata Wood	
Toxicodendron radicans Kuntze.	

Apocynaceae

Vinca minor L.	D-7

Aquifoliaceae

Ilex verticillata Gray	

Araliaceae

Acanthopanax sieboldianus Mak.	F-4
Hedera helix L. var. baltica Rehd.	F-6

Aristolochiaceae

Aristolochia durior Hill.	G-8

Berberidaceae

Berberis x mentorensis Ames	
Berberis thunbergii D.C.	

Berberis thunbergii D.C. var. atropurpurea Chenault	
Berberis thunbergii D.C. 'Crimson Pigmy'	
Mahonia aquifolium Nutt.	D-7

Betulaceae

Alnus glutinosa Gaerth.	D-8
Betula papyrifera Marsh.	F-5
Betula pendula Roth.	D-8
Betula nigra L.	D-8
Betula lenta L.	C-7
Carpinus caroliniana Walt.	G-8
Corylus americana Marsh.	E-9
Corylus avellena L. var. contorta Bean.	I-6
Corylus columa L.	G-9
Ostrya virginiana Koch.	A-2

Bignoniaceae

Campsis radicans Seem.	E-3
Catalpa speciosa Warder.	

Buxaceae

Buxus microphylla Sieb. & Zucc. var. koreana Nakai	

Calycanthaceae

Calycanthus florida L.	C-8

Caprifoliaceae

Kolkwitzia amabilis Graebn.	
Lonicera fragrantissima Lind. & Paxt.	H-8
Lonicera japonica Thunb. 'Halliana'	
Lonicera mackii Maxim. var. podocarpa Franch.	
Lonicera maximowiczii Maxim.	E-8
Lonicera morrowii Gray	G-5
Lonicera tatarica L.	
Lonicera x xylosteoides Tausch. 'Clavey's Dwarf'	
Sambucus canadensis L.	
Symphoricarpos albus Blake	
Symphoricarpos occidentalis Hook	G-6
Symphoricarpos orbiculatus Moench.	
Viburnum x burkwoodii Burkw. & Skipw.	I-6
Viburnum x carlcephalum Hort.	
Viburnum carlesii Hemsl.	
Viburnum cassinoides L.	
Viburnum dentatum L.	
Viburnum dilatatum Thunb.	

Viburnum farreri Stearn.	B-7
Viburnum x juddi Rehd.	
Viburnum lantana L.	
Viburnum lentago L.	
Viburnum opulus L.	
Viburnum opulus L. 'Nanum'	
Viburnum opulus L. 'Roseum'	
Viburnum plicatum Thunb. f. tomentosum Rehd.	
Viburnum prunifolium L.	
Viburnum rafinesquianum Schult.	
Viburnum x rhytidophylloides Surina	
Viburnum rhytidophyllum Hemsl.	
Viburnum rufidulum Raf.	
Viburnum sieboldii Miq.	C-8
Viburnum wrightii Miq.	F-8
Weigela florida A.DC. 'Pink Princess'	

Celastraceae

Celastrus orbiculatus Thunb.	F-5
Euonymus alatus Siebold. 'Compacta'	
Euonymus atropurpureus Jacg.	
Euonymus bungeanus Maxim 'Pendula'	C-3
Euonymus europaeus L.	
Euonymus fortunei Hand.-Mazz. f. colorata Rehd.	
Euonymus fortunei Hand.-Mazz. 'Minima'	
Euonymus fortunei Hand.-Mazz. var. radicans Rehd.	
Euonymus fortunei Hand.-Mazz. 'Sarcoxie'	
Euonymus fortunei Hand.-Mazz. var. vegete Rehd.	
Euonymus nanus Bieb. var. turkestanica Dieck.	F-4

Cercidiphyllaceae

Cercidiphyllum japonicum Sieb. & Zucc.	D-5

Cornaceae

Cornus albus L. 'Argento-marginatus'	
Cornus albus L. 'Siberica'	
Cornus alternifolius L.f.	
Cornus amomum Mill	
Cornus florida L.	E-9
Cornus mas L.	B-7
Cornus racemosa Lam.	
Cornus sericea L.	
Cornus sericea L. 'Flaviramea'	

Elaeagnaceae

Elaeagnus angustifolia L.	C-8
Elaeagnus multiflora Thunb.	B-7
Elaeagnus umbellata Thunb.	C-6
Hippophae rhamnoides L.	

Ericaceae

Rhododendron x 'P.J.M. Hybrids'	
Rhododendron yedoense Maxim.	

Fagaceae

Castanea dentata Borkh.	G-8
Fagus grandifolia Ehrh.	F-9
Fagus sylvatica L.	D-5
Quercus acutissima Carr.	E-5
Quercus alba L.	
Quercus bicolor Willd.	D-7
Quercus borealis Michx.	
Quercus coccinea Muenchh.	
Quercus ellipsoidalis E. H. Hill.	D-7
Quercus imbricaria Michx.	
Quercus macrocarpa Michx.	
Quercus muhlenbergii Engelm.	F-6
Quercus palustris L.	
Quercus robur L.	
Quercus robur L. var. fastigiata Kuntze.	C-8
Quercus velutina Lam.	

Ginkgoaceae

Ginkgo biloba L.	

Hamamelidaceae

Hamamelis vernalis Sarg.	B-7
Hamamelis virginiana L.	C-7
Liquidambar styraciflua L.	F-4

Hippocastanaceae

Aesculus x carnea Hayne	D-5
Aesculus glabra Willd.	D-8
Aesculus hippocastanum L.	D-5

Hypericaceae

Hypericum prolificum L.	B-7

Juglandaceae

Carya cordiformis K. Koch.	
Carya ovata K. Koch	A-2
Juglans cathayensis Dode	I-7
Juglans cinerea L.	G-8
Juglans nigra L.	

Lardizabalaceae

Akebia quinata Decne.	H-8

Lauraceae

Lindera benzoin Blume	D-7

Leguminosae

Amorpha fruticosa L.	
Caragana arborescens Lam.	
Caragana frutex Koch	
Cercis canadensis L.	
Cercis canadensis L.var. alba Rehd.	
Cladrastis lutea Koch	
Gleditsia triacanthos L.	
Gleditsia triacanthos L. var. inermis	
Gymnocladus dioica Koch	G-6
Robinia pseudoacacia L.	
Sophora japonica L.	D-7

Lilaceae

Yucca filamentosa L.	C-9

Magnoliaceae

Liriodendron tulipifera L.	E-5
Magnolia acuminata L.	E-8
Magnolia x soulangeana Soul.	F-4
Magnolia stellata Maxim.	I-6

Moraceae

Maclura pomifera Schneid.	H-6
Morus alba L.	
Morus rubra L.	

Myricaceae

Myrica pensylvanica Loisel.

Nyssaceae

Nyssa sylvatica Marsh.	C-8

Oleaceae

Fontanesia fortunei Carr.	B-9
Forsythia x intermedia Zabel	
Forsythia x intermedia Zabel 'Arnold's Dwarf'	
Forsythia ovata Nakai	
Forsythia suspensa Vahl.	
Forsythia viridissima Lindl.	
Fraxinus americana L.	
Fraxinus quadrangulata Michx.	F-5
Fraxinus pennsylvanica Marsh.	
Fraxinus pennsylvanica Marsh. 'Marshall's Seedless Ash'	
Ligustrum amurense Carr.	
Ligustrum x vicaryi	J-9
Ligustrum vulgare L.	
Syringa x chinensis Willd.	
Syringa patula Nakai	E-3
Syringa x persica L.	
Syringa reticulata Hara	
Syringa reticulata Hara var. mandeschurica Hara.	
Syringa villosa Vahl.	
Syringa vulgaris L.	

Pinaceae

Abies concolor Lindl. & Gord.	
Juniperus chinensis L.	
Juniperus communis L.	
Juniperus horizontalis Moench.	
Juniperus sabina L.	
Juniperus virginiana L.	
Larix decidua Mill.	
Larix laricina K. Koch	E-7
Picea abies Karst.	
Picea glauca Voss.	D-7
Picea pungens Engelm. var. glauca Beiss	
Pinus banksiana Lamb.	
Pinus bungeana Zucc.	H-6
Pinus flexilis James	
Pinus mugo Turra.	
Pinus nigra Arnold.	
Pinus ponderosa Dougl.	

Pinus resinosa Ait. F-8
Pinus strobus L.
Pinus sylvestris L.
Pseudotsuga menziesii Franco.
Thuja occidentalis L.
Tsuga canadensis Carr.

Platanaceae

Platanus occidentalis L.

Polygonaceae

Polygonum cuspidatum Sieb. & Zucc. J-8
Polygonum reynoutria Makino F-5

Ranunculaceae

Clematis x jackmani Th. Moore.
Clematis lanuginosa Lindl.
Clematis paniculata Thunb.
Clematis virginiana L..

Rhamnaceae

Rhamnus cathartica L.
Rhamnus spathulaefolia Fisch. & Mey. B-2

Rosaceae

Amelanchier canadensis Med.
Amelanchier laevis Wieg.
Amelanchier interior Nielsen
Aronia melanocarpa Elliot
Chaenomeles japonica Lindl.
Chaenomeles speciosa Nakai E-5
Cotoneaster acutifolius Turcz. F-5
Cotoneaster apiculatus Rehd. & E. H. Wils. D-7
Cotoneaster divaricatus Rehd. & E. H. Wils. F-7
Cotoneaster lucidus Schlechtend. G-8
Cotoneaster racemiflorus J. R. Booth var. soongoricus C. K. Schneid. F-8
Crataegus crus-galli L.
Crataegus laevigata D.C.
Crataegus mollis Scheele
Crataegus phaenopyrum Medic
Crataegus punctata Jacq.
Exochorda x macrantha Schneid. 'Pearl' D-5
Malus x arnoldiana Rehd.
Malus baccata Borkh. 'Columnaris'
Malus ioensis Britt. 'Plena'

Malus x purpurea Rehd.
Malus sargentii Rehd.
Malus sylvestris Mill.
Malus zumi Rehd. var. calocorpa Rehd.
Physocarpus opulifolius Maxim. var. nanus Zabel
Prunus americana Marsh.
Prunus cerasifera J. F. Ehrh. 'Atropurpurea'
Prunus cerasifera J. F. Ehrh. 'Newportii'
Prunus x cistina N. E. Hansen
Prunus glandulosa Thunb.
Prunus padus L. var. commutata Dipp. G-5
Prunus serotina J. F. Ehrh.
Prunus tomentosa Thunb.
Prunus triloba Lindl. 'Multiplex'
Prunus virginiana L.
Potentilla fruticosa L.
Pyrus calleryana Decne 'Bradfordi'
Pyrus communis L. F-5
Pyrus ussuriensis Maxim. D-5
Rhodotypus scandens Mak
Rosa x Hybrid Tea, Floribunda, Grandiflora hybrids
Rosa blanda Ait.
Rosa setigera Michx.
Rosa spinosissima L.
Rosa virginiana Mill.
Sorbus aucuparia L.
Spiraea albiflora Zab.
Spiraea x bumalda Burv. 'Anthony Waterer'
Spiraea x bumalda Burv. 'Froebelii'
Spiraea chamaedrifolia L.
Spiraea japonica L. f. var. fortunei Rehd.
Spiraea nipponica Maxim. var. tosaensis Mak.
Spiraea prunifolia Sieb. & Zucc. var. plena Schneid.
Spiraea thunbergii Sieb.
Spiraea x vanhoutei Zab.

Rubiaceae

Cephalanthus occidentalis L. D-8

Rutaceae

Phellodendron amurense Rupr.
Ptelea trifoliata L.
Xanthoxylum americanum Mill.

Salicaceae

Populus alba L.
Populus alba L. var. pyramidalis Bunge

Populus deltoides Marsh.
Populus grandidentata Michx.
Populus tremuloides Michx. E-9
Salix alba L.
Salix alba L. var. tristis Gandin
Salix alba L. var. vitellena J. Stokes
Salix amygdaloides Anders.

Saxifragaceae

Deutzia gracilis Sieb. & Zucc.
Hydrangea paniculata Sieb. var. grandiflora Sieb. F-7
Philadelphus coronarius L.
Philadelphus inodorus L.
Philadelphus laxus Schrad.
Philadelphus x lemoinei Lemoine
Philadelphus pubescens Loisel var. verrucosus S.Y. Hu
Philadelphus x virginalis Rehd.
Ribes alpinum L.
Ribes americanum Mill.
Ribes aureum Pursh
Ribes odoratum Wendl.
Ribes missouriensis Nutt.

Simaroubaceae

Ailanthus altissima Swingle

Solanaceae

Solanum dulcamara L.
Lycium chinense Mill.

Staphyleaceae

Staphylea trifolia L.

Taxodiaceae

Taxodium distichum L. Rich
Taxus cuspidata Siebold & Zucc.
Taxux x media Rehd.

Thymelaeaceae

Dirca palustris L. H-8

Tiliaceae

Tilia americana L.	
Tilia cordata Mill.	
Tilia x euchlora C. Koch. 'Redmondi'	I-9
Tilia platyphyllos Scop. 'Fastigiata'	I-9
Tilia tomentosa Moench	C-7

Ulmaceae

Celtis occidentalis L.	
Ulmus americana L.	
Ulmus carpinifolia Gleditsch.	
Ulmus carpinifolia Gleditsch. 'Christine Buisman;	E-3
Ulmus glabra Huds.	G-5
Ulmus parvifolia Jacq.	
Ulmus procera Salisb.	
Ulmus pumila L.	
Ulmus rubra Muhlenb.	

Vitaceae

Parthenocissus quinquefolia Planch.
Parthenocissus tricuspidata Planch.
Vitis riparia Michx.

CHAPTER IV. CONCLUSION

This study has resulted in the identification, collection, and photographing of 290 species along with several subspecies of woody plants found on the Iowa State University Campus. These plants, representing a total of 49 plant families, have been arranged alphabetically according to family, genus, species, and subspecies in a complete inventory of the campus woody flora. The color slides and the herbarium specimens have been placed on file in the respective departments of Horticulture and Botany. A key to all the members of the woody flora has been developed. It is hoped that the key, inventory, herbarium specimens, and colored slides will serve as teaching aids to instructors of many of the plant identification classes on campus and help encourage botanical accuracy in these classes. The author has also provided a suggestion to instructors that can help promote botanical accuracy.

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