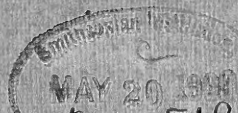


Proceedings
of the
Ohio State
Academy of Science

VOLUME V, PART 3

Special Paper No. 15





11
22
NO. 15-19
N/H
PROCEEDINGS OF THE OHIO STATE ACADEMY OF SCIENCE

Volume V, Part III. Special Paper No. 15

Trees of Ohio and Surrounding Territory

Including the Area Westward to the Limits of
the Prairie and South to the Thirty-
Seventh Parallel.

By

JOHN H. SCHAFFNER

Ohio State University

PUBLICATION COMMITTEE

J. C. Hambleton

E. L. Rice

Bruce Fink

Date of Publication, April 30, 1909

Published by the Academy
Columbus, Ohio

NOTE.

The expense of publication of this paper is covered by a special grant from the Emerson McMillin Research Fund.

WILLIAM R. LAZENBY,

E. L. RICE,

FRANK CARNEY,

Trustees.

COPYRIGHT, 1909

BY

JOHN H. SCHAFFNER

PREFACE.

This manual is intended to aid the amateur botanist and nature student in identifying the trees of Ohio and surrounding territory. There are many books which treat entertainingly of the trees of our region, and these may be of great profit to such as know the plants described. Without such knowledge the reading of popular or scientific descriptions can not be of very much value. The real student desires more especially a first hand acquaintance, and it is hoped that the present volume will be of service to those who wish a direct contact with nature.

The keys have been made very complete so that no difficulty should be encountered in identification except in the case of closely related species. No elaborate technical descriptions have been given but a few brief notes are added in connection with each species, calling attention to economic, ecological, or other data of general interest. Characters given in the keys are usually not repeated in the descriptions.

A single English name is given for each species. These names have been taken mainly from Sudworth's "Check List of the Forest Trees of the United States," which on the whole seems to be a very satisfactory basis for an appropriate list. Synonyms will be found in the index. The nomenclature used is essentially that of Britton's Manual.

Most of our common, cultivated, exotic trees have been included, since these form an integral part of the landscape, in many places more conspicuous than the native species. No attention has been paid to the recent effusive treatment of *Crataegus*. All the trees known to occur in Ohio have been especially mentioned as such.

The study of trees may be made a pleasant and profitable pastime at any season of the year for all who have an interest in nature. When the tree has once been identified its peculiarities should be learned by direct observation until its individuality be-

comes perfectly familiar. In winter one can usually find dry leaves or fruit on the trees, which will make it possible to tell most of the species at a time when many think botanical study out of season.

J. H. S.

INTRODUCTION.

A tree may be defined as — a woody plant of any size which produces naturally one main, erect stem with a definite crown of branches. A shrub is a woody plant which produces small irregular or slanting stems usually in tufts. In attempting to separate “trees” from the larger “shrubs,” one must necessarily be somewhat arbitrary as nature draws no definite division line.

A tree has three main parts, the root system, the stem or trunk, and the crown of branches. The root system is for support in the soil and for taking up water and various mineral substances. This is accomplished by delicate organs called root hairs developed near the root tips. Although largely dependent on their environment the roots still have considerable selective power in taking up the salts dissolved in the soil water. The root system may have a main or tap-root extending deep into the ground with smaller lateral roots; or the tap-root may be only slightly developed or entirely absent, in which case a number of larger branch roots may extend downward from the base of the trunk. The roots which extend laterally near the surface sometimes run to a great distance. Such roots are called tracing roots.

The trunk or bole is a supporting and conducting organ. The water with dissolved mineral substances taken up by the roots passes up through the young wood or xylem while the food material from the young twigs and leaves passes up or down through the phloem cells of the inner bark. There are no real vessels for carrying food and water like the blood vessels of animals, but the sap passes through by osmosis from one cell to another or from one set of cells to another as it frequently happens when some of the cross walls are broken down in a vertical series of cells. The large cells in the wood, however, are called wood vessels. Just how the water is able to pass up to the tops

of high trees is not fully understood. In early spring, as in the sugar maple, the water accumulates in the sap wood since there are no leaves from which it can be thrown off above.

The crown is a system of branches on which the leaves are developed and exposed to the light. In the leaves most of the food is manufactured which the tree uses for its growth and nourishment. This production of organic food is carried on through the agency of sunlight and chlorophyll, as the green coloring matter is called. Another important function of the leaves is the transpiration of the surplus water brought up from below. The water transpired by a large tree in a single day is often very great in amount. The leaves are also important breathing organs, although not exclusively so; for all the living cells in the entire plant carry on the process of respiration.

The system of branching in the crown may be of various types. If the main trunk of a tree extends upward through the crown to the tip it is said to be excurrent, as in the larch and Austrian pine. When the terminal bud has no pre-eminence over others and the main trunk is soon lost, the tree is round-topped or spreading and is said to be deliquescent, as in the apple. Excurrent trees are often spire-shaped like the Norway spruce; while deliquescent stems commonly give rise to dome-shaped crowns, as in the white elm. If the terminal bud withers or is self-pruned, as in the linden, the branching is sympodial. If the leaves are opposite and the two lateral end buds develop, the terminal bud being self-pruned, the result is a sympodial dichotomy, as in the bladdernut. Trees in which the terminal buds are persistent and functional are said to have a monopodial system of branching.

The trunk or any branch of a coniferous or dicotylous tree consists of four main parts, the pith, the wood, the cambium or growing layer, and the bark. The wood consists of a series of annual rings, since if normal growth takes place only a single ring is produced each year. Each ring usually consists of two layers called early wood and late wood. During special seasons or if growth is checked at times during the growing period more than one ring may be produced, although this is never perfect and

can usually be detected by careful examination. In most trees the inner part of the wood and the pith are dead and this is called the heart wood or duramen, while the outer wood is lighter in color with living cells next the cambium layer, and is called the sap-wood or alburnum. Sometimes there is a striking difference in the color of the two parts. Strands of cells pass from the pith or annual rings through the wood to the bark. These are called medullary rays. The peculiar qualities of wood are due to the character of its cells which have their walls lignified or thickened by a deposit of a chemical substance called lignin.

The bark usually consists of two main layers called inner bark and outer bark. The inner bark is often in very thin layers and is hence called liber. The outer bark is very diverse in character. Usually it consists mainly of layers of cork cells which are very impervious to water. Since the outer bark usually does not increase in diameter as rapidly as the wood it is finally torn into strips and peels off on the outside. Trees have many interesting ways of developing and getting rid of their outer bark.

More commonly the outer bark is developed as follows: In a young main stem or twig there is a tissue between the outer layer of cells or epidermis and the circle of vascular bundles which is called the cortex. While the stem is developing and hardening, the outermost layer of cortical cells just below the epidermis is modified and begins to grow. This layer is the cork cambium or phellogen. The layer of tissue thus formed by the repeated divisions of the cells of the phellogen is called the periderm or cork. On the inner side of the phellogen another layer of tissue is produced which is called the phellogerm or secondary cortex. The phellogen may continue to produce periderm until the outer bark becomes very thick; and finally new cork cambiums may develop farther in in the cortex or even in the phloem of the inner bark. In some plants the cork cambium originates from the epidermis and in some from the deeper layers of the cortex.

Some trees have no special means of shedding their leaves while others shed them only after a year or more. Most of our indigenous species are "deciduous," that is they cast their leaves

at the end of each growing season by the formation of a cleavage plane or separation layer through the base of the petiole. They also prepare for winter by developing elaborate winter buds. The function of the winter buds is mainly to check evaporation from the delicate stem tips during the periods of freezing and thawing.

Many of the smaller branches and twigs of a tree especially when growing in a dense forest are continually dying off. But the tree rids itself of these dead branches by forming a collar of tissue from the cambium layer around the base of the dead branch, which finally covers over the wound when the dead member falls off. This process is known as natural pruning. By the formation of a similar callus other wounds are covered up. There is still a more remarkable process present in many trees by which surplus living branches are cut off in one way or another. Terminal and lateral buds are also commonly cut off. This process is known as self-pruning. The most common method is by the formation of a cleavage plane in a basal joint or in the annual nodes of growth. In some genera brittle zones are produced. The self-pruning process is very highly developed in the cottonwood, white oak, white elm, and silver maple.

Trees grow in height only at the tips of the main stem or branches. Some trees are naturally shortlived; others attain an enormous size and age, but from the very nature of their upright development their life must sooner or later come to an end. In some cases the individual organism may continue by a new development from sprouts growing out of the stump or the roots.

All of our trees bear flowers and seeds. After arriving at a certain age depending on the species, the tips of some twigs or the axillary buds will develop flowers. In the more highly developed and typical flowers four sets of organs are present; the calyx composed of sepals, the corolla composed of petals, the androecium composed of stamens, and the gynoecium composed of carpels. The two essential sets of organs in the flower are the stamens and the carpels. These may both be in the same flower, when the flower is said to be bisporangiate or in separate flowers, when the flower is monosporangiate. If the two kinds of flowers are on one individual the plant is monoecious, if on

two distinct individuals the plant is dioecious. The stamens produce microsporangia and the carpels megasporangia or ovules. In the angiosperms the carpel usually has three parts called stigma, style, and ovary, the ovules being completely inclosed in the ovary. Commonly all the carpels of the gynoecium are grown together and in such cases a compound ovary is produced with one or more cavities.

Following a peculiar process known as reduction, which takes place in the cells inside of the microsporangium, a considerable number of microspores are developed, four for each original cell. In nearly the same way, four megaspores one of which survives, are usually produced in each ovule. The flowers are thus modified spore-bearing branches or shoots producing two kinds of nonsexual spores. The flowers are nonsexual organs and the tree itself is always a nonsexual plant called the sporophyte. The microspores germinate and develop into the pollen grains and the megaspores into the so-called embryo sacs, or minute, parasitic, male and female gametophytes respectively. After pollination has taken place, which is simply the transfer of the pollen to the ovules or the stigmas, a tube grows from the pollen grain into the embryo sac. The two sperm cells produced in the pollen grain or in the pollen tube pass down the tube and one unites with the egg cell of the female gametophyte. This union of sperm and egg is called fertilization. The resulting cell which is the oospore germinates and gives rise to an embryo inside of the ovule, the whole finally constituting the body called the seed. This embryo in the seed is the sporophyte and after sprouting develops into the tree. The seed is produced inside of or in connection with the modified carpels and other contiguous parts, the whole being called the fruit. The fruits of our trees are of many types usually with some adaptation for seed distribution, so that the seed with its little embryonic tree inside may be carried away from the parent plants to some other and perhaps more favorable environment. Here, if conditions are proper, it sprouts and begins its life as an independent individual. The whole process of flower, seed, and fruit production is exceedingly complex and requires close study and observation if one would know the more obscure activities going on during the life cycle of a tree.

KEY TO THE GENERA OF TREES IN THE SUMMER CONDITION.

Based mainly on leaf and twig characters. The number following the generic name refers to the list number.

1. Foliage leaves with expanded blades, netted-veined. 8.
1. Foliage leaves needle-shaped, narrowly linear, subulate, or scale-like; conifers. 2.
1. Foliage leaves fan-shaped with dichotomous venation, a number on thick, wart-like, persistent dwarf branches. **Ginkgo.** (1).
2. With typical dwarf branches, persistent for more than 1 year. 3.
2. With feather-like dwarf branches, deciduous each year, the linear leaves spreading into 2 ranks. **Taxodium.** (7).
2. Without dwarf branches. 4.
3. Dwarf branches small, self-pruned, with 2-5 foliage leaves. **Pinus.** (2).
3. Dwarf branches thick, wart-like, persistent, with numerous deciduous leaves. **Larix.** (3).
4. Leaf buds scaly; leaves scattered. 5.
4. Leaf buds not scaly, naked; leaves opposite or whorled. 7.
5. Leaf scar on a sterigma, the twigs covered with scales representing the leaf bases. 6.
5. Leaf scar on the bark; twigs without scales; leaves flat. **Abies.** (6).
6. Leaves flat, those on the upper side of the twig much shorter than the lateral ones; trees. **Tsuga.** (5).
6. Leaves more or less 4-sided, spreading in all directions. **Picea.** (4).
7. Foliage leaves small, scale-like, appressed, opposite, 4-ranked, closely covering the twigs which are decidedly flattened and fan-like; leaves of two shapes, the dorsal and ventral broader and less acute than the lateral ones; scales of the carpellate cone not peltate. **Thuja.** (8).

7. Foliage leaves small, scale-like, appressed, opposite, 4-ranked, closely covering the slightly flattened twigs which are not very fan-like; leaves nearly or quite similar; scales of the carpellate cone peltate.

Chamaecyparis. (9).

7. Foliage leaves of two types, scale-like and subulate, opposite or in threes; the scale-like leaves 4-ranked, appressed, causing the twigs to appear quadrangular, the subulate leaves spreading; one or both types of leaves on a plant; carpellate cone developing into a bluish-black berry-like fruit. **Juniperus.** (10).

—8—

8. Leaves alternate. 9.
 8. Leaves opposite or whorled. 74.
 9. Leaves simple. 10.
 9. Leaves compound. 62.
 10. Leaves pinnately veined or with a simple midrib. 11.
 10. Leaves palmately veined or at least with 2 or more prominent side ribs coming from near the base of the blade. 53.
 11. Leaves truncate or broadly emarginate; with complete stipular rings at the nodes. **Lirodendron.** (33).
 11. Leaves entire. 12.
 11. Leaves serrate, dentate, crenate, pinnatifid, or variously lobed. 25.
 12. With stipular rings at each leaf node; leaves large. **Magnolia.** (32).
 12. Not with stipular rings. 13.
 13. With thorns and milky sap. 14.
 13. Without thorns; sap not milky. 15.
 14. With thorns beside the axillary buds; leaves not tapering at the base, acute or even heart-shaped. **Toxylon.** (27).
 14. With terminal thorns and some axillary thorns; leaves tapering to the base; narrow or slender-cuneate. **Bumelia.** (65).

15. Leaves evergreen, coriaceous, some on wood of the previous season. 16.
15. No leaves on wood of the previous season. 17.
16. Leaves green on both sides, thick, coriaceous, oblong to oblanceolate, 5-10 in. long; winter buds very scaly.
Rhododendron. (62).
16. Leaves green on both sides, or glaucous beneath, coriaceous, 2-5 in. long; oval or oval-lanceolate, winter buds naked. **Kalmia.** (63).
17. Pith with prominent diaphragms but solid; vascular bundles in base of petiole 3-7. 18.
17. Pith not both diaphragmed and solid, but sometimes with lenticular cavities. 19.
18. Leaves 2-ranked; bark with fetid odor; vascular bundles in base of petiole 5-7. **Asimina.** (34).
18. Leaves not 2-ranked; vascular bundles in base of petiole 3. **Nyssa.** (76).
19. Leaves resin-dotted, waxy-dotted or punctate, oblong-lanceolate, spatulate, or oblanceolate, short-pointed, narrowed at the base. **Myrica.** (13).
19. Leaves not dotted nor punctate. 20.
20. Pith prominently 5-angled; leaves with deciduous stipules and with bristle tips. **Quercus.** (22).
20. Pith cylindrical or nearly so; leaves not bristle-tipped. 21.
21. Leaves with the upper 2 lateral veins more or less parallel with the midrib. **Cornus.** (75).
21. Leaves pinnately veined to the tip. 22.
22. Bundle scar central; pith sometimes diaphragmed with lenticular cavities. 23.
22. Bundle scars 2 or more; pith without lenticular cavities. 24.
23. Leaves truncate or short-pointed at the base, usually widest below the middle or somewhat oblong, glabrous when mature; fruit a large pulpy berry, very astringent when green. **Diospyros.** (66).

23. Leaves pointed at the base, widest above the middle, lower surface pubescent; fruit a nut-like drupe. **Symplocos.** (67).
24. With prominent deciduous stipules; bark not resinous. **Cydonia.** (39).
24. Without stipules; bark resinous, aromatic. **Cotinus.** (53).
- 25—
25. Lateral veins from the midrib straight and parallel or nearly so; some or all lateral veins usually ending in the serrations, teeth or lobes. 26.
25. Lateral veins not straight and parallel. 37.
26. Leaves not 2-ranked. 27.
26. Leaves quite regularly 2-ranked, that is with the third leaf over the first. 30.
27. Pith 3-angled, buds stalked. **Alnus.** (19).
27. Pith 5-angled, buds not stalked. 28.
27. Pith cylindrical or nearly so. 29.
28. Leaves or their lobes bristle-tipped, or if not bristle-tipped then the teeth or lobes not sharply acuminate; buds clustered at the tip of the twig; nut in a cup-like involucre of numerous scales. **Quercus.** (22).
28. Leaves with sharply acuminate teeth; buds not clustered at the tip; nuts with a prickly or spiny involucre. **Castanea.** (21).
29. Usually with prominent and typical lateral thorns; carpels of the pome bony. **Crataegus.** (41).
29. Without thorns but sometimes with thorn-like stunted branches; leaves irregularly dentate, serrate, or crenate-dentate; sometimes lobed; pome fleshy without grit cells; carpels papery or leathery. **Malus.** (38).
29. Without thorns; leaves serrate or serrate-dentate; pome berry-like, carpels not bony. **Amelanchier.** (40).
30. Leaves decidedly inequilateral at the base. 31.
30. Leaves not inequilateral or only very slightly so. 32.
31. Axillary buds prominently stalked; leaves repand-dentate. **Hamamelis.** (29).

31. Buds sessile; leaves doubly serrate; bark not scaling off in plates. **Ulmus.** (23).
31. Buds sessile; leaves serrate; bark scaling off in plates like in the Sycamore. **Planera.** (24).
32. Lateral veins ending in the large dentations or serrations which are always simple (a vein for each). 33.
32. Leaves doubly serrate or sometimes simply serrate, the lateral veins ending in the main serrations or teeth but not in the smaller ones, or the veins not ending in the serrations. 34.
33. Leaves ovate or ovate-oblong, short acuminate; teeth not with slender points; bark smooth, light-gray.
Fagus. (20).
33. Leaves oblong-lanceolate, acuminate, with slender often inwardly curved points on the serrations; bark rough.
Castanea. (21).
34. Lateral veins not ending in the serrations or teeth.
Amelanchier. (40).
34. Lateral veins ending in some of the serrations, teeth or lobes. 35.
35. Bark smooth, the trunk and larger branches with fluted or projecting ridges; leaves acute or acuminate, sharply doubly serrate; nuts small, in a large-bracted catkin.
Carpinus. (16).
35. Trunk and larger branches not with fluted or projecting ridges. 36.
36. Bark of trunk and larger branches separating into papery or leathery sheets; trees or shrubs with glabrous, pubescent, or glandular-warty twigs. **Betula.** (18).
36. Bark of trunk scaly, fine furrowed; twigs pubescent; carpellate catkin in fruit appearing like that of the hop.
Ostrya. (17).
36. Bark scaling off in plates like in the Sycamore; fruit coriaceous, nut-like. **Planera.** (24).

37. Leaves 2-ranked. 38.
37. Leaves not 2-ranked. 39.

38. Bark of trunk and larger branches separating into papery or leathery sheets; leaves doubly serrate, the lateral veins ending in the main serrations, teeth or lobes. **Betula.** (18).
38. Bark not in papery or leathery sheets; leaves not doubly serrate, the lateral veins not ending directly in the serrations or teeth. **Amelanchier.** (40).
39. Leaves not with spines. 40.
39. Leaves evergreen, with spine-tipped lobes. **Ilex.** (54).
40. Pith not solid, diaphragmed, with lenticular cavities: 41.
40. Pith solid but with prominent diaphragms; vascular bundles 3 in the base of the petiole. **Nyssa.** (76).
40. Pith solid, without diaphragms. 42.
41. Leaves oval or obovate, serrate or denticulate, abruptly acuminate, wedge-shaped at the base, more or less stellate pubescent beneath; bark of twigs peeling off in slender shreds; fruit 4-winged. **Mohrodendron.** (68).
41. Leaves oblong or slightly obovate, acute or acuminate at both ends, crenate-serrate or repand, short petioled; twigs of the season and lower surface of leaves pubescent, not stellate; fruit a nut-like drupe. **Symplocos.** (67).
42. Leaves with peltate scales, or resin-dotted, oblanceolate or wedge-lanceolate. **Myrica.** (13).
42. Leaves not peltate scaly, nor resin-dotted. 43.
43. Outer bud scales of winter buds more than 1. 44.
43. Outer bud scale 1; twigs with brittle zones, hence easily detached and leaving peculiar self-pruning scars; terminal bud of ripe branches absent; bundle scars or vascular bundles in base of petiole. 3. **Salix.** (12).
44. Pith decidedly 5-angled. 45.
44. Pith cylindrical or nearly so. 46.
45. Bundle scars 3; leaves with gland-tipped teeth, usually broad-based, usually with 2 prominent glands at the base of the blade. **Populus.** (11).
45. Bundle scars several, scattered; leaves without glands; buds clustered at the tip of the twig. **Quercus.** (22).

46. With stipules or stipular scars. 47.
46. Without stipules or stipular scars; leaves sour, with prominent scattered hairs on the midrib beneath; trees; fruit a capsule. **Oxydendrum.** (64).
47. With typical lateral thorns; fruit a drupe-like pome with bony ripe carpels. **Crataegus.** (41).
47. Not with typical lateral thorns, but some may have thorn-like stunted branches. 48.
48. Leaves with 1 or more disc-like, wart-like, or tooth-like glands on the petiole or at the base of the blade. 49.
48. Leaves not with distinct glands on the top of the petiole nor at the base of the blade, but they may be glandular-hairy. 50.
49. Twigs green, red, or red and green; nectar glands disc-like, usually 2-4 near the base at the edge of the blade; terminal bud present; fruit a velvety drupe.
Amygdalus. (43).
49. Glands various; twigs not red and green, some with cleavage planes in basal joints; terminal bud present or absent, fruit a smooth drupe. **Prunus.** (42).
50. Axillary buds usually superposed; leaves lanceolate or oblong-lanceolate, tapering towards the short petiole; fruit a berry-like drupe. **Ilex.** (54).
50. Axillary buds not superposed. 51.
51. Leaves with gland-tipped serrations; terminal bud absent on ripe twigs or if present then the lateral veins prominent and nearly parallel and curving upward at the margin of the leaf; fruit a berry-like drupe.
Rhamnus. (60).
51. Leaves not with gland-tipped serrations, or if so then not as above; terminal bud present; fruit a pome. 52.
52. Leaves sharply and regularly serrate, glabrous when mature, petioles long; pome with grit cells.
Pyrus. (37).
52. Leaves irregularly dentate or serrate, or more or less lobed; pome without grit cells. **Malus.** (38).

—53—

53. Base of petiole covering the axillary bud; twigs with stipular rings. **Platanus.** (31).
53. Axillary buds usually evident; twigs without stipular rings. 54.
54. Leaves 2-ranked. 55.
54. Leaves not 2-ranked. 60.
55. Leaves entire, round-heart-shaped. **Cercis.** (44).
55. Leaves serrate, dentate, or lobed. 56.
56. Pith usually in transverse plates; leaves ovate-lanceolate, inequilateral, taper-pointed. **Celtis.** (25).
56. Pith solid, not diaphragmed. 57.
57. With milky sap. 58.
57. Without milky sap. 59.
58. Twigs gray or brown, glabrous or nearly so; leaves pubescent or glabrous beneath. **Morus.** (26).
58. Twigs grayish-green, downy; leaves tomentose beneath. **Broussonetia.** (28).
59. Leaves not inequilateral; vascular bundles in base of petiole 3. **Betula.** (18).
59. Leaves inequilateral at the base; vascular bundles in base of petiole several, scattered. **Tilia.** (61).
60. Leaves more or less star-shaped, with 3-7 long pointed serrate lobes, strongly aromatic when crushed; pith 5-angled. **Liquidambar.** (30).
60. Leaves entire or three-lobed, bark spicy-aromatic; internodes very unequal. **Sassafras.** (35).
60. Leaves crenate, serrate, dentate, or lobed, not star-shaped and not spicy-aromatic. 61.
61. Pith 5-angled; trees usually with resinous buds; leaves usually broad based. **Populus.** (11).
61. Pith cylindrical or nearly so; usually with prominent typical thorns. **Crataegus.** (41).

—62—

62. Pith diaphragmed, with cavities; large trees with pinnate leaves. **Juglans.** (14).

62. Pith not diaphragmed. 63.
63. Leaves trifoliolate or odd-pinnate. 64.
63. Leaves evenly pinnate or bipinnate; axillary buds superposed. 73.
63. Leaves odd-bipinnate, serrate; twigs and leaves usually prickly. **Aralia.** (74).
64. Lobes or teeth at the base of the leaflets with prominent green glands beneath; leaves pinnate, very large with disagreeable odor. **Ailanthus.** (51).
64. Lobes or teeth if present without green glands. 65.
65. With stipular spines a pair for each leaf; leaflets mostly entire. 66.
65. Without stipular spines, but some may have thorns or prickles. 67.
66. Leaflets oval or ovate, not pointed, usually mucronate, not punctate. **Robinia.** (48).
66. Leaflets ovate, pointed, glandular-punctate.
Xanthoxylum. (49).
67. Base of petiole covering the axillary buds; not prickly. 68.
67. Base of petiole not covering the axillary buds. 70.
68. Leaves 3-foliolate, leaflets crenulate, glandular punctate; bark with disagreeable odor; axillary buds superposed. **Ptelea.** (50).
68. Leaves pinnate, not punctate. 69.
69. Leaflets serrate; pith very large; bark resinous or milky.
Rhus. (52).
69. Leaflets entire; pith small, bark not resinous or milky.
Cladrastis. (47).
70. Leaflets entire or if occasionally few-toothed then the rachis prominently winged. 71.
70. Leaflets serrate or dentate, the rachis not winged. 72.
71. Leaflets decidedly inequilateral, obliquely lanceolate or falcate, acuminate. **Sapindus.** (59).
71. Leaflets not inequilateral or only slightly so, not slender falcate, sometimes poisonous to the touch.
Rhus. (52).

72. Pith 5-angled; stipules none, base of petiole with numerous vascular bundles, scattered or in 3 areas. **Hicoria.** (15).
72. Pith cylindrical or nearly so; leaves with stipules; vascular bundles in base of petiole 3-5. **Sorbus.** (36).
73. Pith small; base of petiole covering the axillary buds; usually with prominent thorns. **Gleditsia.** (45).
73. Pith very large, base of petiole not covering the axillary buds; without thorns. **Gymnocladus.** (46).

—74—

74. Leaves simple. 78.
74. Leaves compound. 75.
75. Leaves digitate with 5 or more leaflets. **Aesculus.** (58).
75. Leaves trifoliolate or pinnate. 76.
76. Base of petiole covering the axillary buds; leaflets dentate, lobed, or nearly entire. **Acer.** (57).
76. Base of petiole not covering the axillary buds. 77.
77. Leaves trifoliolate; bark with strong odor; terminal bud self-pruned. **Staphylea.** (56).
77. Leaflets 5-13; terminal bud present. **Fraxinus.** (69).
78. Leaves pinnately veined. 82.
78. Leaves palmately veined or at least with 2 prominent side ribs from the base. 79.
79. Leaves entire or if somewhat 3-lobed with entire margin. 80.
79. Leaves serrate, crenate, dentate or variously lobed. 81.
80. Pith diaphragmed, or with large cavities; petioles usually hollow; axillary buds superposed. **Paulownia.** (72).
80. Pith and petioles solid; axillary buds not superposed; under side of leaves with glands in the axils of the larger veins. **Catalpa.** (73).
81. Leaves more or less lobed; fruit a 2-winged samara. **Acer.** (57).
81. Leaves not lobed; fruit a drupe. **Rhamnus.** (60).
82. Leaves serrate, dentate, crenate, or variously lobed. 83.
82. Leaves entire. 85.

83. Bark of ripe twigs green, bundles scar or vascular bundle in base of petiole 1; pith rhombic. **Euonymus.** (55).
83. Bark of ripe twigs gray, brown, or red; pith cylindrical or nearly so. 84.
84. Axillary buds sometimes superposed; leaves finely denticulate; twigs light brown, sometimes thorny; drupe narrowly oblong. **Adelia.** (70).
84. Axillary buds not superposed; twigs not 4-angled, brown; flowers epigynous; fruit a fleshy drupe; vascular bundles in the base of the petiole 3. **Viburnum.** (77).
84. Axillary buds not superposed; leaves serrate with stipules, small; bundle scar central; twigs brown, sometimes with thorns; shrub-like trees with drupe-like berries. **Rhamnus.** (60).
85. Leaves coriaceous, evergreen, hence on wood of the previous season. **Kalmia.** (63).
85. Leaves deciduous each year. 86.
86. Leaves with the two outer lateral veins more or less parallel with the midrib; fruit a drupe. **Cornus.** (75).
86. Leaves pinnately veined to the tip, 3-6 in. long, fruit an oblong drupe. **Chionanthus.** (71).

KEY TO THE GENERA OF TREES IN THE WINTER CONDITION.

Based mainly on twig and stem characters. The number following the generic name refers to the list number.

1. Foliage leaves persistent and usually evergreen. 2.
1. Foliage leaves deciduous each year. 11.
2. Foliage leaves needle-shaped, subulate, narrowly linear, or scale-like; conifers. 3.
2. Foliage leaves with expanded blades, netted veined. 8.
3. With dwarf branches, each bearing 2-5 foliage leaves. **Pinus.** (2).
3. Without true dwarf branches. 4.
4. Leaf buds scaly. 5.
4. Leaf buds not scaly, naked. 7.
5. Leaf scar not on a sterigma, prominent, circular; leaves flat. **Abies.** (6).
5. Leaf scar on a sterigma, the base of the leaf remaining as a scale on the twig. 6.
6. Leaves flat, those on the upper side of the twig much shorter than the lateral ones. **Tsuga.** (5).
6. Leaves more or less 4-sided, spreading in all directions. **Picea.** (4).
7. Foliage leaves small, scale-like, appressed, opposite, 4-ranked, closely covering the twigs which are decidedly flattened and fan-like; leaves of two shapes, the dorsal and ventral broader and less acute than the lateral ones; scales of the carpellate cone not peltate. **Thuja.** (8).
7. Foliage leaves small, scale-like, appressed, opposite, 4-ranked, closely covering the slightly flattened twigs which are not very fan-like; leaves nearly or quite similar; scales of the carpellate cone peltate. **Chamæcyparis.** (9).
7. Foliage leaves of two types, scale-like and subulate, opposite or in threes; the scale-like leaves 4-ranked, appressed, causing the twigs to appear quadrangular, the

subulate leaves spreading; one or both types of leaves on a plant; carpellate cone developing into a bluish-black berry-like fruit. **Juniperus.** (10).

- 8. Leaves with spine-tipped lobes or teeth. **Ilex.** (54).
- 8. Leaves without spines. 9.
- 9. Leaves pubescent at least below, lanceolate, mucronate, not evergreen; buds clustered at the tip of the twig; trees with 5-angled pith. **Quercus.** (22).
- 9. Leaves glabrous. 10.
- 10. Leaves green on both sides, thick, coriaceous, oblong to oblanceolate, 5-10 in. long; winter buds very scaly. **Rhododendron.** (62).
- 10. Leaves green on both sides or glaucous beneath, coriaceous, 2-5 in. long, oval to oval-lanceolate; winter buds naked; erect shrubs. **Kalmia.** (63).

—II—

- 11. Twigs with thick wart-like dwarf branches; conifers. 12.
- 11. Twigs without true dwarf branches. 13.
- 12. Young twigs covered with scales. **Larix.** (3).
- 12. Twigs without scales. **Ginkgo.** (1).
- 13. Twigs with numerous small scattered self-pruning scars, without apparent leaf scars but with minute dry scale leaves, with feather-like dwarf branches, some usually remaining in winter; foliage leaves spreading into two ranks; roots often with knees; a conifer. **Taxodium.** (7).
- 13. Twigs with evident leaf scars and lateral winter buds. 14.
- 14. Leaf scars alternate. 15.
- 14. Leaf scars opposite or whorled. 72.
- 15. Twigs with distinct and complete stipular ridges or rings at the leaf nodes. 16.
- 15. Twigs without complete stipular rings. 18.
- 16. Leaf scar surrounding the axillary bud, terminal bud self-pruned; wood with prominent medullary rays. **Platanus.** (31).

16. Leaf scar not surrounding the axillary bud, terminal bud not self-pruned; buds enclosed in the large connate stipules. 17.
17. Buds glabrous; twigs brown; pith diaphragmed; leaf scars oval or circular; bark spicy-aromatic.

Liriodendron. (33).

17. Buds downy, or if glabrous then the twigs red; pith with or without diaphragms; leaf scars U-shaped, oval, or circular; bark usually aromatic. **Magnolia.** (32).
18. With thorns, prickles, or spines; or with spur-like branches ending in thorns. 19.
18. Without thorns, prickles or spines, but some may have thorn-like stunted branches. 26.
19. With stipular spines, a pair for each leaf scar. 20.
19. Twigs with typical lateral thorns, without terminal thorns. 21.
19. With thorns at the ends of branches or with spur-like branches ending in thorns, and in addition axillary thorns may be present. 22.
19. Stems or twigs with prickles; leaf scar extending nearly around the stem, with about 20 bundle scars; pith large. **Aralia.** (74).
20. Leaf scar covering the two or more superposed axillary buds. **Robinia.** (48).
20. Leaf scar below the axillary buds; buds reddish, pubescent. **Xanthoxylum.** (49).
21. With thorns beside the axillary buds; normally one for each leaf axil, becoming gradually smaller toward the tip of the twig, terminal bud absent. **Toxylon.** (27).
21. Thorns axillary, large, rarely branched except on the main trunk; usually with two lateral buds at the base which may develop as twigs; numerous axils without thorns. **Cratægus.** (41).
21. Thorns commonly branched, situated above the axil of the leaf; leaf scar covering the two or more superposed axillary buds; twigs polished, often zigzag.

Gleditsia. (45).

31. Twigs grayish-brown or reddish, usually zigzag; bark mucilaginous fibrous; buds rather fleshy, usually bright red; medullary rays prominent when the bark is removed; the winged fruiting panicle often persistent. **Tilia.** (61).
31. Twigs glabrous or pubescent, reddish or yellowish-brown; pith 5-angled. **Castanea.** (21).
31. Twigs downy, grayish-green; pith white, cylindrical, large; bark very fibrous. **Broussonetia.** (28).
32. Pith interruptedly diaphragmed, with cavities, small, greenish-white. **Celtis.** (25).
32. Pith solid. 33.
33. Terminal bud naked, elongated, tomentose; buds prominently stalked, light gray; twigs zigzag.
Hamamelis. (29).
33. Terminal bud absent, the twig showing a terminal self-pruning scar at the morphological tip; or if present then with scales; buds not stalked. 34.
34. Terminal bud present, long pointed; leaf scar narrow contracted between the bundle scars.
Amelanchier. (40).
34. Terminal bud absent, or if present then the leaf scar oval or semicircular. 35.
35. Twigs dark reddish-brown, speckled, often zigzag; buds reddish-violet, often superposed or clustered; leaf scars not oblique but below the lateral bud.
Cercis. (44).
35. Twigs dark brown, not speckled; buds not superposed; leaf scars oblique. 36.
36. Bark smooth, trunk and large branches with peculiar fluted or projecting ridges; bud scales brown, finely pubescent; staminate catkins in the bud in winter.
Carpinus. (16).
36. Trunk not with fluted or projecting ridges. 37.
37. Bark of trunk scaling off like in the Sycamore; twigs very slender; no catkins. **Planera.** (24).
37. Bark in rough ridges; no catkins; twigs and buds in

most cases pubescent; some species with characteristic transverse self-pruning scars on the twigs, others with corky ridges. **Ulmus.** (23).

37. Bark scaly, fine-furrowed, the furrows usually somewhat spiral; bud scales green with brown tips, nearly glabrous; staminate catkins exposed in winter.

Ostrya. (17).

37. Bark of trunk and larger branches separating into papery or leathery sheets; catkins in winter. **Betula.** (18).

—38—

38. With 2 or more superposed axillary buds; all except 1 may be very small. 39.

38. Axillary buds single or 2 or more side by side; not superposed. 46.

39. Pith diaphragmed, with air cavities. 40.

39. Pith diaphragmed but solid; bundle scars 3; stipular scars none. **Nyssa.** (76).

39. Pith not diaphragmed, solid. 41.

40. Pith large, brown; twigs thick, with large leaf scars and 3 prominent bundle scars. **Juglans.** (14).

40. Pith rather small, white or greenish; leaf scars semi-circular; outer bud scales about 2.

Mohrodendron, (68).

41. Buds partly sunken, hardly projecting beyond the surface; terminal bud self-pruned or tips of branches withering. 42.

41. Buds not sunken in the epidermis. 43.

42. Leaf scar not surrounding the axillary buds; pith large, chocolate-colored; twigs robust, polished, mottled white and purplish-brown. **Gymnocladus.** (46).

42. Leaf scar surrounding the Axillary buds, quadrangular U-shaped; bark with pungent odor; pith white.

Ptelea. (50).

42. Leaf scar covering the axillary buds; pith small; twigs brown, polished, often zigzag. **Gleditsia.** (45).

43. Pith cylindrical or nearly so. 44.

43. Pith more or less 5-angled, yellowish or brownish; terminal bud large; bundle scars scattered; trees with tough twigs. **Hicoria.** (15).
44. Leaf scar surrounding the hairy axillary buds; bundle scars 5-9; terminal bud self-pruned. **Cladrastis.** (47).
44. Leaf scar not surrounding the axillary buds. 45.
45. Bundle scars 3; buds spherical, bark light gray; leaf scars heart-shaped; stipular scars none.

Sapindus. (59).

45. Bundle scar usually 1; buds rounded or somewhat pointed; stipular scars or minute stipules present.

Ilex. (54).

—46—

46. Terminal and lateral buds stalked; pith 3-angled; both staminate and carpellate catkins present all winter.

Alnus. (19).

46. Buds sessile or nearly so; pith not 3-angled. 47.
47. Leaf scars surrounding the axillary buds which are usually sunken; terminal bud self-pruned; bark resinous; pith large. **Rhus.** (52).
47. Leaf scars not surrounding the axillary buds. 48.
48. Bundle scar 1, or if several then closely crowded and confluent, appearing as 1. 49.
48. Bundle scars more than 1. 54.
49. Stipular scars and stipules present. 50.
49. Stipular scars and stipules none. 51.
50. Terminal bud absent; bud scales dark brown or black.

Rhamnus. (60).

50. Terminal bud present; stipules minute, usually persistent. **Ilex.** (54).
51. Terminal bud present. 52.
51. Terminal bud absent. 53.
52. Pith diaphragmed, with cavities; bark reddish; outer bud scales several, short. **Symplocos.** (67).
52. Pith not diaphragmed; bark green, very spicy aromatic; internodes very unequal. **Sassafras.** (35).

53. With polished, greenish-brown, grayish-yellow, or red twigs; bark sour; leaf scar prominent, semi-oval, with a dark central scar usually in the form of a ring; buds small, not projecting much beyond the epidermis; the large terminal paniced raceme with capsules persisting all winter. **Oxydendrum.** (64).
53. With 2 visible scales in the triangular flattened bud; pith sometimes with lenticular cavities; twigs pubescent, zigzag at the tip. **Diospyros.** (66).

—54—

54. Outer bud scales more than 1. 55.
54. Outer bud scale 1; twigs usually with brittle zones and hence very easily detached; stipular scars present; bundle scars 3. **Salix.** (12).
55. Pith diaphragmed but solid; bundle scars 3; no stipular scars. **Nyssa.** (76).
55. Pith not diaphragmed. 56.
56. Pith more or less 5-angled. 57.
56. Pith cylindrical or nearly so. 61.
57. Buds clustered at the tip of the twig; bundle scars numerous, scattered. **Quercus.** (22).
57. Buds not clustered at the tip. 58.
58. Bundle scars numerous usually scattered. 59.
58. Bundle scars 3. 60.
59. Buds small with about 3 outer scales; twigs reddish or yellowish-brown, glabrous or pubescent; terminal bud present or absent; stipular scars prominent.
Castanea. (21).
59. Terminal bud large with 4 or more visible scales, hairy or peltate pubescent; lateral buds usually superposed; twigs tough. **Hicoria.** (15).
60. Without stipular or self-pruning scars; crushed buds fragrant, aromatic; not resinous, glabrous.
Liquidambar. (30).
60. Stipular and self-pruning scars present; crushed buds not fragrant though they may have a resinous odor,

resinous or if only slightly so then the twigs pubescent or tomentose. **Populus.** (11).

61. Pith very large, light brown, bark not resinous, ill-smelling; buds spherical or flattened at the apex, often clustered at the tip of the twig, brown and pubescent; bundle scars about 9 along the lower edge of the very large leaf scar; large trees. **Ailanthus.** (51).
61. Pith small, or if large and brown then the bark resinous. 62.
62. Bark with a resinous or sticky milky sap; pith usually large, if rather small then the bark aromatic. 63.
62. Bark not resinous. 64.
63. Buds clustered at the tip of the twig; bark spicy-fragrant to the smell; base of petiole prominent with several bundle scars; fruiting panicles plumose.

Cotinus. (53).

63. Buds not clustered at the tip; bark sometimes aromatic, often very poisonous to the touch; leaf scar partly surrounding the bud or the bud covered; small trees or shrubs. **Rhus.** (52).
64. Terminal bud absent. 65.
64. Terminal bud present. 68.
65. Stipules or stipular scars absent or indistinct. 66.
65. Stipules or stipular scars present. 67.
66. Buds clustered at the tip of the twig; young twigs glandular dotted. **Myrica.** (13).
66. Buds not clustered at the tip; twigs not glandular.

Prunus. (42).

67. Buds and twigs very downy, twigs dark brown or black.

Cydonia. (39).

67. Buds downy or pubescent; twigs glabrous or pubescent, gray or brown. **Rhamnus.** (60).
68. Twigs green or yellowish-green, glabrous; internodes very unequal; lateral buds minute; small trees.

Cornus. (75).

68. Twigs normally red above and green beneath, glabrous;

bark very bitter; some axils with 2 or 3 hairy buds of nearly equal size; trees. **Amygdalus.** (43).

68. Twigs not green or red and green unless the plants are low shrubs, but gray, brown, black, or reddish. 69.

69. Bundle scars 5 or more in the broad U-shaped leaf scar; tips of the buds quite downy; small trees.

Sorbus. (36).

69. Bundle scars 3. 70.

70. Buds rounded at the apex, often clustered at the tip of the twig; twigs glandular dotted. **Myrica.** (13).

70. Buds rounded at the apex; scales thick; twigs often zigzag; plant usually with some thorns, not glandular dotted. **Cratægus.** (41).

70. Buds pointed; plants sometimes with thorn-like stunted branches, not glandular dotted. 71.

71. Buds glabrous or slightly pubescent; twigs usually glabrous and slender, some shade of black, brown, or reddish, often with 2 or 3 axillary buds; some with self-pruning scars. **Prunus.** (42).

71. Buds downy or strongly pubescent, conical, pungent; twigs glabrous, mostly yellow-olive; trees with erect growth, the branches not spreading as in most of the apples. **Pyrus.** (37).

71. Buds downy or strongly pubescent; twigs strongly pubescent or if glabrous then dark reddish-brown; trees with rounded or spreading crowns.

Malus. (38).

71. Buds and twigs very pubescent; terminal bud with long spreading scales; shrubs or small trees with globose berry-like drupes containing 2-4 stones.

Rhamnus. (60).

—72—

72. Bundle scars 1, or several closely united in a curved line, appearing as 1. 74.

72. Bundle scars more than 1 but not in an ellipse or ring. 78.

72. Bundle scars numerous, in an ellipse or ring; buds small and flat or superposed. 73.

73. Pith with cavities or more or less diaphragmed; axillary buds superposed. **Paulowina.** (72).
73. Pith solid; axillary buds small and flat, not superposed, leaf scars often in trees. **Catalpa.** (73).
74. Twigs very green, more or less 4-angled; pith diamond-shaped or rhomboidal. **Euonymus.** (55).
74. Twigs not green when ripe but gray, brown or red, sometimes 4-angled; pith cylindrical or nearly so. 75.
75. Terminal bud absent, the twig usually ending in a thorn. **Rhamnus.** (60).
75. Terminal bud present. 76.
76. Axillary buds often superposed; twigs often with thorns; leaf scars small. **Adelia.** (70).
76. Axillary buds not superposed; no thorns on the twigs; leaf scars rather large. 77.
77. Twigs and buds pubescent; lateral buds cylindrical or hemispherical; bud scales dry; leaf scar concave, on the short petiole base; lenticels large and conspicuous; fruit a drupe. **Chionanthus.** (71).
77. Buds rough or pubescent; twigs glabrous or pubescent, sometimes 4-angled; lateral buds somewhat flattened, obtuse; bud scales rather dry; leaf scar close to the bark; lenticels not large; fruit a samara. **Fraxinus.** (69).
78. With 4 distinct stipular scars; terminal bud self-pruned; twigs green with strong odor. **Staphylea.** (56).
78. Without definite stipular scars; twigs not green or if so then the terminal bud present. 79.
79. Trees or shrubs with numerous bundle scars, sometimes in 3 areas, in a large heart-shaped leaf scar; pith rather large; terminal bud large, with numerous scales. **Æsculus.** (58).
79. Bundle scars 3 or sometimes 5. 80.
80. Terminal bud with 2 long acuminate pubescent outer scales; line connecting the uppermost leaf scars notched. **Cornus.** (75).

- 80. Terminal bud with one main pair of visible scales and a smaller pair at the base. **Viburnum.** (77).
- 80. Terminal bud with several pairs of visible scales; bundle scars 3-5; twigs sometimes green. **Acer.** (57).

GENERAL KEY TO THE FAMILIES AND GENERA.

Based on the flower and other characters. The number following the generic name refers to the list number.

SPERMATOPHYTA.

1. Ovules naked on an open carpel; pollen falling directly on the ovule; trees or shrubs; ours usually evergreen with narrow leaves, or with fan-shaped leaves and dichotomous venation; monoecious, rarely dioecious. 2.
1. Ovules in a closed carpel or set of carpels; provided with a stigma for the reception of the pollen; flowers more commonly showy. 4.

2. GYMNOSPERMAE.

2. Carpellate flowers developing as woody cones, the carpels arranged in spirals or opposite, each usually with 1-2 ovules; or by coalescence forming a black or blue berry-like fruit. 3.
2. Carpellate flowers developing large plum-like fleshy seeds; dioecious trees with fan-shaped leaves dichotomously veined. GINKGOACEAE.

a. **Ginkgo.** (1).

3. Leaf-buds scaly; carpels usually numerous; leaves spirally arranged, the foliage leaves often situated on dwarf branches. PINACEAE.
 - a. Ovuliferous scales woody; leaves needle-shaped, 2-5 on a dwarf branch. **Pinus.** (2).
 - a. Ovuliferous scales thin; leaves linear or filiform, scattered or on thick wart-like dwarf branches. b.
 - b. Leaves deciduous on wart-like dwarf branches. **Larix.** (3).
 - b. Leaves scattered, persistent. c.
 - c. Cones pendulous. d.

- c. Cones erect. **Abies.** (6).
- d. Leaves more or less 4-angled or tetragonal, sessile.
Picea. (4).
- d. Leaves flat, short-petioled. **Tsuga.** (5).
- 3. Leaf buds naked; carpels few, spiral; leaves on feather-like dwarf branches which are deciduous. TAXODIACEAE.
 - a. **Taxodium.** (7).
- 3. Leaf-buds naked; carpels few, opposite, sometimes forming a black or blue berry-like fruit; leaves opposite or whorled, rarely scattered, persistent. JUNIPERACEAE.
 - a. Cones oblong, ovuliferous scales not peltate.
Thuja. (8).
 - a. Cones globose, ovuliferous scales peltate. **Chamaecyparis.** (9).
 - a. Cones becoming fleshy, berry-like. **Juniperus.** (10).

4. ANGIOSPERMAE.

- 4. Leaves mostly parallel-veined, sometimes netted-veined; parts of the flower very often in threes (trimerous); cotyledon 1; vascular bundles scattered through the pith, usually not in a circle; no annual rings of growth. No trees in our region. MONOCOTYLAE.
- 4. Leaves usually netted-veined; parts of the flower more commonly in fives (pentamerous) or fours (tetramerous); cotyledons usually 2; vascular bundles usually in a circle around a central pith, forming annual rings of growth in perennial stems, with bark on the outside. 5.

5. DICOTYLAE.

- 5. Perianth none or of similar segments or divided into calyx and corolla; corolla when present choripetalous (petals distinct). 6.
- 5. Perianth composed of calyx and corolla, calyx may be minute or suppressed; corolla sympetalous (petals more or less united). 36.

6. Perianth none; sometimes a minute border, cup, or gland may represent the calyx. 7.
6. Only the calyx present, sepals distinct or united, green or colored. 9.
6. Calyx and corolla both present, calyx may be minute. 16.
7. Leaves alternate, simple. 8.
7. Leaves opposite, compound; flowers in crowded panicles or racemes. OLEACEAE.

a. **Fraxinus.** (69).

8. Both staminate and carpellate flowers in aments; ovulary uni-locular many-seeded; seeds with a tuft of cottony hairs. SALICACEAE.
 - a. Stamens numerous, bracts fimbriate or incised; buds with several scales; pith 5-angled. **Populus.** (11).
 - a. Stamens 2-10, bracts entire; buds with one outer scale. **Salix.** (12).
8. Both staminate and carpellate flowers in aments, ovulary uni-locular with 1 erect ovule; carpellate flowers single in each bract of the ament. MYRICACEAE.

a. **Myrica.** (13).

8. Both staminate and carpellate flowers in aments, ovulary bi-locular; carpellate flowers 2 or more in each bract of the ament, or capitate. BETULACEAE.

See 11 below.

8. Flowers monoecious in dense heads; base of petiole covering the axillary bud. PLATANACEAE.

a. **Platanus.** (31).

8. Flowers imperfectly bisporangiate or monoecious, crowded into catkin-like heads; ovules 1-several in each cavity; stamens 4-many. HAMAMELIDACEAE.

a. **Liquidambar.** (30).

9. Flowers, at least the staminate ones in aments or ament-like spikes. 10.

9. Flowers not in aments but variously clustered, sometimes solitary. 12.
10. Leaves simple. 11.
10. Leaves odd-pinnate; fruit a nut inclosed in a husk. JUGLANDACEAE.
- a. Pith of twigs in transverse plates; husk indehiscent; nut rugose. **Juglans.** (14).
- a. Pith solid; husk at length splitting into segments, nut smooth or angled. **Hicoria.** (15).
11. Both staminate and carpellate flowers in aments; sap not milky. BETULACEAE.
- a. Staminate flowers solitary in the axil of each bract, without a calyx; carpellate flowers with a calyx. b.
- a. Staminate flowers 3-6 in the axil of each bract, with a calyx; carpellate flowers without a calyx. c.
- b. Fruiting bractlet flat, 3-cleft and incised; nut small. **Carpinus.** (16).
- b. Fruiting bractlet bladder-like, closed, membranous; nut small. **Ostrya.** (17).
- c. Stamens 2; fruiting bracts 3-lobed or entire, deciduous. **Betula.** (18).
- c. Stamens 4; fruiting bracts woody, persistent; pith 3-angled. **Alnus.** (19).
11. Carpellate flowers subtended by an involucre which becomes a bur or cup in fruit; staminate flowers in aments, or capitate. FAGACEAE.
- a. Staminate flowers capitate; nut triangular. **Fagus.** (20).
- a. Staminate flowers in slender aments; nut rounded. b.
- b. Carpellate flowers 2-5 in each involucre, which becomes prickly in fruit. **Castanea.** (21).
- b. Carpellate flower 1 in each involucre, which consists of numerous scales. **Quercus.** (22).
11. Trees with alternate leaves and milky sap; ovules pendulous. MORACEAE.

See 15 below.

12. Leaves opposite or whorled. 13.
12. Leaves alternate. 14.
13. Trees or shrubs with pinnate leaves and fruit a samara with 1 wing; or leaves simple and fruit a drupe. OLEACEAE.
- a. Leaves compound; fruit a samara; flowers mostly dioecious. **Fraxinus.** (69).
- a. Leaves simple; fruit a drupe; flowers dioecious, from catkin-like scaly buds. **Adelia.** (70).
13. Fruit a 2-winged, 2-seeded samara; leaves palmately veined or if pinnately compound then the petioles covering the axillary buds. ACERACEAE.
- a. **Acer.** (57).
14. Base of petiole covering the axillary bud; the flowers in dense spherical heads, the carpellate on a long slender peduncle; twigs with stipular rings. PLATANACEAE.
- a. **Platanus.** (31).
14. Base of petiole not covering the axillary bud, and inflorescence and twigs not as above. 15.
15. Trees or shrubs with compound punctate leaves. RUTACEAE.
- a. **Xanthoxylum.** (49).
15. Trees usually with serrate pinnately-veined sometimes palmately-veined leaves with fugaceous stipules; ovulary unilocular, 1-2-ovuled; fruit a samara, drupe or nut. ULMACEAE.
- a. Flowers in clusters on twigs of the previous season; fruit a samara or nut-like. b.
- a. Flowers on twigs of the season, fruit a drupe. **Celtis.** (25).
- b. Flowers expanding before the leaves; fruit a samara. **Ulmus.** (23).
- b. Flowers expanding with the leaves; fruit nut-like. **Planera.** (24).
15. Trees with milky sap; stipules fugaceous; fruit aggregate. MORACEAE.

- a. Staminate flowers racemose or spicate, the carpellate capitate. b.
- a. Staminate and carpellate flowers in ament-like spikes.
Morus. (26).
- b. Carpellate perianth deeply 4-cleft; twigs with thorns.
Toxylon. (27).
- b. Carpellate perianth 3-4 toothed; twigs not thorny.
Broussonetia. (28).
- 15. Trees with alternate, palmately lobed, fragrant leaves; the flowers in dense heads, the carpellate ones long-peduncled.
HAMAMELIDACEAE.
 - a. **Liquidambar.** (30).
- 15. Shrubs or trees with 9 or 12 stamens in 3 or 4 cycles; anthers opening by valves; aromatic; fruit a 1-seeded drupe or berry. LAURACEAE.
 - a. **Sassafras.** (35).
- 15. Shrubs or trees with simple leaves, with 4-5 perigynous stamens alternate with the sepals; ovulary 2-5-locular, ovules solitary in each cavity, stigmas 2-5; fruit a drupe. RHAMNACEAE.
 - a. **Rhamnus.** (60).
- 15. Trees with simple alternate leaves and diaphragmed but solid pith; stamens 5-15, flowers epigynous; ovulary unilocular with 1 pendulous ovule. Some CORNACEAE.
 - a. **Nyssa.** (76).

- 16. Flowers hypogynous or perigynous; ovulary free from the calyx or adherent to the perigynous disc. 17.
- 16. Flowers epigynous; calyx above the ovulary. 33.
- 17. Stamens numerous, at least more than 10 and more than twice the petals. 18.
- 17. Stamens not more than twice as many as the petals, when of just the number as the petals then alternate with them. 21.

17. Stamens of the same number as the petals and opposite them; ovulary 2-5-locular; calyx 4-5-cleft, valvate in the bud; petals involute; fruit a drupe or capsule; shrubs, small trees, or vines with simple leaves. RHAMNACEAE.
 - a. **Rhamnus.** (60).
18. Carpels 1 or more, united, but styles and stigmas may be several. 19.
18. Carpels more than 1, distinct; filaments shorter than the anthers; perianth trimerous; leaves 2-ranked. ANONACEAE.
 - a. **Asimina.** (34).
18. Carpels numerous spirally arranged and cohering over each other, forming an aggregate cone-like fruit; trees; sepals and petals in threes; twigs with stipular rings. MAGNOLIACEAE.
 - a. Anthers introrse; leaves not truncate. **Magnolia** (32).
 - a. Anthers extrorse; leaves truncate. **Liriodendron.** (33).
19. Ovulary compound, plurilocular. 20.
19. Ovulary 1-locular, 2-ovuled; fruit a drupe with 1 seed. ROSACEAE. (DRUPATAE).
 - a. Drupe glabrous, stone smooth or nearly so. **Prunus.** (42).
 - a. Drupe velvety, stone deeply pitted. **Amygdalus** (43).
20. Calyx deciduous; flower cluster subtended by a large membranous bract; trees with alternate, 2-ranked leaves and mucilaginous sap. TILIACEAE.
 - a. **Tilia.** (16).
20. Leaves alternate with deciduous stipules; ovulary composed of 2-5 wholly or partly united carpels; fruit a more or less fleshy pome. ROSACEAE. (POMATAE).
 - a. Ripe carpels papery or leathery. b.
 - a. Ripe carpels bony. **Crataegus.** (41).
 - b. Leaves pinnate. **Sorbus.** (36).
 - b. Leaves simple. c.
 - c. Cavities of the ovulary as many as the styles. d.

- c. Cavities of the ovulary becoming twice as many as the styles. **Amelanchier.** (40).
- d. Cavities of the ovulary with 1-3 seeds. e.
- d. Cavities of the ovulary with many seeds. **Cydonia.** (39).
- e. Flesh of the pome with grit-cells. **Pyrus.** (37).
- e. Flesh of the pome without grit-cells. **Malus.** (38).
- 21. Ovulary only 1, carpels 1 to many, united. 24.
- 21. Carpels 2 or more, distinct, or somewhat united at the base. 22.
- 22. Leaves compound. 23.
- 22. Shrubs or trees with alternate simple leaves. **HAMAMELIDACEAE.**
 - a. Ovules 1 in each cavity, fruit a woody capsule. **Hamamelis.** (29).
 - a. Ovules several in each cavity, fruit globular, spiny. **Liquidambar.** (30).
- 23. Leaves punctate with pellucid dots, alternate. **RUTACEAE.**
 - a. Carpels 2-5, distinct. **Xanthoxylum.** (49).
 - a. Ovulary 1, 2-locular. **Ptelea.** (50).
- 23. Leaves large, pinnate, alternate, not punctate but with disc-like glands under the teeth or lobes. **SIMARUBACEAE.**
 - a. **Ailanthus.** (51).
- 24. Carpel 1, ovulary with 1 parietal placenta; leaves alternate, usually with stipules, usually compound. **FABACEAE.**
 - A. Fruit a legume; upper petal inclosed by the lateral ones in the bud; leaves simple or compound mostly with stipules. **CASSIATAE.**
 - a. Leaves simple, flowers bisporangiate. **Cercis.** (44).
 - a. Leaves compound, flowers dioecious or imperfectly dioecious. b.
 - b. Stamens 3-5; pod flat. **Gleditsia.** (45).
 - b. Stamens 10; pod thick, woody. **Gymnocladus.** (46).

- B. Fruit a legume or loment, upper petal inclosing the lateral ones in the bud; leaves compound (sometimes with 1 leaflet) with stipules. PAPILIONATAE.
 - a. Without stipular spines; leaflets large, 3-6 in. long; base of petiole covering the axillary buds like a cap. **Cladrastis.** (47).
 - a. With stipular spines; leaflets small, 1-2 in. long; base of petiole not covering the axillary buds like a cap, but solid. **Robinia.** (48).
- 24. Carpels more than 1 as shown by the compound ovulary, cavities, placentae, styles, or stigmas. 25.
- 25. Ovulary 2-locular to plurilocular. 26.
- 25. Ovulary 1-locular, ovules solitary, stigmas 3; shrubs or trees with resinous or milky sap and alternate leaves without stipules. ANACARDIACEAE.
 - a. Leaves compound, styles terminal. **Rhus.** (52).
 - a. Leaves simple, styles lateral. **Cotinus.** (53).
- 26. Flowers regular or nearly so. 27.
- 26. Flowers irregular; shrubs or trees with opposite digitate leaves; ovulary 3-locular. HIPPOCASTANACEAE.
 - a. **Aesculus.** (58).
- 27. Stamens neither just as many nor twice as many as the petals. 28.
- 27. Stamens just as many or twice as many as the petals. 29.
- 28. Stamens distinct and fewer than the 4 petals; trees or shrubs with opposite pinnate or simple leaves. OLEACEAE.
 - a. Flowers dioecious, from catkin-like scaly buds. **Adelia.** (70).
 - a. Flowers bisporangiate, petals linear. **Chionanthus.** (71).
- 28. Stamens more numerous than the petals; leaves palmately veined, opposite; fruit 2-winged. Some ACERACEAE.
 - a. **Acer.** (57).
- 29. Ovules 1 or 2 in each cavity. 30.

29. Ovules several or many in each cavity; stipules between the opposite and pinnately compound leaves, caducous; shrubs or small trees. STAPHYLEACEAE.

a. **Staphylea.** (56).

30. Leaves palmately veined, or compound. 31.
30. Leaves pinnately veined, simple, not punctate. 32.
31. Leaves pinnately compound, alternate; climbing herbaceous vines with fruit an inflated 3-lobed capsule; or trees with a globose or lobed berry. SAPINDACEAE.

a. **Sapindus.** (59).

31. Leaves palmately veined or pinnately compound; fruit 2-winged; trees or shrubs with opposite leaves and no stipules. ACERACEAE.

a. **Acer.** (57).

31. Leaves 3-foliate, pellucid-punctate, without stipules. Some RUTACEAE.

a. **Ptelea.** (50).

32. Calyx minute, fruit a berry-like drupe; trees or shrubs with simple mostly alternate leaves. ILICACEAE.

a. **Ilex.** (54).

32. Calyx not minute; pod colored, dehiscent; seeds inclosed in a pulpy aril; shrubs or woody climbers with alternate or opposite leaves and with minute fugaceous stipules. CELASTRACEAE.

a. **Euonymus.** (55).

—33—

33. Leaves simple. 34.
33. Leaves compound. 35.
34. Perfect stamens 4, styles 2; leaves alternate, palmately veined and lobed, or if pinnately veined then 2-ranked. HAMAMELIDACEAE.

See 22 above.

34. Stamens 5, 10, or many; styles 2-5; leaves alternate with stipules. ROSACEAE (POMATAE).
See 20 above.
34. Stamens 4 or 5, style and stigma 1; leaves opposite or alternate; fruit a 1-2-seeded drupe. CORNACEAE.
a. Ovulary 2-locular, flowers bisporangiate. **Cornus.** (75).
a. Ovulary 1-locular, flowers dioecious or imperfectly dioecious. **Nyssa.** (76).
34. Stamens 4 or 5 on a flat disc which covers the 3-5-locular ovulary; fruit a somewhat fleshy capsule; shrubs, trees or woody climbers with opposite leaves and minute fugaceous stipules. CELASTRACEAE.
See 32 above.
35. Stamens many; leaves odd-pinnate, fruit a berry-like pome. Some — ROSACEAE (POMATAE).
a. **Sorbus.** (36).
35. Stamens 5, styles usually 2-5; fruit a fleshy berry or drupe; leaves bipinnate. ARALIACEAE.
a. **Aralia.** (74).
—36—
36. Flowers hypogynous (ovulary superior). 37.
36. Flowers epigynous (ovulary inferior); stamens as many as the lobes of the corolla; leaves opposite, usually without stipules, not blackening in drying. CAPRIFOLIACEAE.
a. **Viburnum.** (77).
37. Stamens free from the corolla (or only slightly united at the base) as many as the petals (flowers tetracyclic) and alternate with them, or twice as many (pentacyclic) or more. 38.
37. Stamens united with the corolla, as many as the petals and opposite them or twice as many or more. 39.

37. Stamens united with the corolla or only united at the base, as many as the petals or fewer and alternate with them.
40.
38. Ovary 2-5-locular; shrubs often with evergreen leaves; fruit a capsule, berry or drupe. ERICACEAE.
- a. Fruit a septicidal capsule; leaves remaining green throughout the year. b.
- a. Fruit a loculicidal capsule; leaves deciduous in autumn. **Oxydendrum.** (64).
- b. Corolla somewhat irregular, seeds flat and winged. **Rhododendron.** (62).
- b. Corolla regular, seeds angled or rounded. **Kalmia.** (63).
38. Choripetalous plants in which the petals are sometimes partly or completely united.
- a. Ovary 1-locular (1 carpel) with 1 parietal placenta. FABACEAE.
See 24 above.
- b. Ovary 4-8-locular, with a solitary seed in each cavity; fruit a berry-like drupe. ILICACEAE.
See 33 above.
39. Stamens as many as the lobes of the small white corolla; leaves entire, simple and alternate, with thorns. SAPOTACEAE.
- a. **Bumelia.** (65).
39. Stamens twice as many as the lobes of the greenish-yellow corolla or more; styles 2-8; plants mostly monoecious or dioecious; leaves alternate, simple, and entire. EBENACEAE.
- a. **Diospyros.** (66).
39. Stamens twice as many as the lobes of the yellow corolla or more; style 1; stamens in several series; flowers mostly bisporangiate; leaves alternate and simple. SYMPLOCACEAE.

a. **Symplocos.** (67).

39. Stamens twice as many as the lobes of the white corolla or more; style 1; stamens in 1 series, flowers mostly bisporangiate, leaves alternate and simple. STYRACACEAE.

a. **Mohrodendron.** (68).

40. Flowers regular; seeds 1-4; fruit a samara, drupe, or berry. OLEACEAE.

a. Fruit a samara; leaves pinnate. **Fraxinus.** (69).

a. Fruit a drupe or berry; leaves simple. b.

b. Flowers dioecious. **Adelia.** (70).

b. Flowers bisporangiate, lobes of the corolla linear. **Chionanthus.** (71).

40. Flowers irregular, zygomorphic; seeds numerous, capsule ovoid, acute; stamens 4, didynamous; pith with cavities. Some — SCROPULARIACEAE.

a. **Paulownia.** (72).

40. Flowers irregular, zygomorphic; seeds numerous, capsule long, terete; fertile stamens usually 2; pith solid. BIGNONIACEAE.

a. **Catalpa.** (73).

CLASSIFICATION AND DESCRIPTION OF THE SPECIES.

SERIES III. SPERMATOPHYTA. SEED-PLANTS.

Subkingdom, GYMNOSPERMAE. Gymnosperms.

Class, GINKGOEAE.

Order, GINKGOALES.

Ginkgoaceae. Ginkgo Family.

1. Ginkgo Kaempf. Ginkgo.

Trees with deciduous, fan-shaped, dichotomously veined leaves on wart-like dwarf branches.

* *Ginkgo biloba*. L. Maiden-hair-tree. A large, beautiful and hardy tree with dioecious flowers. Seed large, drupe-like. Autumn leaves orange. Introduced from China and Japan; should be commonly cultivated for ornament.

Class, CONIFERAE. Conifers.

Order, PINALES.

Pinaceae. Pine Family.

2. Pinus L. Pine.

Resinous evergreen trees with small dwarf branches bearing 2-5 narrow foliage leaves; dwarf branches and ordinary twigs covered with scale leaves. Dwarf branches self-pruned after a number of years. Carpellate cones woody, with numerous carpels. Our most important lumber trees.

1. Dwarf branches with 5 foliage leaves; ovuliferous scales little thickened at the tip. *P. strobus*.
1. Dwarf branches with 2-3 foliage leaves; ovuliferous scales much thickened at the tip. 2.
2. Dwarf branches with 3 foliage leaves, rarely 2 or 4. 3.
2. Dwarf branches mostly with 2 foliage leaves some of them may be with 3. 4.
3. Leaves 6-10 in. long; carpellate cone oblong-conic. *P. taeda*.
3. Leaves 3-5 in. long; carpellate cones ovoid. *P. rigida*.
4. Twigs glaucous; resin-ducts parenchymatous; carpellate cones $1\frac{1}{2}$ -3 in. long; ovuliferous scales tipped with a prickle or small spine. 5.
4. Twigs not glaucous. 6.

5. Leaves slender, $2\frac{1}{2}$ -5 in. long; buds not very resinous; prickles of the ovuliferous scales short and small. *P. echinata*.
5. Leaves stout, $1\frac{1}{2}$ - $2\frac{1}{2}$ in. long; buds very resinous; prickles of the ovuliferous scales long and stout. *P. virginiana*.
6. Leaves 1-4 in. long, grayish-green or light green; ovuliferous scales without or with a small prickle, or with a thick point or spine. 7.
6. Leaves 4-6 in. long, dark-green; ovuliferous scale without a spine or prickle, or sometimes with a very small prickle. 9.
7. Ovuliferous scale without a spine or prickle when mature but with a minute central point; leaves $\frac{1}{2}$ - $1\frac{1}{2}$ in. long, curved; resin ducts parenchymatous. *P. divaricata*.
7. Ovuliferous scale with a thick point or spine. 8.
8. Leaves $2\frac{1}{2}$ -4 in. long, light green; twigs orange or orange brown; resin ducts parenchymatous; carpellate cones ovoid. 3-5 in. long. *P. pungens*.
8. Leaves $1\frac{1}{2}$ - $2\frac{1}{2}$ in. long, grayish-green; twigs dull greenish-yellow or greenish-brown; resin-ducts peripheral; carpellate cones ovate-conic, 2-3 in. long. *P. silvestris*.
9. Carpellate cones terminal or subterminal, oval-conic; ovuliferous scales pointless when mature. *P. resinosa*.
9. Carpellate cones lateral, ovoid-conic; ovuliferous scale with a small prickle. *P. laricio*.

1. **Pinus stròbus** L. White Pine. A large tree with nearly smooth bark, except when old; branches horizontal in whorls. Often forming dense forests. Wood soft and straight-grained; used in enormous quantities for building purposes. One of the most valuable timber trees in the world. Has been more extensively used in America for lumber than any other tree. Newf. to Man., south along the Allegh. to Ga. and to Ohio, Ill. and Ia.

2. **Pinus resinòsa** Ait. Red Pine. A tall tree with reddish bark. Wood rather hard but not very durable. Turpentine is obtained to a limited extent from this species. A tree of rapid growth. Newf. to Man., Mass., Penn., and Minn.

3. **Pinus divaricàta** (Ait.) Gord. Jack Pine. A slender tree with spreading branches, the bark becoming flaky. Wood light and rather soft. In sandy soil. N. B. and N. W. Terr., south to Me., N. Y., Ill., and Minn.

4. **Pinus virginiana** Mill. Scrub Pine. A slender, usually small tree with spreading or drooping branches; the old

bark flaky and dark-colored. Wood very resinous, soft and durable but of poor quality. In sandy soil. L. I. to S. C., Ala., Tenn., Ohio, and Ind.

5. *Pinus echinata* Mill. Yellow Pine. A large tree with spreading branches; leaves sometimes in 3's. Wood rather hard and very valuable; much used as lumber. Also furnishes some turpentine. Produces shoots from stumps. In sandy soil. N. Y. to Fla., Ill., Kan., and Tex.

6. *Pinus pungens* Mx. f. Table-mountain Pine. A tree with spreading branches, the old bark rough and in flakes, leaves sometimes in 3's. Wood light and soft; much used for charcoal. N. J. to Ga. and Tenn.

7. *Pinus taeda* L. Loblolly Pine. A tree of very rapid growth with spreading branches and thick, rugged bark, flaky in age. Wood rather hard; much used for lumber in the south. Often growing in old fields. N. J. to Fla., Ark., and Tex.

8. *Pinus rigida* Mill. Pitch Pine. A tree with spreading branches, the old bark rough and furrowed, flaky in strips. Sprouts readily from the stump if cut down or burned. Wood rather hard and brittle and full of resin; used for fuel, charcoal, and coarse lumber. A source of turpentine to a limited extent. In dry, sandy or rocky soil. N. B. to Ont., Tenn., Ohio, W. Va., and Ga.

*. *Pinus silvestris* L. Scotch Pine. A large and valuable tree with drooping branches; much cultivated. From it are obtained the red and yellow deal much used as lumber in Europe.

*. *Pinus laricio* Poir. Austrian Pine. A tall, open, pyramidal tree of rapid growth with the thick branches in regular whorls. Often cultivated.

3. *Làrix* Adans. Larch.

Tall pyramidal trees with horizontal or ascending branches and with clusters of narrowly linear deciduous leaves on thick wart-like dwarf branches. Carpellate cones woody, with numerous carpels.

1. Carpellate cones small, $\frac{1}{2}$ - $\frac{3}{4}$ in. long, oval or almost globular; ovuliferous scales glabrous. *L. laricina*.

1. Carpellate cones rather large, $\frac{3}{4}$ -1 $\frac{1}{2}$ in. long; ovuliferous scales finely tomentose on the back. *L. decidua*.

1. **Larix laricina** (DuRoi) Koch. Tamarack. A slender tree with close or at length scaly bark. Wood hard, durable, and very strong; used in ship-building, for railroad ties, posts, and telegraph poles. In swamps and about the margins of lakes. Newf. to N. W. Terr., south to Minn., Ind., Ohio, and N. J.

*. *Larix decidua* Mill. European Larch. A beautiful tree with horizontal branches and drooping branchlets, conical in shape when young; much cultivated in some parts of the United States. The source of Venice turpentine.

4. **Picea** Link. Spruce.

Evergreen trees, conic in outline, with short linear 4-sided leaves spreading in all directions; the leaf scars on persistent sterigmata. Carpellate cones pendulous.

1. Carpellate cones 2 $\frac{1}{2}$ -6 in. long. *P. excelsa*.
1. Carpellate cones $\frac{3}{4}$ -2 in. long. ?2.
2. Twigs and sterigmata of the leaves glabrous, glaucous; carpellate cones oblong-cylindric. *P. canadensis*.
2. Twigs pubescent, brown; carpellate cones ovoid or oval. 3.
3. Leaves not glaucous. *P. mariana*.
3. Leaves glaucous. *P. brevifolia*.

1. **Picea canadensis** (Mill.) B. S. P. White Spruce. A slender tree sometimes with a strong skunk-like odor. Leaves light green, slender, $\frac{1}{2}$ - $\frac{3}{4}$ in. long, very acute. An important timber tree with light and straight-grained wood. Newf. to Alaska, south to Me., Mich., Black Hills, and Br. Col.

2. **Picea mariana** (Mill) B. S. P. Black Spruce. A tree with spreading branches and smooth or only slightly roughened bark. Leaves not over $\frac{2}{3}$ in. long, stout, green, closely covering the twigs. Wood light and straight-grained; used for paper pulp, for general lumber and for masts and spars of ships. Newf. to N. W. Terr., south to N. J., N. C., Mich., and Minn.

3. **Picea brevifolia** Peck. Swamp Spruce. A small, slender tree, or on mountains a shrub. Leaves nearly straight,

obtuse, or merely mucronate, $\frac{1}{4}$ - $\frac{1}{2}$ in. long. In swamps and bogs. Vt. to Ont., N. Y., and Mich.

*. *Picea excelsa* (Lam.) Link. Norway Spruce. A large tree, conical in shape when young, with numerous stout spreading and drooping branches. Abundant in cultivation. Source of Burgundy pitch.

5. *Tsùga* Carr. Hemlock.

Evergreen trees with slender horizontal or drooping branches. Leaves flat, narrowly linear, spreading more or less into 2 ranks. Leaf scars on short sterigmata. Carpellate cones pendulous.

1. *Tsuga canadensis* (L.) Carr. Hemlock. A tall tree with slender, horizontal or drooping branches, the old bark flaky in scales. Wood very coarse, light and soft; used for wood pulp. Bark used for tanning. Source of Canada pitch. Self-prunes twigs. N. S. to Minn. south to Ohio, and Del., along the Alleghanies to Ala., and to Mich. and Wis.

6. *Abies* Juss. Fir.

Evergreen trees with flat linear leaves. No sterigmata on the twigs but with ordinary circular or oval leaf scars. Carpellate cones erect.

1. Carpellate bract serrulate, shorter than the ovuliferous scale; leaves obtuse. *A. balsamea*.
1. Carpellate bract aristate, longer than the ovuliferous scale; leaves mostly emarginate. *A. fraseri*.

1. *Abies balsamea* (L.) Mill. Balsam Fir. A slender short-lived tree. Wood very light and soft. Canada balsam is obtained from its resin. Newf. to N. W. Terr., south to Penn., along the Alleghanies to Va., and to Mich. and Minn.

2. *Abies fraseri* (Pursh) Lindl. Fraser Fir. A slender tree growing on the high Alleghanies. W. Va., N. Car., and Tenn.

Taxodiaceae. Bald-cypress Family.

7. *Taxodium* Rich. Bald-cypress.

Tall trees with horizontal or drooping branches, ours with feather-like, annually self-pruned, dwarf branches. Carpellate cones, globose.

1. *Taxodium distichum* (L.) Rich. Bald-cypress. A large tree, the old bark flaky in thin strips. The roots develop upright conic "knees." Wood light, soft and durable. In swamps and along rivers. Del. to Fla., west to Tex., north to Mo. and Ind.

Juniperaceae. Juniper Family.

8. *Thuja* L. Arborvitae.

Evergreen trees or shrubs with flattened fan-like twigs. Carpellate cones ovoid or oblong with dry coriaceous scales, not peltate.

1. *Thuja occidentalis* L. Arborvitae. Usually a small conical tree with fan-like branches. Self-prunes twigs. Wood light and durable; used for posts, railroad ties, etc. Usually in wet soil and along the banks of streams. N. B. to Man., south to Ohio and N. J., along the Alleghanies to N. C., and to Ill. and Minn.

9. *Chamaecyparis* Spach. White-cedar.

Evergreen trees, similar to the Thujas. Carpellate cones globose, with thick, peltate scales.

1. *Chamaecyparis thyoides* (L.) B. S. P. White-cedar. A tree with soft, light, and durable wood; used for boat-building, woodenware, shingles, etc. In swamps. N. H. to N. J., Fla., and Miss.

10. *Juniperus* L. Juniper.

Evergreen trees or shrubs with small globose, berry-like bluish or blackish cones.

1. Leaves all subulate, prickly pointed, verticillate, slender, mostly straight; cones axillary. *J. communis*.
1. Leaves of 2 kinds, scale-like and subulate, opposite or verticillate; cones terminal. *J. virginiana*.

1. **Juniperus communis** L. Common Juniper. A low tree with spreading or drooping branches and shreddy bark. Goats are poisoned from eating the leaves. On dry hills. N. S. to Br. Col. south to N. J., Ohio, Mich., Neb., and in the Rocky Mts. to N. Mex. Also in Europe and Asia.

2. **Juniperus virginiana** L. Red Juniper. A tree, with spreading often irregular branches when old, but conic in shape when young. Self-prunes twigs. Wood very valuable, light, straight-grained, durable, and fragrant; used for posts, cabinet-work, interior finish, veneers and cooperage, and almost exclusively in the manufacture of lead pencils. Often infested with the "cedar-apple." Poisonous to goats. In dry soil; common on bluffs. N. B. to Br. Col., Fla., Tex., and Ariz. Also in W. I., Ohio.

Subkingdom, ANGIOSPERMAE. Angiosperms.

Class, DICOTYLAE. Dicotyls.

Subclass, APETALAE.

Order, SALICALES.

Salicaceae. Willow Family.

II. **Pópulus** L. Poplar.

Trees with scaly resinous buds. Flowers in aments; fruit a capsule; seeds with long cottony hairs. Leaves mostly with 2 or more glands at or near the base of the blade and with gland-tipped teeth. Twigs prominently self-pruned by means of cleavage planes in basal joints. Pith 5-angled.

1. Leaves and twigs persistently and densely white tomentose below, usually lobed; self-pruning scars very prominent on the small twigs. *P. alba*.
1. Leaves and twigs glabrous or nearly so when old, not lobed. 2.
2. Petioles terete or channeled, not much flattened laterally; leaves crenate. 3.
2. Petioles strongly flattened laterally. 4.
3. Leaves densely tomentose when young; capsule slender-pedicelled. *P. heterophylla*.
3. Leaves not tomentose but usually somewhat pubescent; capsule short-pedicelled. *P. balsamifera*.
4. Leaves broadly deltoid, abruptly acuminate; terminal winter buds usually angular. 5.

4. Leaves broadly ovate or suborbicular; terminal winter buds rounded or only slightly angular. 7.
5. Trees of tall, narrow growth with strongly erect branches, giving a spire-like appearance, young twigs glabrous; leaves usually wider than long, more or less acute at the base. *P. dilatata*.
5. Trees with spreading branches. 6.
6. Young leaves pubescent; capsules nearly sessile. *P. nigra*.
6. Young leaves not pubescent, shining; capsules slender-pedicelled. *P. deltoides*.
7. Leaves coarsely sinuate-dentate, densely white-tomentose when young, glabrous when mature. *P. grandidentata*.
7. Leaves crenulate-dentate, glabrous except the ciliate margins. *P. tremuloides*.

1. **Populus álba** L. White Poplar. A large tree with smooth, light, greenish-gray bark often with black diamond-shaped scars; sprouting freely from the roots and hence not desirable for yards. Young foliage densely white-tomentose, the leaves becoming glabrate and dark green above, broadly ovate or nearly orbicular in outline, 3-5 lobed, or irregularly dentate, 2-4 in. long. Native of Europe and Asia. Ohio.

2. **Populus heterophylla** L. Swamp Poplar. An irregularly branching tree with rough bark. Leaves long-petioled, broadly ovate, crenulate-denticulate, 5-6 in. long. In swamps. Conn. to Ga., west to La. and northward to Ark., Ind. and Ohio.

3. **Populus balsamifera** L. Balsam Poplar. A large tree with nearly smooth gray bark. Leaves broadly ovate, dark green and shining above, pale beneath, rounded or acute at the base, crenulate, 3-5 in. long. Wood very light and soft. In moist or dry soil, commonly along streams and lakes. The subspecies **P. balsamifera cándicans** (Ait.) Gr. Balm-of-Gilead, has the leaves broadly ovate, truncate or cordate at the base, and the petioles and nerves usually puberulent. Mostly escaped from cultivation. Newf. to Alaska, south to N. Y., Ohio, Neb., and Nev.

4. **Populus nigra** L. Black Poplar. A large tree with terete twigs. Mature leaves firm, broadly deltoid, abruptly acuminate at the apex, broadly cuneate or obtuse at the base, crenate, 2-4 in. long. Naturalized from Europe. N. Y. and southward along the Delaware R.

*. *Populus dilatata* Ait. Lombardy Poplar. A spire-like tree of rapid growth. Commonly planted for ornament.

5. *Populus deltoides* Marsh. Cottonwood. A large tree of very rapid growth, with rough, deeply furrowed, brown bark when old. Bark of young trees grayish-green and rather smooth. The giant of the poplars. Petiole much flattened laterally causing the leaves to rustle in the wind. Leaves glabrous, broadly deltoid-ovate, abruptly acuminate at the apex, crenulate, truncate at the base, 4-7 in. long. Wood light and soft and very durable if kept in the dry; used for building lumber, light boxes, paper pulp, sugar and flour barrels, cracker boxes, crates and wooden ware; also a good fuel wood. A most useful and ornamental tree of very rapid growth if planted in ravines and low places. In cities only staminate trees should be planted. In moist soil, especially on the banks and flood plains of creeks and rivers. Quebec to Man., south to Fla. and Kan. Ohio.

6. *Populus grandidentata* Mx. Largetooth Aspen. A tree with smooth, greenish-gray bark. Leaves tomentose when young, glabrous when mature, short-acuminate, obtuse or truncate at the base, 2-4 in. long. Wood soft and white; used for paper pulp. In rich moist soil. N. S. to Ont. and Minn., south to N. J. and Ohio, and in the Alleghanies to Tenn.

7. *Populus tremuloides* Mx. American Aspen. A slender tree with light green, smooth bark. Leaves usually short-acuminate at the apex, finely crenulate, truncate, rounded or subcordate at the base, 1-3 in. broad. Petioles very slender, causing the leaves to quiver and rustle in the slightest breeze. Wood white and soft; used for making coarse paper. In moist or dry soil. Newf. to Alaska, south to N. J., Ohio, Ky., and Neb.; in the Rocky Mts. to Mexico and to Lower Cal.

12. *Salix* L. Willow.

Trees or shrubs with buds having a single outer scale. Flowers in aments; fruit a capsule; seeds with long cottony hairs. Leaves sometimes with glands on the petiole or at the base of the blade and with gland tipped teeth. Twigs self-pruned by means

of basal brittle zones. The charcoal from the larger species used for making gunpowder.

1. Twigs decidedly pendulous or "weeping", green or yellowish-green; leaves linear-lanceolate, acuminate, serrulate, smooth, rather pale beneath, petioles glandular above; capsule glabrous, pedicel very short, stigma sessile. *S. babylonica*.
1. Twigs not pendulous nor weeping, but some may be drooping. 2.
2. Leaves tapering to the short petioled or nearly sessile base, linear-lanceolate, remotely denticulate, coarsely silky when young, usually glabrate in age; shrubs or small trees with a narrow, slender crown; capsule glabrous or silky; stamens 2. *S. fluviatilis*.
2. Petioles present and rather prominent and slender except in some individuals. 3.
3. Leaves silky, tomentose, or hairy below when mature; stamens 2. 4.
3. Leaves glabrous below, or nearly so, when mature, sometimes finely pubescent when young. 5.
4. Leaves long linear-lanceolate, sparingly repand-crenulate, or entire, white or silvery silky beneath, without glands on the petiole, acuminate; twigs terete, green; capsule nearly sessile, silky or tomentose, style long. *S. viminalis*.
4. Leaves lanceolate, narrowed at the base, serrulate, silky pubescent and glaucous beneath, usually with glands on the petiole at the base of the blade; capsule glabrous, pedicel very short, stigma sessile. *S. alba*.
4. Leaves ovate-lanceolate, slender-pointed, firm, pubescent or white-tomentose beneath, sharply serrate or entire; bracts yellow, linear-oblong or lanceolate; capsule silky or tomentose, pedicel filiform. *S. bebbiana*.
5. Petioles usually without glands, or if with glands then the leaves of the ovate type and short pointed; stamens 2. 6.
5. Petioles usually with glands on the top or at the base of the blade; stamens 3-12, in one species 2; capsule glabrous. 8.
6. Length of leaf-blade less than 3 times its breadth; mature leaves thin and dull, elliptic, ovate-oval, or obovate, acute or obtuse at the apex; stamens 2. *S. balsamifera*.
6. Length of leaf-blade 3 times its breadth or more. 7.
7. Leaves oblanceolate or spatulate, acute, serrulate, somewhat glaucous beneath; twigs purplish, flexible; filaments of stamens united; capsule silky or tomentose, sessile; stigma sessile. *S. purpurea*.
7. Leaves lanceolate or oblanceolate, acuminate, finely serrate with minute gland-tipped teeth, pale and glaucous beneath; twigs of the season pubescent or puberulent; capsule glabrous. *S. missouriensis*.

7. Leaves obovate, oblong or oblanceolate, rather thin, acute at both ends, irregularly or indistinctly toothed, glaucous and nearly white beneath; bracts fuscous, obovate or cuneate, long-hairy; capsule silky or tomentose, stalked. *S. discolor*.
8. Petioles short; leaves narrowly lanceolate, usually falcate, narrowed at the base, glabrous or slightly pubescent, green on both sides or slightly paler beneath. *S. nigra*.
8. Petioles rather prominent and slender except in some individuals; leaves lanceolate or broader. 9.
9. Leaves dark-green above, glaucous or whitish beneath not coriaceous. 10.
9. Leaves yellow-green and glossy on both sides, thick, normally ovate, very long acuminate with a slender tip; catkins thick and dense, stamens mostly 3, flower bracts dentate; capsule large, short-pedicelled; twigs brown, polished. *S. lucida*.
10. Leaves ovate-lanceolate, broadest below the middle, acuminate, petioles often red; stamens 5-12; capsule narrow-conic, pedicel slender, 3-5 times as long as the gland; bark rough, brown. *S. amygdaloides*.
10. Leaves lanceolate, long-acute; stamens 2, capsules very narrow-conic, pedicel short, about twice as long as the gland; bark gray. *S. fragilis*.
10. Leaves lanceolate or oblong-lanceolate, rounded, subcordate, or narrowed at the base, 3-8 in. long; very white and somewhat pubescent beneath; capsule conic, pedicel slender, 3-5 times as long as the gland; bark dark reddish-brown with small scales. *S. longipes*.

1. **Salix nigra** Marsh. Black Willow. A medium-sized tree with rough, flaky, dark brown bark. Leaves narrowed at the base, serrulate, 2-5 in. long, $\frac{1}{8}$ - $\frac{1}{2}$ in. wide, or wider; capsule ovoid, acute, about as long as its pedicel. Along streams and lakes. The subspecies *S. nigra falcate* (pursh.) Torr. has narrower more falcate leaves. Hybridizes with *S. alba*. N. B. to Ont., Fla., Cal., and Kan. Ohio.

2. **Salix longipes** And. Ward Willow. A tree with spreading or drooping branches and dark reddish-brown bark. Leaves lanceolate or oblong-lanceolate, rounded, subcordate, or narrowed at the base, 2-7 in. long, $\frac{1}{2}$ - $1\frac{1}{2}$ in. wide, somewhat pubescent beneath; capsule conic. Wood dark brown. Along streams and lakes. Md. to Mo., south to Fla., and Texas.

3. **Salix amygdaloides** And. Peachleaf Willow. A tree with rough, brown, scaly bark. Leaves pubescent when young, glabrous when old, dark green above, pale and slightly glaucous beneath, narrowed at the base, 3-5 in. long, $\frac{1}{2}$ - $\frac{3}{4}$ in. wide; capsule narrowly ovoid, acute, glabrous, finally about as long as the filiform pedicel. Along streams, lakes and ponds. Quebec to Br. Col., N. Y., Ohio, Mo., and N. Mex.

4. **Salix lucida** Muhl. Shining Willow. A tall shrub or small tree with smooth or slightly scaly bark, the twigs yellowish brown and shining. Leaves lanceolate, ovate-lanceolate, or ovate, mostly long-acuminate, narrowed or rounded at the base, sharply serrulate, green and glossy on both sides or with a few scattered hairs when young, 3-5 in. long, $\frac{3}{4}$ - $2\frac{1}{2}$ in. wide; capsule narrowly ovoid, acute, glabrous, much longer than its pedicel. A very beautiful willow in swamps and along streams and lakes. Newf. to N. W. Terr., N. J., Ohio, Ky., and Neb.

5. **Salix fragilis** L. Crack Willow. A tall slender tree with roughish, gray bark and green branches. Leaves lanceolate, long-acuminate, narrowed at the base, sharply serrulate, glabrous on both sides, rather dark green above, paler beneath, 3-6 in. long, $\frac{1}{2}$ -1 in. wide; capsule long-conic. Twigs used for basket work. Native of Europe. Hybridizes with *S. alba*. Mass. to N. J. and Ohio.

6. **Salix álba** L. White Willow. A large tree with rough gray bark. Leaves lanceolate, narrowed at the base, serrulate, silky-pubescent on both sides when young, less so and pale and glaucous beneath when mature, 2-5 in. long, $\frac{1}{4}$ - $\frac{1}{2}$ in. wide; capsule ovoid, acute. In moist soil. Native of Europe. The subspecies *S. alba vitellina* (L.) Koch., has the mature leaves glabrous and the twigs yellowish-green. N. B. and Ont. to Ohio and Penn.

7. **Salix babylónica** L. Weeping Willow. A large graceful tree with weeping branches, often planted in yards and cemeteries. Leaves linear-lanceolate, serrulate, narrowed at the base, glabrous when mature, green above, paler beneath, 3-6 in. long, $\frac{1}{4}$ - $\frac{1}{2}$ in. wide; capsule ovoid-conic. Native of Asia.

8. **Salix balsamifera** (Hook.) Barr. Balsam Willow. Usually a shrub but sometimes arborescent with a slender erect stem. Leaves elliptic, ovate-oval, or obovate, thin, glabrous, acute at the apex, rounded or subcordate at the base, glaucous beneath, 2-3 in. long, $\frac{3}{4}$ -1 $\frac{1}{2}$ in. wide, slightly crenulate-serrulate; capsule very narrow, acute. In swamps. Lab. to Man. south to Me., Mich., and Minn.

9. **Salix missouriensis** Bebb. Missouri Willow. A tree with small, appressed scales on the thin bark. Leaves lanceolate, or oblanceolate, acuminate, finely serrate with minute gland-tipped teeth, rounded or narrowed at the base, glabrous or nearly so when mature, pale and glaucous beneath, 2 $\frac{1}{2}$ -5 in. long, $\frac{1}{2}$ -1 in. wide; capsule ovoid. Wood dark brown. On river banks and in moist places. The closely related *S. cordata* is a shrub with pale bracts and the leaves not whitish beneath. Mo., Kan., Neb., and Iowa.

10. **Salix fluviatilis** Nutt. Sandbar Willow. A shrub or small slender tree usually forming thickets. Flowers can be found for a long time. Leaves linear-lanceolate, acuminate, remotely denticulate with somewhat spreading teeth, short-petioled; 2 $\frac{1}{2}$ -4 in. long; capsule ovoid-conic, finely silky when young, glabrate in age. Along streams and ponds and in ravines, sometimes on high ground. Quebec to N. W. Terr., south to Va. and Texas, Ohio.

11. **Salix discolor** Muhl. Pussy Willow. A shrub or low tree in swamps or moist hill-sides. Leaves obovate, oblong or oblanceolate, usually glabrous, glaucous and nearly white beneath, irregularly serrulate or nearly entire, slender-petioled, 1 $\frac{1}{2}$ -4 in. long; capsule narrowly conic, tapering to a slender beak. N. S. to Man., Del., Ohio and Mo.

12. **Salix bebbiana** Sarg. Bebb Willow. A shrub or small tree. Leaves elliptic, oblong, or oblong-lanceolate, sparingly serrate or entire, dull green and puberulent above, pale and tomentose beneath, nearly glabrous when very old; capsule very narrowly long-conic, twice as long as the filiform pedicel. In dry soil along streams. Anticosti to Hudson Bay and Br. Col., south to N. J., Ohio, Neb., and Utah.

13. **Salix viminalis** L. Osier Willow. A small slender tree or shrub with green twigs. Leaves long linear-lanceolate, sparingly repand-crenulate or entire, revolute-margined, short-petioled, glabrous above, silvery-silky beneath, 3-6 in. long; capsule narrowly ovoid-conic, acute. Cultivated for wicker-ware. Native of Europe and Asia.

14. **Salix purpurea** L. Purple Willow. A slender shrub or small tree with smooth and very bitter bark, the branches often trailing. Leaves oblanceolate or spatulate, acute, serrulate, narrowed at the base, short-petioled, glabrous above, paler and somewhat glaucous beneath, $1\frac{1}{2}$ - $2\frac{1}{2}$ in. long; capsule ovoid-conic, obtuse, tomentose. Cultivated for wicker-ware. Native of Europe.

Order, MYRICALES.

Myricaceae. Bayberry Family.

13. **Myrica** L. Bayberry.

Shrubs or trees with alternate simple leaves without stipules. Drupe globose or ovoid, its exocarp waxy. Flowers in catkins.

1. **Myrica cerifera** L. Wax-myrtle. A slender dioecious tree with gray, nearly smooth bark. In sandy swamps or wet woods. Pa. and Md. to Fla., and Tex. north to Ark.

Order, JUGLANDALES.

Juglandaceae. Walnut Family.

14. **Juglans** L. Walnut.

Trees with spreading branches, superposed buds, diaphragmed pith with cavities, and odd-pinnate leaves; monoecious. Fruit a nut in a fleshy husk. Staminate flowers in aments. Seed of nut edible.

1. Leaflets almost entire; nut rather smooth and thin-shelled; twigs glabrous. *J. regia.*

1. Leaflets serrate; nut rough, thick-shelled. 2.

2. Petioles smoothish or puberulent; axil of leaf without a hairy cushion below the buds; dark brown or black, rough; fruit globose, not viscid. *J. nigra.*

2. Petioles pubescent, sticky or gummy when young; axil of the leaf with a hairy cushion below the buds; bark gray, the ridges smooth on the surface; fruit oblong, viscid. *J. cinerea.*

1. **Juglans nigra** L. Black Walnut. A large tree with rough brownish black bark and a long tap root. Wood heavy, hard, strong, of coarse texture; heart-wood dark brown, of great value; used for cabinet-work, interior finish, gun-stocks, turnery, and as veneer. Common on flood plains of streams. Mass. to Ont. and Minn., south to Kan., Tex. and Fla., Ohio.

2. **Juglans cinerea** L. Butternut. A large tree with gray bark the outer surface of the ridges smooth. Heart-wood lighter colored and softer than in *J. nigra*; used for ornamental cabinet-work, interior finish, and cooperage. In rich or rocky woods. N. B. to N. Dak., Neb., Del., Ga., Ark., and Ohio.

*. *Juglans regia* L. English Walnut. A round-headed tree with the leaflets almost entire and nearly glabrous. Husk of the nut friable. Cultivated for the sweet nuts; from Asia.

15. **Hicoria** Raf. Hickory.

Trees with odd-pinnate leaves and serrate leaflets; monoecious. Axillary buds usually superposed; pith solid, 5-angled. Staminate flowers in aments. Fruit a nut in a husk.

1. Terminal bud-scales valvate, 4-6; leaflets 7-15, lanceolate or oblong-lanceolate, more or less falcate. 2.
1. Terminal bud-scales imbricate, more than 6; leaflets 3-9, not falcate, the uppermost larger and generally obovate. 4.
2. Nut elongated, almost terete, seed sweet; leaflets 11-15, inequilateral, acuminate. *H. pecan.*
2. Nut somewhat compressed or angled, usually as broad as long; seed intensely bitter; lateral leaflets falcate. 3.
3. Leaflets 7-9; nut smooth; husk thin, splitting to below the middle. *H. minima.*
3. Leaflets 9-13; nut angled, husk thin, splitting to the base. *H. aquatica.*
4. Terminal bud large, $\frac{1}{2}$ -1 in. long; husk splitting freely to the base, nut angled, seed sweet; middle lobe of the staminate calyx narrow, often at least twice as long as the lateral ones. 5.
4. Terminal bud small, $\frac{1}{4}$ - $\frac{1}{2}$ in. long; husk thin, not splitting freely to the base, nut slightly or not angled; lobes of the staminate calyx mostly nearly equal. 8.
5. Bark shaggy, separating in long plates; husk very thick, splitting to the base; outer bud-scales persisting through the winter. 6.

5. Bark close, rough; leaflets 7-9, stellate pubescent; outer bud scales falling away in autumn; husk not separating quite to the base; twigs and petioles tomentose. *H. alba*.
6. Leaflets 3-5, rarely 7, nut rounded at the base, $\frac{1}{2}$ -1 in. long. 7.
6. Leaflets 7-9; nut usually pointed at both ends, 1-1 $\frac{1}{4}$ in. long. *H. laciniosa*.
7. Leaflets oblong-lanceolate to obovate; twigs puberulent. *H. ovata*.
7. Leaflets narrowly lanceolate; twigs glaucous. *H. carolinac-septentrionalis*.
8. Fruit nearly globular; nut thin-shelled; bark of old trees separating in strips. 9.
8. Fruit obovoid; nut thick-shelled; bark close. 10.
9. Fruit little flattened; middle lobe of staminate calyx short; leaflets 5-7. *H. microcarpa*.
9. Fruit much flattened; middle lobe of staminate calyx long; leaflets 5; occasionally 3. *H. borealis*.
10. Leaves glabrous or nearly so; leaflets 5-7, rarely 3 or 9. *H. glabra*.
10. Leaves with silvery peltate glands; leaflets 5-9. *H. villosa*.

1. **Hicoria pecán** (Marsh.) Britt. Pecan (Hickory). A large tree of rapid growth with rough bark and a long tap root. Leaflets 11-15, oblong-lanceolate, short-stalked, inequilateral, acuminate; fruit oblong-cylindric; husk thin, 4-valved; nut smooth, oblong, thin-shelled, pointed, seed delicious and important commercially; wood like *H. ovata*. Along streams and in moist soil. Ind. to Iowa, south to Ky. and Tex.

2. **Hicoria minima** (Marsh.) Britt. Bitternut (Hickory). A slender tree with close rough bark. Leaflets 7-9, sessile, long-acuminate, the lateral ones falcate; fruit subglobose, narrowly 6-ridged; husk thin tardily and irregularly 4-valved; nut short-pointed, thin-shelled. Wood heavy, strong, and tough. In moist woods and swamps. Quebec to Minn., Fla., and Tex. Ohio.

3. **Hicoria aquática** (Mx. f.) Britt. Water Hickory. A tree with close bark, living in swamps. Leaflets 9-13, lanceolate, or the terminal one oblong, long acuminate at the apex, narrowed at the base, the lateral ones falcate; fruit oblong, ridged, pointed; husk thin, tardily splitting; nut oblong, thin-shelled, angular. Wood of poorer quality than that of other hickories. Va. to Fla., Ill., Ark., and Tex.

4. **Hicoria ovàta** (Mill.) Britt. Shagbark (Hickory).

A large tree with shaggy bark in narrow plates. Leaflets 5, sometimes 7, oblong, oblong-lanceolate, or the upper obovate, acuminate at the apex, narrowed to the sessile base; fruit subglobose; husk thick, soon splitting; nut white, somewhat compressed, pointed, slightly angled, thin-shelled. Seed finely flavored, most "hickory nuts" of the markets being from this species. Wood very heavy, hard, tough, and elastic; used for agricultural implements, carriages, wagon stock, axe-handles, cooperage, sucker rods, wheel spokes, etc. Also a fine fuel wood. Not durable in the ground. In rich soil. Quebec to Minn., Fla., Kan., Tex., and Ohio.

5. *Hicoria carolinae-septentrionalis* Ashe. Southern Shagbark (Hickory). A tree with gray bark hanging in loose strips. Leaflets 3-5, glabrous, ciliate; fruit subglobose; husk soon falling into four pieces; nut white or brownish, much compressed, angled, cordate or subcordate at the top, thin-shelled. In sandy or rocky soil. Del. to Ga. and Tenn.

6. *Hicoria laciniòsa* (Mx. f.) Sarg. Shellbark (Hickory). A large tree with the bark separating in long narrow plates and with a long tap root. Leaflets 7-9, rarely 5, acute or acuminate, sometimes 8 in. long; fruit oblong; husk thick, soon splitting to the base; nut oblong, somewhat compressed, thick-shelled, pointed at both ends, yellowish-white; seed sweet and edible. In rich soil. N. Y. and Ohio to Iowa, Kan., Okla. and Tenn.

7. *Hicoria álba* (L.) Britt. Mockernut (Hickory). A large tree with close rough bark. Leaflets 7-9, oblong-lanceolate or the upper oblanceolate or obovate, long-acuminate; fruit globose or oblong-globose; husk thick; nut grayish-white, angled, pointed at the summit, little compressed, thick-shelled; kernel small but sweet and edible. Wood much like in *H. ovata*. In rich soil. Mass. to Ont., Neb., Fla., Tex. and Ohio.

8. *Hicoria microcàrpa* (Nutt.) Britt. Small Pignut (Hickory). A tree having the older bark separating in narrow plates. Leaflets 5-7, oblong, or ovate-lanceolate, acuminate at the apex; fruit globose or globose-oblong; husk thin, tardily and incompletely splitting to the base; nut subglobose, slightly con-

pressed, thin-shelled, pointed; seed sweet. In rich soil. Mass. to Ohio and Mich., Va. and Mo.

9. **Hicoria borealis** Ashe. Northern Hickory. A small tree with rough furrowed bark when young, becoming shaggy in narrow strips when old. Leaflets 5, occasionally 3, lanceolate; fruit ovoid, much flattened; husk very thin, rugose, coriaceous, usually not splitting; shell thin and elastic; seed large, sweet and edible. In dry uplands. Mich.

10. **Hicoria glabra** (Mill.) Britt. Pignut (Hickory). A tree with close rough bark. Leaflets 3-7, rarely 9, oblong, oblong-lanceolate or the upper obovate, sessile, acuminate at the apex, usually narrowed at the base; fruit obovoid or obovoid-oblong; husk thin, the valves very tardily dehiscent; nut brown, angled, pointed, very thick-shelled; seed bitter and astringent, not edible. In dry or moist soil. Me. to Ont., Minn., Kan., Tex., Fla., and Ohio.

11. **Hicoria villòsa** (Sarg.) Ashe. Scurfy Hickory. A small or medium-sized tree with deeply furrowed, dark gray bark. Leaflets 5-9, thickly covered beneath with silvery peltate glands, mixed with resinous globules, generally pubescent; fruit obovoid, the husk partly splitting; nut brown, thick-shelled, angled; seed small, sweet. N. J. to Fla. and from Mo. and Ark. to Tex.

Order, FAGALES.

Betulaccac. Birch Family.

16. **Carpinus** L. Blue-beech.

Monoecous trees or shrubs with smooth gray bark and ridged stems. Flowers in aments. Leaves with straight and parallel lateral veins. Nuts small in a large-bracted catkin, bracts leaf-like.

1. **Carpinus caroliniana** Walt. Blue-beech. A small tree with slender terete gray twigs. Wood white, very compact, strong, and heavy, not durable in the ground; used for turnery, tool handles, etc. The charcoal is used for making powder. In moist soil and along streams. N. S. to Minn., Fla., Tex., and Ohio.

17. *Ostrya* Scop. Hop-hornbeam.

Monoecious trees with the flowers in aments. Leaves with straight and parallel lateral veins. Nuts small, in a hop-like catkin.

1. *Ostrya virginiana* (Mill.) Willd. Hop-hornbeam. A small tree with scaly bark. Wood white, compact, and very strong. In dry or moist soil. Cape Breton I. to Minn., Fla., Neb., Kan., Tex., and Ohio.

18. *Bétula* L. Birch.

Aromatic, monoecious trees or shrubs; bark usually papery or leathery; nuts small, samara-like, in a cone-like ament.

1. Leaves acute, obtuse, or truncate at the base, rarely cordate, prominently doubly serrate or serrate-dentate; bark chalky white or greenish brown; bark of twigs not with the flavor of wintergreen, usually bitter; fruiting aments peduncled. 2.
1. Leaves usually cordate or rounded at the base, sharply serrate, only slightly doubly serrate; bark brown or yellowish, close or separating into layers; bark of twigs with wintergreen flavor; fruiting aments sessile or nearly so. 5.
2. Bark of trunk and larger branches chalky white, usually peeling off in thin layers; fruiting aments cylindrical, pendant or spreading. 3.
2. Bark greenish brown, hardly peeling in layers; leaves rhombic, acute at both ends; young leaves and twigs tomentose; fruiting aments oblong, erect. *B. nigra*.
3. Leaves deltoid, very long acuminate at the apex; bark not readily separable into thin layers; twigs with numerous resinous glands. *B. populifolia*.
3. Leaves acute or acuminate, usually ovate, in some cultivated forms of various shapes; bark peeling off in thin layers. 4.
4. Leaves various, commonly triangular or rhombic-ovate, on slender petioles; twigs pendulous or weeping; much cultivated, from Europe and Asia. *B. alba*.
4. Leaves ovate or suborbicular; twigs pendulous; native, occasionally cultivated. *B. papyrifera*.
5. Bark not separating in layers, becoming furrowed; leaves shining above; fruiting bracts less than $\frac{1}{4}$ in. long, lobed at the apex. *B. lenta*.
5. Bark separating in layers or sometimes close, somewhat silvery; leaves dull above; fruiting bracts more than $\frac{1}{4}$ in. long, lobed to about the middle. *B. lutea*.

1. **Betula populifolia** Marsh. American White Birch. A slender, short-lived tree with smooth white bark, tardily separating in thin sheets. Autumn leaves pure yellow. Wood soft, white, not durable; used for making spools, shoe-pegs, etc. Leaves tremulous like those of the aspens. In moist or dry soil. N. B. to Ont., and Del.

2. **Betula papyrifera** Marsh. Paper Birch. A large tree with chalky white-bark separating in thin layers. The bark is very water-proof and is used for making canoes by Indians and trappers. Wood rather heavy, hard, and very close-grained; decays rapidly when exposed; used for making spools, pegs, shoe-lasts, woodenshoes, wagon hubs, ox-yokes, wood-carving, wood pulp, and in wood turnery. Newf. to Alaska, Penn., Mich., Neb., and Wash.

3. **Betula nigra** L. River Birch. A slender tree with reddish or greenish-brown bark peeling off in very thin layers. Branches long and slender, arched and heavily drooping. Wood rather light, hard, strong and close grained; used for furniture and turnery. "Birch brooms" are made from the twigs. Along streams. Mass. and N. H. to Iowa, Kan., Fla., Tex., and Ohio.

4. **Betula lenta** L. Sweet Birch. A large tree with dark brown, close, smooth bark, becoming furrowed and not separating in layers. Wood hard, fine-grained, of a reddish tint; used for cabinet-work. Newf. to Ont., Fla., Tenn., and Ohio.

5. **Betula lutea** Mx. f. Yellow Birch. A large tree with yellowish or gray bark, separating in thin layers or close. Autumn leaves pure yellow. Wood hard and close-grained; used in making furniture, wheel-hubs, pill-boxes, etc. Newf. to Man., N. Car., Ga., Tenn., and Ohio.

*. **Betula álba** L. European White Birch. A tree with chalky-white bark, much cultivated for ornament, especially the "weeping" and cut-leaved varieties.

19. **Alnus** Gaert. Alder.

Shrubs or trees with the flowers in aments, monoecious. Pith 3-angled; buds stalked. Nuts small, compressed, in woody cone-like catkins, which are persistent throughout the year.

1. Leaves obovate, broadly oval or suborbicular, dull; catkins expanding long before the leaves. 2.
1. Leaves oblong, shining above, catkins expanding in autumn. *A. maritima*.
2. Leaves finely tomentose or glaucous beneath. *A. incana*.
2. Leaves green, glabrous or sparingly pubescent beneath. 3.
3. Leaves finely serrulate, foliage not glutinous. *A. rugosa*.
3. Leaves dentate-serrate; twigs glutinous. *A. glutinosa*.

1. **Alnus incana** (L.) Willd. Hoary Alder. A shrub or small tree with the young shoots pubescent. In wet soil. Newf. to N. W. Terr., N. Y., Penn., Ohio and Neb. Also in Europe and Asia.

2. **Alnus rugosa** (DuRoi) Koch. Smooth Alder. A shrub or small tree with smooth bark, the young shoots somewhat pubescent. In wet soil or on hillsides. Me. to Ohio, Minn., Fla., and Tex.

3. **Alnus glutinosa** (L.) Medic. European Alder. A tree of rapid growth, developing readily in ordinary dry soil. Usually in wet places. Native of Europe, N. Y. and N. J.

4. **Alnus maritima** (Marsh.) Muhl. Seaside Alder. A small tree, glabrous or nearly so. In wet soil. Del. and Md.; also in Okl.

Fagaceae. Beech Family.

20. **Fagus** L. Beech.

Monoecious trees with smooth, light-gray bark. Leaves 2-ranked, the lateral veins straight and parallel. Twigs with prominent medullary rays and very long-pointed winter buds. Nut 3-angled, and enclosed in a 4-valved burr with soft spines.

1. **Fagus americana** Sw. American Beech. A large tree, the lower branches spreading. Autumn leaves pure yellow. Nut sweet and edible. Wood hard, heavy, light-colored, rather close-grained, not durable in the ground; used for making chairs, handles, plane-stocks, shoe-lasts, in turnery, and for "acid wood." In rich but not necessarily deep soil. N. S. to Ont. and Wis., Ohio, Fla., and Tex.

21. *Castanea* Adans. Chestnut.

Trees or shrubs, the leaves mostly 2-ranked with straight and parallel lateral veins. Fruit a rounded coriaceous nut, several in a globose, mostly 4-valved, very spiny involucre.

1. Leaves green on both sides; large trees. *C. dentata*.
1. Leaves densely white-tomentose beneath; shrubs or small trees. *C. pumila*.

1. *Castanea dentata* (Marsh.) Borkh. Chestnut. A large tree of very rapid growth with rough bark in longitudinal ridges. Nut sweet and edible. Wood soft, light, and coarse-grained; used for cabinet-work, railway ties, posts, cooperage, "acid wood," and telegraph poles. Sprouts freely from stumps. In rich or gravelly soil. Me. to Mich., Ga., Ala., and Ohio.

2. *Castanea pumila* (L.) Mill. Chinquapin. A shrub or small tree. Nut very sweet. Wood much like in *C. dentata*. In dry soil. N. J. to Ind., Fla., and Tex.

22. *Quercus* L. Oak.

Trees or shrubs with the flowers in aments, monoecious. Pith 5-angled; buds clustered at the tip of the twigs. Fruit a 1-seeded coriaceous nut (acorn) in an involucrate cup.

1. Leaves with bristle-tips; acorns maturing in the autumn of the second year. 2.
1. Leaves not bristle-tipped; acorns maturing the first year. 12.
2. Leaves pinnatifid or pinnately lobed. 3.
2. Leaves 3-5 lobed above the middle, or entire, obovate or spatulate in outline. 10.
2. Leaves entire, oblong, linear-oblong or lanceolate. 11.
3. Leaves green on both sides. 4.
3. Leaves white or gray-tomentose below. 8.
4. Cup of the acorn shallow, saucer-shaped, much broader than deep. 5.
4. Cup of the acorn top-shaped or hemispheric. 6.
5. Leaves dull; cup $\frac{1}{2}$ -1 in. broad; acorn ovoid. *Q. rubra*.
5. Leaves shining; cup $\frac{1}{4}$ - $\frac{1}{2}$ in. broad; acorn subglobose or short-ovoid. *Q. palustris*.
5. Leaves shining; cup $\frac{1}{2}$ - $\frac{3}{4}$ in. broad; acorn ovoid. *Q. schneckii*.

6. Inner bark orange; leaves sometimes lobed to beyond the middle; acorn ovoid, more or less longer than the cup. *Q. velutina*.
6. Inner bark gray or reddish; leaves deeply lobed. 7.
7. Leaves dull and paler beneath; acorn ovoid. *Q. borealis*.
7. Leaves shining on both sides, lobed to near the mid-rib; acorn ovoid; cup $\frac{1}{2}$ in. wide, more or less. *Q. ellipsoidalis*.
8. Leaf-lobes lanceolate or linear-lanceolate, long; large trees. 9.
8. Leaf-lobes triangular-ovate, short; shrubs or low trees. *Q. nana*.
9. Leaves rounded or obtuse at the base, 3-5 lobed; lobes linear or lanceolate, often falcate. *Q. digitata*.
9. Leaves cuneate or acute at the base, 5-11-lobed; lobes triangular. *Q. pagodaefolia*.
10. Leaves obovate-cuneate, brown-floccose beneath; cup deep, acorn ovoid. *Q. marylandica*.
10. Leaves spatulate, glabrous on both sides; cup saucer-shaped, acorn globose-ovoid. *Q. nigra*.
11. Leaves linear-oblong, green and glabrous on both sides. *Q. phellos*.
11. Leaves oblong or lanceolate, tomentulose beneath. *Q. imbricaria*.
12. Leaves pinnatifid or pinnately lobed. 13.
12. Leaves crenate or dentate, not lobed. 17.
13. Mature leaves pale, or glaucous and glabrous below. 14.
13. Mature leaves pubescent or tomentose below, lyrate-pinnatifid. 15.
14. Bark separating in thin scales, light gray or light brown; cup shallow; bracts thick and warty. *Q. alba*.
14. Bark furrowed and ridged, not scaly, dark gray or dark brown; cup hemispherical, with imbricated, appressed scales; cultivated in many varieties. *Q. robur*.
15. Upper scales of the cup not awned. 16.
15. Upper scales awned, forming a fringe around the acorn. *Q. macrocarpa*.
16. Leaves yellowish-brown, tomentulose beneath; acorn ovoid. *Q. minor*.
16. Leaves white-tomentulose beneath; acorn depressed-globose. *Q. lyrata*.
17. Fruit peduncled; teeth or shallow lobes of the leaves rounded. 18.
17. Fruit sessile or nearly so; teeth or shallow lobes of the leaves acute. 20.
18. Peduncle much longer than the petioles; leaves white-tomentulose beneath. *Q. platanoïdes*.
18. Peduncle as long or shorter than the petioles; leaves gray-tomentulose beneath. 19.
19. Bark white, flaky; seed sweet and edible; fruit short peduncled or sessile. *Q. michauxii*.
19. Bark close; seed edible; petioles slender; peduncles equalling or shorter than the petioles. *Q. prinus*.

20. Shrub or low tree, leaves obovate or oval; seed edible. *Q. prinoides*.
20. Tall trees. 21.
21. Leaves mostly oblong to lanceolate; cup deep; bark close; seed edible. *Q. acuminata*.
21. Leaves obovate; cup shallow; bark more or less flaky. *Q. alexanderi*

1. **Quercus rubra** L. Red Oak. A large tree with dark gray bark, somewhat roughened. Leaves oval or somewhat obovate, 4-8 in. long, dull green above, paler beneath, lobes triangular-lanceolate, tapering from a broad base to an acuminate apex; cup saucer-shaped, its base flat or slightly convex $\frac{1}{2}$ -1 in. broad; acorn ovoid, 2-4 times as long as the cup. Autumn leaves purplish red. Wood very coarse-grained, reddish in color, porous, and not very durable; used in carpentry, cooperage, and for clapboards. The most rapid grower of all the oaks. An important tree for tan-bark. Sprouts readily from stumps. N. S. to Ont., Minn., Fla., Kan., Tex., and Ohio.

2. **Quercus palustris** DuRoi. Pin Oak. A medium-sized tree with brown bark, rough when old, the lower branches deflexed. Leaves broadly oblong or obovate, deeply pinnatifid, brighter green and shining above, duller beneath, $2\frac{1}{2}$ -5 in. long, the lobes oblong, lanceolate or triangular-lanceolate, divergent; cup saucer-shaped, $\frac{1}{4}$ - $\frac{1}{2}$ in. broad, base flat; acorn subglobose or ovoid, 2-3 times as long as the cup. Wood coarse-grained, reddish, and not durable. In moist ground. Mass. to Ohio and Wis., Del. and Ark.

3. **Quercus schneckii** Britt. Schneck's Red Oak. A medium-sized tree with reddish-brown bark with broad ridges broken into plates. Leaves mostly obovate, bright green and shining above, paler beneath, 2-6 in. long, truncate or broadly wedge-shaped at the base, deeply pinnatifid; lobes oblong or triangular; cup saucer-shaped, $\frac{1}{2}$ inch broad more or less, acorn ovoid, 2-3 times as high as the cup. Ind. to Iowa, Mo., Fla., and Tex.

4. **Quercus coccinea** Wang. Scarlet Oak. A tree with pale reddish or gray inner bark. Leaves deeply pinnatifid, glabrous, bright green above, paler beneath, 4-8 in. long; cup hem-

ispheric or top-shaped, acorn ovoid, about twice as long as the cup. Autumn leaves red. In dry soil. Me. to Minn., Fla., Mo., and Ohio.

5. *Quercus ellipsoidalis* Hill. Oval-leaf Oak. A tall tree with gray, close, fissured bark, the innermost layer yellowish; lowest branches drooping. Leaves oval to obovate-orbicular, $2\frac{1}{2}$ -6 in. long, deeply 5-7-lobed, broadly cuneate to truncate at the base; cup turbinate, short-peduncled, acorn ellipsoid to subglobose, $\frac{1}{2}$ - $\frac{3}{4}$ in. long, 1-2 times as long as the cup. Ill., Mich., and Minn.

6. *Quercus borealis* Mx. f. Gray Oak. A large tree with leaves like those of *Q. rubra* and acorns like those of *Q. coccinea*. Leaves 7-13-lobed to the middle or somewhat beyond; cup turbinate, peduncled; acorn ovoid, 1-2 times as long as the cup. Quebec to Ont., N. Y. and Penn.

7. *Quercus velutina* Lam. Quercitron Oak. A large tree of rapid growth with very dark brown outer bark, rough in ridges, and bright orange inner bark. Leaves firm, sometimes lobed to beyond the middle, brown-pubescent or sometimes stellate-pubescent when young, glabrous when mature, the lobes broad, oblong or triangular-lanceolate; cup hemispheric or top-shaped, commonly narrowed into a short stalk; acorn ovoid, as long or longer than the cup. The inner bark (quercitron) yields a valuable dye; rich also in tannin. Wood hard, heavy, and strong but not tough. Sparingly self-prunes small twigs by means of basal joints. Me. to Minn., Fla., Neb., Tex., and Ohio.

8. *Quercus digitata* (Marsh.) Sudw. Spanish Oak. A tree growing in dry soil. Leaves glabrous above, gray-tomentulose beneath, deeply pinnatifid into 3-7 linear or lanceolate lobes; cup saucer-shaped with a turbinate base, about $\frac{1}{2}$ in. broad; acorn subglobose or depressed, about twice as high as the cup. Wood very hard and strong; used for cooperage. An important tan-bark oak. N. J. to Fla., Mo., Neb., and Tex.

9. *Quercus pagodaefolia* (Ell.) Ashe. Swamp Spanish Oak. A tree with spreading branches and dark gray, rough bark. Leaves oval or oblong, cuneate to truncate at the base, 8-12 in. long, deeply 5-11-lobed, persistently white-tomentulose beneath,

lobes narrowly triangular, spreading or somewhat ascending, usually entire; cup sessile, shallow, acorn globose, about $\frac{1}{2}$ enclosed in the cup. In wet or moist soil. Va. and N. Car. to Ga., Ind., and Mo.

10. **Quercus nana** (Marsh.) Sarg. Bear Oak. A shrub or small tree, often forming thickets. Leaves mostly obovate, 2-5 in. long, short-petioled, grayish-white tomentulose beneath 3-7-lobed, lobes triangular-ovate, acute; cup saucer-shaped, $\frac{1}{4}$ - $\frac{1}{2}$ in. broad, with a turbinate or rounded base; acorn globose-ovoid, longer than the cup. In sandy or rocky soil. Me. to Pa., Del., and in mountains of N. C. and Ky.

11. **Quercus marylandica** Muench. Black-Jack (Oak). Usually a small shrubby tree; bark nearly black with very rough ridges. Leaves obovate, 3-5 lobed toward the broad usually nearly truncate apex, cuneate below, the lobes short, stellate-pubescent above, brown-tomentose beneath when young, mature leaves glabrous above; cup deep about $\frac{1}{2}$ in. broad; acorn ovoid, 2-3 times as high as the cup. In dry sterile soil. Hybridizes with *Q. phellos* and *Q. nana*. L. I. to Ohio, Neb., Fla., and Tex.

12. **Quercus nigra** L. Black Water Oak. A tree of rapid growth with gray bark, rough in ridges. Leaves spatulate or obovate, 1-3-lobed at the apex or some of them entire and rounded, short-petioled; cup saucer-shaped, rounded at the base, about $\frac{1}{2}$ in. wide; acorn globose-ovoid, 2-3 times as high as the cup. Wood heavy, hard, and strong; used for fuel. Usually along streams and swamps. Del. to Ky., Mo., Fla., and Tex.

13. **Quercus phellos** L. Willow Oak. A tree with slightly roughened, reddish brown bark. Leaves narrowly-oblong or oblong-lanceolate, entire, very short petioled; cup saucer-shaped, nearly flat on the base; acorn subglobose, bitter. Wood poor. In moist woods. Hybridizes with *Q. nana* and probably *Q. rubra*, producing the form known as *Q. heterophylla* Mx. L. I. to Fla., Mo., and Tex.

14. **Quercus imbricaria** Mx. Shingle Oak. A large stout tree, the leaves dying off but remaining on the tree until about April 1. Leaves oblong or lanceolate, entire, persistently gray-tomentulose beneath, 3-7 in. long; cup hemispheric or turbi-

nate, about $\frac{1}{2}$ in. broad; acorn subglobose, bitter. Wood poor; used for shingles and clapboards. Self-prunes twigs by means of basal joints. *Q. leana* Nutt. is a hybrid of this and *Q. velutina*. *Q. tridentata* Engelm. is a hybrid with *Q. marylandica*. Also hybridizes with *Q. palustris* and *Q. rubra*. Pa. to Mich., Neb., Ga., Ark., and Ohio.

15. **Quercus álba** L. White Oak. A large tree with light gray bark scaling off in thin plates. Leaves obovate, pinnatifid, lobes oblong, toothed or entire; cup depressed-hemispheric, its bracts thick and warty, appressed; acorn ovoid-oblong, 3-4 times as high as the cup, sweet and edible. Autumn leaves red and russet. Self-prunes extensively. Wood light-colored, hard and tough; valuable for many purposes; an ideal wood for railroad ties; used for poles, posts, and piling, for fuel and "acid wood," for cooperage, furniture, interior finishing lumber, farm implements, wharves, ship building, and car and wagon work. The most valuable of the American oaks. Hybridizes with *Q. macrocarpa*, *Q. minor*, *Q. prinus*, and *Q. acuminata*. Me. to Ont., Minn., Fla., Kan., Tex., and Ohio.

*. *Quercus robur* L. English Oak. A large strong tree with stout more or less spreading branches forming a broad round-topped head; self-prunes. Many forms are cultivated for ornament, including yellow-leaved and cut-leaved varieties, also forms with varied branches. Native of Europe.

16. **Quercus minor** (Marsh.) Sarg. Post Oak. A shrub or usually a small tree with a long tap root and with rough gray bark and valuable wood. Leaves broadly obovate, deeply lyrate-pinnatifid, glabrous above, brown-tomentulose beneath, 4-8 in. long; cup hemispheric, nearly sessile; acorn ovoid, 2-3 times as long as the cup, very sweet. In dry soil. Mass. to Ohio and Mich., Fla., and Tex.

17. **Quercus lyràta** Walt. Overcup Oak. A large tree with gray or reddish bark in thin plates. Leaves obovate, lyrate-pinnatifid or lobed to beyond the middle 6-8 in. long, shining above, densely white-tomentulose beneath, cup depressed-globose, peduncled, 1-1 $\frac{1}{4}$ in. broad; acorn depressed-globose, nearly or

quite immersed in the cup. Wood like in white oak. In swamps. N. J. to Ind., Mo., Fla., and Tex.

18. **Quercus macrocarpa** Mx. Bur Oak. A large tree with flaky gray bark and with a long tap root. Leaves obovate or oblong-obovate, irregularly lobed, pinnatifid, or coarsely crenate; shining above, grayish-white-tomentulose beneath, 4-8 in. long; cup short peduncled or sessile, hemispheric or subglobose, $\frac{1}{2}$ -1 in. broad, the tips of the bracts forming a fringe around the acorn; acorn ovoid, 1-2 times as high as the cup. Self-prunes abundantly. A very valuable tree with hard and tough wood resembling the White Oak. In rich soil or on river bluffs where it is sometimes small and shrubby. Hybridizes with *Q. acuminata*. N. S. to Man., Mass., Ohio, Kan., and Tex.

19. **Quercus platanooides** (Lam.) Sudw. Swamp White Oak. A large tree with flaky gray bark. Leaves obovate, or oblong-obovate, coarsely toothed or sometimes lobed nearly to the middle, dull and glabrous above, densely white-tomentulose beneath; peduncles of the hemispheric cup 2-5 times as long as the petioles; acorn oblong-ovoid, seed rather sweet. Self-prunes. Wood similar in value to that of the White Oak. In moist or swampy soil. Quebec to Ohio and Mich., Ga., and Ark.

20. **Quercus michauxii** Nutt. Cow Oak. A large tree with flaky white bark. Leaves obovate or broadly oblong, crenately toothed the teeth often mucronulate, 4-8 in. long, cup depressed-hemispheric, short-peduncled, 1-1 $\frac{1}{4}$ in. broad; acorns ovoid, about 3 times as high as the cup, sweet and edible. Wood valuable like the White Oak. In moist soil. Del. to Ind., Mo., Ark., Fla., and Tex.

21. **Quercus prinus** L. Rock Chestnut Oak. A large tree with brown bark, ridged, close or slightly flaky. Leaves oblong, oblong-lanceolate, or obovate, coarsely crenate, glabrous above, finely gray-tomentulose beneath, petioles slender; cup hemispheric, $\frac{1}{2}$ -1 $\frac{1}{4}$ in. broad, peduncles equalling or shorter than the petioles; acorn ovoid, 2-3 times as high as the cup, seed edible but not very sweet. Self-prunes. Wood hard and strong; used in fencing and for railroad ties. Bark rich in tannin. In dry soil. Me. to Ont., Ala., Tenn., and Ohio.

22. *Quercus acuminàta* (Mx.) Houda. Chestnut Oak. A tree with close gray bark. Leaves oblong, lanceolate, or sometimes obovate, coarsely toothed with acute teeth, shining above, pale and gray-tomentulose beneath, 4-6 in. long; cup sessile or very short-peduncled, hemispheric; acorn ovoid about twice as high as the cup, sweet and edible. Self-prunes abundantly. Wood strong and durable, much like White Oak. Usually in dry soil, commonly on lime stone ridges. Ont. to Minn., Ga., Ala., Tex., and Ohio.

23. *Quercus alexànderi* Britt. Alexander's Chestnut Oak. A tree with gray bark, flaky, especially when old. Leaves obovate or oblong-obovate, broadest above the middle, coarsely toothed; cup short-stalked or sessile, shallow; acorn ovoid, 2-3 times as high as the cup. Self-prunes. Vt. to Mich., and Ind.

24. *Quercus prinoides* Willd. Scrub Chestnut Oak. A shrub or small tree with gray bark. Leaves obovate, coarsely toothed, bright green and shining above, gray-tomentulose beneath, narrowed at the base; cup sessile, hemispheric, thin; acorn ovoid, 2-3 times as long as the cup; seed sweet and edible. Self-prunes. In dry sandy or rocky soil. Me. to Ohio and Minn., Ala., and Tex.

Order, URTICALES.

Ulmaceae. Elm Family.

23. *Ulmus* L. Elm.

Trees of rapid growth with 2-ranked inequilateral leaves, the lateral veins straight and parallel. Flowers bisporangiate or imperfectly bisporangiate in clusters or racemes. Fruit a samara.

1. Leaves very rough above; inner bark very mucilaginous; twigs not corky-winged and not self-pruned, but large numbers of lateral buds cut off; samara not ciliate. *U. fulva*.
1. Leaves smooth or sometimes rather rough above; inner bark not mucilaginous. 2.
2. None of the branches corky-winged; twigs smooth, self-pruned by basal joints and by cleavage planes in the nodes of annual growth; samara faces glabrous. *U. americana*.
2. None of the branches with corky ridges; twigs glabrous or nearly so, not self-pruned; samara glabrous or nearly so, deeply notched. *U. campestris*.

2. Some or all of the branches corky-winged, or twigs puberulent, self-pruned; samara-faces pubescent. 3.
3. Most of the branches with corky wing-like ridges; twigs glabrous or nearly so; leaves 1-3 in. long. *U. alata*.
3. Branches often with corky wing-like ridges; twigs puberulent; leaves 2-5 in. long. *U. racemosa*.

1. **Ulmus americana** L. White Elm. A large tree of rapid growth, with gray flaky bark, much cultivated in cities and along roadsides. Samara ovate-oval, its faces glabrous. Wood heavy, hard, flexible, and very tough; used for wheel-hubs, saddle-trees, rough cooperage and furniture, in boat and ship building, and in the construction of cars and wagons. Common on bluffs and on the flood plains of rivers and creeks. Graceful in form and very suitable for cultivation. Newf. to Man., Fla., Tex., and Ohio.

2. **Ulmus racemosa** Thom. Cork Elm. A large tree with puberulent young twigs, the branches or some of them with corky wings. Samara oval, its margins densely ciliate. Wood harder, stronger, and more durable than that of the White Elm. In rich soil. Quebec to Ont., Mich., N. J., Tenn, Neb., and Ohio.

* *Ulmus campestris* L. English Elm. A tree, rather pyramidal in shape, the twigs ascending, not drooping except in "weeping" forms. Samara not ciliate, nearly or quite glabrous. A good timber tree. Cultivated, from Europe.

3. **Ulmus alata** Mx. Winged Elm. A small tree, branches usually with corky wing-like ridges; twigs glabrous or nearly so. Samara oblong, pubescent on the faces. Wood very compact; used for wheel hubs. In dry or moist soil. Va. to Fla., Ill., Ark., and Tex.

4. **Ulmus fulva** Mx. Slippery Elm. A medium-sized tree with rough grayish-brown fragrant bark and rough-pubescent twigs. Samara oval-orbicular, pubescent over the seed. Inner bark mucilaginous and medicinal. Wood hard and strong but splitting easily when dry. Along streams, on flood plains and on hills. Quebec to N. Dak., Fla., Tex., and Ohio.

24. **Planera** Gmel. Planertree.

Trees similar to the elms but with a nut-like fruit and the flowers expanding with the leaves. Bark of the trunk scaling off in plates.

1. **Planera aquatica** (Walt.) Gmel. Planertree. A small tree with nearly glabrous leaves growing in swamps and on wet banks. Ind. to Mo., Ky., N. Car., La., and Fla.

25. **Céltis** L. Hackberry.

Trees or shrubs with 2-ranked leaves and the pith diaphragmed. Fruit an ovoid or globose drupe.

1. Leaves sharply serrate; smooth or scabrous above; twigs glabrous, especially the fruiting ones, or pubescent. *C. occidentalis*.
1. Leaves entire or few-toothed, small. *C. mississippiensis*.

1. **Celtis occidentális** L. Common Hackberry. A medium-sized tree with rough bark. Commonly much distorted with "witches brooms." Drupe sweet and edible. Self-prunes the fruiting twigs in winter. Wood heavy, hard, strong, quite tough, greenish-white. In dry soil and on flood plains. Quebec to Man., La., N. Car., Mo., Kan., and Ohio.

2. **Celtis mississippiensis** Bosc. Southern Hackberry. A medium-sized tree with light gray, rough bark. Usually in dry soil. N. Car., to Ill., Mo., Kan., Fla., and Tex.

Moraceae. Mulberry Family.

26. **Mòrus** L. Mulberry.

Shrubs or trees with 2-ranked leaves and milky sap. Fruit aggregate, berry-like.

1. Leaves scabrous above, pubescent beneath. *M. rubra*.
1. Leaves smooth and glabrous on both sides, or nearly so. *M. alba*.

1. **Morus rubra** L. Red Mulberry. A small tree with rough gray bark. Fruit dark purple-red, edible, delicious. Wood rather heavy, hard, strong, and rather tough; very durable in contact with the ground, very valuable for posts; used for farm implements, in cooperage, "acid wood," and ship building. In rich soil. Vt. and Ont., to Ohio and Mich., S. Dak., Fla., and Tex.

2. **Morus álba** L. White Mulberry. A small rapid-growing tree with rough light gray bark and spreading branches. Fruit edible but usually rather insipid. Leaves used for feeding silk-worms. Wood suitable for posts. Although growing best in rich moist soil, it does well in quite dry regions and should be much planted on the dry prairies, especially varieties with the better grade of berries. Introduced from the Old World. Me. and Ont., to Fla., Kan., and Ohio.

27. **Tóxylon** Raf. Osage-orange.

A tree with milky sap, sharp thorns, and entire leaves. Fruit a large spherical, greenish or yellowish syncarp.

1. **Toxylon pomiferum** Raf. Osage-orange. A small thorny tree much planted for hedges. Wood very heavy, exceedingly hard, and strong, but not tough, brownish-yellow; valuable for fence posts and fire wood, also used for wagon making. The thorns produce painful wounds. Horses acquire a strong liking for the young shoots and eat them in large quantities without apparent ill effects. Mo. and Kan. to Tex. Escaped in Ohio and other eastern states.

28. **Broussonétia** L'Her. Paper-mulberry.

Trees with 2-ranked leaves and milky sap. Drupes in a globular head.

1. **Broussonetia papyrifera** (L.) Vent. Paper-mulberry. A small, low-branching, large-headed tree with dark scarlet fruit which is sweet but insipid. Native of eastern Asia. In Japan and China the bark is made into paper. Escaped from cultivation. N. Y. to Ga., and Mo.

Order, PLATANALES.

Hamamelidaceae. Witch-hazel Family.

29. **Hamamèlis** L. Witch-hazel.

Trees or shrubs with alternate simple leaves and bisporangiate or imperfectly bisporangiate flowers. Fruit a 2-locular woody or cartilaginous capsule.

1. **Hamamelis virginiana** L. Witch-hazel. A shrub or small tree with 2-ranked leaves and stalked buds. Blooms in late autumn. In low ground and on banks. N. B. and N. S. to Minn., Mo., Fla., Tex., and Ohio.

30. **Liquidambar** L. Sweet-gum.

Large trees with resinous, aromatic sap. Capsules in a dense spinose globular head.

1. **Liquidambar styraciflua** L. Sweet-gum. A fine large tree with wide spreading branches, the twigs often covered with corky ridges. Leaves with a peculiar sweet fragrance when crushed. Autumn leaves red, yellow, and brown. Wood valuable, of medium weight, rather soft, strong, tough, and of fine texture, difficult to season. Sometimes used as a substitute for black walnut. Used for furniture, veneer, wooden plates, plaques, baskets, hat blocks and wagon hubs. In low ground. Conn., N. Y. and Ohio. to Fla., Ill., Mo., and Mex.

Platanaceae. Planetree Family.

31. **Plátanus.** L. Planetree.

Large trees, the twigs with complete stipular rings and the axillary buds covered by the base of the petiole. Fruit in a spherical head composed of numerous nutlets.

1. **Platanus occidentalis** L. Sycamore. A very large tree, the largest in the northeastern United States, with whitish or green bark which peels off freely in thin plates; the largest trunks usually hollow. Autumn leaves brown. Wood rather hard, compact, coarse-grained, difficult to split, tough, and of a light-brown color; used for tobacco boxes, cooperage, cabinet-work, and finishing lumber. Along the banks of streams and in moist ground but grows well in ordinary mesophytic conditions. Me. to Ont. and Minn., Fla., Kan., Tex., and Ohio.

Sub-class, CHORIPETALAE.

Order, RANALES.

Magnoliaceae. Magnolia Family.

32. **Magnòlia** L. Magnolia.

Trees or shrubs with bitter aromatic bark, the twigs showing

complete stipular rings. Flowers bisporangiate, large, solitary. Buds covered with conduplicate sheathing stipules. Pith usually diaphragmed but solid. Fruit aggregate, cone-like.

1. Leaves auriculate, glabrous. Leaf buds glabrous. *M. fraseri*.
1. Leaves rounded or truncate at the base, thin. Leaf buds silky pubescent. *M. acuminata*.
1. Leaves acute at the base. 2.
2. Leaves light green beneath, 1-2 ft. long. Leaf buds glabrous. *M. tripetala*.
2. Leaves glaucous beneath, 3-6 in. long. Leaf buds pubescent. *M. virginiana*.

1. **Magnolia fraseri** Walt. Fraser Magnolia. A tree with spreading branches and glabrous leaf buds. Leaves elongated-obovate or oblong, auriculate, $\frac{1}{2}$ -2 ft. long; flowers white. In mountain woods. Va. and Ky. to Fla. and Miss.

2. **Magnolia tripetala** L. Umbrella Magnolia. A low tree with glabrous leaf-buds and irregular branches. Leaves obovate, acute, cuneate at the base, 1-2 ft. long, flowers white, slightly odorous. Wood soft and light. Penn. to Ga., Ark., and Miss.

3. **Magnolia virginiana** L. Laurel Magnolia. A tree with pubescent leaf buds. Leaves oval or oblong, acute at the base, 3-6 in. long; flowers white, deliciously fragrant. In swamps. Mass. to Penn., Fla., and Tex.

4. **Magnolia acuminata** L. Cucumber Magnolia. A large tree with silky pubescent leaf-buds. Leaves oval, acute or somewhat acuminate, rounded or truncate at the base $\frac{1}{2}$ -1 ft. long; flowers greenish-yellow. Wood soft, light, and durable; used for cabinet-work, pump-logs, and water-troughs. N. Y. to Ohio and Ill., Ga., Ala., and Ark.

33. **Liriodéndron** L. Tuliptree.

Trees with alternate truncate leaves, diaphragmed but solid pith, and complete stipular rings. Fruit aggregate, cone-like.

1. **Liriodendron tulipifera** L. Tuliptree. A very large, magnificent, rapid-growing tree with glabrous leaf-buds. Flowers greenish-yellow, orange-colored within. Buds covered with con-

duplicate sheathing stipules. Autumn leaves pure yellow. Next to the Sycamore, probably the largest tree in the Northeastern United States. Wood light, soft, and straight-grained, easily worked; heart wood light yellow or brown; sapwood thin, nearly white. Used for interior finish, shingles, boat-building, panels of carriages, wooden pumps, wooden ware of various kinds, wood pulp, furniture, implements, boxes, shelving, drawers, and for carving and toys. One of the best woods for panelling. Should be extensively cultivated. Vt. and R. I. to Fla., Ohio, Mich., and Ark.

Anonaceae. Custard-apple Family.

34. **Asimina** Adans. Papaw.

Small trees or shrubs with naked silky buds. Leaves 2-ranked; pith diaphragmed but solid; bark with fetid odor.

1. **Asimina triloba** (L.) Dunal. Papaw. A small tree or shrub with smooth dark bark and nodding young twigs. Flowers axillary, nodding; fruit a large fleshy, oblong, greenish-yellow, edible berry which, however, does not agree with some persons. A case of severe poisoning from eating the fruit is recorded. In creek and river bottoms and on hillsides. Ont. and N. Y. to Mich., Neb., Tex., Fla., and Ohio.

Lauraceae. Laurel Family.

35. **Sassafras** Nees and Eberm. Sassafras.

A tree with yellow dioecious flowers and spicy aromatic bark. Fruit a blue drupe.

1. **Sassafras sassafras** (L.) Karst. Sassafras. A large rough-barked tree, the sap of the bark and leaves mucilaginous. Autumn leaves red, yellow, and green. Wood reddish, light and rather soft, of coarse texture, durable; used in cooperage, for small boats, and fencing. The bark of the roots yields a powerful, aromatic stimulant. Fruit pungent, poisonous. Excessive doses of sassafras tea produce narcotic poisoning. In dry or sandy soil. Me. to Ont., Mich., Fla., Tex., and Ohio.

Order, ROSALES.

Rosaceae. Rose Family.

Pomatae. Apple Subfamily.

36. *Sórbus* L. Mountain-ash.

Trees or shrubs with odd-pinnate leaves, the leaflets serrate. Fruit a small red berry-like pome in compound cymes.

1. Leaflets glabrous above. 2.
1. Leaflets pubescent on both sides; calyx and pedicels usually woolly. *S. aucuparia.*
2. Leaflets long-acuminate; fruit less than $\frac{1}{4}$ in. in diameter. *S. americana.*
2. Leaflets obtuse or short-pointed; fruit more than $\frac{1}{4}$ in. in diameter. *S. sambucifolia.*

1. *Sorbus americana* Marsh. American Mountain-ash. A small tree with smooth bark. Bark and unripe fruit very astringent. In moist ground. Much prized for ornamental planting. Newf., Man., N. Car., and Mich.

2. *Sorbus sambucifolia* (C. & S.) Roem. Elderleaf Mountain-ash. A small tree with smooth bark. In moist ground. Lab. to Alaska, N. Eng., Ohio, Mich., and in Rocky Mts. to Colo. and Utah.

3. *Sorbus aucuparia* L. European Mountain-ash. A small tree, native of Europe. Frequently cultivated. Fruit poisonous to man, but eaten by some birds. N. S. to N. H.

37. *Pyrus* L. Pear.

Trees or shrubs with simple leaves. Fruit a pome, its flesh containing grit-cells.

1. *Pyrus communis* L. Pear. A pyramidal usually slender tree, often with thorn-like stunted branches. Bark smooth. Cultivated for its large fleshy fruit. Native of Europe and Asia. Me to N. J. and Ohio.

38. *Màlus* Hill. Apple, Crab-apple.

Trees or shrubs with simple leaves. Fruit a fleshy pome without grit-cells.

1. Leaves glabrous, at least when mature. 2.
1. Leaves persistently pubescent or tomentose beneath. 3.
2. Leaves oblong, oval, or lanceolate, narrowed at the base. *M. angustifolia*.
2. Leaves ovate, rounded or cordate at the base, often somewhat lobed. *M. coronaria*.
2. Leaves ovate, acute or acuminate at the apex and acute at the base, on slender petioles; finely and nearly evenly serrate. *M. baccata*.
3. Leaves mostly narrowed at the base; pome 1-2 in. in diameter. 4.
3. Leaves rounded or cordate at the base; pome usually large, 2-4 in. in diameter. *M. malus*.
4. Pedicel slender, pubescent, 1-2 in. long. *M. ioensis*.
4. Pedicel stout, white-tomentose, $\frac{1}{2}$ -1 in. long. *M. soulardi*.

1. **Malus angustifolia** (Ait.) Mx. Narrowleaf Crab-apple. A small tree usually with thorn-like stunted branches or spurs. Leaves oblong, oblong-lanceolate, or oval, thick, shining above, sometimes pubescent beneath when young, dentate or often entire. On low ground. N. J. to Ill., Kan., Fla., La., and Ohio.

2. **Malus coronaria** (L.) Mill. Fragrant Crab-apple. A small tree with hard and sour fruit suitable for preserving. Leaves ovate, to triangular-ovate, sparingly pubescent beneath when young, sharply serrate and often somewhat lobed. On low ground. Ont. to Mich., and S. Car., Ohio.

3. **Malus ioensis** (Wood) Britt. Iowa Crab-apple. A small tree much resembling *M. coronaria*. Leaves ovate, oval, or oblong, dentate, crenate or with a few rounded lobes, white-pubescent beneath at length glabrous above. Minn., Wis., and Ill. to Neb., Ky., La., and Okl.

4. **Malus soulardi** (Bail.) Britt. Soulard Crab-apple. A small tree resembling the two preceding. Leaves ovate, elliptic or obovate, irregularly crenate-dentate or sometimes few-lobed, rugose and densely tomentose beneath. Minn. to Mo. and Tex.

*. *Malus baccata* (L.) Siberian Crab-apple. A small spreading tree with compact crown. Pedicels very slender; fruit small, not becoming mellow. Cultivated.

5. **Malus malus** (L.) Britt. Common Apple. A medium-sized tree with spreading branches. Leaves ovate or oval, glabrous or nearly so above, pubescent and often woolly beneath.

Fruit large, various. Introduced from Europe and escaped in many places. The seeds are poisonous. Me. to N. Y., N. J., Ohio, and Ga.

39. *Cydonia* Tourn. Quince.

Shrubs or low, small trees with fleshy pomes.

*. *Cydonia cydonia* (L.) Karst. Quince. A low tree with crooked stem and rambling branches. Cultivated for the large sour fleshy fruit.

40. *Amelanchier* Medic. Juneberry.

Shrubs or small trees with simple mostly 2-ranked leaves and small berry-like pomes.

1. Leaves acute or acuminate at the apex; top of the ovulary glabrous or nearly so. 2.
1. Leaves rounded, obtuse or subacute at the apex; top of the ovulary woolly; petals $\frac{1}{2}$ - $\frac{3}{4}$ in. long. *A. rotundifolia*.
2. Leaves glabrous when mature, but pubescent or woolly when young, ovate to ovate-lanceolate; base cordate or rounded. *A. canadensis*.
2. Leaves densely white-woolly beneath, at least when young, oblong to obovate, rarely sub-cordate at the base. *A. botryapium*.

1. *Amelanchier canadensis* (L.) Med. Common Juneberry. A medium-sized tree with a small, red or purple, sweet and edible, berry-like pome. In dry soil. Newf. to Ont., Fla., La., and Ohio.

2. *Amelanchier botryapium* (L. f.) DC. Swamp Juneberry. A shrub or small tree growing in swamps and moist soil. N. B. to Man., Fla., La., and Ohio.

3. *Amelanchier rotundifolia* (Mx.) Roem. Roundleaf Juneberry. A tall shrub or small tree growing in woods and thickets. N. B. to Minn., N. Y., Ohio and Mich.

41. *Crataegus* L. Hawthorn.

Small trees or shrubs usually with typical, sometimes branched thorns. Pome drupe-like with bony ripe carpels. Only the common tree-forms are here included.

1. Corymbs many flowered. 2.
1. Corymbs 1-7 flowered; calyx-lobes deeply incised; leaves obovate or spatulate, obtuse. *C. uniflora*.

2. Leaves obovate, spatulate, oblanceolate, or flabellate. 3.
2. Leaves ovate, oval, orbicular-obovate, or nearly orbicular. 5.
3. Leaves, calyx, and peduncles glabrous; oblanceolate or obovate, sharply serrate. 4.
3. Lower surface of leaves, calyx, and peduncles more or less pubescent, at least when young; leaves slender-petioled, obovate, dull, irregularly serrate; fruit large, red or yellow, globose or oval. *C. punctata*.
4. Thorns long, slender; leaves shining; fruit globose or slightly pear-shaped, dark red. *C. crus-galli*.
4. Thorns short, stout, leaves dull; fruit globose, purple-black. *C. brevispina*.
5. Leaves, calyx, and peduncles glabrous or nearly so. 6.
5. Lower surface of leaves or their teeth, calyx, and peduncles pubescent or glandular. 9.
6. Leaves mainly truncate or cordate at the base. 7.
6. Leaves narrowed or wedge-shaped at the base. 8.
7. Leaves lobed; fruit depressed-globose, $\frac{1}{4}$ in. or less high, bright red. *C. cordata*.
7. Leaves irregularly serrate; fruit glaucous, sub-globose, $\frac{1}{2}$ in. high. *C. eggerti*.
8. Leaves deeply cleft; fruit globose or globose-ovoid, small, coral-red. *C. oxyacantha*.
8. Leaves serrate or somewhat lobed; fruit globose or oval, persistent into the winter. *C. viridis*.
9. Leaves glabrous or nearly so. 10.
9. Leaves pubescent, especially along the veins beneath. 12.
10. Leaves or most of them truncate or cordate at the base, sharply incised and serrate; fruit globose or oval, red. *C. coccinea*.
10. Leaves or most of them narrowed at the base. 11.
11. Fruit about $\frac{1}{2}$ in. in diameter, globose to oval, red; bractlets and calyx very glandular. *C. rotundifolia*.
11. Fruit about $\frac{1}{4}$ in. in diameter, globose or oval; bractlets and calyx glandular. *C. macrantha*.
12. Leaves mostly truncate or cordate at the base, ovate-orbicular; fruit bright red, hairy. *C. mollis*.
12. Leaves mostly cuneate or narrowed at the base, ovate or oval, sharply dentate or somewhat lobed; fruit oval or oblong, large, crimson or orange-red, eatable. *C. tomentosa*.

1. **Crataegus crús-gállí** L. Cockspur Hawthorn. A small tree with spreading branches and numerous slender thorns. Leaves coriaceous, shining above, sharply serrate. Fruit remain-

ing on the branches until late in the winter. The best hawthorn for hedges. Quebec to Manitoba, N. H., Fla., Tex., and Ohio.

2. *Crataegus brevispina* (Dougl.) Farw. Black Hawthorn. A small tree. Leaves obovate, unequally serrate or somewhat lobed, cuneate or narrowed at the base. Mich., to Br. Col., Colo., and Ore.

3. *Crataegus punctata* Jacq. Dotted Hawthorn. A shrub or small tree with horizontal wide-spreading branches. Leaves obovate, slender-petioled, irregularly serrate or serrulate. Fruit somewhat edible. Quebec and Ont., to N. H., Ga. and Iowa. Ohio.

4. *Crataegus cordata* (Mill.) Ait. Washington Hawthorn. A tree with slender thorns. Leaves broadly ovate, generally sharply 3-7-lobed and serrate. A very desirable species for cultivation. Va. to Ga., Ill., and Tenn. Also from N. J. to Ohio.

5. *Crataegus éggerti* Britt. Eggert Hawthorn. A small tree growing in dry soil. Leaves ovate-orbicular, dull green above, pale beneath, sharply and irregularly serrate or somewhat lobed. Iowa to Mo. and Kan.

6. *Crataegus oxyacantha* L. English Hawthorn. A shrub or small tree with numerous stout thorns. Leaves broadly ovate or slightly obovate, sharply 3-7-lobed. Sparingly escaped from cultivation. Ohio.

7. *Crataegus viridis* L. Green Hawthorn. A small tree often without thorns. Fruit persisting into the winter. Leaves ovate to lanceolate or somewhat obovate, sharply serrate, and somewhat lobed. Mo. and Kan. to Tex., S. Car., and Fla.

8. *Crataegus coccinea* L. Scarlet Hawthorn. A shrub or small low tree with crooked spreading branches and short stout thorns. Leaves broadly ovate or orbicular, sharply incised and serrate, teeth gland-tipped. Fruit somewhat edible. Of considerable decorative value. Petioles with glands. Newf. to Man., Fla., Tex., and Ohio.

9. *Crataegus rotundifolia* (Ehrh.) Borck. Glandular Hawthorn. A shrub or small tree, the petioles with glands. Leaves oval, ovate, obovate, or nearly orbicular, incised-serrate

with gland-tipped teeth, or sometimes lobed. Conn. to Ind., Fla., Ala., and Ohio.

10. *Crataegus macracantha* Lodd. Longspine Hawthorn. A shrub or small tree with bright brown thorns, the petioles glandular. Leaves sharply and often doubly serrate with gland-tipped teeth. Quebec to N. Dak., Va., Mo., and Ohio.

11. *Crataegus mollis* (T. & G.) Scheele. Downy Hawthorn. A small tree with short stout thorns and with densely pubescent twigs. Leaves usually broadly ovate, incised and sharply serrate with gland-tipped teeth. One of the best hawthorns. Quebec to Mich., Neb., Kan., Penn., La., Tex., and Ohio.

12. *Crataegus tomentosa* L. Pear Hawthorn. A small thickly branching tree with stout thorns and tomentose twigs. Leaves broadly oval or ovate-oval, sharply dentate or somewhat lobed. Ont. to N. J., Ga., Ohio, Mich., and Mo.

13. *Crataegus uniflora* Muench. Dwarf Hawthorn. A shrub or small tree, the branches with numerous slender thorns. Leaves coriaceous, nearly sessile, crenate at the apex and entire at the base. In sandy soil. N. Y. to Fla., W. Va., Mo., and La.

Drupatae. Plum Subfamily.

42. *Prunus* L. Plum, Apricot, Cherry.

Trees or shrubs, the fruit a drupe, mostly edible. Leaves alternate, simple, with glands on the petioles or at the base of the blade; some of the leaves often without glands. Terminal bud sometimes self-pruned, and in some species also twigs of various sizes.

1. Flowers in lateral umbellate clusters or somewhat corymbose, expanding with or before the leaves; stone flattened or globular; terminal bud of twigs absent or present. 2.
1. Flowers in racemes, terminating twigs of the season; stone globular; terminal bud of twigs present. 9.
1. Flowers corymbose, terminating twigs of the season; leaves ovate, abruptly acute at the apex, rounded or slightly cordate at the base; fruit small, stone slightly flattened; terminal bud of twigs present. *P. mahaleb*.

1. Flowers solitary or in twos, appearing before the leaves; fruit velvety, stone compressed; leaves ovate to round-ovate, abruptly pointed; terminal bud of twigs absent. *P. armeniaca*.
2. Leaves mostly convolute in vernation; fruit usually large; stone more or less flattened; terminal bud of twigs absent. 3.
2. Leaves conduplicate in vernation; fruit mostly small; stone mostly globose; terminal bud of twigs present. 8.
3. Leaves abruptly acuminate; drupe red or yellowish. 4.
3. Leaves obtuse, acute, or gradually acuminate; drupe red or purple. 6.
4. Calyx lobes entire, pubescent within; drupe globose; leaves ovate or obovate. *P. americana*.
4. Calyx lobes glandular-serrate; drupe subglobose or oval. 5.
5. Calyx lobes glabrous within; leaves oval or obovate. *P. nigra*.
5. Calyx lobes pubescent on both sides; leaves ovate-lanceolate. *P. hortulana*.
6. Leaves glabrous when mature, acute or acuminate. 7.
6. Leaves pubescent beneath, not pointed, ovate or obovate. *P. domestica*.
7. Leaves lanceolate; drupe red, thin-skinned, with little or no bloom. *P. angustifolia*.
7. Leaves ovate; drupe dark purple with a bloom. *P. alleghaniensis*.
8. Leaves glabrous; inflorescence umbellate; drupe with thick flesh, sour. *P. cerasus*.
8. Leaves glabrous, shining; inflorescence more or less corymbose; drupe with thin sour flesh. *P. pennsylvanica*.
8. Leaves pubescent beneath at least on the veins; inflorescence umbellate; fruit sweet. *P. avium*.
9. Fruit red or purple, astringent; leaves obovate or oval, abruptly acute or acuminate, thin; glands on the petiole usually rounded or disc-like; bark gray. *P. virginiana*.
9. Fruit dark-purple or black, sweet; leaves oval or obovate, acute or obtusish, thick; otherwise much like the preceding. *P. demissa*.
9. Fruit dark-purple or black, sweet; leaves oval-lanceolate to ovate, acuminate or acute; glands on the petiole usually elongated and tooth-like; bark black. *P. serotina*.

Plums and Apricot.

*. *Prunus armeniaca* L. Apricot. A small round-topped tree with reddish bark. Drupe nearly smooth, short stalked, yellow, edible. Cultivated.

1. *Prunus americana* Marsh. Wild Plum. A shrub or small tree with stunted thorn-like branches and thick black bark.

Leaves ovate, or obovate sharply and often doubly serrate, rounded at the base, slender-petioled. Drupe with a tough skin, globose, red or yellowish, edible. Often used as a stock on which to graft domestic plums. Wood hard, reddish in color. N. Y. to Mont., Fla., Colo., and Ohio.

2. ***Prunus nigra*** Ait. Canada Plum. A tree with thin bark. Leaves oval, ovate, or obovate, long-acuminate, crenulate-serrate; drupe oval, orange-red, thick-skinned, with little or no bloom. Petals pink in age. Newf. to Man., Mass. and Wis.

3. ***Prunus hortulàna*** Bail. Wild-goose Plum. A small tree with spreading branches and thin bark. Leaves ovate-lanceolate to ovate, long-acuminate, closely glandular-serrate. Drupe bright red and thin-skinned, edible. Ill. to Kan., Tenn., and Tex.

4. ***Prunus angustifolia*** Marsh. Chickasaw Plum. A small tree with thorn-like stunted branches. Leaves acute, serrulate, often rounded at the base. Drupe globose, red, and edible. In dry soil. N. J. to Fla., west to Rocky Mts.

*. *Prunus domestica* L. Common Garden Plum. A small tree with about 100 cultivated varieties. Drupe of various colors, covered with a thick glaucous bloom.

5. ***Prunus alleghaniensis*** Port. Alleghany Plum. A low shrub or small tree, seldom thorny. Leaves acute or acuminate, finely serrate, rounded at the base. Drupe pleasantly acid, globose-ovoid, with a conspicuous bloom. Penn.

Cherries.

6. ***Prunus cérasus*** L. Sour Cherry. A small tree with globose, red or reddish-black, sour, edible drupes. Leaves ovate or ovate-lanceolate, abruptly acute or acuminate, rounded at the base, very resinous when young. Self-prunes the fruiting branchlets. Native of Europe. N. H. and Mass. to N. Y. and Ohio.

7. ***Prunus àvium*** L. Sweet Cherry. A medium-sized tree with globose, black or dark red, sweet, edible drupes. Leaves ovate, oval, or slightly obovate, abruptly short-acuminate, irregularly serrate. Native of Europe. Ont. to Mass., Ohio and Va.

8. ***Prunus pennsylvànica*** L. f. Red Cherry. A small tree with sour globose, red drupes. Leaves oval or lanceolate,

acute or acuminate, mainly rounded at the base, glabrous, serrulate. Leaves poisonous; kernels probably poisonous. In rocky woods. Newf. to Ga., west to Rocky Mts. Ohio.

9. **Prunus mahaleb** L. Mahaleb Cherry. A small tree with pale smooth bark. Leaves ovate, abruptly acute at the apex, rounded or slightly cordate at the base, denticulate, glabrous, fragrant. Drupes with thin flesh and slightly flattened stone. From Europe. Conn. to Ont., N. Y., to Ohio and Kan.

10. **Prunus virginiana** L. Choke Cherry. A shrub or small tree with gray bark. Leaves obovate or broadly oval, abruptly acute or acuminate at the apex, rounded at the base, serrulate with slender teeth, glabrous or nearly so. Drupe red to nearly black, sometimes yellow, very astringent, not edible. Leaves poisonous; kernels probably poisonous. Self-prunes leafy fruiting branches. Along river banks and in rocky places. Newf. to Man., Br. Col., Ga., Neb., Tex., Colo., and Ohio.

11. **Prunus demissa** (Nutt.) Walp. Western Choke Cherry. A shrub or small tree; drupe dark purple or black, globose, sweet or somewhat astringent. Leaves similar to those of the preceding, thicker, acute or often obtusish at the apex, with shorter teeth. Probably poisonous like the last. On bluffs, and dry ground. N. Dak. to Kan., N. Mex., Br. Col., and Cal.

12. **Prunus serotina** Ehrh. Black Cherry. A large tree with rough, black, flaky bark; drupe globose, dark-purple or black, sweet but slightly astringent. Leaves oval, oval-lanceolate, or ovate, acuminate or acute, serrate with appressed teeth. Leaves very poisonous to cattle, especially when half-wilted. Kernels very poisonous. Wood rather heavy, hard, strong, of fine texture, of a brown or reddish color; much used in cabinet-work and interior finish, especially in cars and boats, also used in turnery. Self-prunes twigs by means of cleavage planes in basal joints. Ont. to Fla., N. Dak., Kan., Tex., and Ohio.

43. **Amygdalus** L. Peach.

Trees or shrubs. Drupe in our species velvety with a deeply pitted stone.

1. **Amygdalus pérsica** L. Peach. A small tree with

beautiful pink or white flowers and a large edible drupe. Leaves with prominent nectar glands on the petiole or at the base of the blade. Leaves and kernels bitter, poisonous. Native of Asia; abundantly escaped. Ohio.

Fabaceae. Pea Family.

Cassiatae. Senna Subfamily.

44. *Cercis* L. Redbud.

Small trees or shrubs with simple, palmately veined, 2-ranked leaves. Fruit a flat bean.

1. *Cercis canadensis* L. Redbud. A small tree with bright red-purple flowers before the leaves; fine for ornamental purposes. Wood hard and heavy, beautifully variegated. In rich soil. Easily cultivated. Ont. to Minn., Neb., N. J., Fla., Tex., and Ohio.

45. *Gleditsia* L. Honey-locust.

Large usually thorny trees with evenly once or twice pinnate leaves and superposed buds. Fruit a bean.

1. Pod linear-oblong, many seeded, pulpy within; leaflets short stalked, oblong-lanceolate or oval, obtuse at both ends, inequilateral at the base. *G. triacanthos*.

1. Pod obliquely oval, 1-seeded, not pulpy; leaflets thicker, darker green, usually larger, ovate-lanceolate or lanceolate, the margin more crenulate. *G. aquatica*.

1. *Gleditsia triacanthos* L. Honey-locust. A large tree of rapid growth, usually with stout branching or simple thorns and with rough bark. Used as a hedge plant. Autumn leaves pure yellow. Wood heavy, hard, strong, and tough; used for fencing, fuel and wagon hubs. Sprouts freely from the roots if disturbed by plowing. Grows well in dry or sandy soil. Ont. to S. Dak., Ohio, Ga., Kan., and Tex.

2. *Gleditsia aquatica* Marsh. Water Honey-locust. A tree growing in swamps. Ind. to Mo., S. Car., Fla., and La.

46. *Gymnócladus* Lam. Coffee-bean.

Trees with large evenly bipinnate leaves, superposed buds sunken in the epidermis, and large chocolate-colored pith. Fruit a woody bean.

I. *Gymnocladus dioica* (L.) Koch. Coffee-bean. A large, slow-growing tree with rough bark and few branches. Bean short and thick, the greenish pulp within poisonous. The bruised leaves are used as a fly poison, and the seeds have been used as a substitute for coffee. Wood compact, heavy, hard, strong, tough, reddish in color, of coarse texture, and taking a good polish; used to some extent in cabinet-work. In rich soil. Ont to Ohio and Penn., Tenn., S. Dak., and Okl.

Papilionatae. Pea Subfamily.

47. *Cladrástis* Raf. Yellow-wood.

Trees with odd pinnate leaves and showy, fragrant, white flowers. Axillary buds superposed, covered by the base of the petiole. Fruit a slender bean.

I. *Cladrastis lutea* (Mx.) Koch. American Yellow-wood. Trees with smooth bark, close like in the beech. Wood light-yellow. In rich soil; much planted. Ky., Mo., Tenn., and N. Car.

48. *Robinia* L. Locust.

Trees or shrubs with odd-pinnate leaves and usually with spiny stipules. Fruit a bean.

1. Twigs, petioles and pods glabrous or nearly so; flowers white. *P. pseudacacia*.

1: Twigs and petioles glandular; pods hispid; flowers pinkish. *P. viscosa*.

I. *Robinia pseudacacia* L. Common Locust. A large slender tree with very rough bark, of rapid growth. Wood very heavy, hard, strong, tough, valuable, and very durable in contact with the ground; used for posts, railroad ties, wagon hubs, furniture, and in ship building. All parts of the plant very poisonous.

It is troublesome from sprouting from the roots. Penn. and Ohio to Ga., Iowa, Kan., and Okl.

2. **Robinia viscosa** Vent. Clammy Locust. A small tree with rough bark. Underground parts somewhat poisonous. Va. to Ga. Also escaped in Middle and Eastern States. Ohio.

Order, GERANIALES.

Rutaceae. Rue Family.

49. **Xanthoxylum** L. Prickly-ash.

Trees or shrubs with punctate, odd-pinnate leaves and usually with stipular spines. Capsule with 1-2 seeds.

1. **Xanthoxylum americanum** Mill. Prickly-ash. A prickly shrub or small tree with small flowers in sessile axillary cymes. Quebec to Va., S. Dak., Neb., Kan., and Ohio.

50. **Ptelea** L. Hoptree.

Shrubs or small trees with bitter bark. Fruit a samara with a membranous wing.

1. **Ptelea trifoliata** L. Hoptree. A shrub or small tree with sunken superposed axillary buds covered by the petiole base. Bark and flowers with a disagreeable odor. Conn. to Fla., Ont., Minn., Kan., Tex., and Ohio.

Simarubaceae. Ailanthus Family.

51. **Ailanthus** Desf. Ailanthus.

Large trees with odd-pinnate leaves; branches robust with large brown pith. Samara linear or oblong, usually twisted.

1. **Ailanthus glandulosa** Desf. Tree-of-heaven. A large tree of rapid growth with thick branches and smooth bark. Leaves ill-scented; leaflets with green glands under the lobes or teeth. Autumn leaves pure yellow. Wood hard and useful. Sprouts freely from the roots and is easily propagated from root cuttings. A pest in pastures in some states; cows will not eat grass near the young shoots. Water contaminated by the leaves is poisonous. Naturalized from China. Ont. to Mass., Va., Kan., and Ohio.

Order, SAPINDALES.

Anacardiaceae. Sumac Family.

52. **Rhús** L. Sumac.

Small trees, shrubs, or climbing vines with acrid resinous or milky sap. Fruit a small, red or gray drupe, in panicles.

1. Petioles not completely covering the axillary buds; leaflets entire. 2.
1. Petioles covering the axillary buds; leaflets serrate. 3.
2. Rachis of the leaf wing-margined; leaflets 7-31; twigs and the red drupes pubescent. *R. copallina*.
2. Rachis not winged; leaflets 7-13; poisonous to the touch; twigs and the gray drupes glabrous. *R. vernix*.
3. Leaves and twigs velvety-pubescent. *R. hirta*.
3. Leaves and twigs glabrous, somewhat glaucous. *R. glabra*.

1. **Rhus copallina** L. Dwarf sumac. A shrub or small tree with a dense terminal panicle of small globose, crimson drupes, covered with short acid hairs. Leaves used for tanning purposes. In dry soil. Me. and Ont. to Fla., Minn., Neb., Tex., and Ohio.

2. **Rhus hirta** (L.) Sudw. Staghorn Sumac. A small tree or shrub with red, pubescent drupes. Wood very soft and brittle. In dry or rocky soil. A good lemonade or "sumacade" is made by steeping the drupes and sweetening to taste. Leaves used for tanning. N. S. to Ga., Ont., S. Dak., Mo., Miss., and Ohio.

3. **Rhus glàbra** L. Smooth Sumac. A shrub or small tree with dense panicles of small crimson drupes covered with short acid hairs. Noted for its beautiful, brilliant, red-colored leaves in autumn. Leaves used for tanning. Common on hill-sides and bluffs. N. S. to Br. Col., Fla., Miss, Ariz., and Ohio.

4. **Rhus vérnix** L. Poison Sumac. A shrub or small tree, very poisonous to the touch. Drupes gray, glabrous, in loose axillary panicles. In swamps and wet places. N. S. to Fla., Minn., Neb., Ark., and Ohio.

53. **Cótinus** Adans. Smoketree.

Shrubs or small trees with resinous sap, with buds clustered at the tips of the twigs. Drupes compressed, gibbous.

1. Blade of the leaf slightly decurrent on the petiole, thin, glabrous or slightly pubescent beneath. *C. cotinoides*.
1. Leaves mostly rounded or obtuse at the base, coriaceous, more pubescent. *C. cotinus*.

1. **Cotinus cotinoides** (Nutt.) Britt. American Smoke-tree. A small wide-branched tree. Mo. and Okl. to Tenn. and Ala.

*. *Cotinus còtinus* (L.) European Smoketree. A small tree, native of Europe.

Ilicaceae. Holly Family.

54. **Ilex** L. Holly.

Shrubs or trees with watery sap, and alternate simple leaves. Drupe berry-like, with 4-8 long nutlet-like stones.

1. Leaves thick, persistent, evergreen, spiny. *I. opaca*.
1. Leaves thin, deciduous, not spiny. 2.
2. Leaves small, obovate or spatulate, crenate; nutlets of the fruit ribbed.
I. decidua.
2. Leaves large, ovate or lanceolate, sharply serrate, nutlets ribbed.
I. monticola.

1. **Ilex opàca** Ait. American Holly. A tree of slow growth with thick, glabrous, evergreen leaves and globose red or rarely yellow drupes. Twigs with leaves and fruit much used for Christmas decoration. Wood very white, fine-grained, hard, strong, tough, light in weight, and easily worked; used for cabinet-work and in turnery. Bird-lime is prepared from the middle bark. In moist soil. Should be much planted for ornament in suitable places. The leaves should be cut off when transplanted. Me. to Fla., Penn., Mo., Tex., and Ohio.

2. **Ilex decidua** Walt. Deciduous Holly. A shrub or small tree with light-gray, glabrous twigs and red drupes. In swamps and low ground. D. C. to Fla., Kan., and Tex.

3. **Ilex monticola** Gr. Mountain Holly. A shrub or slender, erect tree growing in mountain woods. Drupes red. N. Y. to N. Car. and Ala.

Celastraceae. Stafftree Family.

55. **Euonymus** L. Wahoo.

Shrubs or small trees with opposite leaves and 3-5-locular capsules. Seeds enclosed in a red aril.

1. Flowers purple; cymes 6-15-flowered; winter buds long-pointed with long bud scales. *E. atropurpureus*.
1. Flowers greenish yellow; cymes 3-7-flowered; winter buds very short pointed with short bud scales. *E. europæus*.

1. **Euonymus atropurpureus** Jacq. Wahoo. A high shrub or small tree with green, obtusely 4-angled twigs. Leaves dark red and fruit very ornamental in autumn. Self-prunes small twigs by basal joints. Ont. to Fla., Mont., Okl., and Ohio.

2. **Euonymus europæus** L. Spindletree. A shrub or small tree resembling the preceding. Self-prunes twigs. Cultivated from Europe. Escaped. N. H., N. Y., and N. J.

Staphyleaceae. Bladdernut Family.

56. **Staphylèa** L. Bladdernut.

Shrubs sometimes tree-like with opposite compound leaves and bladdery capsules.

1. **Staphylea trifolia** L. American Bladdernut. A shrub or rarely small tree with smooth striped bark. In moist soil. Quebec to Minn., S. Car., Kan., and Ohio.

Aceraceae. Maple Family.

57. **Acer** L. Maple.

Trees or shrubs with opposite leaves and with watery often saccharine, or sometimes milky sap. Fruit a 2-winged samara.

1. Leaves pinnate or trifoliate; twigs green, glaucous. *A. negundo*.
1. Leaves simple. 2.
2. Leaves with very large teeth or lobes, the divisions not serrate or serrate-dentate. 3.
2. Leaves with the large divisions or lobes serrate or serrate-dentate. 5.
3. Leaves with stipules which are often large and foliaceous; leaves green and pubescent beneath at least on the veins; flowers corymbose, unfolding with the leaves; wings of fruit diverging a little less than a right angle. *A. nigrum*.

3. Leaves without stipules. 4.
4. Leaves with much milky sap in the petiole, glabrous, dark green above, lighter below, usually with 7 prominent palmate veins; flowers corymbose, unfolding with the leaves; wings of the fruit diverging nearly in a straight line; petals present; winter buds rounded. *A. platanoides*.
4. Leaves with watery or frothy sap, pale and nearly glabrous beneath, usually with 5 prominent palmate veins; flowers corymbose, unfolding with the leaves; wings of the fruit diverging a little less than a right angle; petals none; winter buds pointed. *A. saccharum*.
5. Leaves very sharply and finely serrate, 3-lobed at the outer end, widest above the middle, the lobes abruptly narrow-acuminate, brown pubescent below when young; twigs green, striped with darker lines; flowers racemed, terminal, unfolding after the leaves. *A. pennsylvanicum*.
5. Leaves dentate-serrate or lobed, not abruptly narrow-acuminate; twigs not striped. 6.
6. Leaves broadly 3-5-lobed, the lobes rather regularly and continuously dentate-serrate or dentate-crenate; flowers racemed, terminal, unfolding after the leaves. 7.
6. Leaves usually with 3-7 slender, long and pointed lobes, the lobes irregularly or interruptedly serrate or serrate-dentate; flowers in dense sessile lateral clusters, appearing before the leaves. 8.
7. Leaves longer than wide, slightly 3-lobed at the outer end, usually only very slightly lobed at the lower end, not glaucous below; bark of twigs green or grayish; racemes erect; a shrub, rarely a small tree. *A. spicatum*.
7. Leaves as broad or broader than long, prominently 5-lobed, glabrous and dark green above, pubescent and light glaucous below, on long reddish petioles; bark of twigs reddish-brown; racemes drooping; wings of fruit pubescent, moderately spreading; a large tree. *A. pseudo-platanus*.
8. Leaves usually deeply 5-lobed, lobes slender, acute, white and glaucous beneath; notches between the lobes often somewhat rounded; fruiting pedicel short and stiff, 1-2 in. long; wings divergent; petals none. *A. saccharinum*.
8. Leaves sharply 3-5-lobed, whitish glaucous beneath, notches acute; fruiting pedicel long, slender and drooping, 2-4 in. long; wings incurved; petals present. *A. rubrum*.

i. **Acer saccharinum** L. Silver Maple. A large tree with flaky bark, the twigs often reddish, self-pruned by basal joints. Leaves deeply 5-lobed, the lobes rather narrow, acumi-

nate, coarsely and irregularly dentate, truncate or slightly cordate at the base, green above, silvery white and more or less pubescent beneath. A fine shade tree and much planted. Wood soft and white; used for furniture. Yields a small amount of sugar. Along streams. N. B. to Fla., Ont., N. Dak., Neb., Okl., and Ohio.

2. **Acer rubrum** L. Red Maple. A tree with flaky or smoothish bark and reddish twigs. Leaves sharply 3-5-lobed, the lobes irregularly dentate, acute or acuminate, cordate at the base, green above, whitish beneath. Wood of considerable value when it shows a "curly grain." Leaves crimson, scarlet or yellow in autumn. Self-pruning like the preceding. In swamps and low ground, also on moist hillsides. N. B. to Man., Fla., Tex., and Ohio.

3. **Acer saccharum** Marsh. Sugar Maple. A large tree with yellow or sometimes red leaves in autumn. Leaves cordate or truncate at the base, 3-7-lobed, the lobes acuminate, irregularly sinuate, dark green above, pale and nearly glabrous beneath. Its sap is the main source of maple sugar and syrup. An average tree will yield 2-10 lbs. of sugar a season. A fine shade tree. The ashes give large quantities of potash. Wood heavy, hard, strong and tough; used for fuel, interior finish, furniture, keels of boats and ships, implements and machinery, sucker rods, shoe pegs, piano action, school apparatus, large wood type, tool and broom handles, and wood carving. Newf. to Man., south to Fla. Tex., and Ohio.

4. **Acer nigrum** Mx. Black Maple. A large fine tree with rough blackish bark. Leaves cordate or truncate at the base, 3-7-lobed, the lobes broad and short, green on both sides, generally more or less pubescent beneath. It is equally valuable for the making of sugar. Wood much the same as in the Sugar Maple, and used for the same purposes. Ont. and Vt. to Ga., Minn., La., Ark., and Ohio.

5. **Acer pennsylvanicum** L. Striped Maple. A small tree with smoothish green bark striped with darker lines. Leaves broadest above the middle, thin, glabrous above slightly pubescent beneath when young, truncate or somewhat cordate at the base.

3-lobed near the apex. Wood white and soft. In rocky soil. N. S. to Lake Superior, and along the mountains to Ga. and Tenn.

6. **Acer spicatum** Lam. Mountain Maple. A shrub or small tree, the bark green but not striped. Leaves 3-5-lobed, the lobes acute or acuminate, glabrous above, pubescent beneath at least when young. In damp rocky woods. Newf. to Man., south to N. Car., Tenn., Minn., and Ohio.

*. *Acer platanoides* L. Norway Maple. A medium-sized tree with a broad rounded crown, with brown twigs and milky sap. Leaves sharply 5-7-lobed, very dark green above. Much cultivated.

*. *Acer pseudo-platanus* L. Sycamore Maple. A fine tree with spreading branches. Leaves deeply 3-5-lobed. Self-prunes. Much cultivated.

7. **Acer negundo** L. Boxelder. A small tree with spreading branches and glabrous, sometimes pubescent, green and glaucous twigs. Leaves 3-7 foliate, leaflets ovate or oval. The sap produces a slight amount of sugar. Wood light and of slight value. Along streams. Planted on the prairies for small groves and wind breaks. Vt. to Man., Fla., Kan., N. Mex., and Ohio.

Hippocastanaceae. Buckeye Family.

58. **Aesculus** L. Buckeye, Horse-chestnut.

Trees or shrubs with opposite digitate leaves, and leathery capsules containing large shining nut-like seeds.

1. Flowers white, mottled with yellow and purple; leaflets abruptly acuminate; winter buds gummy; capsule spiny; bundle scars arranged in a curved line. *AE. hippocastanum*.
1. Flowers yellow or purplish; leaflets acuminate, more or less abrupt; winter buds not gummy; bundle scars arranged in 3 areas. 2.
2. Capsule spiny, stamens exserted. 3.
2. Capsule glabrous; stamens not longer than the petals, corolla yellow or purplish. *AE. octandra*.
3. Leaflets acuminate, finely serrate, 5-7; a tree. *AE. glabra*.
3. Leaflets long-acuminate, unequally serrate, 7-9; a shrub-like small tree. *AE. arguta*.

1. **Aesculus hippocástanum** L. Horse-chestnut. A large tree with very resinous, gummy winter buds. Autumn leaves orange. The seeds are poisonous and symptoms of poisoning have been produced from eating the green rind. The twigs contain Aesculin which is fluorescent in aqueous solution. Escaped from cultivation; native of Asia.

2. **Aesculus glábra** Willd. Ohio Buckeye. A large tree with rough and fetid bark. Leaves, young shoots, and seeds poisonous to cattle. Wood light and hard to split; used for making artificial limbs, wooden-ware, and paper pulp. Penn. to Ala., Mich., Neb., Okl., and Ohio.

3. **Aesculus argùta** Buckl. Western Buckeye. A shrub-like small tree with smooth bark. On flood plains. Kan. to Tex.

4. **Aesculus octándra** Marsh. Yellow Buckeye. A large tree with brown scaly bark. Seeds poisonous. Wood light and hard to split; used for making artificial limbs, wooden-ware, and paper pulp. **Aesculus octandra hybrida** (DC.) Sarg. has purplish or pink flowers, leaflets pubescent beneath, and light brown bark. Penn. to Ga., Iowa and Tex., Ohio.

Sapindaceae. Soapberry Family.

59. **Sapindus** L. Soapberry.

Trees or shrubs with alternate, odd-pinnate leaves. Fruit a berry.

1. **Sapindus drúmmondi** H. & A. Drummond Soapberry. A tree with white flowers in dense terminal panicles and very saponaceous, globose berries. Kan. and La. to Ariz.

Order, RHAMNALES.

Rhamnaceae. Buckthorn Family.

60. **Rhámnus** L. Buckthorn.

Shrubs or small trees, sometimes with thorns, with berry-like drupes, containing 2-4 nutlet-like stones.

1. Leaves with 3 or 4 pairs of lateral veins, the basal pair prominent; nutlets of the fruit grooved; flowers dioecious or imperfectly monosporangiate. *R. cathartica*.

1. Leaves acute, with 6-10 pairs of lateral veins; nutlets smooth; umbels peduncled; flowers bisporangiate. *R. caroliniana*.

1. **Rhamnus cathartica** L. Common Buckthorn. A shrub or small tree with black injurious fruit. Somewhat thorny and used for hedges. Introduced from Europe. Eastern states.

2. **Rhamnus caroliniana** Walt. Carolina Buckthorn. A tall thornless shrub or small tree with a globose sweet drupe. In wet soil. Va. and Ohio to Kan., Fla., and Tex.

Order, MALVALES.

Tiliaceae. Linden Family.

61. **Tilia** L. Linden.

Trees with 2-ranked inequilateral, serrate leaves, the dry drupaceous fruit in cymose clusters, the peduncle subtended by a broad membranous bract.

1. Petals with scales at the base. 2.
1. Petals without scales at the base; leaves glabrous or nearly so; cultivated. *T. europaea*.
2. Leaves glabrous or nearly so on both sides. *T. americana*.
2. Leaves glabrous above, pubescent beneath. *T. pubescens*.
2. Leaves glabrous above, silvery-white beneath. *T. heterophylla*.

1. **Tilia americana** L. American Linden. A large, straight-trunked tree with spreading branches. Inner bark very tough; used for mats and coarse rope. Wood soft and very white, light and uniform in texture, not liable to crack; called "basswood;" used for wooden-ware, cabinet-work, trunks, panelling of carriages, in cooperage, and for toys. The bark and wood of the other lindens are much the same. In rich soil, on bluffs, and along river bottoms. N. B. to Ga., Manitoba, Kan., Tex., and Ohio.

2. **Tilia pubescens** Ait. Downy Linden. A small tree growing in moist soil, mostly along the coast. L. I. to Fla., west to Tex.

3. **Tilia heterophylla** Vent. White Linden. A tree with larger leaves than either of the preceding species. N. Y. to Fla., Ala., Ill., Ky., Tenn., and Ohio.

*. *Tilia europaëa* L. European Linden. A large tree much cultivated in parks. Its name, Lin, was the origin of the family name of Linnaeus.

Subclass, HETEROMERAE.

Order, ERICALES.

Ericaceae. Heath Family.

62. **Rhododéndron** L. Rhododendron.

Shrubs or low trees with alternate persistent, coriaceous leaves; usually with a woody capsule and numerous seeds.

1. **Rhododendron máximum** L. Great Rhododendron. A tall shrub or small tree with beautiful flowers and striking evergreen leaves. Leaves poisonous to stock and the nectar said to produce poisonous honey. On rocky hillsides and along streams. Occasionally cultivated. N. S. to Ont., Ohio, and Ga.

63. **Kálmia** L. Kalmia.

Erect shrubs or small trees with evergreen coriaceous leaves. Fruit a capsule.

1. **Kalmia latifòlia** L. Mountain Kalmia. A shrub or small tree with evergreen leaves. All parts of the plant poisonous to cattle, sheep, and other animals. The honey from the flowers is said to be poisonous; also the flesh of game that has fed upon the leaves or fruit. In woods and on rocky hillsides. Occasionally planted. N. B. to Ont., Ohio, Fla., and La.

64. **Oxydéndrum** DC. Sorrel-tree.

A tree with alternate sour leaves and numerous white flowers in terminal paniced racemes. Fruit a capsule.

1. **Oxydendrum arbòreum** (L.) DC. Sorrel-tree. A small tree with smooth bark and brilliantly red-colored leaves in autumn. Wood hard and close-grained; used for handles of tools, bearings of machinery, etc. On hillsides. Ohio and Penn to Va., Fla., and Miss.

Order, EBENALES.

Sapotaceae. Sapodilla Family.

65. **Bumelia** Sw. Bumelia.

Shrubs or trees with milky sap, usually with thorns, and with very hard wood. Fruit a fleshy berry with a single seed.

1. Leaves glabrous or nearly so; oblanceolate to oblong-ovate, 2-5 in. long. *B. lycioides*.
1. Leaves tomentose or silky, oblong-obovate to cuneate-obovate, usually obtuse, 1-3 in. long. *B. lanuginosa*.

1. **Bumelia lycioides** (L.) Pers. Buckthorn Bumelia. A shrub or small tree usually with thorns and thorn-like spurs and with gray bark. Leaves tardily deciduous. In moist soil. Va. to Ill., Mo., Fla., and Tex.

2. **Bumelia lanuginosa** (Mx.) Pers. Woolly Bumelia. A shrub or rather large tree with persistent leaves. Ill., to Kan., Tex., Ga., and Fla.

Ebenaceae. Ebony Family.

66. **Diospyros** L. Persimmon.

Trees or shrubs with very hard wood, the fruit a berry.

1. **Diospyros virginiana** L. Persimmon. A handsome tree with hard, dark, furrowed bark. Pith often with lenticular cavities or diaphragmed. Berry large, pulpy, yellow, exceedingly astringent when green but sweet and edible after frost. Bark astringent and tonic. Wood very hard, heavy, strong, and tough. close-grained and dark-colored; used in turnery, for shuttles, plane stocks, and shoe lasts. R. I. to Ohio and Kan., Fla., and Tex.

Symplocaccae. Sweetleaf Family.

67. **Symplocos** L. Sweetleaf.

Trees or shrubs with alternate leaves, the fruit a small, mostly nearly dry drupe.

1. **Symplocos tinctoria** (L.) L'Her. Sweetleaf. A shrub or small tree, the pith diaphragmed. Flowers bright yellow, fragrant; drupe nutlike. Del. to Fla. and La.

Styracaceae. Storax Family.

68. **Mohrodéndron** Britt. Silverbell.

Small trees or shrubs, more or less stellate-pubescent, with large, white, bell-shaped flowers and 2-4-winged, dry fruit.

1. **Mohrodendron carolinum** (L.) Britt. Silverbell. A small tree with diaphragmed pith. In woods and along streams. Va. to Ill., Fla., and Ala.

Subclass, SYMPETALAE HYPOGYNAE.

Order, GENTIANALES.

Oleaceae. Olive Family.

69. **Fráxinus** L. Ash.

Trees with opposite leaves, in our species odd-pinnate. Fruit a samara.

1. Lateral leaflets sessile, 7-11; samara winged all around; calyx none. *F. nigra*.
1. Lateral leaflets more or less stalked; calyx present in the carpellate flower. 2.
2. Body of the samara terete or nearly so, the wing chiefly terminal; twigs not 4-sided. 3.
2. Body of the samara flat, the wing extending around it; twigs 4-sided, often with 4 sharp ridges especially on vigorous shoots; leaflets 7-11. *F. quadrangulata*.
3. Wing almost entirely terminal. 4.
3. Wing extending somewhat down the sides of the body of the samara; leaflets 5-9. 5.
4. Leaves and twigs glabrous or nearly so, pale below, leaflets 5-9. *F. americana*.
4. Leaves and twigs pubescent, leaflets 7-9. *F. biltmoreana*.
5. Wing of the samara spatulate. 6.
5. Wing long linear. *F. darlingtonii*.
6. Leaves, twigs, and pedicels glabrous or nearly so; leaves bright green on both sides. *F. lanceolata*.
6. Leaves, young twigs and pedicels velvety-pubescent; samara 1-2 in. long. *F. pennsylvanica*.

1. **Fraxinus americana** L. White Ash. A large tree of rapid growth, with glabrous twigs. Leaflets 5-9, ovate, ovate-lanceolate, oblong, or rarely slightly obovate, entire or denticulate,

pale and often pubescent beneath, acuminate or acutè; body of the samara terete, not margined, winged only from near the summit, $\frac{1}{4}$ - $\frac{1}{2}$ the length of the wing. Autumn leaves brown, purple, and salmon. Wood tough and elastic, of very great value; widely used in the manufacture of agricultural implements, boat oars, and carriage shafts; in cabinet-work, for harness work, hoops, baskets, and clothespins. In rich soil. N. S. to Minn., Fla., Kan., Tex., and Ohio.

2. **Fraxinus biltmoreana** Bead. Biltmore Ash. A tree with the young twigs pubescent. Leaflets 7-9, ovate to lanceolate, acuminate, entire or obscurely denticulate, more or less pubescent beneath; body of the samara narrowly elliptic, terete; wing linear, or somewhat broadened above, 2-3 times the length of the body. Penn. and Ohio to Ga.

3. **Fraxinus lanceolata** Borck. Green Ash. A large tree with glabrous twigs. Leaflets 5-9, entire or denticulate, ovate or oblong-lanceolate, acuminate or acute, green on both sides; samara similar to that of the two preceding species, wing usually spatulate and decurrent on the sides of the body below the middle. Wood rather inferior in value to that of the white ash. In moist soil, on flood-plains, and on bluffs. Vt. to N. W. Terr., Fla., Ariz., and Ohio.

4. **Fraxinus pennsylvanica** Marsh. Red Ash. A large tree with velvety-pubescent twigs. Leaflets 5-9, ovate, ovate-lanceolate, or oblong, acuminate or acute, usually denticulate; body of the samara linear margined above by the linear or spatulate decurrent wing. In moist soil. N. B. to S. Dak., Fla., Ala., Kan., and Ohio.

5. **Fraxinus darlingtonii** Britt. Darlington Ash. A tree similar to *F. lanceolata* and *F. pennsylvanica*, the leaves and twigs pubescent or glabrate. Leaflets similar to the two preceding species; pubescent or glabrate; wing of the samara longer than the narrowly linear body and decurrent on it for $\frac{1}{4}$ - $\frac{1}{3}$ of its length. N. Y. and Penn.

6. **Fraxinus quadrangulata** Mx. Blue Ash. A large tree with 4-sided or 4-winged twigs. Leaflets 7-11, ovate, oblong, or lanceolate, acuminate, green on both sides, sharply serrate or

serrulate; samara linear-oblong or cuneate, winged all around, parallel-nerved, the body extending more than half way to the apex. The inner bark furnishes a blue dye. Wood heavy, hard and valuable; used for flooring, carriage-making, etc. Ont., Minn. and Mich. to Ala., Iowa, Ark., and Ohio.

7. **Fraxinus nigra** Marsh. Black Ash. A large tree. Leaflets 7-11 glabrous, green on both sides, sessile, oblong-lanceolate, long acuminate, sharply serrate or serrulate; samara oblong or linear-oblong, parallel-nerved, the body flat, winged all around and extending to or beyond the middle. Wood used for barrel-hoops, baskets, cabinet-work, and interior finish. In swamps and wet soil. Newf. to Manitoba, Va.; Ark., and Ohio.

70. **Adelia** Br. *Adelia*.

Shrubs or small trees with opposite simple leaves. Fruit a drupe; flowers fascicled or paniculate, from scaly buds.

1. **Adelia acuminata** Mx. *Adelia*. A shrub or small tree usually with somewhat thorny branches. On river banks. Ill. to Ga., Mo., and Tex.

71. **Chionanthus** L. Fringetree.

Shrubs or small trees with opposite simple, entire leaves. Fruit a drupe.

1. **Chionanthus virginica** L. Fringetree. A shrub or small tree with handsome, white, fragrant flowers in drooping panicles. In moist soil. Del. and Ohio to Fla. and Tex.

Order, POLEMONIALES.

Scrophulariaceae. Figwort Family.

72. **Paulownia** Sieb. & Zucc. Paulownia.

A large tree with opposite, petioled leaves, the pith with cavities. Fruit an ovoid, acute capsule.

1. **Paulownia tomentosa** (Thumb.) Baill. Paulownia. A large rapid-growing tree with violet flowers in terminal panicles. Native of Japan; escaped from cultivation.

Bignoniaceae. Trumpet-creeper Family.73. **Catálpa** Scop. Catalpa.

Trees or shrubs with opposite or verticillate simple leaves and large white or mottled flowers in terminal panicles or corymbs. Leaves with large nectar glands in the axils of the veins on the under side. Capsule long and bean-like.

1. Young twigs glabrous or nearly so, leaf-blades downy below; flowers large, white, with 2 yellow stripes inside and spotted purplish brown. 2.
1. Young twigs and petioles with long hairs; leaf blades glabrous below or nearly so, commonly 3-lobed or angled, strong-scented; flowers small, yellow with orange stripes inside and violet spots; capsule very slender. *C. ovata*.
2. Leaves strong-scented, young petioles glabrous or nearly so; wings of seed usually narrowed at the ends; panicles many-flowered; lower corolla lobe entire; bark thin, flaky. *C. catalpa*.
2. Leaves not unpleasantly scented, young petioles usually pubescent, wings of seed usually broad, the threads parallel; panicles few-flowered; lower corolla lobe emarginate; bark thick and rough. Usually blooms a week or more earlier than *C. catalpa*. *C. speciosa*.

1. **Catalpa catálpa** (L.) Karst. Common Catalpa. A tree with thin flaky bark and spreading branches. Wood much less valuable than that of *C. speciosa*. The flowers are said to produce irritation of the skin. Gulf States. Escaped in the northern states as far as Ohio and N. Y.

2. **Catalpa speciôsa** Ward. Hardy Catalpa. A large rapid-growing tree with thick rough bark. Wood light, soft, not strong, brittle, of very coarse texture and brown in color, very durable in the ground; used for railroad ties, posts, furniture and interior finish; also suitable for paper pulp. Ill. to Tenn., Mo., Ark., and Ohio.

*. *Catalpa ovata* Don. Japan Catalpa. A small tree, commonly with 3-lobed or angled leaves.

Subclass, SYMPETALAE EPIGYNAE.

Order, UMBELLALES.

Araliaceae. Ginseng Family.

74. **Aràlia** L. Aralia.

Herbs, shrubs, or small trees with alternate, pinnately or ternately decomposed leaves. Fruit a small berry.

1. **Aralia spinòsa** L. Angelica-tree. A prickly shrub or small tree with long-petioled bipinnate leaves. In low ground and along streams. Sometimes cultivated. Conn. to Fla., Ohio, Mo., and Tex.

Cornaceae. Dogwood Family.

75. **Córnus** L. Dogwood.

Shrubs or small trees with drupes in cymes or heads, the cymes self-pruned when the fruit is ripe.

1. Leaves opposite. 2.

1. Leaves alternate; twigs green, smooth; flowers in cymose panicles, drupe blue. *C. alternifolia*.

2. Leaves oval or ovate, pointed; axillary buds minute, hidden underneath the base of the petiole; flowers in heads with 4-6 large white bracts; drupe red. *C. florida*.

2. Leaves ovate or ovate-lanceolate; axillary buds larger, not covered; flowers cymose; drupe globose, white. *C. asperifolia*.

1. **Cornus flòrida** L. Flowering Dogwood. A small very ornamental tree, with rough reticulate bark. Wood solid and valuable; used for shuttles. The drupes are reputed to be poisonous. Me. and Ont. to Fla., Ohio, Mo., and Tex.

2. **Cornus asperifòlia** Mx. Rough-leaf Dogwood. A tall shrub, sometimes tree-like, with reddish brown twigs. In rich or moist ground. Ont. to Fla., Iowa, Kan., Tex., and Ohio.

3. **Cornus alternifòlia** L. f. Blue Dogwood. A shrub or small tree with smooth, greenish, bitter bark. In rich soil. N. S. to Ga., Ont., Minn., W. Va., Ala., and Ohio.

76. *Nyssa* L. Tupelo.

Trees or shrubs with alternate leaves and solid but diaphragmed pith. Fruit a drupe.

1. Leaves mostly entire, mostly acute or acuminate; carpellate flowers 2-14 together; stone little flattened. *N. sylvatica*.
1. Leaves mostly entire, mostly obtuse; carpellate flowers 1-3 together, stone much flattened. *N. biflora*.

1. *Nyssa sylvatica* Marsh. Tupelo. A large tree with horizontal branches and with rough bark. Leaves bright crimson, scarlet, or purple in autumn. Wood firm, heavy, strong, tough, close-grained, and hard to split; used for hubs of wheels, pulleys, handles, wooden shoes, wooden ware, etc. Not durable if exposed. In rich moist soil. Not easily transplanted. Me. and Ont. to Fla., Mich., Tex., and Ohio.

2. *Nyssa biflora* Walt. Water Tupelo. A large tree similar to the preceding, the base swollen. In swamps and along ponds. N. J. to Va., Fla., and Ala.

Order, RUBIALES.

Caprifoliaceae. Honeysuckle Family:

77. *Viburnum* L. Viburnum.

Trees or shrubs with opposite leaves and 1-seeded drupes.

1. Leaves prominently acuminate; petioles slender, margined. *V. lentago*.
1. Leaves obtuse or merely acute. 2.
2. Petioles slender, rarely margined; leaves glabrous or nearly so. *V. prunifolium*.
2. Veins of the lower leaf surfaces and winged petioles tomentose. *V. rufotomentosum*.

1. *Viburnum lentago* L. Sheepberry. A shrub or small tree with glabrous acuminate winter buds. Drupe reddish-black, with a bloom, sweet and edible. Wood hard, ill-smelling. In rich soil. Hudson Bay to Man., N. J., Ga., Kan., and Ohio.

2. *Viburnum prunifolium* L. Black Haw. A shrub or small tree with acute winter buds, often reddish-pubescent. Drupe

blue-black, glaucous, sweet and edible. In dry soil. Conn. to S. Car., Mich., Kan., Tex., and Ohio.

3. **Viburnum rufotomentosum** Small. Southern Black Haw. A small tree with elliptic or obovate, mostly obtuse leaves, with brown-tomentose, winged petioles. Wood ill-smelling. On uplands and dry flood plains. Va. to Ill., Mo., Fla., and Tex.

GLOSSARY.

- Achene. A one-seeded dry indehiscent fruit with a tightly fitting pericarp around the seed.
- Actinomorphic. Radially symmetrical; a flower or organ which can be cut into similar equal halves by two or more planes.
- Acuminate. Tapering gradually to the apex.
- Acute. Sharp pointed.
- Adnate. An organ adhering to another; an anther attached longitudinally to the end of the filament.
- Adventive. Apparently becoming naturalized.
- Alternate. With a single leaf or other organ at each node.
- Ament. A slender usually flexible spike of flowers, as in the willows.
- Androecium. The whole set of stamens in a flower.
- Anther. The spore-bearing part of a stamen; the part which finally contains the pollen sacs.
- Anthesis. The period of flowering.
- Apetalous. Without petals.
- Appressed. Lying close against another organ.
- Aril. A fleshy organ around the hilum.
- Auricled. With ear-like lobes.
- Axillary bud. A bud in the axil of a leaf.
- Axil. The point of a stem just above the base of the leaf.
- Axile. In the axis of an organ.
- Baccate. Berry-like.
- Berry. A fruit with a fleshy or pulpy pericarp.
- Bilocular (2-locular). Having two cavities.
- Bisporangiate. Having both microsporangia and megasporangia; having both stamens and carpels.
- Blade. The expanded part of a leaf.
- Bract. A small, rudimentary, or imperfectly developed leaf.
- Bud scale. One of the scales in the winter bud.
- Bundle scar. A scar in a leaf scar produced by a vascular bundle or strand of bundles.
- Caducous. Falling away very soon after development.
- Calyx. The outer set of sterile floral leaves; the whole set of sepals.
- Canescent. With gray or hoary fine pubescence.
- Capitate. Arranged in a head.
- Capsule. A dry fruit of two or more carpels usually dehiscent by valves or teeth.
- Carpel. The megasporophyll of a seed plant; the modified leaf or stem bearing the ovules.

- Carpellate. Having only carpels, or carpellate flowers.
- Catkin. Same as ament.
- Cauline. Pertaining to the stem.
- Chaff. Dry thin scales.
- Chlorophyll. The green coloring matter of plants.
- Choripetalous. Having the petals separate or free.
- Ciliate. Provided with marginal hairs.
- Ciliolate. Minutely ciliate.
- Conduplicate. Folded lengthwise.
- Cone. A primitive flower as the carpellate cone of the pine.
- Connate. Similar organs more or less united.
- Convolute. Rolled around or rolled up longitudinally.
- Cordate. Heart-shaped.
- Coriaceous. Leathery.
- Corolla. The inner set of sterile, usually colored, floral leaves; the whole set of petals.
- Cotyledon. A leaf-like organ of the embryo in the seed.
- Crenate. With rounded teeth.
- Crenulate. Minutely crenate.
- Cuneate. Wedge-shaped.
- Cuspidate. With a sharp stiff point.
- Cyme. An inflorescence of the determinate type, the central flower developing first.
- Deciduous. Falling away at the end of the growing period.
- Decomound. More than once compound.
- Decurrent. Applied to an organ extending along the side of another.
- Dehiscence. The opening of an ovulary, sporangium, or pollen sac for the discharge of the contents.
- Deltoid. Broadly triangular.
- Dentate. With outwardly projecting teeth.
- Diadelphous. Having the stamens united into two sets.
- Diaphragm. A septum or transverse plate in the pith or other parts.
- Dichotomous. Two-forked.
- Didymous. Twin-like.
- Digitate. Diverging like the spread fingers.
- Diocious. Having the microsporangiate or staminate flowers and the megasporangiate or carpellate flowers on separate plants.
- Dissected. Divided into many segments.
- Divided. Cleft to the base or to the midrib.
- Drupe. A simple usually indehiscent fruit with fleshy exocarp and bony endocarp.
- Dwarf branch. A highly specialized and reduced shoot on a twig, as in the pine and larch.

- Emarginate. With a notched apex.
- Embryo. An incipient plant in the seed.
- Embryo sac. The female gametophyte, contained in the ovule of seed plants.
- End bud. The bud at the end of the twig in case the terminal bud is self-pruned.
- Endocarp. The inner layer of the pericarp.
- Endosperm. The nourishing tissue developed around the embryo in the female gametophyte of the angiosperms.
- Entire. Without teeth, serrations or lobes.
- Ephemeral. Continuing for only a day or less.
- Epigynous. Having the calyx, corolla, and androecium above the ovulary.
- Evanescent. Disappearing early.
- Exocarp. The outer layer of the pericarp.
- Exserted. Extending beyond surrounding organs or parts.
- Extrorse. Facing outwards.
- Falcate. Scythe-shaped.
- Fertile. Bearing spores or seeds.
- Fertilization. The conjugation of the male and female gametes.
- Fetid. Ill-smelling.
- Filament. The stalk of an anther.
- Flower. The modified spore-bearing branch of the seed plants.
- Foliaceous. Leaf-like.
- Follicle. A simple fruit dehiscent along one suture.
- Fruit. The ripe ovulary with the seeds and whatever parts are consolidated with it.
- Fugaceous. Falling soon after development.
- Fugitive. Plants not native, but recurring here and there, without apparently becoming established.
- Gamete. A sexual cell.
- Gametophyte. The sexual generation of plants.
- Geophilous. Earth-loving; growing partly or completely subterranean.
- Gibbous. Enlarged or swollen on one side.
- Glabrate. Nearly without hairs.
- Glabrous. Without hairs.
- Gland. A group of secreting cells.
- Glaucous. Covered with a bluish or white bloom.
- Globose. Spherical or nearly so.
- Glutinous. Sticky or gummy.
- Gynoecium. The whole set of carpels in a flower.
- Habit. General aspect.
- Habitat. The place where a plant grows.
- Hastate. Arrow-shaped with the basal lobes diverging.

- Head. A dense, round inflorescence of sessile or nearly sessile flowers.
Herbaceous. Leaf-like in texture and color.
Hirsute. Having rather coarse stiff hairs.
Hispid. With bristly stiff hairs.
Hydrophyte. A water plant.
Hypogynous. Having the calyx, corolla, and androecium below the gynoecium.
- Imbricated. Overlapping.
Imperfect. Monosporangiate flowers; having only stamens or only carpels.
Incised. Cut into sharp lobes.
Included. Not projecting beyond surrounding parts.
Indehiscent. Not opening.
Inequilateral. With unequal sides.
Inferior. Situated or arising below other organs.
Inflorescence. The flower cluster of a plant and its mode of arrangement.
Internode. The part of a stem between two successive nodes.
Introrse. Facing inwards.
Involucre. A whorl of bracts subtending a flower or flower cluster.
Involute. Rolled inwardly.
Irregular. A flower with one or more organs of a set unlike the others.
Isobilateral. A flower or organ which can be cut into equal halves by two planes, the halves of the one being unlike those of the other.
- Lanceolate. Lance-shaped.
Lateral bud. An axillary bud, any bud not the terminal bud of a branch.
Latex. The milky sap of certain plants.
Leaflet. One of the divisions of a compound leaf.
Leaf scar. The scar or cicatrix formed where the petiole of a leaf separates from the stem or twig.
Legume. A simple, dry fruit dehiscent along both sutures.
Lenticel. A small usually oval or rounded spot on the bark of a twig or stem, produced by a special tissue of cells under a stoma and breaking through the epidermis.
Limb. The expanded part of a petal, sepal, or sympetalous corolla.
Linear. A long and narrow organ with the sides nearly parallel.
Lobed. Divided to about the middle or less.
Loculicidal. A capsule which splits longitudinally through the middle of the back of each cavity or component carpel.
Medullary rays. Strips of cells passing radially through the wood from the pith or annual rings to the bark.

Megaspore. The larger of the two kinds of nonsexual spores produced in the flower. The megaspore develops into the female gametophyte.

Megasporangium. A sporangium which produces megaspores; the ovule in seed plants.

Membranous. Thin and rather soft and pliable.

Mesophyte. A land plant adapted to ordinary conditions of moisture.

Microspore. The smaller of the two kinds of nonsexual spores produced in the flower. The microspore develops into the male gametophyte.

Microsporangium. A sporangium which produces the microspores; the incipient pollen sacs in the seed plants.

Midrib. The central rib of a leaf or other organ.

Monadelphous. Stamens with united filaments.

Monococious. Having staminate and carpellate flowers on the same plant.

Monosporangiate. Flowers bearing only one kind of spores; a flower with only stamens or carpels.

Mucronate. With a sharp abrupt point.

Mucronulate. Slightly mucronate.

Naturalized. Plants not indigenous to a region but having become established as part of the flora.

Natural pruning. The process by which dead twigs and branches are separated from the tree by the formation of a collar or callus.

Nectary. A nectar-secreting organ.

Node. The place where two internodes join, normally with a single leaf or more.

Nut. An indehiscent one-seeded fruit with a hard or bony pericarp.

Nutlet. A very small nut.

Obcordate. Inversely heart-shaped.

Oblanceolate. Inversely lanceolate.

Oblong. Somewhat longer than broad with the sides nearly or quite parallel.

Oosphere. The unfertilized egg; the female gamete.

Oospore. The fertilized egg.

Ovary. The female organ of reproduction; an egg-producing organ.

Ovate. Shaped like the longitudinal section of a hen's egg.

Ovulary. The ovule-bearing part of a closed carpel or set of carpels.

Ovule. The megasporangium of a seed plant which later develops into a seed.

Ovum. The egg or oosphere.

Palmate. Diverging like the fingers of a hand.

Panicle. A compound inflorescence of the racemose type usually of pyramidal form.

- Parasitic. Growing upon other living plants or animals and absorbing their juices and tissues as food.
- Parietal. Borne on the wall of the ovulary, or pertaining to it.
- Parted. Deeply cleft.
- Pedice! The stalk of a flower in a flower cluster.
- Peduncle. The stalk of a flower.
- Pellucid. Transparent.
- Peltate. Shield-shaped, as a leaf with the petiole attached at or near the centre of the blade.
- Pentacyclic. Having five cycles.
- Pentamerous. Five-parted.
- Perfect. A flower having both stamens and carpels.
- Perfoliate. Leaves so clasping the stem as to appear as if pierced by it.
- Perianth. The calyx and corolla taken collectively.
- Pericarp. The wall of a fruit; the carpel wall.
- Perigynium. The sac-like envelope around the gynoecium of a *Carex* flower.
- Perigynous. Having the sepals, petals and stamens borne on a disc surrounding the gynoecium.
- Persistent. Remaining attached after the growing period.
- Petal. One of the leaves of the corolla.
- Petiole. The stalk of a leaf.
- Pilose. With long soft hairs.
- Pinna. The primary divisions of a pinnately compound leaf.
- Pinnate. Leaves divided into leaflets or segments along a common axis.
- Pinnatifid. Pinnately cleft to the middle or beyond.
- Pinnule. A division of a pinna in a compound leaf.
- Placenta. The ridge or surface bearing the ovules.
- Plicate. Folded like a fan.
- Plumose. Resembling a plume or feather.
- Plurilocular. Having several or many cavities.
- Pollen grain. The male gametophyte of seed plants.
- Pome. The fruit of the apple and related plants, with an adnate fleshy perigynous disc.
- Prickle. A stiff sharp-pointed outgrowth from the epidermis.
- Puberulent. With very short hairs.
- Pubescent. Hairy, especially with fine and soft hairs.
- Punctate. With translucent dots or glands.
- Raceme. An elongated inflorescence with each flower on a peduncle.
- Rachis. The axis of a compound leaf, spike, or raceme.
- Receptacle. The end of the flower stalk bearing the floral organs.
- Reflexed. Bent backward abruptly.
- Regular. Having the parts of each set alike in size and shape.
- Reniform. Kidney-shaped.

- Repand: With a more or less wavy margin.
- Retuse. With a shallow notch at the end.
- Revolute. Rolled backward.
- Rotate. With a flat round corolla; wheel-shaped.
- Sagittate. Shaped like an arrow head.
- Samara. A simple indehiscent winged fruit.
- Scabrous. Rough.
- Scale. A highly modified dry leaf as in the winter bud of most plants; also a dry, flat, more or less membranous outgrowth from a leaf or stem.
- Scurfy. Covered with scurf, minute membranous scales, as in *Chenopodium*.
- Scarious. Thin, dry, and translucent, not green.
- Seed. The matured and modified ovule with a dormant embryo.
- Self-pruning. The process by which living buds or twigs are naturally separated from the plant.
- Self-pruning scar. A scar produced where a twig or bud has been self-pruned.
- Sepal. One of the leaves of a calyx.
- Septicidal. A capsule which splits longitudinally through its partitions thus dividing it into its component carpels.
- Serrate. With teeth projecting forward.
- Sessile. Without a stalk.
- Sinuate. With strongly wavy margins.
- Sinus. The space between two lobes.
- Spermary. The male reproductive organ.
- Spermatozoid. The male gamete.
- Spike. An elongated inflorescence with sessile or nearly sessile flowers.
- Spine. A sharp thorn-like organ not representing a stem in origin, as the spines on the leaves of the Christmas holly.
- Spore. A modified reproductive cell.
- Sporophyte. The nonsexual generation of plants.
- Spur. A short stunted branch not representing a true dwarf branch and not ending in a thorn-like point; any projecting appendage of a flower looking like a spur.
- Stamen. The organ of a flower which produces microsporangia, which contain the microspores which later develop into pollen grains.
- Staminate. Having only stamens or staminate flowers.
- Stellate. Star-like.
- Sterigma. A small, short, peg-like projection on which certain leaves, spores, etc., are borne.
- Sterile. Not producing spores or seeds.
- Stigma. The upper part of the carpel; a special organ of the Angiosperms to catch the pollen grains.

- Stipel. The stipule of a leaflet.
- Stipular scar. The mark made on the bark by deciduous stipules.
- Stipular spine. A spine representing a stipule or having the position of a stipule.
- Stipules. Bract-like appendages at the base of the petiole of many leaves.
- Strigose. With stiff appressed or ascending hairs.
- Style. The narrow top of the carpel or united carpels between the ovulary and stigma.
- Subulate. Awl-shaped.
- Succulent. Soft and juicy.
- Superposed. Placed one above the other.
- Sympetalous. With petals more or less united.
- Synantherous. Having the stamens united by their anthers.
- Syncarp. A fleshy aggregate fruit.
- Terete. Circular in cross section.
- Terminal bud. The bud at the morphological tip of the twig.
- Ternate. Divided into three segments; arranged in threes.
- Tetracyclic. A flower with four cycles.
- Tetradynamous. With four long stamens and two short ones as in the Brassicaceae.
- Tetramerous. Four-parted.
- Thorn. A highly modified sharp-pointed branch.
- Thorn-like spur. A short stunted branch ending in a sharp point or thorn.
- Tomentose. Covered with dense wool-like hairs.
- Triadelphous. Having stamens united by their filaments into three bundles.
- Trilocular (3-locular). With three cavities.
- Trimerous. Three-parted.
- Truncate. Terminating abruptly by a nearly straight edge or surface.
- Two-ranked. Disposed in two vertical rows along the twig; with the third leaf in line with the first.
- Umbel. A determinate inflorescence with all the peduncles or pedicles arising from the same point.
- Undulate. With wavy margins.
- Unilocular (1-locular). With one cavity.
- Utricle. A one-seeded fruit with a loose pericarp.
- Valvate. Meeting by the margins in the bud, not overlapping; dehiscent by valves.
- Vascular bundle. The conducting strands in the plant body composed of wood and bast in which water and food materials are conducted through the roots, stems and leaves.
- Vein. One of the branches of the vascular portion of leaves or other organs.

Venation. The arrangement of the veins.

Vernation. The arrangement of the leaves in the bud.

Versatile. An anther attached at or near its middle to the filament.

Verticillate. Whorled.

Villous. With long, soft hairs not matted together.

Whorled. A group of three or more similar organs radiating from a node.

Winged. With a thin expansion.

Xerophyte. A plant adapted to desert conditions.

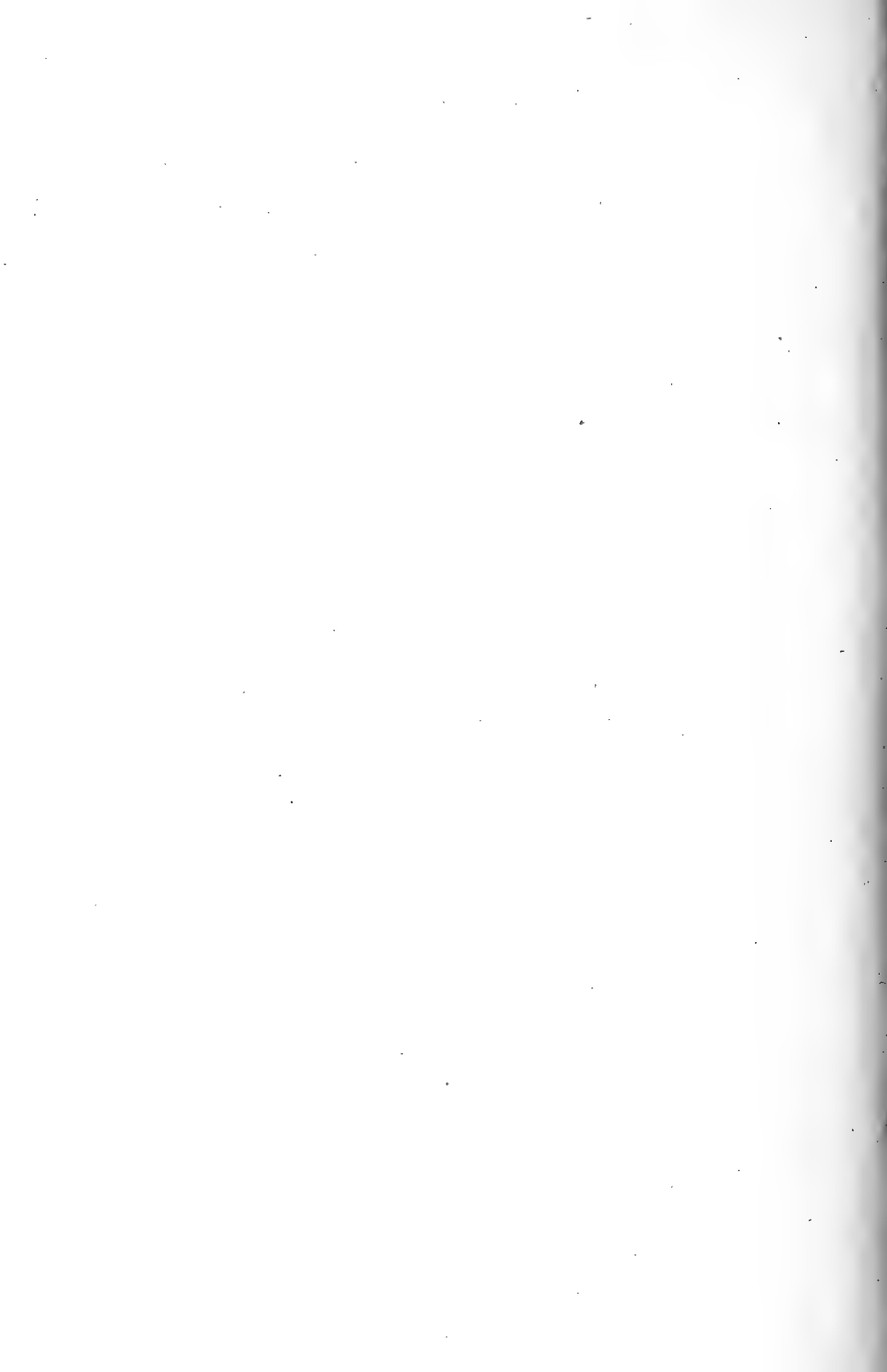
Zygomorphic. A flower or organ which can be cut into similar halves by only one plane.

INDEX

Abies	129	Burning-bush, see Wahoo.....	165
Acer	165	Butternut	130
Adelia	175	Buttonwood, see Sycamore...	148
Aesculus	168	Canoe Birch, see Paper Birch.	135
Ailanthus	162	Carpinus	133
Alder	135	Carya, see Hicoria.....	130
Alnus	135	Castanea	137
Amelanchier	153	Catalpa	176
Amygdalus	159	Cedar, see Juniper.....	121
Angelica-tree	177	Celtis	146
Apple	151	Cercis	160
Apricot	156	Chamaecyparis	121
Aralia	177	Cherry	156
Arborvitae	121	Cherry Birch, see Sweet Birch	135
Ash	173	Chestnut	137
Asimina	150	Chinquapin	137
Aspen	124	Chionanthus	175
Bald-cypress	121	Choke Pear, see Pear.....	151
Basswood, see Linden.....	170	Cladrastis	161
Bayberry	129	Coffee-bean	161
Beech	136	Cornel, see Dogwood.....	177
Betula	134	Cornus	177
Birch	134	Cotinus	163
Bitternut	131	Cottonwood	124
Black Gum, see Tupelo.....	178	Crab-apple	151
Black Haw	178	Crataegus	153
Black Locust, see Common Locust	161	Cydonia	153
Black Oak, see Quercitron....	140	Diospyros	172
Bladdernut	165	Dogwood	177
Blue-beech	133	Elm	144
Boxelder	168	Euonymus	165
Broussonetia	147	Fagus	136
Buckeye	165	Fir	120
Buckthorn	169	Fraxinus	173
Buckthorn, see Bumelia.....	172	Fringetree	175
Bumelia	172	Ginkgo	116

Gleditsia	160	Mockernut	132
Great Laurel, see Rhododendron	171	Mohrodendron	173
Gymnocladus	161	Morus	146
Hamamelis	147	Mountain-ash	151
Hackberry	146	Mountain Laurel, see Kalmia.	171
Haw	178	Mulberry	146
Haw, see Hawthorn	153	Myrica	129
Hawthorn	153	Nannyberry, see Black Haw..	178
Hemlock	120	Nyssa	178
Hercule's Club, see Angelica-tree	177	Oak	137
Hickory	130	Osage-orange	147
Hicoria	130	Ostrya	134
Holly	164	Oxydendrum	171
Honey-locust	160	Papaw	150
Hop-hornbeam	134	Paper-mulberry	147
Hoptree	162	Paulownia	175
Horse-chestnut	168	Peach	159
Ilex	164	Pear	151
Iron Oak, see Post Oak.	142	Pecan	131
Ironwood, see Hop-hornbeam.	134	Pepperidge, see Tupelo.	178
Judastree, see Redbud.	160	Persimmon	172
Juglans	129	Picea	119
Juneberry	153	Pignut	132
Juniper	121	Pine	116
Juniperus	121	Pinus	116
Kalmia	171	Planera	146
Kentucky Coffeetree, see Coffee-bean	161	Planer tree	146
Larch	118	Plane tree	148
Larix	118	Platanus	148
Laurel, see Rhododendron and Kalmia	171	Plum	156
Liquidambar	148	Poison Elder, see Poison Sumac	163
Linden	170	Poplar	122
Liriodendron	149	Poplar, Yellow, see Tuliptree.	149
Locust	161	Populus	122
Maclura, see Toxylon.	147	Prickly-ash	162
Magnolia	148	Prunus	156
Maiden-hair-tree	116	Ptelea	162
Malus	151	Pyrus	151
Maple	165	Quercitron	140
		Quercus	137
		Quince	153
		Redbud	160
		Red Cedar, see Red Juniper..	122

Red Elm, see Slippery Elm..	145	Sycamore	148
Rhamnus	169	Symplocos	172
Rhododendron	171	Tamarack	119
Rhus	163	Taxodium	121
Robinia	161	Thorn, see Hawthorn.....	153
Rock Elm, see Cork Elm....	145	Thuja	121
Rock Maple, see Sugar Maple.	167	Tilia	170
Salix	124	Toxylon	147
Sapindus	169	Tree-of-heaven	162
Sassafras	150	Tsuga	120
Serviceberry, see Juneberry...	153	Tuliptree	149
Shadbush, see Juneberry.....	153	Tupelo	178
Sheepberry	178	Ulmus	144
Silverbell	173	Viburnum	178
Smoke tree	163	Wahoo	165
Snowdrop-tree, see Silverbell..	173	Walnut	129
Soapberry	169	Water-beech, see Blue-beech..	133
Soft Maple, see Silver Maple.	166	Water Elm, see Planertree....	146
Sorbus	151	Wax-myrtle	129
Sour Gum, see Tupelo.....	178	White-cedar	121
Sorreltree	171	White Maple, see Silver Maple	166
Sourwood, see Sorrel-tree....	171	Whitewood, see Linden.....	170
Spindletree	165	Willow	124
Spruce	119	Witch-hazel	147
Stafftree	165	Xanthoxylum	162
Staphylea	165	Yellow Oak, see Chestnut Oak	144
Sumac	163	Yellow Poplar, see Tuliptree..	149
Sweet-gum	148	Yellow-wood	161
Sweetleaf	172		



PROCEEDINGS OF THE OHIO STATE ACADEMY OF SCIENCE.
Volume V, Part 5, Special Paper No. 16.

The Pteridophytes of Ohio

BY

JOHN H. SCHAFFNER

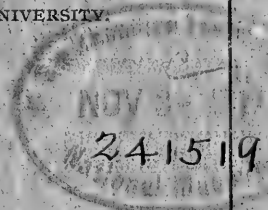
BOTANICAL DEPARTMENT, OHIO STATE UNIVERSITY.

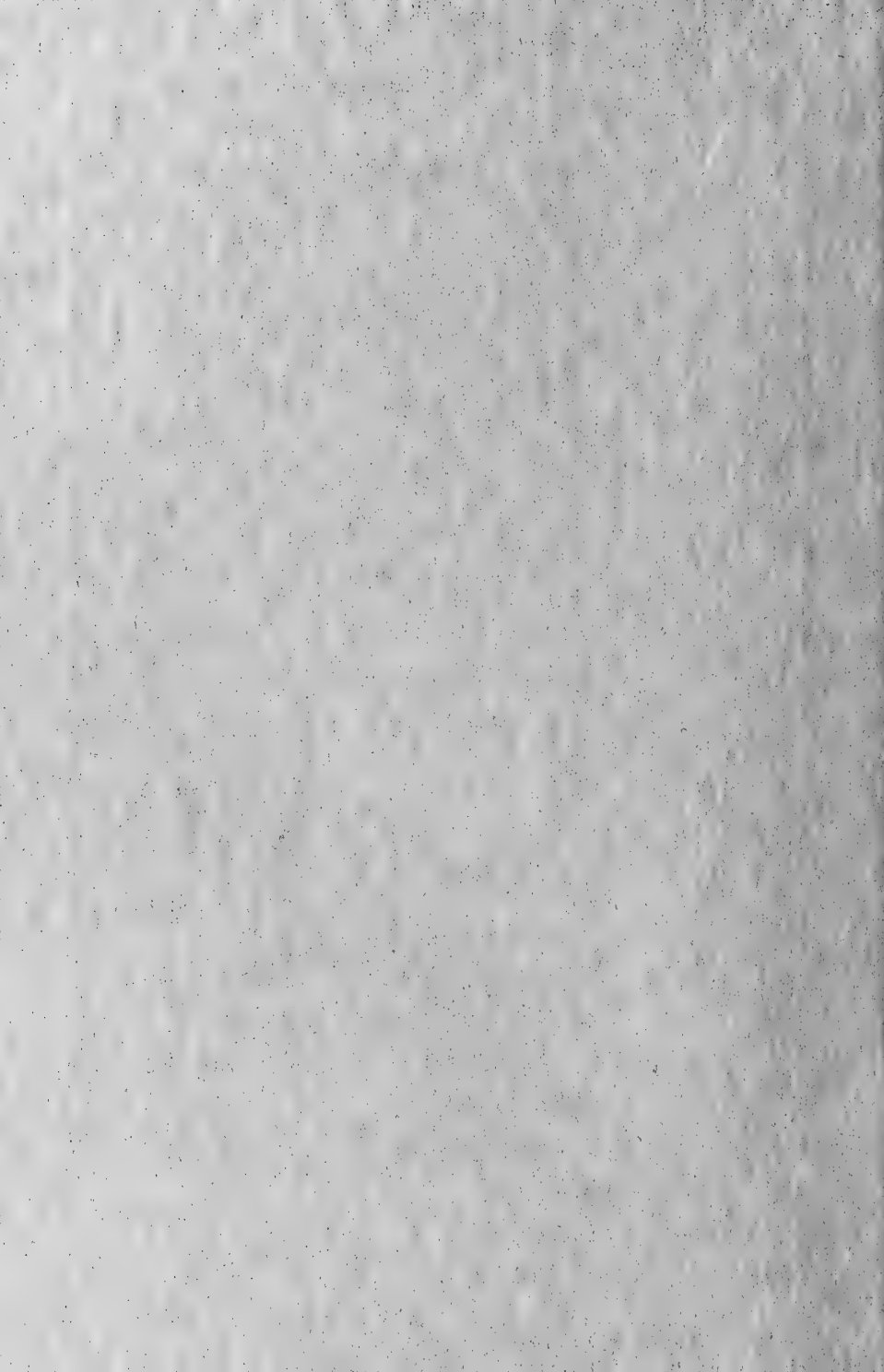
PUBLICATION COMMITTEE.

J. C. HAMBLETON. E. L. RICE. BRUCE FINK,

DATE OF PUBLICATION, JAN. 5, 1910.

PUBLISHED BY THE ACADEMY,
COLUMBUS, OHIO.





PROCEEDINGS OF THE OHIO STATE ACADEMY OF SCIENCE.
Volume V, Part 5, Special Paper No. 16.

The Pteridophytes of Ohio

BY

JOHN H. SCHAFFNER

BOTANICAL DEPARTMENT, OHIO STATE UNIVERSITY.

PUBLICATION COMMITTEE.

J. C. HAMBLETON. E. L. RICE. BRUCE FINK,

DATE OF PUBLICATION, JAN. 5, 1910.

PUBLISHED BY THE ACADEMY,
COLUMBUS, OHIO.

NOTE.

The expense of publication of this paper is covered by a grant from the Emerson McMillin Research Fund.

WILLIAM R. LAZENBY,

E. L. RICE,

FRANK CARNEY,

Trustees.

Contribution from the Botanical Laboratory of Ohio State University, 52.

INTRODUCTION.

Aside from their esthetic value, our native Pteridophytes are of little practical use, and this may be said of most of the species living in the world today. Ecologically considered, however, they are of considerable importance, and in the past geological ages also, the ferns and their allies were most important plants, contributing largely to the formation of coal.

It is hoped that this presentation of the Ohio species will enable all who so desire to become acquainted with these most graceful plant forms.

The keys have been made very complete so that one should be certain of the specimen in hand when the name has been traced out, except perhaps in a few of the more difficult genera. Only brief descriptions have been given in the catalog of species, and usually the characters enumerated in the keys have not been repeated.

The list of Ohio Pteridophytes, as it now stands, contains 61 species and a number of varieties, all being represented by herbarium specimens. Unless otherwise stated the records are based on specimens in the state herbarium of the Ohio State University. It is possible that several other species will be found in the state.

The census of species is as follows :

- Ferns — 44 species.
- Equisetums — 8 species.
- Lycopods — 6 species.
- Water-ferns — 1 species.
- Quillworts — No species.
- Selaginellas — 2 species.

Among those who have published lists of the Ohio ferns and fern allies, either separately or in some more extensive

catalog, the following deserve special mention: John L. Riddell, Wm. S. Sullivant, Thos. G. Lea, Joseph Clark, J. S. Newberry, H. C. Beardslee, A. P. Morgan, Joseph F. James, Herbert L. Jones, E. L. Moseley, Wm. A. Kellerman, and Lewis S. Hopkins. Many other botanists have contributed either directly or indirectly to the knowledge of Ohio Pteridophytes, and the names of those who have presented specimens to the collection now in the State Herbarium would make a very extensive list.

Our forefathers considered ferns to be mysterious and uncanny things. They could not quite comprehend what seemed to be real plants without flowers or seeds. Thus many superstitions arose, the chief one of which, perhaps, was in regard to fern seed. It was supposed that the fern seed could be obtained only on the night of St. John's Eve, the 24th of June. Those who went to obtain the seed took a white cloth along in which to catch it. In some parts the fern seed was supposed to be in the keeping of the devil and could be obtained from him only at midnight. In some parts of England the general name for ferns was devil's bushes. On the night of St. John's Eve all the hosts of Elfland were also abroad in their greatest power. The fern would then produce a small blue flower at dusk and the wonderful seed would be ripe and fall from the plant at midnight. The fern seed was said to insure good luck. It would confer on one the strength of thirty or forty men. Another property was that it would enable the possessor to discover hidden treasure and to unlock anything that required opening. The sap of a plant from which fern seed is obtained would confer on the person taking the draft the blessing of eternal youth.

But the greatest property of all which the magic seed possessed was that by it one might become invisible. There is, however, no authentic record of anyone thus becoming invisible by its aid, so fern seed must have been about as scarce then as it is at present. This belief in the power of the fern seed to make men invisible arose in the age when the doctrine of signatures was taught and believed. Nature in giving particular

shapes to leaves and flowers plainly taught our credulous ancestors for what diseases they were especially useful. A heart-shaped leaf was a cure for diseases of the heart; a leaf resembling the liver was for liver complaints; a bright-eyed flower was for the eyes; a foot-shaped flower was a certain cure for gout, etc. It was thus a clear conclusion that a plant with invisible reproductive organs would if properly used confer the property of invisibility. Shakespeare refers to this belief in the first part of *King Henry IV.*, Act II., Scene 1: "We have the receipt of fernseed; we walk invisible." Ben Johnson alludes to the same superstition, as follows:

"I had no medicine, Sir, to go invisible,
No fern seed in my pocket."

Butler, in *Hudibras*, Part III., Canto 3, refers to the fern in a more scientific manner:

"Who would believe what strange bugbears
Mankind creates itself of fears,
That spring, like fern, that insect weed,
Equivocally, without seed,
And have no possible foundation
But merely in th' imagination?"

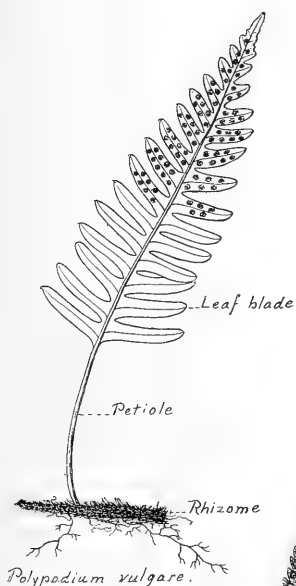
It was customary in the seventeenth century to set fire to growing ferns under the belief that the practice would produce rain. The smoke of ferns was also believed to drive away snakes and other noxious creatures. In some places it was believed that by taking a bite from the leaf of the first fern that appeared in Spring the toothache would depart for a year. In the Tyrol, *Osmunda* is placed over the door for good luck. In some parts of England there was a practice of cutting the rhizome of a fern slantwise, when a picture of an oak tree could be made out; and the saying was that the more perfect the representation the more lucky the person would be who cut it. A certain species of spleenwort was supposed to make the spleen wither away. Thus in the Island of Crete the flocks and herds were said to be without spleens because they browsed on this

herb. In some parts of the island where the plant did not grow, the cattle were said to have the usual spleens.

As stated above, the uses of ferns and fern allies in the household and the arts are insignificant. They are, however, much valued as ornamental plants. The species usually cultivated belong to the ordinary ferns and selaginellas. The Male Fern, *Dryopteris filix-mas* is officinal. It is an anthelmintic which is considered especially effective in removing tape-worms. It is not found in Ohio, but our *Dryopteris marginalis* is used in the same way as a taenifuge. *Equisetum arvense* is supposed to be injurious to horses, at least when in the form of hay. *Pteridium aquilinum* is supposed to be injurious to cattle and horses. Some of the scouring rushes, like *Equisetum hyemale*, are used for scouring utensils and polishing wood. The petioles of *Adiantum pedatum* are used by the Indians for basket-work.

The spores of *Lycopodium clavatum* and other species have a pharmaceutical use for coating pills and other adhesive surfaces. The spores are also used as baby powder to prevent chafing. The spore powder is highly inflammable and is used in the manufacture of fireworks and the artificial representation of lightning on the stage. Some species of *Lycopodium*, as *L. obscurum*, are extensively used for Christmas decorations.

A few of the ferns have a culinary value. The rhizome of the eagle fern, *Pteridium aquilinum*, is gathered and boiled by some savages and used as food. The succulent petioles of the eagle fern also furnish an article of food. They should be gathered just before the leaf-blade begins to unroll, and after cutting off the blade and the lower rather woody part and scraping off the bitter hairs and scales, they may be cooked much like asparagus or greens. The taste is not unpleasant and is agreeable to many persons. The petioles of the royal fern, *Osmunda regalis*, are used in the same way. Other ferns are also used as pot herbs. Among the more important are the cinnamon fern, *Osmunda cinnamomea*; Clayton's fern, *Osmunda claytoniana*; and the ostrich fern, *Matteuccia struthiopteris*. The leaves are collected just as they are unrolling and boiled as greens.



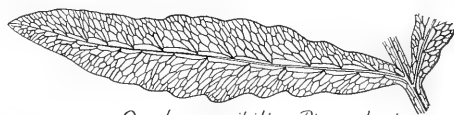
Pinnule showing sorus with sporangia and indusium.....



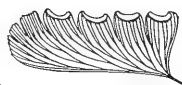
Dryopteris marginalis.



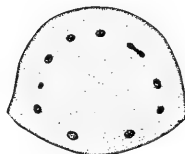
Pteridium aquilinum. Pinna showing continuous marginal sorus and indusium



Onoclea sensibilis. Pinna showing areolate or anastomosing venation.



Adiantum pedatum. Pinnule showing dichotomous venation and marginal sori.



Dryopteris marginalis. Cross section of petiole showing vascular bundles



Filix bulbifera. Cross section of petiole showing vascular bundles.

Drawings of the common parts of fern leaves, by Clara G. Mark.

CLASSIFICATION OF PTERIDOPHYTES.

ARCHEGONIATA. Archegoniates.

The intermediate plants; normally aerial plants but moisture-loving; always with an alternation of generations, the gametophyte comparatively large and often hermaphrodite in the lower forms but minute and always unisexual in the highest; the sporophyte small and without vascular tissue and permanently parasitic in the lower forms but large and with vascular tissue and becoming independent when mature in the higher; either homosporous or heterosporous, eusporangiate or leptosporangiate, never seed-producing; growing point commonly with a definite, two- or three-sided apical cell; stems sometimes having secondary thickening by means of a more or less perfect cambium or by division in the cortical cells; oosphere produced in an ovary of definite character called an archegonium and always cutting off a ventral canal cell; fertilization asiphonogamic, the spermatozoids swimming through water.

1. Sporophyte without roots, leaves or fibrovascular tissue.....
.....BRYOPHYTA. Mosses and Liverworts.
1. Sporophyte independent when mature with true roots, leaves, and fibrovascular tissue.....PTERIDOPHYTA. 2.
2. With one kind of nonsexual spores.....PTERIDOPHYTA HOMOSPORAE.
2. With two kinds of nonsexual spores....PTERIDOPHYTA HETEROSPORAE.

In this manual the Pteridophytes are still classified in their subkingdoms representing the lower and higher stages of development. They may more properly be classified according to their natural relationships into three great branches or phyla as follows:

I. *Ptenophyta*. About 4,500 known living species. Vascular seedless plants with comparatively large multiciliate sperms and usually with large, commonly compound leaves, the sporophylls not in cones.

Classes, Filices,
Hydropterides,
Isoeteae.

2. *Calamophyta*. 25 known living species. Vascular seedless plants with jointed stems and small whorled leaves with comparatively large multiciliate sperms, and with the sporophylls in cones.

Classes, Equiseteeae,
Sphenophylleae (Fossil),
Calamariaeae (Fossil).

3. *Lepidophyta*. 660 known living species. Vascular seedless plants with simple, usually small leaves covering the stem, with small biciliate sperms, and with the sporophylls in cones or sometimes forming zones alternating with the sterile leaves.

Classes, Lycopodieae,
Selaginelleae.

KEY TO THE CLASSES OF HOMOSPOROUS AND HETEROSPOROUS PTERIDOPHYTES OF OHIO.

1. With comparatively large, broad, compound or rarely simple, abundantly veined leaves; homosporous, the spores all of one kind; sporangia borne on the foliage leaves or on special sporangio-phores.....I. FILICES. Ferns.
1. With 4-foliolate, slender-petioled leaves from a horizontal rhizome; or small, free-floating plants with small 2-ranked foliage leaves; heterosporous, the spores of two sizes, microspores and megaspores; sporangia in sporocarps.....IV. HYDROPTERIDES. Water-ferns.
1. Leaves small, short, and scale-like, scattered or in whorls; or long, grass-like, and in a rosette; plants not floating; homosporous or heterosporous. 2.
2. With minute scale-like leaves in a whorl, forming sheaths at the nodes of the jointed stem; homosporous, the spores with appendages, the peltate sporophylls in cones.....II. EQUISETEEAE. Horsetails and Scouring Rushes.

2. With simple, long, grass-like leaves containing a ligule and forming a rosette on a short 2- or 3-lobed stem; heterosporous, the sporangia in the bases of the leaves.....V. ISOETEAEE. Quillworts.
2. With numerous, small, lanceolate, subulate, or scale-like, 1-nerved leaves covering the stem. 3.
3. Leaves without a ligule; homosporous, sporangia single in the axils of the sporophylls which are arranged in cones or in zones alternating with foliage leaves.....III. LYCOPODIEAEE. Clubmosses.
3. Leaves with a ligule; green cells often with only 1 large chloroplast; heterosporous, the sporangia single in the axils of the sporophylls which are arranged in cones....VI. SELAGINELLEAEE. Selaginellas.

SUBKINGDOM, PTERIDOPHYTA HOMOSPORAE.

Homosporous Pteridophytes; 4,500 known living species.

Plants in which the herbaceous or tree-like sporophyte, after the juvenile stage, has an independent existence with true fibrovascular tissue, roots, and leaves, and with a terminal growing point; homosporous and either eusporangiate or leptosporangiate. Gametophyte usually rather large, normally hermaphrodite although often unisexual; thalloid and green but sometimes tuberous and subterranean and without chlorophyll.

Class I. FILICES. Ferns. About 4,000 living species.

Sporophyte herbaceous or tree-like, usually with a horizontal rhizome, simple or branched; leaves usually large, alternate and mostly compound, rarely slender and grass-like; sporangia borne on the under side of the leaves or on simple or branched sporangiophores; eusporangiate or leptosporangiate; sporophylls not forming cones. Gametophyte comparatively large, tuber-like without chlorophyll and subterranean, or commonly developed as a flat, simple or branched thallus, hermaphrodite or unisexual; spermatozoids multiciliate.

KEY TO THE GENERA OF OHIO FILICES.

Required for identification — perfect leaves with the entire petioles, some of the leaves with sporangia which need not, however, be mature. The vascular bundles should be determined at or very near the base of the petiole. The number following the generic name refers to the list number.

1. Leaf blades areolate, the veins anastomosing to form a network. 2.
1. Leaf blades not areolate, the veins not anastomosing, but dichotomous or pinnate, and ending free. 5.
2. Leaf blades simple, entire, with a distinct sporangiophore with two rows of sporangia, vascular bundles in petiole 3-6.....
.....*Ophioglossum* (1).

2. Leaf blades compound or somewhat lobed, the sporangia on the blade or on distinct leaves. 3.
3. Leaves rooting freely at the long tapering apex, simple or somewhat lobed; sori linear or oblong; vascular bundles in base of petiole 2.*Camptosorus* (11).
3. Leaves not rooting at the tip, pinnatifid or pinnate. 4.
4. Sterile pinnae sharply serrate; vascular bundles in base of petiole 2 or numerous, sori oblong in chain-like rows.....*Woodwardia* (8).
4. Sterile pinnae coarsely toothed or lobed; vascular bundles in base of petiole 2; sori round, enclosed in the leaflet....*Onoclea* (19).
5. Vascular bundles in base of petiole 3 or more. 6.
5. Vascular bundles in base of petiole 1 or 2, but additional brown or black sclerenchyma bundles may be present. 11.
6. Sporangia on a more or less branched sporangiophore distinct from the leaf blade; vascular bundles in the base of the common petiole in a ring.....*Botrychium* (2).
6. Sporangia not on a sporangiophore distinct from the leaf blade. 7.
7. Leaflets with continuous marginal indusia; leaves large, ternate, with nectar glands in the axils of the main divisions; vascular bundles in base of petiole about 12, irregularly arranged..
.....*Pteridium* (6).
7. Sori with special indusia or naked, not covered by the leaf margin; vascular bundles in base of petiole 10 or less. 8.
8. With oblong or linear sori in chains parallel to the midrib; leaflets areolate in the middle; vascular bundles in base of petiole 7-9.
.....*Woodwardia* (8).
8. Sori round or roundish, indusia less than twice as long as broad. 9.
9. Pinnae strongly auricled on the upper side at the base; fertile part of leaf specialized; indusium orbicular, peltate, without a sinus, fixed by the centre; vascular bundles in base of petiole 4-5.
.....*Polystichum* (12).
9. Pinnae not auricled. 10.
10. Leaves simply pinnatifid; petioles articulated to the rhizome; sori naked, circular; vascular bundles in base of petiole 3...
.....*Polypodium* (4).
10. Leaves 2- or more- pinnatifid or pinnate; indusium reniform or if orbicular with a narrow sinus.....*Dryopteris* (13).
11. Sporangia borne on specialized leaves, without foliage leaflets, on specialized pinnae at the middle or end of the foliage leaf, or on special sporangiophores distinct from the leaf blade. 12.
11. Sporangia on leaflets of ordinary foliage leaves, some or all of which may be fertile. 14.

12. Vascular bundles 2, often uniting, not incurved; sori on specialized leaves; pinnules pinnately veined, barely dichotomous.....
.....*Matteuccia* (18).
12. Vascular bundles strongly incurved, venation distinctly dichotomous.
13.
13. Sporangiphore distinct, usually on a stalk beside the leafblade; sporangia large, globular.....*Botrychium* (2).
13. Sporangia on specialized leaflets at the end or sides of the foliage leaves; or on specialized leaves; vascular bundle in base of petiole 1; leaves 2 or more feet long, bipinnatifid or bipinnate.....*Osmunda* (3).
14. Sori with marginal indusia formed by the more or less altered and reflexed edge of the leaflet or its lobes. 15.
14. Sori with special indusia or naked, not covered by the margin of the leaflet. 16.
15. Only the tips of the lobes of the leaflets reflexed as indusia.
.....*Adiantum* (5).
15. Entire margin of the leaflets reflexed to form the indusium, rarely interrupted.*Pellaea* (7).
16. Sori linear or oblong, indusia more than twice as long as broad. 17.
16. Sori round or roundish, indusia less than twice as long as broad. 18
17. Sori elongated, on the upper sides of the veins.... *Asplenium* (9).
17. Sori and indusia somewhat curved, sometimes horseshoe-shaped many of them crossing the veinlet, sometimes with 2 sori placed back to back; leaves bipinnatifid or bipinnate in our species, usually 2-3 feet long.....*Athyrium* (10).
18. Sori naked, circular; petiole with 2 united vascular bundles; leaf blades triangular or ternate.....*Phegopteris* (14).
18. Sori with indusia, sometimes inferior and obscure; leafblade not triangular nor ternate. 19.
19. Indusium superior, cordate or reniform, attached by the sinus.
.....*Dryopteris* (13).
19. Indusium convex, delicate and partly inferior, attached by a broad base at the side and enclosing the sorus like a hood; leaves sometimes with brood-buds.....*Filix* (15).
19. Indusium wholly inferior. 20.
20. Indusium roundish or stellate, delicate, cleft into narrow segments; leaves in our species usually not over 16 inches long. *Woodsia* (16).
20. Indusium cup-shaped, somewhat 2-valved; leaves in ours usually over 2 feet long.....*Dennstaedtia* (17).

Subclass, EUSPORANGIATAE.

Sporangia arising from the tissues beneath the epidermis.

Order, *Ophioglossales.*

Ophioglossaceae. Adder-tongue Family.

Sporophyte more or less succulent with fleshy roots; sporangia opening by a transverse slit, spores yellow. Gametophyte subterranean, without chlorophyll.

1. **Ophioglossum** L. Adder-tongue.

Low plants with simple leaves and sporangia in two rows on a slender sporangiophore. Veins reticulate.

1. *Ophioglossum vulgatum* L. Adder-tongue.

A low plant with a short rhizome and simple leaves, the sporangia borne on a spike-like sporangiophore. In moist meadows and thickets, on the ground. Rather generally distributed in Ohio, but local and not common.

2. **Botrychium** Swz. Grape-fern.

Plants with a short erect rhizome and fleshy roots. Leaves pinnately or ternately divided or compound; sporangiophore branched. Veins ending free.

- 1. Leaf blade pinnate or ternate, sessile on the common petiole or on a stalk not more than 1 inch in length. 2.
- 1. Leaf blade ternate; on a stalk over 2 inches in length. 6.
- 2. Leaf blade more or less fleshy, pinnate or bipinnate, or if ternate then small, not much over 2 inches long. 3.
- 2. Leaf blade membranous, ternately decomposed with three main sessile divisions, large; the sporangiophore stalked, usually 6 inches or more in length. Bud enclosed in a cavity at one side of the base of the petiole.....*B. virginianum.*
- 3. Sporangiphore stalked, leaf blade usually pinnatifid, pinnate or bipinnate, stalked or sometimes nearly sessile. 4.
- 3. Sporangiphore sessile or nearly so, leaf blade closely sessile on the common petiole, 3-lobed and 2-pinnatifid.....*B. lanceolatum.*
- 4. Leaf blade simply pinnatifid or pinnate. 5.
- 4. Leaf blade 2-pinnatifid or 2-pinnate, with narrow segments, occasionally in 3 divisions.....*B. neglectum.*
- 5. Leaf blade usually short-stalked, pinnatifid or nearly entire; sporangiophore nearly simple or little branched.....*B. simplex.*

- 5. Leaf blade pinnate, nearly sessile, with fan-shaped segments; sporangiophore much branched.....*B. lunaria*.
- 6. Leaf segments obliquely ovate or oblong, large, $\frac{1}{2}$ -1 inch long.....*B. obliquum*.
- 6. Leaf segments finely lacinate, narrow, $\frac{1}{8}$ inch wide or less.....
.....*B. dissectum*.

1. *Botrychium lunaria* (L.) Sw. Moonwort.

A fleshy low plant with the leaf blade usually sessile at about the middle of the common petiole. Lobes of the leaf fan-shaped, 3-8 pairs. Sporangioophore much branched. In open places and fields. Northern. Lake Co.

2. *Botrychium simplex* Hitch. Little Grape-fern.

A delicate plant, 4-10 inches high with the leaf blade simply lobed or pinnatifid and usually short-stalked at about the middle of the common petiole, the lobes only slightly fan-shaped. In moist rich woods and meadows. Cedar Point, Erie Co.

3. *Botrychium neglectum* Wood. Matricary Grape-fern.

A plant 6-12 inches high often very fleshy; leaf blade ovate or oblong 1-2 pinnatifid or pinnate with obtuse divisions and narrow toothed segments. Sporangioophore 2-3-pinnate. (*B. matricariaefolium* A. Br.) In rich grassy woods and swamps. Portage, Ashtabula, Cuyahoga and Erie Cos.

4. *Botrychium lanceolatum* (Gmel.) Angs. Lanceleaf Grape-fern.

A somewhat fleshy plant with a closely sessile leaf blade near the summit of the common petiole. Blade triangular and ternately twice pinnatifid. Sporangioophore sessile or short-stalked, 2-3-pinnate. In rich woods, meadows and swamps, on the ground. Geauga and Portage Counties.

5. *Botrychium obliquum* Muhl. Oblique Grape-fern.

Plant robust, the leaf blade on a long stalk arising from near the base of the common petiole, ternate, the segments obliquely

ovate or oblong. Sporangiphore long-stalked, much branched. Low woods and open places: Root contraction very prominent. General in Ohio.

6. *Botrychium disséctum* Spreng. Cutleaf Grape-fern.

Plant rather robust with a much dissected leaf blade on a long stalk from near the base of the common petiole, the sporangiphore also long-stalked and much branched. Ultimate segments laciniate. Roots with prominent contraction. In various habitats, meadows and open woods. General in the state.

7. *Botrychium virginianum* (L.) Sw. Virginia Grape-fern.

A plant from 1-2 feet high with a large, ternate, membranous leaf, sessile on the common petiole; sporangiphore long-stalked, 2-3-pinnate. In rich woods and moist rocky ravines. General and common in the state.

Subclass, LEPTOSPORANGIATAE.

Sporangia arising from the epidermal cells commonly stalked.

Order, *Filicales*.

Osmundàccae. Royal Fern Family.

Large ferns with 1-2-pinnate leaves with free veins. Sporangia large, globose, without a ring.

3. **Osmúnda** L.

Tall ferns, growing in moist places, swamps or bogs, in large rosettes or crowns. Sporangia opening by a longitudinal cleft into two halves.

- 1. Leaves truly bipinnate fertile at the apex; veins in the pinnules once and twice dichotomous.....*O. regalis*.
- 1. Sterile leaves bipinnatifid. 2.
- 2. Leaves with fertile pinnae in the middle, sterile pinnae without a tuft of tomentum at the base.....*O. claytoniana*.

2. Fertile leaves distinct from the foliage leaves; pinnae of the foliage leaf with a distinct tuft of tomentum at the base; veins in the pinnules regularly once dichotomous.....*O. cinnamomea*.

1. *Osmunda regalis* L. Royal Fern.

A large fern with stout rhizome bearing a cluster of bipinnate leaves, 2-6 feet high. Sporophylls with the upper pinnae developed as a specialized sporangiophore. In swamps and wet places. General in Ohio.

2. *Osmunda claytoniana* L. Clayton's Fern.

A large fern with stout rhizome bearing a rosette of 2-pinnatifid leaves 2-6 feet high. Sporophylls with specialized spore-bearing pinnae in the middle. In moist places. General in the state.

3. *Osmunda cinnamomea* L. Cinnamon Fern.

A large fern with a very large, widely creeping rhizome bearing a rosette of large sterile leaves with brown colored sporophylls within. Petioles with abundant tomentum when young. Veins in the pinnules regularly once dichotomous. In swamps and wet places. General.

Polypodiaceae. Polypody Family.

Ferns of various habits, the rhizome horizontal or erect. Sporangia opening transversely and provided with a vertical ring.

4. **Polypodium** L. Polypody.

Ferns with creeping rhizomes articulated petioles and pinnate or simple leaves. Sori hemispherical without indusia. Veins free.

1. Leaves glabrous; plant green.....*P. vulgare*.

1. Lower surface of the leaf densely scaly; plant grayish.....
.....*P. polypodioides*.

1. *Polypodium vulgare* L. Common Polypody.

Rhizome widely creeping, densely covered with brown scales. Leaves evergreen, glabrous, with light-colored petioles. On rocks and rocky banks. General in the eastern half of the state.

1. *Polypodium polypodioides* (L.) Hitch. Gray Polypody.

Rhizome widely creeping covered with small brown scales. Leaves coriaceous evergreen, glabrous or nearly so above, densely covered with gray peltate scales below. On trees or occasionally on rocks. Adams and Hamilton counties.

5. **Adiantum** L.

Graceful ferns with much-divided leaves, with polished and shining petioles and dichotomous venation. Sori marginal under the reflexed tips of the pinnules.

1. *Adiantum pedatum* L. Maidenhair Fern.

A fern with dichotomously forked leaves with pinnate branches, and with dark-brown or purplish petioles. On the ground in woods and on rocky hillsides. General and common.

6. **Pteridium** Scop.

Large and usually coarse ferns with marginal, continuous sori and indusia and free veins. (Pteris).

1. *Pteridium aquilinum* (L.) Kuhn. Eagle-fern.

Rhizome horizontal and very extensive, the leaves ternate and large with nectar glands in the axils of the main divisions. The nectar is eaten by ants. In sunny places, especially on hillsides; sometimes also in the shade. Often called Bracken. General in Ohio.

7. **Pellaea** Link. Cliff-brake.

Rather small ferns growing on rocks, with marginal sori and indusia. Leaves pinnate or pinnatifid with dark-colored petioles. Veins free.

1. *Pellaea atropurpurea* (L.) Link. Purple Cliff-brake.

Rhizome short and densely covered with hair-like scales. Leaves coriaceous, evergreen, simply pinnate or 2-pinnate below. Usually on limestone rocks. Ottawa, Stark, Franklin, Clark, Greene, Highland, and Adams counties.

8. **Woodwardia** Sw. Chain-fern.

Large ferns with pinnate or nearly 2-pinnate leaves and oblong linear sori arranged in chain-like rows parallel to the margins of the pinnae. Venation, partly areolate.

1. *Woodwardia virginica* (L.) Sw. Virginia Chain-fern.

Rhizome long, stout and chaffy. Sterile and fertile leaves similar in outline, pinnate, the pinnae linear-lanceolate. In swamps and wet ground. Ashtabula, Defiance, Geauga, Summit, Wayne, and Williams counties.

9. **Asplenium** L. Spleenwort.

Large or small ferns with leaves of various types, the sori linear or oblong oblique to the midribs or rachises. Veins free.

1. Leaves pinnatifid, or pinnate only near the base, tapering to a long point. 2.
1. Leaves once pinnate, with numerous pinnae. 3.
1. Leaves 2-3-pinnate or pinnatifid. 6.
2. Lobes of the leaf rounded or the lowest acuminate...*A. pinnatifidum*.
2. Lobes acute or acuminate, the tip of the leaf frequently rooting...*A. platyneuron* X *Camptosorus rhizophyllus*. (*A. ebenoides*.)
3. Petioles pale, green or straw-colored; pinnae linear-lanceolate with a long point; leaves usually 2-3 feet long.....*A. angustifolium*.

- 3. Petioles black or dark purple; pinnae mostly rather short and blunt. 4.
- 4. Pinnae auricled at the upper side of the base. 5.
- 4. Pinnae not auricled; alternate or opposite on the rachis, oval or roundish oblong, inequilateral.....*A. trichomanes.*
- 5. Pinnae opposite, oblong; plants small; rachis dark brown or black.*A. parvulum.*
- 5. Pinnae partly alternate usually lanceolate; plants usually much larger; rachis chestnut brown or reddish.....*A. platyneuron.*
- 6. Petioles usually green, pinnules fan-shaped, usually incised....
.....*A. ruta-muraria.*
- 6. Petioles dark at the base, pinnules ovate-oblong, the lowest pinnately cleft into oblong or ovate cut-toothed lobes.....*A. montanum.*

1. *Asplenium pinnatifidum* Nutt. Pinnatifid Spleenwort.

A fern with a short, chaffy, creeping rhizome and pinnatifid or sometimes somewhat pinnate leaves with long tapering points. Evergreen. On rocks. Licking, Fairfield, Hocking, and Lawrence counties.

2. *Asplenium platyneuron* (L.) Oakes. Ebony Spleenwort.

Rhizome short; leaves linear, 6-18 inches long, tufted, with purplish-brown shining petioles, and 20-40 pairs of lanceolate or subfalcate pinnae auricled on the upper side at the base. Evergreen on rocks and banks, especially in limestone soil. General except in the northeastern fourth of the state.

Hybridizes with *Camptosorus rhizophyllus*. The form known as *Asplenium ebenoides* Scott is probably this hybrid. It is found in Hocking county.

3. *Asplenium parvulum* Mart. & Gal. Small Spleenwort.

A small fern with short, chaffy rhizome and tufted, rather firm, linear-oblong or linear-oblancoate leaves. Petioles blackish and shining; pinnae mostly opposite, oblong, obtuse, somewhat auricled on the upper side and nearly sessile. On limestone. Southern. In Adams county.

4. *Asplenium trichomanes* L. Maidenhair Spleenwort.

A small evergreen fern with short, nearly erect, chaffy rhizome and tufted linear leaves. Petioles purplish-brown and shining, with one vascular bundle in the base; pinnae oval or roundish-oblong, inequilateral, cuneate at the base, partly alternate and partly opposite. Usually on limestone and other rocks. General except in the northwestern fourth of the state.

5. *Asplenium angustifolium* Mx. Narrow-leaf Spleenwort.

Rhizome stout and creeping, rooting throughout. Leaves in a rosette, lanceolate, about 2 feet long, with brownish or green petioles. Pinnae 20-30 pairs, linear-lanceolate. In moist woods. General in Ohio.

6. *Asplenium ruta-muraria* L. Rue Spleenwort.

A delicate fern with short, ascending rhizome and tufted ovate or deltoid-ovate, glabrous, evergreen leaves, Petioles green, naked; pinnae and pinnules stalked. On limestone. Greene county.

7. *Asplenium montanum* Willd. Mountain Spleenwort.

Rhizome short and chaffy at the summit. Leaves tufted, evergreen, ovate-lanceolate, acuminate at the apex, 1-2-pinnate, delicate; petioles slender, naked, blackish at the base. On rocks. Hocking, Fairfield, and Summit counties. (Tuscarawas county, Hopkins.)

10. **Athyrium** Roth.

Sori more or less curved, sometimes horseshoe-shaped, often crossing to the outer or lower side of the fruiting veinlet; veins free. Our species large; leaves usually two feet or more in length. (*Asplenium*.)

1. Leaves 2-pinnatifid; segments blunt, scarcely crenate; vascular bundles of petiole 2.....*A. thelypteroides*.
1. Leaves 2-pinnate, pinnules acute, toothed or pinnatifid, vascular bundles 2.....*A. filix-foemina*.

1. *Athyrium thelypteroides* (Mx.) Desv. Silvery Spleenwort.

A large fern with sinuous, creeping, rhizome. Leaves lanceolate in outline; petiole straw-colored, somewhat chaffy below. Segments of the pinnae blunt, scarcely crenate. (*Asplenium acrostichoides* Sw.). In rich moist woods. General in Ohio.

2. *Athyrium filix-fœmina* (L.) Roth. Common Lady-fern.

A large graceful fern with a rather slender creeping rhizome. Leaves broadly oblong-ovate or oblong-lanceolate, acuminate at the apex; pinnules oblong-lanceolate, incised or serrate. On the ground in rich moist woods and more open places. General in the state.

II. *Camptosorus* Link. Walking-fern.

Slender evergreen ferns with tapering simple leaves rooting freely at the tips. Venation reticulate; sori linear or oblong.

1. *Camptosorus rhizophyllus* (L.) Link. Walking-fern.

Rhizome chaffy, short, usually creeping; petioles light green; leaves auricled, the auricles sometimes rooting. On rocks, especially limestone. General in Ohio.

12. *Polystichum* Roth.

Coarse pinnate or bipinnate ferns with an erect or creeping rhizome and round sori. Indusium orbicular, superior, peltate; petiole not jointed; veins free.

1. *Polystichum acrostichoides* (Mx.) Schott. Christmas Fern.

An evergreen fern with a stout, creeping rhizome. Leaves once pinnate, petioles densely chaffy, pinnae half-halberd-shaped. Fertile leaves contracted at the summit. In woods and rocky places. General in Ohio.

The form, *P. acrostichoides schweinitzii* (Beck.) Small, has toothed or pinnatifid pinnae and has been found in Wayne county.

13. *Dryopteris*. Adans. Shield-fern.

Ferns with 2-3-pinnate or pinnatifid leaves and round sori with cordate-reniform indusia. Veins free; petioles not jointed. (*Aspidium*).

1. Vascular bundles of petiole 2, free or united; veins simple or once forked; leaves thin-membranous. 2.
1. Vascular bundles 5 or more; veins forking freely; texture of the leaf firmer. 3.
2. Lower pinnae very much reduced; vascular bundles usually bridged.....*D. noveboracensis*.
2. Lower pinnae little smaller than the middle ones; veins once forked; vascular bundles 2, distinct.....*D. thelypteris*.
3. Leaves 2-pinnatifid or 2-pinnate, the segments not spinnulose 4.
3. Leaves 2-pinnate or 3-pinnatifid, the segments spinulose-toothed. 6.
4. Sori marginal; petiole densely scaly below; indusia convex.....*D. marginalis*.
4. Sori not marginal; petiole with few scales; indusia flat and thinnish. 5.
5. Vascular bundles in petiole 5; pinnae widest at the base.
.....*D. cristata*.
5. Vascular bundles in petiole 7; pinnae widest at the middle.
.....*D. goldieana*.
6. Leaves ovate-lanceolate, usually not narrowed below....*D. spinulosa*.
6. Leaves elongated-lanceolate, usually narrowed at the base..*D. bootii*.

1. *Dryopteris noveboracensis* (L.) Gr. New York Shield-fern.

Rhizome slender and creeping; leaves lanceolate, tapering both ways from the middle, 1-2 feet long or more, petioles more or less chaffy. On the ground in moist woods. General.

2. *Dryopteris thelypteris* (L.) Gr. Marsh Shield-fern.

Rhizome slender and creeping; leaves lanceolate or oblong-lanceolate, scarcely narrower at the base than at the middle, usually two to four feet long. In swamps and marshes. General.

3. *Dryopteris cristata* (L.) Gr. Crested Shield-fern.

Rhizome stout and densely chaffy; leaves evergreen, linear-oblong or lanceolate, acuminate, gradually and slightly narrowed

at the base, rather firm, one to three feet long; pinnae lanceolate or triangular ovate, acuminate; petiole with large scales. In moist woods and swamps. General.

The form *D. cristata clintoniana* (Eat.) Und. has oblong-lanceolate pinnae which are broadest at the base. Wayne county. (Geauga county, Hopkins.)

4. *Dryopteris goldicàna* (Hook.) Gr. Goldie's Shield-fern.

Rhizome stout and chaffy; leaves broadly ovate, rather firm, two to four feet long; petioles chaffy at least below. In rich woods. Rather general, but no specimens from the southern third nor from the northeastern counties.

5. *Dryopteris marginàlis* (L.) Gr. Marginal Shield-fern.

Rhizome ascending, stout with brown shining scales; leaves evergreen, ovate-oblong or ovate-lanceolate, subcoriaceous, two to three feet long; petiole chaffy; sori near the margin of the segments. In woods or on rocks. General in Ohio and common.

6. *Dryopteris spinulòsa* (Retz.) Ktz. Spinulose Shield-fern.

Rhizome chaffy; leaves evergreen, ovate-lanceolate, the pinnae oblique to the rachis; pinnae elongated-triangular; petiole with a few deciduous scales; indusium glabrous. In rich woods. General in Ohio.

The form, *D. spinulosa intermedia* (Muhl.) Und., has oblong-lanceolate spreading pinnae and the indusium beset with stalked glands. Rather general in Ohio.

The form, *D. spinulosa dilatata* (Hoffm.) Und., with broadly ovate or triangular-ovate, commonly three-pinnate leaves and glabrous indusia has been found by Hopkins in Tuscarawas county.

7. *Dryopteris boottii* (Tuck.) Und. Boott's Shield-fern.

Rhizome ascending; leaves elongated-oblong or lanceolate, thin, acuminate at the apex, slightly narrowed at the base; petiole

scaly at least below; pinnae lanceolate, long-acuminate, broadest at the base; pinnules very obtuse, the lower pinnatifid; indusium minutely glandular. In woods. Geauga county. (Wayne county, Hopkins).

14. *Phegopteris* Fee. Beech-fern.

Medium-sized ferns with 2-3-pinnatifid or ternate leaves and small round sori without indusia. Veins free.

1. Leaves 2-pinnatifid, triangular pinnae sessile; rachis winged. 2.
1. Leaves ternate with the three nearly equal divisions petioled; rachis wingless.....*P. dryopteris*.
2. Leaves longer than broad, usually dark-green; upper part of the petiole usually pubescent.....*P. phegopteris*.
2. Leaves as broad as long or broader, usually light-green; petiole mostly smooth.....*P. hexagonoptera*.
1. *Phegopteris phegopteris* (L.) Und. Long Beech-fern.

A fern with a slender, creeping, somewhat chaffy rhizome. Leaves triangular, mostly longer than broad, acuminate and pubescent. Pinnae broadest above the base, pinnately parted very nearly to the rachis into oblong obtuse, entire segments, the lower pair deflexed. (*P. polypodioides* Fee). In moist woods. Rather general but apparently local.

2. *Phegopteris hexagonoptera* (Mx.) Fee. Broad Beech-fern.

A fern with a creeping, chaffy, somewhat fleshy rhizome. Leaves triangular, as broad as long or broader, slightly pubescent, acuminate at the apex; the lowest pair of pinnae broadest near the middle, pinnately parted into linear-oblong, obtuse segments. In dry rich woods. General in the state.

3. *Phegopteris dryopteris* (L.) Fee. Oak-fern.

A fern with a creeping rhizome and thin, broadly triangular ternate leaves. Petioles slender, chaffy near the base; the three main divisions of the leaf stalked. In most woods and swamps. Geauga, Lake, Ashtabula, and Wayne counties.

15. *Filix* Adans. Bladder-fern.

Delicate ferns with 2-4-pinnate leaves and slender petioles. Sori roundish on the backs of the free veins; indusium hood-like and attached by a broad base partly beneath the sorus. (*Cystopteris*).

- 1. Leaves broadest at the base, elongated into a tapering point, bearing brood-buds beneath; vascular bundles of the petiole oval or flat.....*F. bulbifera*.
- 1. Leaves scarcely broader at the base, short-pointed, without brood-buds; vascular bundles of the petiole roundish.....*F. fragilis*.

1. *Filix bulbifera* (L.) Und. Bulbiferous Bladder-fern.

Ferns with a short rhizome and elongated leaves lanceolate with a broad base, 2-3-pinnatifid or pinnate, the pinnules crowded. Rachis wingless bearing fleshy brood-buds. On moist rocks, especially limestone. General in the state but no specimens from the northwest.

2. *Filix fragilis* (L.) Und. Fragile Bladder-fern.

Ferns with a short rhizome and thin oblong-lanceolate, 2-3-pinnatifid or pinnate leaves slightly tapering below; pinnae lanceolate-ovate, irregularly pinnatifid. Rachis margined or winged, without brood-buds. On rocks and in moist grassy woods and ravines. General. The variety, *F. fragilis magnasora* (Clute), is reported from Wayne county by Hopkins.

16. *Woodsia* R. Br.

Small or medium-sized ferns with 1-2-pinnate or pinnatifid leaves and round sori, with inferior often evanescent indusia, on the backs of the free veins.

1. *Woodsia obtusa* (Spreng.) Torr. Obtuse Woodsia.

A graceful evergreen fern with a short rhizome and broadly lanceolate, minutely glandular-pubescent leaves without joints in

the petiole. Leaves 6-12 inches long. Indusium distinct splitting into jagged lobes. On rocks. Apparently common in the southern half of the state.

17. **Dennstaédtia** Bernh.

Large beautiful ferns with 2-3-pinnatifid leaves and small, globular, marginal or submarginal sori with membranous, cup-shaped, inferior indusia, which open at the top. Veins free. (*Dicksonia*.)

1. *Dennstaedtia punctilobula* (Mx.) Moore. Boulder Fern.

Rhizome creeping, not chaffy; leaves usually two feet long or more, thin and delicate, minutely glandular and pubescent; petiole pale green, stout, chaffless, and sweet-hay-scented, usually producing "leaf shoots" at its base. Growing under various conditions, especially on open hillsides. In the southern and eastern parts of the state. (Erie Co. Moseley Herb.)

18. **Matteúccia** Todaro.

Large ferns with erect rhizomes and large leaves in a crown. Sporophylls unlike the foliage leaves. Veins free. (*Onoclea*.)

1. *Matteuccia struthiopteris* (L.) Todaro. Ostrich Fern.

Rhizome stout and ascending, bearing a circle of sterile leaves with one or more sporophylls within. Leaves 2-6 feet high, bipinnatifid; sporophylls simply pinnate, the pinnae lobed. In moist thickets, especially along streams. Cuyahoga county. (Erie Co. Moseley Herb.)

19. **Onoclèa** L.

Coarse ferns with slender creeping rhizomes with leaves growing separately. Sporophylls unlike the foliage leaves. Veins forming small areolae.

1. *Onoclea sensibilis* L. Sensitive Fern.

Rhizome slender and rooting; leaves 1-4 feet high, broad, deeply pinnatifid; easily injured by frost; sporophylls bipinnate, persisting over winter, the pinnules unrolling at maturity. Young petioles red. In moist soil. General in Ohio.

Class II. Equisetaceae. Horsetails and Scouring-rushes.

25 species.

Sporophyte perennial, herbaceous, with a rhizome, and with jointed, mostly hollow, simple or branched aerial stems which are either annual or perennial; vascular bundles in a circle; leaves reduced to sheaths around the joints, the sheaths toothed; sporangia borne on small peltate sporophylls arranged in whorls on a terminal cone; eusporangiate; spores with four narrow, strap-like, hygroscopic appendages. Gametophyte a small green thallus, usually unisexual; spermatozoids multiciliate.

Order, *Equisetales*.

Equisetaceae, Horsetail Family.

20. *Equisetum* L. Horsetail. Scouring-rush.

- 1. Aerial stems annual, mostly with numerous branches except in some of the fertile stems; cones rounded not with a point; stomata scattered in the grooves. 2.
- 1. Aerial stems annual or evergreen, mostly unbranched, not tuberculate; cones with or without a point; stomata in a single regular row on each side of the groove, ridges with broad transverse or diagonal wart-like protuberances; sheaths funnel-shaped, constricted at the base.....*E. laevigatum*.
- 1. Aerial stems evergreen, sheaths nearly cylindrical or appressed; cones with a rigid point, stomata in regular rows; simple or sparingly branched. 5.
- 2. Aerial stems of two kinds, the succulent pale and brownish fertile ones sometimes appearing before the green sterile ones. 3.
- 2. Aerial stems, all alike with whorls of simple, usually short, branches; sheaths nearly cylindrical; central cavity four-fifths the diameter.....*E. fluviatile*.

3. Fertile stems soon withering, silex of the sterile stems in dots; branches of the sterile stems simple or compound.....*E. arvense*.
3. Fertile stems branched and becoming green when old, only the apex withering. 4.
4. Branches of the sterile and fertile stems simple; silex of broad spinules on the ridges.....*E. pratense*.
4. Branches compound; silex of the fertile stems in 2 rows of prominent spinules.....*E. sylvaticum*.
5. Stems low and slender, tufted, usually 5-10 grooved, central cavity one-third the diameter of the stem; sheaths 5-10-toothed..
.....*E. variegatum*.
5. Stems tall and rigid, rough and tuberculate, usually many-grooved; central cavity large, sheaths appressed. 6.
6. Ridges of the stem with 2 indistinct lines of tubercles; ridges of the sheath obscurely 4-carinate; stems less robust than in the following.....*E. hyemale*.
6. Ridges with 1 line of tubercles; ridges of the sheath tricarinate; stem very stout.....*E. robustum*.

1. *Equisetum arvense* L. Field Horsetail.

Stems annual, 6 inches to 2 feet high, with scattered stomata, the fertile appearing in early spring before the sterile. Fertile stems not branched, soon withering; sterile stems green, much branched, rather slender. Stomata of the branches in two rows in the furrows. Quite a variable species. In moist soil and on hillsides and railroad embankments. General and abundant in the state.

2. *Equisetum pratense* Ehrh. Thicket Horsetail

Stems annual, 6-18 inches high, with scattered stomata, the fertile appearing in spring before the sterile. Fertile stems branched when old, only the apex withering. In sandy soil. Apparently general in Ohio.

3. *Equisetum sylvaticum* L. Wood Horsetail.

Stems annual with scattered stomata, 1-2 feet high; the fertile appearing in early spring before the sterile, developing whorls of compound branches when old. Silex of the fertile stems in two rows of prominent spinules. In moist, sandy woods. Auglaize and Cuyahoga counties.

4. *Equisetum fluviatile* L. Swamp Horsetail.

Stems all alike, annual, 1-4 feet high, branched, the branches hollow and slender. Rhizome hollow. In swamps and wet places. Not common but to be found in most parts of the state in suitable habitats.

5. *Equisetum laevigatum* A. Br. Smooth Scouring-rush.

Stems annual or perennial, 1-5 feet high, simple or little branched, pale green; sheaths funnel shaped. Stomata in regular rows; ridges with broad transverse or diagonal, wart-like protuberances. Cones pointed or without a point and merely acute. In sandy soil and on clay banks. General but apparently not common in Ohio.

6. *Equisetum variegatum* Schleich. Variegated Scouring-rush.

Stems evergreen, slender, usually simple, 6-18 inches high. Central cavity small, stems 5-10 furrowed, with stomata in regular rows. In sandy places. Lake county. (Erie Co., Moseley herbarium.)

7. *Equisetum hyemale* L. Common Scouring-rush.

Stems slender and stiff, evergreen, 1-4 feet high, sometimes branched, often with water or ice in the central cavity in winter; ridges with two indistinct lines of tubercles, ridges of the sheath obscurely 4-carinate. Cones pointed. In wet places and on banks, especially along streams. General in Ohio.

8. *Equisetum robustum* A. Br. Great Scouring-rush.

Stems very stout, sometimes branched, evergreen, 2-8 feet high, 20-48-furrowed, the ridges with a single series of siliceous tubercles. Ridges of the sheath 3-carinate. Cones pointed. In wet places and on banks. Apparently general in Ohio.

Class III. LYCOPODIEAE. Lycopods. 155 species.

Sporophyte perennial, herbaceous, with or without rhizome, the aerial stems upright or trailing; branching monopodial

or dichotomous; leaves small, without a ligule, scattered on the stem, in two or many ranks; sporangia solitary on the upper surface of the leaves or in their axils, eusporangiate; sporophylls in bands alternating with the sterile leaves or arranged in spirals in terminal cones; spores small, not appendaged. Gametophyte small, sometimes subterranean, with or without chlorophyll, hermaphrodite; spermatozooids biciliate.

Order, *Lycopodiales*.

Lycopodiaceae, Club-moss Family.

21. *Lycopodium* L. Club-moss.

1. Sporangia borne on leaves similar to the foliage leaves, not in terminal cones. 2.
1. Sporangia or specialized, scale-like sporophylls which are arranged in terminal cones. 3.
2. Stems dichotomously branched only at the base, the branches long; leaves nearly linear and entire, rather short and rigid, but not uniformly ascending.....*L. porophyllum*.
2. Stems branched successively; leaves larger, widely spreading or reflexed, minutely toothed, and usually widest above the middle.*L. lucidulum*.
3. Leaves many-ranked on the cylindrical stem, not spreading into two ranks. 4.
3. Smaller branches flattened, or the leaves spreading into two ranks; stems with erect or ascending tree-like branches. 5.
4. Cones usually single, sporophylls much like the foliage leaves.*L. inundatum*.
4. Cones usually in twos or long peduncles, sporophylls very unlike the foliage leaves.....*L. clavatum*.
5. Sterile stems with linear-lanceolate spreading leaves; cones erect, closely sessile.....*L. obscurum*.
5. Sterile stems flattened, with fan-like ascending clusters of branches, .. leaves of two forms; cones clustered on long peduncles....
.....*L. complanatum*.

1. *Lycopodium porophyllum* Lloyd & Und. Rock Club-moss.

Stem dichotomously branched only near the base, the prostrate portion rooting freely; sporophylls in zones alternating with the sterile leaves; sterile leaves broadest at the base but

very gradually tapering, entire or minutely denticulate; sporophylls minutely denticulate above the middle or entire, acuminate, only very slightly broadened above the middle. Plants evergreen, commonly with brood-buds. On sandstone rocks. Licking, Fairfield, Hocking, and Portage counties.

2. *Lycopodium lucidulum* Mx. Shining Club-moss.

Stems lax and successively, dichotomously branched, ascending or spreading, the plants evergreen, about six to twelve inches long; leaves dark green, shining, widest above the middle; sporophylls alternating with zones of sterile leaves. Plants commonly bearing brood-buds. On sandstone rocks and in cool, damp woods. General in the eastern half of the state.

3. *Lycopodium inundatum* L. Bog Club-moss.

Stems long, creeping, flaccid, forking, and brittle, closely appressed to the earth; fertile stems erect, solitary, slender, terminating in short cones; leaves lanceolate or lanceolate-subulate, with hyaline margins. In sandy bogs. Portage county. (Hopkins).

4. *Lycopodium obscurum* L. Tree Club-moss.

Stems erect, bushy, with fan-like branches, six to twelve inches high, from a slender subterranean, horizontal rhizome; leaves lanceolate-linear, entire, eight-ranked on the main stem; cones, one to ten on each plant, sessile. Plants evergreen. In moist woods. Ashtabula, Lake, Medina, Licking, Fairfield, and Defiance counties.

5. *Lycopodium clavatum* L. Common Club-moss.

Stems creeping with similar short irregular ascending or decumbent densely leafy branches; leaves evergreen, linear-subulate, incurved, bristle-tipped; cones one to four on long peduncles. In rich woods. Geauga county. (Stark county, Hopkins).

6. *Lycopodium complanatum* L. Trailing Club-moss.

Stems creeping extensively, with erect or ascending, fan-shaped, evergreen branches; leaves minute, appressed, four-ranked, the lateral rows with somewhat spreading tips; peduncle slender, dichotomous, with two to four cones. In woods. Cuyahoga, Carroll, Geauga, Licking, Fairfield, Hocking, and Lake counties. (Erie county, Moseley Herb; Wayne county, Hopkins.)

SUBKINGDOM, PTERIDOPHYTA HETEROSPORAE.

Heterosporous Pteridophytes. 700 living species.

Plants in which the sporophyte in the living species is herbaceous and after a brief embryonic stage has an independent existence with true fibro-vascular tissue, roots, and leaves; heterosporous, with microspores and megaspores which give rise to greatly reduced male and female gametophytes respectively; eusporangiate or leptosporangiate. Gametophytes always unisexual, with little or no chlorophyll, living on food stored in the spore and developing entirely inside of the spore wall or protruding only slightly through the side, the nonsexual spores often germinating before being discharged.

Class IV. HYDROPTERIDES. Water-ferns. About 75 living species.

Sporophyte with a horizontal rhizome or floating on the surface of the water; leaves alternate or whorled; microsporangia and megasporangia borne together enclosed in sporocarps, leptosporangiate. Gametophytes developing entirely within the spore walls or protruding only slightly, very short lived; spermatozoids large, spirally coiled, multiciliate.

- I. Floating plants with minute leaves spreading into two ranks and with rootlets on the under side. *Azolla* (SALVINIALES.)
- I. Leaves four-foliate with slender petioles.....
..... *Marsilea* (MARSILEALES.)

Order, *Salviniàles*.

Small floating plants with small leaves with globose sporocarps containing the megasporangia and microsporangia.

Salviniàceae. *Salvinia* Family.

Besides the native species below *Salvinia natans* (L.) Hoffm. is often kept in green houses and conservatories.

22. **Azólla** Lam.

1. *Azolla caroliniana* Willd. Carolina Azolla.

Small greenish or reddish plants, deltoid or triangular-ovate in outline, pinnately branching, and free-floating, with minute two-lobed, imbricated leaves and delicate rootlets. Sporocarps of two kinds, the smaller ovoid containing a single megaspore, the larger globose, producing many stalked microsporangia, which contain several peculiar spore-containing masses beset with arrow-like processes. Sometimes covering large surfaces of water. Hamilton, Lucas, and Lake counties.

Order, *Marsileàles*.

Herbaceous perennials with slender creeping rhizomes and four-foliolate or filiform leaves. Sporocarps borne on the petioles, containing both megasporangia and microsporangia.

Marsileàceae. *Marsilea* Family.

Water-ferns with four-foliolate leaves on slender petioles; leaflets turning with the light.

23. **Marsi'lea** L.

1. *Marsilea quadrifolia* L. European Marsilea.

Occasionally cultivated and found as a waif in Franklin county.

Class V. ISOETEAÆ. Quillworts. 60 species.

Sporophyte with a short tuberous stem with a peculiar type of secondary thickening and with long, erect, grass-like leaves which have a ligule; roots dichotomous; microsporangia and megasporangia large, borne singly, sunken in the expanded bases of the leaves, eusporangiate. Gametophytes very much reduced; spermatozoids spirally coiled, multiciliate.

Order, *Isoëtàles*.

Isoëtàcææ. Quillwort Family.

24. **Isòetes** L.

Aquatic or marsh plants rooting in the mud, with a short 2-lobed or 3-lobed stem. One species of Quillwort might possibly be found in Ohio.

Class VI. SELAGINELLEAE. Selaginellas. 500 species.

Sporophyte dorsiventral or erect, with monopodial or apparently dichotomous branching and dichotomous roots; leaves small, opposite or spirally arranged, ligulate; cells often with a single chloroplast; sporophylls in bisporangiate cones, the eusporangiate microscorangia and megasporangia single in the axils of the sporophylls. Gametophytes small and short-lived; spermatozoids very minute, biciliate.

Order, *Selaginellàles*.

Selaginellàcææ. Selaginella Family

25. **Selaginélla** Beauv.

Terrestrial annual or perennial plants with branching stems and scale-like leaves, either 4-ranked or many-ranked.

1. Leaves all alike and uniformly imbricated and many-ranked, the stem much branched in close tufts.....*S. rupestris*.
1. Leaves 4-ranked, shorter above and below, stipule-like, the lateral ones spreading into two planes; plants small and delicate...*S. apus*.

1. *Selaginella rupéstris* (L.) Spring. Rock Selaginella.

Low, evergreen, tufted plants with occasional sterile runners and subpinnate branches, commonly curved when dry. Leaves rigid, appressed-imbricated, linear or linear-lanceolate, convex on the back, tipped with a distinct transparent point; cones sessile at the ends of the branches, strongly quadrangular. On dry rocks and sandy ground. Licking, Fairfield, and Hocking counties.

2. *Selaginella àpus* (L.) Spring. Creeping Selaginella.

Annual, light green, delicate plants with creeping, much-branched flaccid stems, angled on the face. Leaves minute, 4-ranked, membranous, of two kinds, spreading into two planes; cones obscurely quadrangular. In moist, shady places. Lake and Trumbull counties.

GLOSSARY.

- Acuminate — Tapering gradually to the apex.
Acute — Sharp-pointed.
Anastomosing — Connecting so as to form a network.
Annual — Living but one year; yearly.
Annulus — The ring of cells partly or completely surrounding the sporangium.
Antheridium — The male organ of reproduction; a spermary.
Asiphonogamic — Not with a pollentube but having the spermatozoids discharged from the antheridium.
Archegonium — A female organ of reproduction; a special kind of ovary.
Areola — A space enclosed by anastomosing veinlets.
Areolate — Mapped off into small areas, or areolae.
Ascending — Growing obliquely upward.
Auricled — With ear-like lobes or appendages.
- Bipinnate — Twice pinnate.
Bipinnatifid — Twice pinnatifid.
Bisporangiate — Having both microsporangia and megasporangia
- Cambium — The cylinder of growing cells in some stems.
Carinate — With a keel or longitudinal ridge.
Caudate — Tailed; pointed like a tail.
Cell — The unit of plant and animal structure; usually consisting of a small mass of protoplasm containing a nucleus and with a cell wall.
Chlorophyll — The green coloring matter of plants.
Chloroplasts — The minute green, chlorophyll-bearing color bodies in the cell of a plant.
Ciliate — Provided with marginal hairs; having cilia.
Circinate — Rolled inward from the apex.
Clavate — Club-shaped.

Compound — Composed of several parts or divisions.

Cone — A primitive flower; a specialized branch of sporophylls whose apical growth has ceased.

Cordate — Heart-shaped.

Coriaceous — Leathery.

Crenate — With rounded teeth.

Crenulate — Minutely crenate.

Cuneate — Wedge-shaped.

Decomound — More than once compound.

Decurrent — Applied to an organ extending along the sides of another.

Deltoid — Broadly triangular.

Dentate — With outwardly projecting teeth.

Denticulate — Finely toothed.

Dichotomous — Two-forked.

Divided — Cleft to the base or to the midrib.

Emarginate — With a notched apex.

Entire — Without teeth, or serrations.

Epidermis — The external layer of cells of a plant.

Eusporangiate — Having the sporangia developed from sub-epidermal cells.

Falcate — Scythe-shaped.

Fertile — Bearing spores, gametes, or seeds.

Fibro-vascular — Containing fibers, vessels, and tubular cells.

Filiform — Thread-like.

Flaccid — Soft and weak.

Fronde — Sometimes wrongly applied to the leaves of ferns.

Fruiting — Bearing spores, seed or fruit.

Gamete — A sexual cell.

Gametophyte — The sexual generation of plants.

Glabrous — Without hairs.

Gland — A secreting hair, or group of secreting cells.

Glaucous — Covered with a bluish or white bloom.

Habit — General aspect.

Habitat — The place where a plant grows.

Halberd-shaped — Same as hastate.

Hastate — Arrow-shaped with the basal lobes diverging.

Herbaceous — Having the texture of common leaves.

Hermaphrodite — An individual having both male and female sexual organs.

Heterosporous — Having microspores and megaspores.

Homosporous — Having only one kind of spores on the sporophyte.

Hyaline — Clear and translucent.

Hygroscopic — Readily absorbing and giving off water, by which means movements are produced.

Imbricate — Overlapping.

Incised — Cut into sharp lobes.

Indusium — The membranous covering of the sori in many species of ferns.

Inequilateral — With unequal sides.

Inferior — Situated or arising below other organs.

Laciniate — Cut into narrow segments or lobes.

Lamina — The blade of a leaf.

Lanceolate — Lance-shaped.

Leaflet — One of the divisions of a compound leaf.

Ligulate — Provided with or resembling a ligule.

Ligule — A strap-shaped organ, sometimes minute.

Linear — A long and narrow organ with the sides nearly parallel.

Lobed — Divided to about the middle or less.

Lunate — Crescent-shaped.

Megaspore — The larger of the two kinds of nonsexual spores produced by heterosporous plants.

Megasporangium — A sporangium which produces megaspores.

Membranous — Thin and rather soft and pliable.

Microspore — The smaller of the two kinds of nonsexual spores produced by heterosporous plants.

Microsporangium — A sporangium which produces microspores.

Midrib — The central rib of a leaf or other organ.

Mucronate — With a sharp, abrupt point.

Nectary — A nectar-secreting organ.

Node — The place where two internodes join, normally with one or more leaves.

Oblong — Somewhat longer than broad, with the sides nearly parallel.

Obovate — Inversely ovate.

Oosphere — The unfertilized egg; the female gamete.

Oospore — The fertilized egg.

Orbicular — Nearly circular in outline.

Ovary — The female organ of reproduction.

Ovate — Shaped like the longitudinal section of a hen's egg.

Palmate — Diverging like the fingers of a hand.

Panicle — An open cluster, consisting of more or less branching stems bearing fruit.

Peltate — Shield-shaped.

Perennial — Growing for many years.

Petiole — The stalk of a leaf.

Pilose — With long, soft hairs.

Pinna — The primary division of a pinnately compound leaf.

Pinnate — Leaves divided into leaflets or segments along a common axis.

Pinnatifid — Pinnately cleft to the middle and beyond.

Pinnule — A division of a pinna in a compound leaf.

Prothallium — Sometimes applied to the thalloid gametophytes of the Pteridophytes.

Pubescent — Hairy, especially with fine, soft hairs.

- Rachis — The axis of a compound leaf, spike or raceme.
Receptacle — The part to which the sporangia are attached.
Reniform — Kidney-shaped.
Reticulate — Arranged as a network.
Revolute — Rolled backward.
Rhizoid — The filamentous, root-like outgrowths from the thallus of the gametophyte.
Rhizome — An underground stem.
Rootstock — Same as rhizome.
- Sagittate — Shaped like an arrow-head.
Sclerenchyma — Bundles of thick walled fibers, in ferns usually brown or black.
Segment — One of the divisions of a pinnatifid or compound leaf.
Serrate — With teeth projecting forward.
Sessile — Without a stalk.
Silex — The silicious coating in the Equisetums.
Sinuate — With strongly wavy margins.
Sinus — The split or space between two lobes.
Sorus — A cluster of sporangia in the ferns.
Spatulate — Widened at the top like a spatula.
Spermatozoid — The male gamete.
Spinulose — With small, sharp spines.
Sporangiophore — A leaf or other organ bearing sporangia.
Sporangium — A spore-producing organ.
Spore — A modified reproductive cell.
Sporocarp — A carpel-like spore-bearing organ.
Sporophyll — A spore-bearing leaf.
Sporophyte — The nonsexual generation of plants.
Stellate — Star-shaped.
Sterile — Not producing spores or seeds.
Stipe — Sometimes used for the petiole of a fern leaf.
Stoma — The transpiring pores in the epidermis of the higher plants. (Plural, Stomata.)
Subcoriaceous — Somewhat coriaceous.
Subulate — Awl-shaped.

Succulent — Soft and juicy.

Superior — Above.

Ternate — Divided into three segments; arranged in threes.

Thalloid — Having the form of a typical thallus.

Thallus — The plant body of a thallophyte, or of the gametophyte of the Archegoniates.

Tomentose — Covered with dense wool-like hairs.

Truncate — Terminating abruptly by a nearly straight edge or surface.

Undulate — With wavy margins.

Unisexual — Having only ovaries or spermaries on one individual.

Vascular bundle — The conducting strands in the plant body composed of wood and bast.

Venation — The arrangement of the veins.

Vernation — The arrangement of the leaves in the bud.

Villous — With long, soft hairs not matted together.

I N D E X.

	PAGE		PAGE
Adder-tongue	276	Lycopodium	293
Adiantum	280	Maidenhair Fern	280
Aspidium	285	Marsilea	296
Asplenium	281	Matteuccia	289
Athyrium	283	Moonwort	277
Azolla	296	Oak-fern	287
Beech-fern	287	Ovoclea	289
Bladder-fern	288	Ophioglossum	276
Botrychium	276	Osmunda	278
Boulder Fern	289	Ostrich Fern	289
Bracken	280	Pellaea	281
Camptosorus	284	Phegopteris	287
Chain-fern	281	Polypodium	279
Christmas Fern	284	Polypody	279
Cinnamon Fern	279	Polystichum	284
Clayton's Fern	279	Pteridium	280
Cliff-brake	281	Pteris	280
Club-moss	293	Quillwort	297
Cystopteris	288	Royal Fern	279
Dennstaedtia	289	Salvinia	296
Dicksonia	289	Scouring-rush	290
Dryopteris	285	Selaginella	297
Eagle-fern	280	Sensitive Fern	290
Equisetum	290	Shield-fern	285
Filix	288	Spleenwort	281
Grape-fern	276	Walking-fern	284
Horsetail	290	Water-fern	295
Isoetes	297	Woodsia	288
Lady-fern	284	Woodwardia	281



PROCEEDINGS OF THE OHIO STATE ACADEMY OF SCIENCE.
Volume V, Part 7, Special Paper No. 17.

THE FAUNA OF THE MAXVILLE LIMESTONE

BY

WILLIAM CLIFFORD MORSE

OHIO STATE UNIVERSITY

PUBLISHED BY THE ACADEMY
COLUMBUS, OHIO
1911





PROCEEDINGS OF THE OHIO STATE ACADEMY OF SCIENCE.
Volume V, Part 7, Special Paper No. 17.

THE FAUNA OF THE
MAXVILLE LIMESTONE

BY

WILLIAM CLIFFORD MORSE

OHIO STATE UNIVERSITY

PUBLISHED BY THE ACADEMY
COLUMBUS, OHIO
1911



The expense of the publication of this paper is covered by a grant from the Emerson McMillin Research Fund.

WILLIAM R. LAZENBY,
E. L. RICE,
FRANK CARNEY,

Trustees.

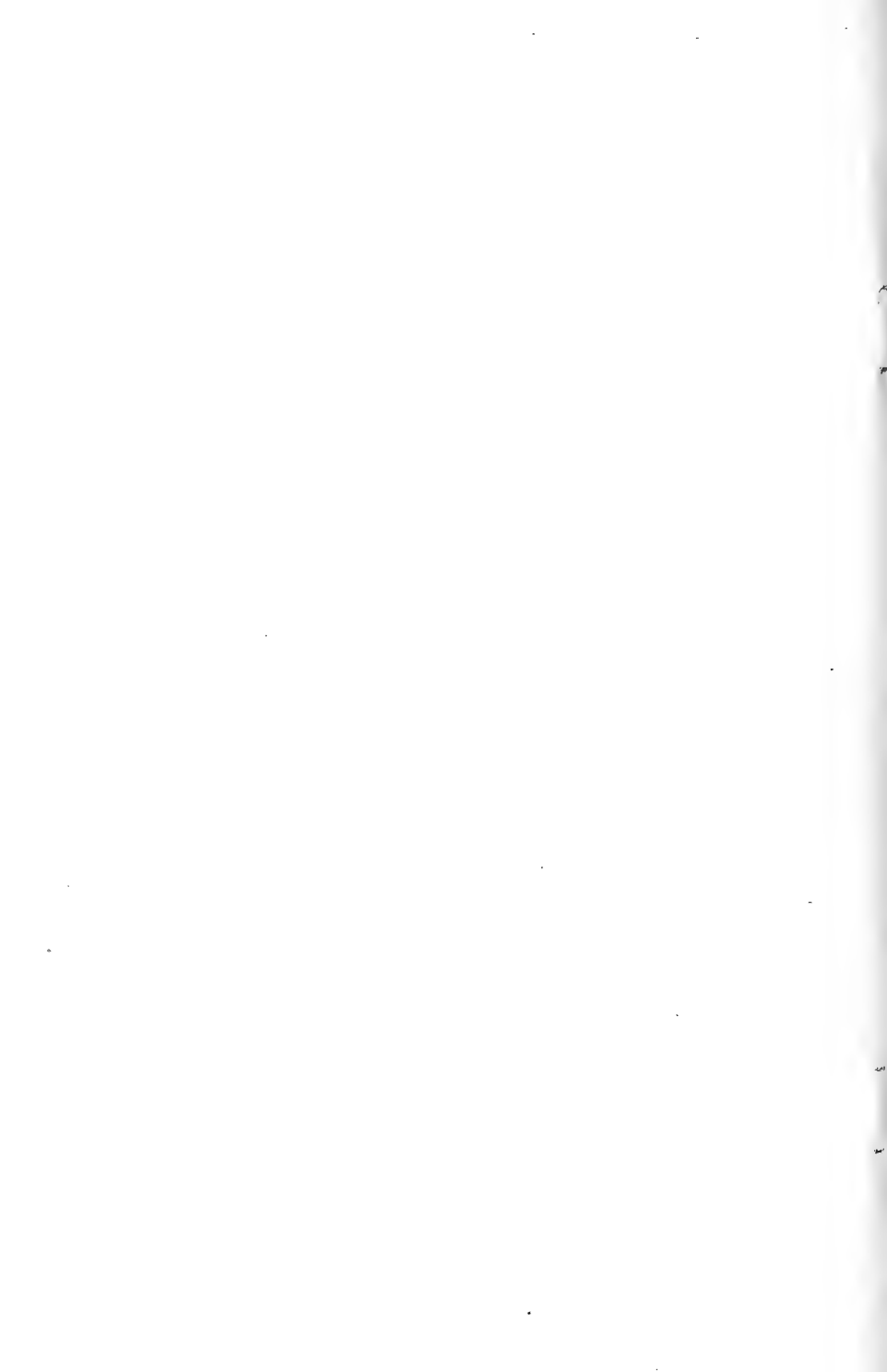
Publication Committee:

J. C. HAMBLETON,

E. L. RICE,

BRUCE FINK.

Date of publication, June 15, 1911.



CONTENTS.

	PAGE
Introduction	357
Description of species.....	359
Phylum Cœlenterata	359
Class Anthozoa	359
Phylum Echinodermata	360
Class Blastoidea	360
Class Crinoidea	361
Phylum Molluscoidea	363
Class Bryozoa	363
Class Brachiopoda	366
Phylum Mollusca	390
Class Pelecypoda	390
Class Scaphopoda	395
Class Gastropoda	396
Class Cephalopoda	410

ILLUSTRATIONS.

Figures 1-36	359-416
--------------------	---------



THE
FAUNA OF THE MAXVILLE LIMESTONE.

WILLIAM CLIFFORD MORSE,
Ohio State University.

INTRODUCTION.

The present paper represents the final results of a study of the Maxville limestone begun in 1906, the historic, stratigraphic, and economic portions of which are soon to appear as Bulletin 13 of the Geological Survey of Ohio. In that publication it was shown that the region of outcrop of the limestone is naturally divisible into three parts, a Northern Area, a Central Area, and a Southern Area, and that in the stratum itself, in many places, may be recognized three divisions, a lower zone, a middle (shale-nodular) zone, and an upper zone. The Northern Area extends from a point near Zanesville on the north to one near Logan on the south, and contains the best exposures of the limestone. The Southern Area reaches from Hamden on the north to the Kentucky side of the Ohio River on the south, and has but a few widely separated exposures. The Central Area lies between the other two and so far as known contains no exposures. The limestone of the lower zone is an impure one, nearly destitute of regular bedding planes, poor in fossils, and about twenty-five feet in thickness. The middle zone is about three feet thick, and consists of alternating nodular-like layers of limestone and thin intervals of shale, both of which are fossiliferous. In the upper zone, the maximum thickness of which is twenty-two feet, the fossils are common, the limestone purer, and the medium layers are separated by shaly partings in such a manner that the stratification is the conspicuous feature.

Twenty-four species of fossils from the Maxville limestone have been described and illustrated by Whitfield. The present study has resulted in the discovery of twelve additional species which are new to the stratum. Pursuant to the original idea of making the report as complete as possible, these thirty-six species are described and illustrated in the following pages, and with the exception of those after Whitfield the illustrations are either camera lucida drawings or actual photographs by the author.

The bibliography of each species has been made as complete as possible simply for convenience, and in questions of synonymy the arrangement in Weller's Bibliographic Index of North American Carboniferous Invertebrates has been followed. The horizon and locality from which the described specimens came have also been added to the bibliography so that a glance would suffice to show both their geologic range and geographic distribution.

Although sections have been made at practically all of the places mentioned in the following "Table of Distribution" and each one carefully located in Bulletin 13, it will probably be more convenient for some readers if the location of each be again briefly described. With the exception of the Harper Shaft, which is near Olive Furnace in the Southern Area, all of the localities are in the Northern Area. Of those along Jonathan Creek, the Bridge Gully, Cuts No. 2 to No. 6, and the Mouth of Hough Hollow are between Mt. Perry and Fultonham, the Mouth of Buckeye Fork and the North Bank are just below Fultonham, and Gladstone Mill is at White Cottage. The Kroft Residence, the Kroft Bridge, and the Thompson Residence are located along the lower portion of Kents Run within a mile of White Cottage. West Jockey Hollow crosses the "State Road" at a point about three and a half miles east of Rushville and the Folk Quarry is located on the Zanesville and Maysville Pike a like distance east of the same village. The Stimmel Residence is about a mile north of Maxville and Smith Chapel about two miles south-east of Logan.

1910
1911
1912
1913
1914
1915
1916
1917
1918
1919
1920
1921
1922
1923
1924
1925
1926
1927
1928
1929
1930
1931
1932
1933
1934
1935
1936
1937
1938
1939
1940
1941
1942
1943
1944
1945
1946
1947
1948
1949
1950
1951
1952
1953
1954
1955
1956
1957
1958
1959
1960
1961
1962
1963
1964
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025

1910
1911
1912
1913
1914
1915
1916
1917
1918
1919
1920
1921
1922
1923
1924
1925
1926
1927
1928
1929
1930
1931
1932
1933
1934
1935
1936
1937
1938
1939
1940
1941
1942
1943
1944
1945
1946
1947
1948
1949
1950
1951
1952
1953
1954
1955
1956
1957
1958
1959
1960
1961
1962
1963
1964
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025

Distribution.

Shale-Nodular Zone.		Lower Zone							
Jonathan Creek.	Kents Run.	Rush Creek.	Little Mon-Day Creek.	Three Mile Run.	Jonathan Creek.	Kents Run.	Rush Creek.	Little Mon-Day Creek.	Three Mile Run.
Cut No. 6. Middle.				Smith Chapel.	Jonathan Creek.	Kents Run.	Rush Creek.	Little Mon-Day Creek.	Three Mile Run.
Mouth of Hough Hollow.				Stimmel Residence.	Jonathan Creek.	Kents Run.	Rush Creek.	Little Mon-Day Creek.	Three Mile Run.
Mouth of Buckeye Fork.				Folk Quarry.	Jonathan Creek.	Kents Run.	Rush Creek.	Little Mon-Day Creek.	Three Mile Run.
North Bank.				West Jockey Hollow.	Jonathan Creek.	Kents Run.	Rush Creek.	Little Mon-Day Creek.	Three Mile Run.
Glad-stone Mills.				Folk Quarry.	Jonathan Creek.	Kents Run.	Rush Creek.	Little Mon-Day Creek.	Three Mile Run.
Kroft Residence.				Stimmel Residence.	Jonathan Creek.	Kents Run.	Rush Creek.	Little Mon-Day Creek.	Three Mile Run.
Kroft Bridge.				Folk Quarry.	Jonathan Creek.	Kents Run.	Rush Creek.	Little Mon-Day Creek.	Three Mile Run.
Thompson Residence.				West Jockey Hollow.	Jonathan Creek.	Kents Run.	Rush Creek.	Little Mon-Day Creek.	Three Mile Run.
Below Thompson Residence.				Folk Quarry.	Jonathan Creek.	Kents Run.	Rush Creek.	Little Mon-Day Creek.	Three Mile Run.
				Stimmel Residence.	Jonathan Creek.	Kents Run.	Rush Creek.	Little Mon-Day Creek.	Three Mile Run.
				Smith Chapel.	Jonathan Creek.	Kents Run.	Rush Creek.	Little Mon-Day Creek.	Three Mile Run.
				Bridge Gully.	Jonathan Creek.	Kents Run.	Rush Creek.	Little Mon-Day Creek.	Three Mile Run.
				Cut No. 2.	Jonathan Creek.	Kents Run.	Rush Creek.	Little Mon-Day Creek.	Three Mile Run.
				Cut No. 3.	Jonathan Creek.	Kents Run.	Rush Creek.	Little Mon-Day Creek.	Three Mile Run.
				Cut No. 4.	Jonathan Creek.	Kents Run.	Rush Creek.	Little Mon-Day Creek.	Three Mile Run.
				Cut No. 5.	Jonathan Creek.	Kents Run.	Rush Creek.	Little Mon-Day Creek.	Three Mile Run.
				Cut No. 6. Upper end.	Jonathan Creek.	Kents Run.	Rush Creek.	Little Mon-Day Creek.	Three Mile Run.
				Cut No. 6. Middle.	Jonathan Creek.	Kents Run.	Rush Creek.	Little Mon-Day Creek.	Three Mile Run.
				Mouth of Hough Hollow.	Jonathan Creek.	Kents Run.	Rush Creek.	Little Mon-Day Creek.	Three Mile Run.
				Mouth of Buckeye Fork.	Jonathan Creek.	Kents Run.	Rush Creek.	Little Mon-Day Creek.	Three Mile Run.
				North Bank.	Jonathan Creek.	Kents Run.	Rush Creek.	Little Mon-Day Creek.	Three Mile Run.
				Glad-stone Mills.	Jonathan Creek.	Kents Run.	Rush Creek.	Little Mon-Day Creek.	Three Mile Run.
				Kroft Residence.	Jonathan Creek.	Kents Run.	Rush Creek.	Little Mon-Day Creek.	Three Mile Run.
				Kroft Bridge.	Jonathan Creek.	Kents Run.	Rush Creek.	Little Mon-Day Creek.	Three Mile Run.
				Thompson Residence.	Jonathan Creek.	Kents Run.	Rush Creek.	Little Mon-Day Creek.	Three Mile Run.
				Below Thompson Residence.	Jonathan Creek.	Kents Run.	Rush Creek.	Little Mon-Day Creek.	Three Mile Run.
				West Jockey Hollow.	Jonathan Creek.	Kents Run.	Rush Creek.	Little Mon-Day Creek.	Three Mile Run.
				Folk Quarry.	Jonathan Creek.	Kents Run.	Rush Creek.	Little Mon-Day Creek.	Three Mile Run.
				Stimmel Residence.	Jonathan Creek.	Kents Run.	Rush Creek.	Little Mon-Day Creek.	Three Mile Run.
				Smith Chapel.	Jonathan Creek.	Kents Run.	Rush Creek.	Little Mon-Day Creek.	Three Mile Run.
				Cut No. 6 (Middle of Lower and Shale-nodular zones).	Jonathan Creek.	Kents Run.	Rush Creek.	Little Mon-Day Creek.	Three Mile Run.
				Harper Shaft.	Jonathan Creek.	Kents Run.	Rush Creek.	Little Mon-Day Creek.	Three Mile Run.

Table of Distribution.

Species.	Upper Zone.						Shale-Nodular Zone.						Lower Zone						
	Jonathan Creek.		Kents Run.	Rush Creek.	Little Mon-day Creek.	Three Mile Run.	Jonathan Creek.		Kents Run.	Rush Creek.	Little Mon-Day Creek.	Three Mile Run.	Jonathan Creek.		Kents Run.	Rush Creek.	Little Mon-Day Creek.	Three Mile Run.	
	Bridge Gully.	Cut No. 2.	Cut No. 3.	Cut No. 4.	Cut No. 5.	Cut No. 6. Upper end.	Cut No. 6. Middle.	Mouth of Hough Hollow.	Mouth of Buckeye Fork.	North Bank.	Gladstone Mills.	Kroft Residence.	Kroft Bridge.	Thompson Residence.	Below Thompson Residence.	West Jockey Hollow.	Folk Quarry.	Stimmel Residence.	Smith Chapel.
1. Zaphrentis cliffordana.....																			
2. Pentremites elegans.....																			
3. Cyathocrinus maxvillensis.....																			
4. Septopora rectistyla.....																			
5. Penestella serratula.....																			
6. Rhombopora armata.....																			
7. Derbya crassa.....																			
8. Productus pileiformis.....																			
9. Productus cestransis.....																			
10. Martinia contracta.....																			
11. Spirifer keokuk.....																			
12. Dielasma turgida.....																			
13. Seminula subquadrata.....																			
14. Eumetria marcyi.....																			
15. Cleiothyris hirsuta.....																			
16. Schizodus chesterensis.....																			
17. Pinna maxvillensis.....																			
18. Allorisma andrewsi.....																			
19. Allorisma maxvillensis.....																			
20. Cypricardella oblonga.....																			
21. Dentalium illinoense.....																			
22. Straparollus similis.....																			
23. Holopea newtonensis.....																			
24. Bulimorphia melanoidea.....																			
25. Bulimorphia canaliculata.....																			
26. Spherodoma subcorpulenta.....																			
27. Naticopsis ziczac.....																			
28. Bellerophon alternodosus.....																			
29. Bellerophon sublavus.....																			
30. Orthonychia acutirostre.....																			
31. Strophostylus carleyana.....																			
32. Murchisonia vermicula.....																			
33. Endolobus spectabilis.....																			
34. Nautilus pauper.....																			
35. Orthoceras randolphense.....																			
36. Orthoceras okawense?.....																			

Cut No. 6 (Middle of Lower and Shale-nodular zones.)
Harper Shaft.

1.
2.
3.
4.
5.
6.
7.
8.
9.
0.
1.
2.
3.
4.
5.
6.
7.
8.
9.
0.
1.
2.
3.
4.
5.
6.

DESCRIPTION OF SPECIES.

PHYLUM CŒLEENTERATA.

CLASS ANTHOZOA.

ZAPHRENTIS CLIFFORDANA—Milne-Edwards and Haime.

1851. *Zaphrentis cliffordana*. Milne-Edwards and Haime, Monog. des Polyp. Foss., p. 329, pl. 3, fig. 5.
Carboniferous: Buttonmould Knobs, Mammoth Cave, and Grayson County, Kentucky.
1860. *Zaphrentis cliffordana*. Milne-Edwards, Hist. Nat. Corr., Vol. III, p. 337.
Carboniferous: Kentucky.
1890. *Zaphrentis cliffordana*. Worthen, Geol. Surv. Ill., Vol. VIII, p. 75, pl. 10, figs. 1, 1a, 1b.
Kinderhook group: Monroe County, Illinois.
1891. *Zaphrentis cliffordana*. Whitfield, Ann. N. Y. Acad. Sci., Vol. V, p. 576, pl. 13, figs. 1-3.
Maxville limestone: Maxville and Newtonville, Ohio.
1895. *Zaphrentis cliffordana*. Whitfield, Geol. Surv. Ohio, Vol. VII, p. 465, pl. 9, figs. 1-3.
Maxville limestone: Maxville and Newtonville, Ohio
1909. *Zaphrentis cliffordana*. Grabau and Shimer, N. A. Index Foss., p. 58.
Lower Carbonic.

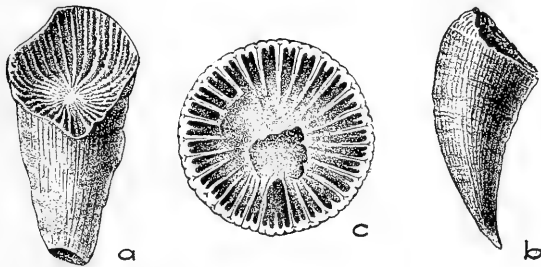


FIG. 1.—*Zaphrentis cliffordana*.
a.—View of a specimen showing the interior of the calyx.
b.—Lateral view of another specimen showing the curvature of the cone.
c.—Transverse section of a specimen just beneath the calyx, enlarged. (After Whitfield.)

Description.—Corallum a small, curved, tapering cone with a deep calyx. Epitheca thin, and generally shows the edges of the septa. Primary septa thirty to thirty-six in number, and of nearly equal strength. Secondary septa rudimentary, equal in number to the primary. Fossula on the side of least curvature. Dissepiments not so distinctly developed as the primary septa.

Length 17 to 33 mm. Greatest diameter 15 mm.

This coral is characterized by its small size, curved cone, thin epitheca, which exposes the septa, and in cross section by the equal development of the primary septa.

Horizon and locality.—Maxville limestone.

Upper zone: Mouth of Buckeye Fork, Fultonham; Gladstone Mills, White Cottage.

Lower zone: Bridge Gully, Cut No. 3, Mt. Perry-Fultonham.

PHYLUM ECHINODERMATA.

CLASS BLASTOIDEA.

PENTREMITES ELEGANS—Lyon.

1858. *Pentremites elegans*. Lyon, Trans. St. Louis Acad. Sci., Vol. I, p. 632, pl. 20, figs. 4a-c.
Millstone grit: Near Grayson Springs and Litchfield, Kentucky.
1891. *Pentremites elegans*. Whitfield, Ann. N. Y. Acad. Sci., Vol. V, p. 577, pl. 13, fig. 4.
Maxville limestone: Newtonville, Ohio.
1895. *Pentremites elegans*. Whitfield, Geol. Surv. Ohio, Vol. VII, p. 466, pl. 9, fig. 4.
Maxville limestone: Newtonville, Ohio.
1909. *Pentremites elegans*. Wood, U. S. Nat. Mus., Bull. 64, p. 14, pl. 2, figs. 10-12.

Description.—“Body small, broadly subpyriform, the length equal to about once and a half the height, but somewhat variable with age; the greatest width being at the base of the ambulacral areas, or considerable below the middle of the height, the outline of the lower portion being nearly straight lines, or a little concave between the base of the ambulacral areas and the lower extremities of the basal plates, while above the form is

generally rounding or convex. In a basal view the form is pentangular, and viewed from above somewhat pentalobate; the ambulacral areas being slightly sulcated. Basal plates small, extending to rather less than half the height of the body below the base of the areas, and in their lower half are somewhat more attenuate than above, the cicatrix for the attachment of the column being very small. Forked plates elongated, and the sinus very broad and deep; the length of the plates being equal to more than once and a half their greatest width, and their summits slightly truncated for the reception of the small pointed inter-



FIG. 2. — *Pentremites elegans*. Lateral view. (After Whitfield.)

ambulacral plates, which are in length about equal to one-fourth of the entire length of the areas. Ambulacral areas proportionally wide, distinctly depressed along their middle and composed, in the specimen figured, of about twenty-six pairs of transverse poral-plates, from ten to eleven of which occupy the space of an eighth of an inch in length, in the lower and middle portions, but become shorter above. Summit openings rather large, surface smooth [Whitfield, 1893].”

Horizon and locality. — Maxville limestone.
Upper zone: Mouth of Buckeye Fork, Fultonham.

CLASS CRINOIDEA.

CYATHOCRINUS MAXVILLENSIS—Whitfield.

1882. *Cyathocrinus inequidactylus*. Whitfield, Ann. N. Y. Acad. Sci., Vol. II, p. 219, (Not *C. inequidactylus* McCoy, 1844).
Maxville limestone: Newtonville, Ohio.
1891. *Cyathocrinus maxvillensis*. Whitfield, Ann. N. Y. Acad. Sci., Vol. V, p. 577, pl. 13, figs. 5-8.
Maxville limestone: Newtonville, Ohio.

1895. *Cyathocrinus Maxvillensis*. Whitfield, Geol. Surv. Ohio, Vol. VII, p. 465, pl. 9, figs. 5-8.

Maxville limestone: Newtonville, Ohio.

Description.—“Body of rather small size. Calyx deep cyathiform, being nearly hemispherical in one example, and somewhat broad abconical in another, and composed of smooth plates, which have only the general convexity of the body, or very slightly tuberose. Basal plates minute to moderate size, higher than wide. Subradials large; height and width nearly equal; two of them heptagonal and the others hexagonal, the lower sides barely diverging from a straight line. First radials wider than high, and about two-thirds as high as the subradials.

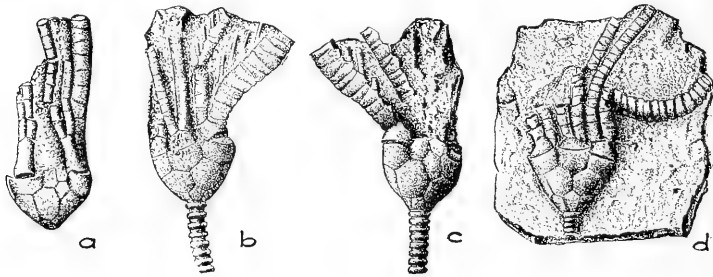


FIG. 3.—*Cyathocrinus maxvillensis*.

- a.—View of the anal side of a specimen showing the long second radials, enlarged to two diameters.
- b and c.—Anterior and posterior views of another specimen showing the large outer arm.
- d.—Anterior view of a third specimen. (After Whitfield.)

Anal's visible, three in number; the first elongate pentagonal, nearly twice as high as wide, and situated a little obliquely on the right side of the area; the other two are small and pentagonal. Second radials, or first arm plates, smaller than the first radials and narrowing upward, wedge-formed above, and each supporting two arms. On the postero-lateral rays they are long and cylindrical, with the arms slender. On the anterior ray, it is short and supports two slender arms; while on the antero-lateral rays they support a slender arm similar to those of the other

rays on the anterior side, and on the outer side an arm several times larger and stronger than the others, and composed of larger and stronger plates.

"Plates of the arms short and unequal-sided, and giving origin to jointed tentaculæ from the longer side of each plate, which is upon the alternate sides of the arm, or on the same side from every second plate. Surface of the plates smooth. Length of the arms and subsequent bifurcation not known. Column small, round, and composed of unequal-sized plates alternating with each other.

"The slender arms are preserved on two individuals to the length of about one inch, and the strong antero-lateral arm on one, to more than an inch; but no evidence of bifurcation appears.

"The inequality of the antero-lateral arms will be the distinctive feature of the species, as the form of the calyx is similar to many other species of the group [Whitfield, 1895]."

Horizon and locality. — Maxville limestone.

Upper zone: Mouth of Buckeye Fork, Fultonham.

PHYLUM MOLLUSCOIDEA.

CLASS BRYOZOA.

SEPTOPORA RECTISTYLA—Whitfield.

1882. *Synocladia rectistyla*. Whitfield, Ann. N. Y. Acad. Sci., Vol. II, p. 220.
Maxville limestone: Newtonville, Ohio.
1891. *Synocladia rectistyla*. Whitfield, Ann. N. Y. Acad. Sci., Vol. V, p. 579, pl. 13, figs. 9, 10.
Maxville limestone: Newtonville, Ohio.
1895. *Synocladia rectistyla*. Whitfield, Geol. Surv. Ohio, Vol. VII, p. 467, pl. 9, figs. 9, 10.
Maxville limestone: Newtonville, Ohio.

Description. — Zoarium a spreading, funnel-shaped frond with a rooted base. Branches slender, straight, from 0.35 mm. to 0.40 mm. in diameter, and with bifurcations at frequent intervals. About 10 branches to each cm. Branches more or

less carinate, with distant, stout, laterally compressed spines, and with a row of large apertures on either side of the carina. Dissepiments nearly as large as the branches, in some cases bent upward in the center, in others directed obliquely upward from both sides of a branch, and in still others directed transversely, and bear one to three apertures. Fenestrules more or

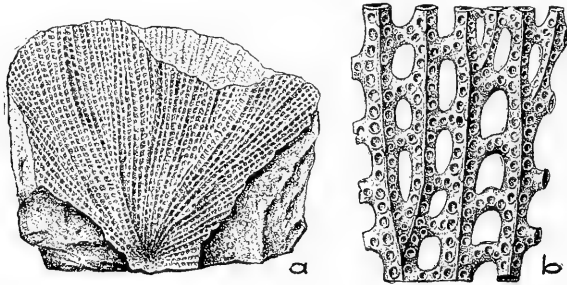


FIG. 4.—*Septopora rectistyla*.

a.—Inside of a frond, natural size.

b.—Enlarged portion showing the apertures. (After Whitfield.)

less variable and bordered, laterally, by apertures which, as a rule, are three in number. The latter are less than their own diameter apart and have a prominent peristome.

Reverse side not known.

Horizon and locality.—Maxville limestone.

Shale-nodular zone: Kroft Bridge, White Cottage.

Undetermined zone: Harper Shaft, Olive Furnace.

FENESTELLA SERRATULA—Ulrich.

1890. *Fenestella serratula*. Ulrich, Geol. Surv., Ill., Vol. VIII, p. 544, pl. 50, figs. 5-5c.

Keokuk group: Nauvoo, Illinois.

Warsaw beds: Monroe County and Warsaw, Illinois.

St. Louis limestone: Caldwell, Lyon, and Crittendon Counties, Kentucky.

1894. *Fenestella serratula*. Keyes, Mo. Geol. Surv., Vol. V, p. 23.

Keokuk limestone: Keokuk, Iowa.

1906. *Fenestella serratula*. Cumings, Ind. Dept. Geol. Nat. Res., 30th Ann. Rept., p. 1280, pl. 30, figs. 2-2c, 3-3a.
Salem limestone: Bedford, Indiana.

Description.—“Zoarium a foliar expansion, from 3 to 5 cms. in diameter. Branches rigid, small, 0.25 mm. wide, twenty-five or twenty-six in 1 cm., with a comparatively strong mesial carina, carrying small nodes, which give it on a side view the serrated appearance that has suggested the name. Nodes and zoecia twenty-four to twenty-six in 5 mm., and three to each fenestrule. Apertures very small, 0.07 mm. in diameter with a prominent peristome when perfect. Dissepiments thin, not more than half as wide as the branches, depressed and carinate on the obverse side. Fenestrules narrow elliptical, seventeen to nine-



FIG. 5.—*Fenestella serratula*. A branch enlarged twenty diameters to show the apertures and the nodes on the mesial carina.

teen in one cm. Reverse of branches granulo-striate or nearly smooth (?) with an occasional long, barbed, spine-like appendage [Ulrich, 1890].”

The Maxville forms are like the Chester specimens in that they lack the granules on the longitudinal striæ of the obverse side. More strictly speaking, the obverse side instead of having striæ is marked with very fine longitudinal plications, which bifurcate and diverge toward the top.

Horizon and locality.—Maxville limestone.
Shale-nodular zone: Kroft Bridge, White Cottage.
Undetermined zone: Harper Shaft, Olive Furnace.

RHOMBOPORA ARMATA—Ulrich.

1884. *Rhombopora armata*. Ulrich, Jour. Cinn. Soc. Nat. Hist., Vol. VII, p. 31, pl. 1, figs. 5, 5a.
Kaskaskia group: Tateville, Kentucky.

Description.—Zoarium slender, ramose, solid. Zoecia with deep, narrow, rhombic vestibules, arranged regularly in a quincuncial manner, thus forming vertically, transversely, and obliquely intersecting series. The oblique series slightly more evident. Apertures subcircular and comparatively large. The peripheries of the vestibules form rounded ridge-like thickenings,

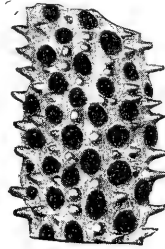


FIG. 6.—*Rhombopora armata*. Zoarium magnified twenty times to show the apertures and spines.

and at the intersections of the oblique ones of these are located one or two prominent spines.

Zoarium 1 mm. in diameter; and with eleven to thirteen zoecia to one circumference.

This species can be readily recognized by its slender cylindrical zoarium with rhombic vestibules and prominent spines.

Horizon and locality.—Maxville limestone.

Undetermined zone: Harper Shaft, Olive Furnace.

CLASS BRACHIOPODA.

DERBYA CRASSA—Meek and Hayden.

1853. *Orthis umbraculum?* Hall, Stansbury Explo. and Survey Gt. Salt Lake, p. 412, pl. 3, fig. 6.
Carboniferous: Missouri River.

1852. *Orthis umbraculum?* Owen, Geol. Rept. Wis., Iowa, and Minn., tab. 5, fig. 11.
Carboniferous: Missouri River.
1852. *Orthis arachnoidca.* Roemer, Kreid. von Texas, p. 89, tab. 1, figs. 9 a, b.
Carboniferous: San Saba Valley, Texas.
1858. *Orthisina crassa.* Meek and Hayden, Proc. Acad. Nat. Sci. Phil., p. 261.
Coal Measures: Leavenworth, Kansas.
1858. *Orthis crenistria.* Marcou, Geol. North America, p. 49.
Mountain limestone: Pecos Village, New Mexico.
1859. *Orthisina crassa.* Meek and Hayden, Proc. Acad. Nat. Sci. Phil., p. 26.
Coal Measures: Leavenworth, Kansas.
1859. *Orthisina umbraculum?* Meek and Hayden, Proc. Acad. Nat. Sci. Phil., p. 26.
Upper Coal Measures: Fort Riley and Cottonwood Creek, Kansas
1860. *Orthis lasallensis.* McChesney, Desc. New Pal. Foss., p. 32.
Upper Coal Measures: Lasalle, Illinois.
1860. *Orthis richmonda.* McChesney, Desc. New Pal. Foss., p. 32.
Coal Measures: N. W. Richmond, Missouri.
1860. *Orthis pratteni.* McChesney, Desc. New Pal. Foss., p. 33.
Coal Measures: Charboniér, Missouri.
1861. *Streptorhynchus umbraculum.* Newberry, Ivés' Colo. Expl. Exped., p. 125.
Upper Carboniferous (Cherty limestone): Various.
1864. *Hemipronites crassus.* Meek and Hayden, Smithsonian Cont. Knowledge, Vol. XIV, No. 172, p. 26, pl. 1, figs. 7a-d.
Coal Measures: Leavenworth City, Kansas.
1865. *Orthis lasallensis.* McChesney, Ill. New Spec. Foss., p. 1, figs. 5a-c.
1865. *Orthis lasallensis.* McChesney, Ill. New Spec. Foss., pl. 1, figs. 6a, b.
1868. *Hemipronites lasallensis.* McChesney, Trans. Chicago Acad. Sci., Vol. I, p. 28, pl. 1, figs. 5a-c.
Coal Measures: N. W. Richmond, Missouri.
1868. *Hemipronites lasallensis.* McChesney, Trans. Chicago Acad. Sci., Vol. I, p. 28, pl. 1, figs. 6a, b.
Upper Coal Measures: Lasalle, Illinois.
1872. *Hemipronites crassus.* Meek, U. S. Geol. Surv. Nebr., p. 174, pl. 5, figs. 10a-c; pl. 8, fig. 1.
Coal Measures: Nebraska, Kansas, Iowa, Missouri, Illinois.
Chester limestone: West Virginia.

1873. *Hemipronites crassus*. Meek and Worthen, Geol. Surv. Ill., Vol. V, p. 570, pl. 25, fig. 12.
Upper Coal Measures: Lasalle, Illinois.
1876. *Hemipronites crenistria*. White, Powell's Rep. Geol. Unita Mts., pp. 90, 91.
Lower and Upper Aubrey group: Utah.
1877. *Hemipronites crenistria*. White, U. S. Geog. Surv. W. 100 Merid., Vol. IV, p. 124, pl. 10, fig. 9a.
Carboniferous: Utah, Nevada.
1883. *Streptorhynchus Richmondi*. Hall, Rep. N. Y. State Geol. for 1882, pl. (10) 40, figs. 10, 11.
Coal Measures: Iowa.
1884. *Hemipronites crassus*. White, Ind. Geol. Nat. Hist., 13th Rep. pt. II, p. 129, pl. 26, figs. 4-11.
Coal Measures: Indiana.
1887. *Hemipronites crassus*. Herrick, Bull. Sci. Lab. Denison Univ., Vol. II, p. 50, pl. 2, fig. 19.
Coal Measures: Flint Ridge, Ohio.
1888. *Streptorhynchus crenistria*. Keyes, Proc. Acad. Nat. Sci. Phil., p. 229.
Lower Coal Measures: Des Moines, Iowa.
1891. *Streptorhynchus crassum*. Whitfield, Ann. N. Y. Acad. Sci., Vol. V, p. 580, pl. 13, figs. 11, 12.
Maxville limestone: Ohio.
1892. *Derbya crassa*. Hall and Clarke, Int. to Study of Brach., pt. I, pl. 17, figs. 1-4, 9.
Upper Coal Measures: Missouri, Iowa.
1892. *Derbya crassa*. Hall and Clarke, Pal. N. Y., Vol. VIII, pt. I, pl. 10, figs. 10, 11; pl. 11A, figs. 28-33; pl. 11B, figs. 23, 24; pl. 20, figs. 12, 13.
Upper Coal Measures: Missouri, Iowa.
1894. *Streptorhynchus crenistria*. Keyes, Mo. Geol. Surv., Vol. V, p. 67, pl. 38, figs. 8a-h.
Coal Measures: Missouri.
1895. *Streptorhynchus crassum*. Whitfield, Geol. Surv. Ohio, Vol. VII, p. 468, pl. 9, figs. 11, 12.
Maxville Limestone: Ohio.
1897. *Derbya crassa*. Smith, Proc. Am. Phil. Soc., Vol. XXXV, p. 28.
Coal Measures: Indian Territory, Arkansas.
1900. *Derbya crassa*. Beede, Univ. Geol. Surv. Kansas, Vol. VI, p. 62, pl. 8, figs. 11, 11b.
Upper and Lower Coal Measures: Fort Scott, Kansas City, Lawrence, Topeka, Kansas.

1903. *Derbya crassa*. Girty, U. S. Geol. Surv., Prof. Paper 16, p. 347.
 Hermosa formation: San Juan region, Ouray, Colorado.
 Weber limestone and Maroon formation: Crested Butte district,
 Colorado.
 Weber formation: Leadville district, Colorado.
1904. *Derbya crassa*. Girty, U. S. Geol. Surv., Prof. Paper 21, p. 52,
 pl. 11, fig. 3.
 Naco limestone: Bisbee quadrangle, Arizona.
1909. *Orthothes (Derbya) crassus*. Grabau and Shimer, N. A. Index
 Foss., p. 231, fig. 282 a-d.
 Upper Carbonic: North America.

Description. — “Shell very variable in size and form, but usually more or less plano-convex as seen in profile, somewhat semi-oval in outline, but usually a little too long from beak to base to be strictly so considered. Ventral valve more or less flattened, a little prominent on the umbo, but usually becoming slightly concave toward the front of the shell; cardinal area of

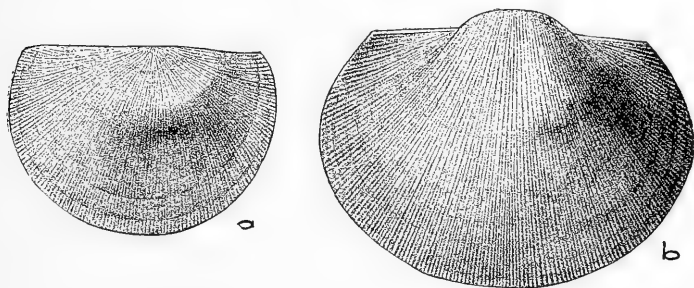


FIG. 7. — *Derbya crassa*.

a and b. — Impression of a ventral and dorsal valve. (After Whitfield.) Shell decidedly variable, but the ventral valve of many specimens is very flat except for the beak which rises abruptly and which is commonly distorted.

moderate height with a covered deltidium; beak more or less distorted. Dorsal valve convex, often quite rotund, but usually depressed convex, with a slightly prominent umbo. Surface of the shell marked by radiating striæ of considerable strength, which are sometimes sharply elevated and uniform, but on other specimens may be distinctly alternating in strength or arranged in

fascicles; these are crossed by fine concentric striæ which give a finely crenulated surface when viewed through a lens. Coarser concentric undulations of growth also mark the shell at irregular distances [Whitfield, 1895]."

Length 30-35 mm.; width 35-40 mm.

As pointed out by Whitfield this shell is decidedly variable. However, the ventral valves of most specimens may be characterized by their flattened appearance and the somewhat sudden prominence and distortion of the beak. At the extreme margin, the valve is bent upwards.

Horizon and locality.—Maxville limestone.

Upper zone: Mouth of Buckeye Fork, Fultonham; Gladstone Mills?, Thompson Residence?, Below Thompson Residence, White Cottage.

Lower zone: Bridge Gully, Mt. Perry-Fultonham.

Undetermined zone: Harper Shaft, Olive Furnace.

PRODUCTUS PILEIFORMIS—McChesney.

1859. *Productus pileiformis*. McChesney, Desc. New Paleozoic Foss., p. 40.

Kaskaskia limestone: Chester, Illinois.

1891. *Productus pileiformis*. Whitfield, Ann. N. Y. Acad. Sci., Vol V, p. 582, pl. 13, figs. 13, 14.

Maxville limestone: Ohio.

1895. *Productus pileiformis*. Whitfield, Geol. Surv. Ohio, Vol. VII, p. 470, pl. 9, figs. 13, 14.

Maxville limestone: Ohio.

1909. *Productus pileiformis*. Girty, U. S. Geol. Surv., Bull. 377, p. 26, pl. 2, fig. 7.

Caney shale: McAlester quadrangle, Oklahoma.

1911. *Productus pileiformis*. Girty, U. S. Geol. Surv., Bull. 439, p. 44, pl. 4, figs. 1, 2.

Moorefield shale: Batesville quadrangle, Marshall quadrangle, Arkansas.

Description.—Shell larger than medium, fragile, decidedly concavo-convex with a reflected margin.

Pedicle valve strongly curved in the posterior region and decidedly recurved at the anterior margin. Valve pointed at

the beak and gradually increases in size to near the margin where it rapidly expands into a trumpet-shaped opening. Hinge line straight, of medium length, with medium sized auricular extremities. Surface marked by fine radiating plications, which increase in number by bifurcation or insertion, and many of which decrease in number by coalescence at a point just posterior to the expansion of the anterior margin. Auricular margins

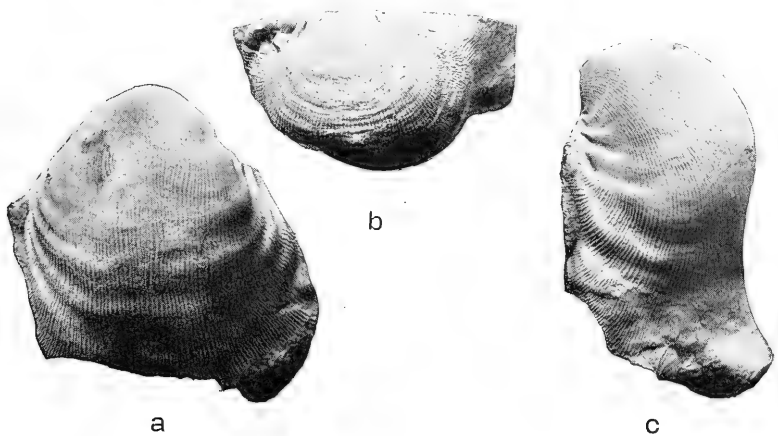


FIG. 8.—*Productus pileiformis*.

- a.—A view of a pedicle valve, the anterior margin of which is more or less broken.
- b.—A view of the internal portion of the umbonal half of a brachial valve and the external portion of the anterior half of the pedicle valve.
- c.—Profile view of a specimen (with a broken beak) showing the trumpet-like expansion of the anterior margin of the shell.

marked by prominent concentric wrinkles which disappear at the side of the shell so that the umbonal region is free from them or so that the latter region is marked by only faint representations of them.

Brachial valve slightly concave in the umbonal region, suddenly reflected at the anterior margin to conform to the pedicle valve, into which it is deeply withdrawn. Interior (?) surface

marked by fine radiating plications which are crossed by prominent concentric wrinkles in both the auricular and umbonal regions.

Length 43 mm.; width 30 mm.; hinge line 16-20 mm.

The shell is characterized by its fragile nature, fine plications, and trumpet-shaped aperture. The umbonal half of the pedicle valve is, in most specimens, broken away, leaving the interior surface of the umbonal half of the brachial valve and the outer surface of the anterior half of the pedicle valve exposed, *seemingly* as one valve (Fig. 8b).

The specimen that Whitfield figured was undoubtedly an imperfect one. The shell must have been so broken that the ventral view showed the umbonal half of the brachial valve and the anterior half of the pedicle valve. And, furthermore, the expanded, anterior margin was evidently broken away. As a result of this imperfection, the pedicle valves of the Maxville specimens resemble Hall's figures of *P. tenuicostus* (Geol. Surv. Iowa, Vol. I, pl. 24, fig. 2 a-c), whereas the brachial valves agree with Whitfield's figures. The shell differs, though, from *P. tenuicostus* in that the beak of the pedicle valve is more pointed, in that the transverse section is rounded instead of subquadrate, and in that the umbonal half of the brachial valve is slightly concave rather than flat. The hinge line of *P. pileiformis*, also, varies from 16 to 20 mm. whereas the one of the only specimen used by Hall is 23 mm.

Horizon and locality. — Maxville limestone.

Upper zone: Mouth of Buckeye Fork, Fultonham; Gladstone Mills; Thompson Residence (aa), below Thompson Residence, White Cottage.

Lower zone: Cut No. 4, Mt. Perry-Fultonham; Folk Quarry, Rushville.

PRODUCTUS CESTRIENSIS—Worthen.

1855. *Productus elegans*. Norwood and Pratten, Jour. Acad. Nat. Sci. Phil. (2), Vol. III, p. 3, pl. 1, figs. 7a-c. (Not *P. elegans* McCoy).

Mountain limestone: Chester and Kaskaskia, Illinois; near Hat Island, Missouri.

1860. *Productus cestriensis*. Worthen, Trans. St. Louis Acad. Sci., Vol. I, p. 570.
Chester limestone: Chester, Illinois.
1877. *Productus elegans*. Hall and Whitfield, U. S. Geol. Expl. 40 Par., Vol. IV, p. 268, pl. 5, figs. 3, 4.
Lower Carboniferous limestone: Utah.
1891. *Productus elegans*. Whitfield, Ann. N. Y. Acad. Sci., Vol. V, p. 581, pl. 13, figs. 15, 16.
Maxville limestone: Ohio.
1894. *Productus cestriensis*. Keyes, Mo. Geol. Surv., Vol. V, p. 44.
Kaskaskia limestone: Ste. Mary, Missouri.
1895. *Productus elegans*. Whitfield, Geol. Surv. Ohio, Vol. VII, p. 469, pl. 9, figs. 15, 16.
Maxville limestone: Ohio.
1897. *Productus cestriensis*. Weller, Trans. N. Y. Acad. Sci., Vol. XVI, p. 256, pl. 19, figs. 7-9.
Batesville sandstone: Batesville, Arkansas.
1911. *Diaphragmus elegans*. Girty, U. S. Geol. Surv., Bull. 439, p. 51, pl. 4, figs. 4, 5.
Moorefield shale: Batesville quadrangle, Arkansas

Description. — Shell of medium size, highly curved. Hinge line straight and short.

Pedicle valve strongly curved, gradually increases in breadth from the beak toward the anterior end where it is slightly expanded in the older forms. Auricular depressions at the extremities of the hinge line very small. In many specimens a shallow, ill-defined sinus extends from near the beak to the anterior end. Surface marked with numerous, medium-sized, radiating plications which bear a number of spine bases. Plications crossed by concentric wrinkles in the posterior region.

Brachial valve with central portion nearly flat or concave and with anterior half bending abruptly forward and fitting in the opposite valve so as to greatly restrict the visceral cavity. Surface ornamented with medium-sized, radiating plications which are less distinct on the flattened portion and which, in this area, are crossed by concentric wrinkles.

Length 16 mm.; width 16 mm.

This species is characterized by the highly curved pedicle

valve and by the withdrawal of the brachial valve far within the pedicle valve, as shown in Fig. 9 c and e.

This contact causes a plane of weakness along which the

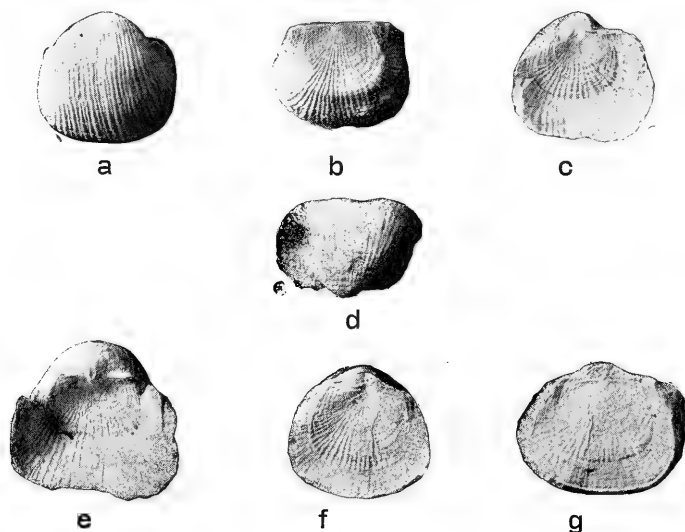


FIG. 9.—*Productus cestriensis*.

- a.—A view of a pedicle valve, a portion of the margin of which has been broken away.
- b.—An internal view of a brachial valve, showing the abrupt, forward bend of this valve.
- c.—A dorsal view, showing the concave structure of the brachial valve.
- d.—A view of a pedicle valve showing the beak and concentric wrinkles.
- e.—A dorsal view showing especially the concavity of the brachial valve.
- f and g.—Portions of the same specimen, which have separated along the plane of weakness caused by the abrupt forward bend of the anterior half from the flat posterior half of the brachial valve.

shells of many specimens break (Fig. 9 f and g). Its smaller size and coarser plications readily separate it from *P. pileiformis*, the other Maxville species.

This shell is one of the four abundant forms found in the Maxville limestone. It occurs in association with *Seminula subquadrata* and like it in great numbers in the shale nodular zone and very commonly in the shaly partings of the upper zone.

Horizon and locality.—Maxville limestone.

Upper zone: Gladstone Mills, Thompson Residence, below Thompson Residence, White Cottage; Smith Chapel, Logan.
 Shale-nodular zone: Cut No. 5, Upper end of Cut No. 6, Middle of Cut No. 6, Mouth of Hough Hollow, Mt. Perry-Fultonham; Kroft Residence, Kroft Bridge, White Cottage; Stimmel Residence, Maxville; Smith Chapel, Logan.
 Lower zone: Bridge Gully, Cut No. 3, Cut No. 4, Cut No. 5, Mt. Perry-Fultonham; West Jockey Hollow, Rushville.
 Undetermined zone: Middle of Cut No. 6, Mt. Perry-Fultonham; Harper Shaft, Olive Furnace.

MARTINI · CONTRACTA—Meek and Worthen.

1861. *Spirifera glabra* var. *contracta*. Meek and Worthen, Proc. Acad. Nat. Sci. Phil., p. 143.
 Chester limestone: Pope County and Chester, Illinois.
1866. *Spirifer glaber* var. *contracta*. Meek and Worthen, Geol. Surv. Ill., Vol. II, p. 298, pl. 23, figs. 5a, b.
 Chester group: Pope County and Chester, Illinois.
1874. *Spirifer (Martinia) glaber* var. *contracta*. White, Prelim. Rept. Inv. Foss., p. 20.
 Carboniferous (Coal Measures): Camp Cottonwood, Nevada.
1877. *Spirifer (Martinia) glaber* var. *contracta*. White, U. S. Geol. Surv. W. 100 Merid., Vol. IV, p. 136, pl. 10, figs. 2a-c.
 Carboniferous: Camp Cottonwood, Nevada.
1888. *Spirifer glaber*. Herrick, Bull. Denison Univ., Vol. IV, pl. 11, fig. 15.
 Chester limestone: Ohio.
1891. *Spirifera (Martinia) contractus*. Whitfield, Ann. N. Y. Acad. Sci., Vol. V, p. 583, pl. 12, figs. 17-19.
 Maxville limestone: Ohio.
1894. *Spirifera contracta*. Keyes, Mo. Geol. Surv., Vol. V, p. 83.
 Kaskaskia limestone: Chester, Illinois.

1895. *Spirifera (Martinia) contracta*. Whitfield, Geol. Surv. Ohio, Vol. VII, p. 471, pl. 9, figs. 17-19.
 Maxville limestone: Ohio.
1909. *Martinia glabra* var. *contracta*. Grabau and Shimer, N. A. Index Foss., p. 341.
 Chester: Illinois, Ohio and Nevada.

Description. — Shell of medium and of larger than medium size, fairly robust, broadly ovate in general outline.

Ventral valve robust, with incurved beak. Hinge line short, equal to half the width of the shell. Area small, divided by a rather large triangular pedicle opening. Median sinus shallow, narrow, and indistinct on the beak, but gradually increasing in width toward the anterior end where it is somewhat extended into the fold of the opposite valve.

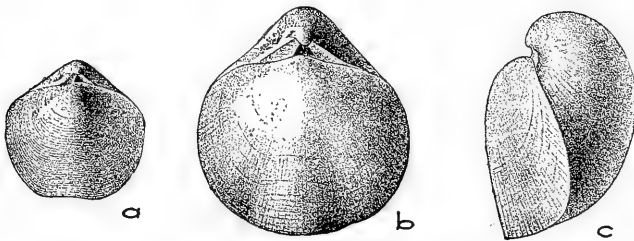


FIG. 10. — *Martinia contracta*.

- a. — Dorsal view of the type specimen from the Chester limestone of Illinois.
- b and c. — Dorsal and profile views of a Maxville specimen. (After Whitfield.)

Brachial valve less convex and nearly circular in outline, with minute beak. Median fold developed only in the anterior half toward which margin it increases in size.

Surface marked by very minute radiating plications, which alternate in size and which are crossed by still finer concentric lines.

Length 14-35 mm.; width 14-40 mm.

The shell is characterized by its robust form and by the minute radiating plications and the finer concentric lines: Frag-

ments of the smaller shells may be readily separated from *Seminula subquadrata* and *Dielasma turgida* by the absence of the round foramen and from the latter also by the absence of the punctate surface.

Horizon and locality.—Maxville limestone.

Upper zone: Mouth of Buckeye Fork, Fultonham; Gladstone Mills, Thompson Residence, Below Thompson Residence, White Cottage.

SPIRIFER KEOKUK—Hall.

1852. *Spirifer attenuatus*. Owen, Geol. Rep. Wis., Iowa, and Minn., tab. 5, fig. 5, tab. 3 A, fig. 18.
Lower Carboniferous limestone: Skunk River, Iowa.
Carboniferous limestone: Keokuk Rapids of the Mississippi.
1858. *Spirifer keokuk*. Hall, Geol. Iowa, Vol. I, pt. II, p. 642, pl. 20, figs. 3 a-d, 2d.
Keokuk limestone: Keokuk, Iowa; Nauvoo and Warsaw, Illinois.
1858. *Spirifer keokuk* var. Hall, Geol. Iowa, Vol. I, pt. II, p. 676, pl. 24, figs. 4 a-d.
St. Louis limestone: Mouth of Lizard Creek, Iowa.
1876. *Spirifer keokuk* (?) Meek, Bull. U. S. Geol. and Geog. Surv. Terr., Vol. II, p. 355, pl. 1, figs. 3, 3a.
Carboniferous: Kootenay Range of Rocky Mountain.
1883. *Spirifera keokuk*. Hall, Rep. N. Y. State Geol. for 1882, pl. (30) 55, figs. 21-24.
Keokuk and St. Louis limestone: Keokuk, Lizard Creek, and Marion County, Iowa.
1888. *Spirifer keokuk*. Herrick, Bull. Denison Univ., Vol. IV, p. 114.
Waverly group: Rushville and Loudonville, Ohio.
1888. *Spirifer incrcbescons*. Herrick, Bull. Denison Univ., Vol. IV, pl. 11, figs. 14, 23.
Chester limestone: Ohio.
Limestone fragments in Coal Measures: Licking County, Ohio.
1891. *Spirifer Rockymontana?* Whitfield, Ann. N. Y. Acad. Sci., Vol. V, p. 584, pl. 13, fig. 20.
Maxville limestone: Newtonville, Ohio.
1894. *Spirifer keokuk*. Hall and Clarke, Int. Study of Brach., pt. 2, pl. 27, figs. 14, 15.
Keokuk group: Keokuk, Iowa.
1894. *Spirifera keokuk*. Keyes, Mo. Geol. Surv., Vol. V, p. 81, pl. 40, fig. 2.
Keokuk limestone: Wayland, Missouri; Keokuk, Iowa.

1895. *Spirifera Rockymontana?* Whitfield, Geol. Surv. Ohio, Vol. VII, p. 471, pl. 9, fig. 20.
 Maxville limestone: Newtonville, Ohio.
1895. *Spirifer keokuk*. Hall and Clarke, Pal. N. Y., Vol. VIII, pt. 2, pl. 30, figs. 21-24.
 Keokuk group: Keokuk, Lizard Creek and Marion County, Iowa.
1895. *Spirifer keokuk* var. ? Hall and Clarke, Pal. N. Y., Vol. VIII, pt. II, pl. 37, figs. 13-15.
 St. Louis group: Southern Indiana?
1897. *Spirifer keokuk*. Weller, Trans. N. Y. Acad. Sci., Vol. XVI, p. 257, pl. 19, figs. 10-12.
 Batesville sandstone: Batesville, Arkansas.
1909. *Spirifer keokuk*. Grabau and Shimer, N. A. Index Foss., p. 333, fig. 425 a, b.
 Keokuk: Ohio, Illinois, Iowa, Utah.

"Spirifera Rockymontana?"

Plate IX, fig. 20.

- "Spirifera Rockymontana* Marcou, Geol. N. Amer., p. 50, pl. 7, fig. 4, Feb. 1858.
- "Spirifera keokuk* Hall, Geol. Rept. Iowa, Vol. I, pt. 2, p. 642, pl. 20, fig. 3, Sept. 1858.
- "Spirifera keokuk* Var. Hall, Ibid., p. 672, pl. 24, fig. 4.
- "Spirifera opima* Hall, Ibid., p. 711, pl. 28, fig. 1.

"Several specimens of a *Spirifera*, of the form referred to *S. keokuk* var. Prof. Hall, have been obtained from Newtonville, Ohio, which are so entirely similar to those from the St. Louis and Chester limestones of Iowa, as to be absolutely indistinguishable; the form of the shell, the form and number of the plications, and the minute surface structure being exactly as in those.

"The form of the shell will vary from longer than wide to much wider than long, dependent on the extension of the hinge line. In profile the shell is extremely ventricose, with a strongly enrolled beak; a moderate cardinal area, vertically striated; a well-marked mesial fold and sinus; from seven to ten simple, rounded, or sub-angular plications on each side, and from four to six bifurcating or dividing plications on the fold and sinus.

The plications and intervening spaces, when the surface is well preserved, are marked by fine longitudinal lines, showing even on partially exfoliated specimens, and are also crossed by still finer transverse striae which undulate in crossing the plications, and on perfectly preserved surfaces appear to be minutely setose on their edges.

"The species is extremely variable in its general outline, as exhibited among the collections from all of the many localities from which I have examined specimens, especially in the extension of the hinge-line, and the proportional width of the shell below, and also in the prominence of the mesial fold; but the form of the plications and the character of those marking the fold and sinus are usually the same in all; while the most constant and persistent character, and one I have been able to



FIG. 11. — *Spirifer keokuk*. Pedicle valve. (After Whitfield.) The form of this species varies greatly in the Maxville limestone.

detect on specimens from almost every locality noticed, consists of the minute structure of the surface. I have lately examined a large number of examples from the limestones and sandstones of the Coal Measures of New Mexico, which correspond exactly with those figured by Prof. Marcou under the name *S. Rockymontana*, and find them showing all the variations in form noticed among the Keokuk, St. Louis, Chester and Coal Measure limestones of Ohio and the West, and am thoroughly convinced they cannot be separated, even as local varieties, with any degree of safety or satisfaction [Whitfield, 1895]."

In the above bibliography Weller's arrangement has been followed, except for the listing of Herrick's *S. increbescens*, which is undoubtedly the same as the other Maxville *Spirifers*. Had the writer been bolder and followed his own inclinations,

he would have adopted Whitfield's and added *S. increbescens* to the latter's list.

Hall's inability to separate *S. keokuk* var. (St. Louis limestone, 1858) from *S. keokuk* (Keokuk limestone, 1858) seems especially significant. *S. keokuk* appears to represent one extreme, the short hinge line, and *S. increbescens* (Kaskaskia limestone, 1858) the other extreme, the long hinge line, of an otherwise very similar series of specimens. Between the two is *S. keokuk* var. with specimens exhibiting both long and short hinge lines. The ones with the long hinge lines might as well have been selected as the type in this case and the name *S. increbescens* var. applied rather than *S. keokuk* var. To be sure, it is not difficult to identify specimens of one extreme as *S. keokuk* and those of the other as *S. increbescens*, but what is to be done with the intermediate forms which fall as readily under one species as the other?

Just why *Spirifer opimus* (Coal Measures of Ohio, Maryland and Iowa, 1858) should have been originally referred to *S. rockymontani* (Mountain limestone of New Mexico, 1858) rather than to *S. keokuk*, which it more closely resembles, is not clear. *S. opimus* is undoubtedly an offspring of one of the Mississippian forms, and more probably one from the adjacent Mississippian series rather than one from the western Mississippian.

If any specific division is to be made in the above forms it would seem to fall between *S. rocky-montani* (1858) on the one hand and *S. keokuk* (1858), *S. keokuk* var. (1858), *S. increbescens* (1858), and *S. opimus* (1858) on the other. This, of course, would give specific rank to the first and second and make all of the rest synonyms of the second. Should no division be deemed advisable then all of Hall's species become synonyms of *Spirifer rockymontanus* Marcou (1858).

In the lower half of the Maxville limestone are found specimens of *Spirifer* which resemble very closely the figures of *S. rockymontanus* Marcou (especially 4 c-e) in two respects: first, the plications are small and sharply angular; and second,

the plications, in their growth toward the anterior end, bend decidedly toward the lateral margins. However, the mesial fold is sometimes much more abrupt with a suppression of all of its plications except two and in this respect the specimens resemble *S. kcokuk*. In the upper half another small form is found which resembles *S. kcokuk* somewhat more closely than it does *S. rockymontanus*. In this same division and especially in the Olive Furnace Shaft occur still other forms which are larger and coarser and which can with equal propriety be referred to either *S. kcokuk* or *S. increbescens*.

In the Maxville limestone, therefore, the separation of *S. kcokuk* and *S. increbescens* is attended with a great deal of difficulty if not impracticable. The same trouble is experienced in the attempt to refer some specimens to *S. rockymontanus* (1858) on the one hand and to *S. kcokuk* (1858) on the other. That this should be the case is not at all surprising when the principles of evolution are taken into consideration; and when this is done one species will probably be the result.

Horizon and locality.—Maxville limestone.

Upper zone: Mouth of Buckeye Fork, Fultonham; Gladstone Mills, Thompson Residence, White Cottage.

Lower zone: Cut No. 4, Mt. Perry-Fultonham.

Undetermined zone: Harper Shaft, Olive Furnace.

DIFLASMA TURGIDA—Hall.

1856. *Terebratulula turgida*. Hall, Trans. Albany Inst., Vol. IV, p. 6.
St. Louis limestone: Alton, Illinois; Bloomington and Spergen Hill, Indiana.
1882. *Terebratulula turgida*. Whitfield, Bull. Am. Mus. Nat. Hist., Vol. I, p. 54, pl. 6, figs. 53-58.
St. Louis group: Indiana, Iowa, Illinois and Missouri.
1883. *Terebratulula turgida*. Hall, Ind. Dept. Geol. Nat. Hist., 12th Rept., p. 336, pl. 29, figs. 53-58.
St. Louis group: Alton, Illinois; Bloomington, Lanesville and Spergen Hill, Indiana.
1891. *Terebratulula turgida*. Whitfield, Ann. N. Y. Acad. Sci., Vol. V, p. 586, pl. 13, figs. 21, 22.
Maxville limestone: Maxville and Newtonville, Ohio.

1894. *Diclasma turgida*. Hall and Clarke, Int. to Study of Brach., pt 2, pl. 53, figs. 10-12.
Chester limestone: Spencer County, Indiana.
St. Louis group: Washington County, Indiana.
1895. *Diclasma turgida*. Hall and Clarke, Pal. N. Y., Vol. VIII, pt. 2, pl. 81, figs. 1-8.
Chester limestone: Spencer County, Indiana.
St. Louis group: Washington County, Indiana.
1895. *Terebratula turgida*. Whitfield, Geol. Surv. Ohio, Vol. VII, p. 473, pl. 9, figs. 21, 22.
Maxville limestone: Maxville and Newtonville, Ohio.
1906. *Diclasma turgidum*. Beede, Ind. Dept. Geol. Nat. Res., 30th Ann. Rep. p. 1309, pl. 22, figs. 53-58; pl. 19, figs. 5-5a.
Salem limestone: Indiana, Illinois and Missouri.
1909. *Diclasma turgidum*. Grabau and Shimer, N. A. Index Foss., p. 302, fig. 376 d-f.
Warsaw and St. Louis: Ohio, Kentucky, Indiana, Illinois, Missouri, Iowa.

Description. — Shell small, egg-shape in general outline, elongate, nearly as thick as broad with anterior end truncated and slightly emarginated.



FIG. 12. — *Diclasma turgida*.
a and b. — Dorsal and profile views of the same specimen. (After Whitfield.)

Pedicle valve convex, with a rather deep median sinus in the anterior half. Beak incurved, obliquely truncate, with a round foramen.

Brachial valve convex with two small grooves in the anterior portion of the valve of some specimens.

Shell structure finely punctate, and surface ornamented with faint lines of growth.

Length 7-11 mm.; width 5-10 mm.

This species is characterized by its punctate structure, thick shell, and obliquely truncated beak.

Horizon and locality. — Maxville limestone.

Upper zone: Gladstone Mills, Thompson Residence, Below Thompson Residence, White Cottage.

Shale-nodular zone: Cut No. 5, Mouth of Hough Hollow, Mt. Perry-Fultonham; Kroft Bridge, White Cottage; Stimmel Residence, Maxville; Smith Chapel, Logan.

Lower zone: Cut No. 2, Cut No. 3, Cut No. 4?, Cut No. 5, Mt. Perry-Fultonham.

Undetermined zone: Middle of Cut No. 6, Mt. Perry-Fultonham.

SEMINULA SUBQUADRATA—Hall.

1858. *Athyris subquadrata*. Hall, Geol. Surv. Iowa, Vol. I, pt. II, p. 703, pl. 27, figs. 2 a-d; p. 708, fig. 118.
Kaskaskia limestone: Chester, Illinois; Crittenden County, Kentucky.
1877. *Athyris subquadrata* ? Hall and Whitfield, U. S. Geol. Expl. 40 Par., Vol. IV, p. 271, pl. 5, figs. 19, 20.
Wasatch limestone: Utah.
1886. *Athyris subquadrata*. Heilprin, 2d Geol. Surv. Penn., Ann. Rep. for 1885, p. 453, p. 440, fig. 2.
Mill Creek limestone, Upper Coal Measures: Wilkesbarre, Pennsylvania.
1886. *Athyris subquadrata*. Heilprin, Proc. and Coll. Wyo. Hist. and Geol. Soc., Vol II, pt. II, p. 269, fig. 2.
Mill Creek limestone, Upper Coal Measures: Wilkesbarre, Pennsylvania.
1891. *Athyris subquadrata*. Whitfield, Ann. N. Y. Acad. Sci., Vol. V, p. 585, pl. 14, figs. 1-3.
Maxville limestone: Newtonville and Maxville, Ohio.
1894. *Seminula subquadrata*. Hall and Clarke, Int. to Study of Brach., pt. II, pl. 35, figs. 13, 15.
Chester limestone: Crittenden County, Kentucky.
St. Louis limestone: Pella, Iowa.
1894. *Athyris subquadrata*. Keyes, Mo. Geol. Surv., Vol. V, p. 92.
Kaskaskia limestone: Ste. Mary, Missouri.

1895. *Seminula subquadrata*. Hall and Clarke, Pal. N. Y., Vol. VIII, pt. II, pl. 47, figs. 7-9, 15, 16; pl. 84, figs. 30, 31.
Kaskaskia limestone: Chester, Illinois; Crittenden County, Kentucky.
St. Louis limestone: Pella, Iowa; Spergen Hill, Indiana.
1895. *Athyris subquadrata*. Whitfield, Geol. Surv. Ohio, Vol. VII, p. 472, pl. 10, figs. 1-3.
Maxville limestone: Newtonville and Maxville, Ohio.
1897. *Athyris subquadrata*. Weller, Trans. N. Y. Acad. Sci., Vol. XVI, p. 258, pl. 19, fig. 16.
Batesville sandstone: Batesville, Arkansas.
1903. *Seminula subquadrata*. Girty, U. S. Geol. Surv., Prof. Paper 16, p. 296, pl. 1, fig. 5.
Leadville limestone: Leadville district, Colorado.
Millsap limestone: Castle Rock quadrangle, Colorado.
1909. *Seminula subquadrata*. Grabau and Shimer, N. A. Index Foss., Vol. I, p. 354.
Kaskaskia: Ohio, Kentucky, Illinois, Utah.

Description. — Shell of medium size or smaller, subquadrate in outline, wider than long in most specimens; the widest portion being anterior of the middle. The bunching of the concentric

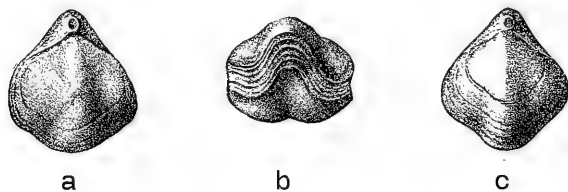


FIG. 13. — *Seminula subquadrata*.
a and b. — Dorsal and anterior views of the same specimen.
c. — Dorsal view of another individual. (After Whitfield.)

lines of growth at the anterior end often gives a thickened appearance to the shell.

Pedicle valve ventricose at the posterior end, with extended and incurved beak, the extremity of which is truncated thus forming a round foramen. Mesial sinus increasing in depth and breadth toward the anterior end, and culminating in a lingual extension, limited on either side by a lateral fold.

Brachial valve most rotund on the umbo, with beak incurved beneath the one on the other valve. Mesial fold prominent, rapidly increases in size toward the anterior end, due to the sudden development, on either side, of a sinus which corresponds to the two lateral folds of the opposite valve. A lateral fold on both sides of the valve and beyond each lateral sinus. The median fold with this lateral fold on either side gives a strong trilobate effect to this valve.

Surface marked by concentric lines of growth which are, in most specimens, crowded toward the anterior end.

Length 16 mm.; width 18 mm.

The shell is characterized by the rounded foramen; the trilobate, brachial valve; and the crowding of the concentric, growth lines toward the anterior margin, thus producing a thickened shell.

This species is one of the four most abundant forms in the Maxville limestone. It occurs in great numbers in the shale-nodular zone and rather abundantly in the shaly partings of the upper half of the stratum. It separates quite readily from the shales, and its greater abundance in these is due to the greater destruction of life during these intervals caused, perhaps, by the clay impurities.

Horizon and locality. — Maxville limestone.

Upper zone: Gladstone Mills, Thompson Residence, White Cottage.

Shale-nodular zone: Cut No. 5, Upper end of Cut No. 6, Middle of Cut No. 6, Mouth of Hough Hollow, Mt. Perry-Fultonham; Kroft Residence, Kroft Bridge, White Cottage; Stimmel Residence, Maxville; Smith Chapel, Logan.

Lower zone: Bridge Gully, Cut No. 3, Cut No. 4, Mt. Perry-Fultonham.

Undetermined zone: Middle of Cut No. 6, Mt. Perry-Fultonham; Harper Shaft (?), Olive Furnace.

EUMETRIA MARCYI—Shumard.

1852. *Terebratula serpentaria* ? Owen, Geol. Rep. Wis., Iowa and Minn., tab. 3 A, fig. 13, (Not deKoninck).
Carboniferous: Skunk River, Iowa.
1854. *Terebratula marcyi*. Shumard, Marcy's Rep. U. S. Expl. Red River of Louisiana, p. 177, pl. 1, figs. 4a, b.
Carboniferous: Washington and Crawford counties, Arkansas.
1856. *Retzia Verneuiliana*. Hall, Trans. Albany Inst., Vol. IV, p. 9.
St. Louis limestone: Bloomington and Spergen Hill, Indiana.
1858. *Retzia verneuiliana*. Hall, Geol. Iowa, Vol. I, pt. II, p. 657, pl. 23, figs. 1 a-d.
Warsaw limestone: Spergen Hill and Bloomington, Indiana.
1858. *Retzia vera*. Hall, Geol. Iowa, Vol. I, pt. II, p. 704, pl. 27, fig. 3a.
Kaskaskia limestone: Chester, Illinois.
1858. *Retzia vera* var. *costata*. Hall, Geol. Iowa, Vol. I, pt. II, p. 704, pl. 27, figs. 3b, c.
Kaskaskia limestone: Chester, Illinois.
1882. *Eumetria Verneuiliana*. Whitfield, Bull. Am. Mus. Nat. Hist. Vol. I, p. 50, pl. 6, figs. 28-30.
St. Louis group: Spergen Hill, Paynter's Hill and Bloomington, Indiana; Alton, Illinois.
1883. *Eumetria verneuiliana*. Hall, Ind. Dept. Geol. Nat. Hist., 12th Rep., p. 335, pl. 29, figs. 28-30.
St. Louis group: Spergen Hill, Lanesville and Bloomington, Indiana.
1884. *Retzia Verneuiliana*. Walcott, U. S. Geol. Surv., Mon. VIII, p. 220, pl. 7, figs. 5, 5a.
Lower Carboniferous: Little Belt Mountains, Montana.
1894. *Eumetria Verneuiliana*. Hall and Clarke, Int. to Study of Brach., pt. II, pl. 37, figs. 1-4, 6, 10.
St. Louis group: Spergen Hill, Indiana.
1894. *Retzia verneuiliana*. Keyes, Mo. Geol. Surv., Vol. V, p. 95.
St. Louis limestone: St. Louis, Missouri.
1894. *Eumetria vera* var. *costata*. Hall and Clarke, Int. to Study of Brach., pt. II, pl. 37, figs. 5, 11.
Chester limestone: Chester, Illinois; Crittenden County, Kentucky.
1894. *Eumetria vera*. Hall and Clarke, Int. to Study of Brach., pt. II, pl. 37, figs. 8, 12.
Chester limestone: Crittenden County, Kentucky.
1894. *Retzia vera*. Keyes, Mo. Geol. Surv., Vol. V, p. 95.
Kaskaskia limestone: St. Mary, Missouri.

1895. *Eumetria vera* var. *costata*. Hall and Clarke, Pal. N. Y., Vol. VIII, pt. II, pl. 51, figs. 27-33.
Chester limestone: Crittenden County, Kentucky; Chester, Illinois.
1895. *Eumetria vera*. Hall and Clarke, Pal. N. Y., Vol. VIII, pt. II, pl. 51, figs. 36, 37.
Chester group: Crittenden County, Kentucky.
1895. *Eumetria Verneuiliana*. Hall and Clarke, Pal. N. Y., Vol. VIII, pt. II, p. 117, figs. 104, 105, pl. 51, figs. 13-26, 34, 35, pl. 83, figs. 26, 27.
St. Louis group: Spergen Hill, Indiana; Green County, Missouri.
1897. *Eumetria verneuiliana*. Weller, Trans. N. Y. Acad. Sci., Vol. XVI, p. 259.
Batesville sandstone: Batesville, Arkansas.
1899. *Eumetria verneuiliana*. Girty, U. S. Geol. Surv., Mon. 32, pt. II, p. 560, pl. 68, figs. 12a-12b.
Madison limestone: Yellowstone National Park.
1903. *Eumetria marcyi*? Girty, U. S. Geol. Surv., Prof. Paper 16, p. 303
Ouray limestone: San Juan region, Colorado.
1904. *Eumetria marcyi*. Girty, U. S. Geol. Surv., Prof. Paper 21, p. 49, pl. 10, figs. 15-17.
Mississippian (Escabrosa limestone): Bisbee quadrangle, Arizona.
1906. *Eumetria marcyi*. Beede, Ind. Dept. Geol. Nat. Res., 30th Ann. Rep., p. 1319, pl. 22, figs. 28-30.
Salem limestone: Spergen Hill, etc., Indiana.
1909. *Eumetria marcyi*. Grabau and Shimer, N. A. Index Foss., p. 346, fig. 444 d, e.
St. Louis and Kaskaskia; Tennessee, Missouri, Arkansas, Indiana, Iowa, Illinois.
1911. *Eumetria marcyi*. Girty, U. S. Geol. Surv., Bull. 439, p. 77, pl. 8, fig. 10.
Moorefield shale: Batesville quadrangle, Arizona.

Description.—Shell very variable, ranging from smaller than medium to medium size, longitudinally ovate, almost equally biconvex.

Pedicle valve most convex in the umbonal region. Beak large, elevated, incurved, truncated by a nearly vertical plane, which produces a large rounded foramen.

Brachial valve more circular in outline with a small incurved beak.

Surface marked by numerous rounded, radiating plications which vary in size with the size of the shell.

Length 9-19 mm.; width 7-17 mm.



FIG. 14.—*Eumetria marcyi*. A dorsal view of a completely compressed and flattened specimen, which was drawn by the aid of a camera lucida and which is, therefore, much broader than a normal specimen.

This shell is readily distinguished by its ovate outline, bi-convexity, and rounded, radiating plications.

Horizon and locality.—Maxville limestone.

Undetermined zone: Harper Shaft, Olive Furnace.

CLEIOTHYRIS HIRSUTA—Hall.

1856. *Spirigera hirsuta*. Hall, Trans. Albany Inst., Vol. IV, p. 8.
St. Louis limestone: Spergen Hill and Bloomington, Indiana;
Alton, Illinois.
1882. *Athyris hirsuta*. Whitfield, Bull. Am. Mus. Nat. Hist., Vol. I,
p. 49, pl. 6, figs. 18-21.
St. Louis group: Spergen Hill, Paynter's Hill and Bloomington,
Indiana; Alton, Illinois.
1883. *Athyris hirsuta*. Hall, Ind. Geol. Nat. Hist., 12th Rep., p. 328,
pl. 29, figs. 18-21.
St. Louis group: Alton, Illinois; Spergen Hill, Lanesville and
Bloomington, Indiana.
1884. *Athyris hirsuta*. Walcott, Pal. Eureka Dist., p. 222, pl. 18, fig. 5.
Lower Carboniferous: Nevada.
1895. *Cleiothyris hirsuta*. Hall and Clarke, Pal. N. Y., Vol. VIII, pt. II,
pl. 46, figs. 25-28.
St. Louis limestone: Bloomington, Indiana.
1906. *Cleiothyris hirsuta*. Beede, Ind. Dept. Geol. Nat. Res., 30th Ann.
Rep., p. 1320, pl. 22, figs. 18-21, pl. 19, figs. 1-1 a.
Spergen Hill, etc., Indiana.

1909. *Cleiothyris hirsuta*. Grabau and Shimer, N. A. Index Foss., p. 354, fig. 464.

St. Louis and Kaskaskia: Kentucky, Indiana, Illinois, Montana.

Description. — Shell small, biconvex, sub-circular to obovate in general outline.

Pedicle valve most convex in the umbonal region. Beak small, incurved over the one of the opposite valve, and obliquely truncated. Foramen small. Sinus absent, generally not represented even by a slight depression at the anterior end.

Brachial valve uniformly convex except at the posterio-lateral angles where it is slightly flattened. Fold absent. Beak small, inconspicuous.

Surface marked by concentric, imbricating lamellæ which give rise to successive rows of minute, flat spines.

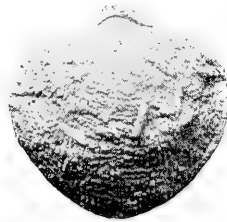


FIG. 15. — *Cleiothyris hirsuta*. A dorsal view showing some of the flat spines which have escaped removal, enlarged three diameters.

Length and width of average-sized individuals 10 mm.; a larger crushed specimen reached 14 mm. in length and width.

In the Maxville specimens the posterior margin is more nearly straight than it is in the ones figured by Whitfield, so that the greatest width of the shell is nearer the posterior end. The spines are more or less removed leaving commonly only the concentric lines.

The species is readily recognized by the concentric rows of flat spines.

Horizon and locality. — Maxville limestone.

Undetermined zone: Harper Shaft, Olive Furnace.

PHYLUM MOLLUSCA.

CLASS PELECYPODA.

SCHIZODUS CHESTERENSIS—Meek and Worthen.

1860. *Schizodus Chesterensis*. Meek and Worthen, Proc. Acad. Nat. Sci., Phil., p. 457.
Upper Chester limestone: Chester, Illinois.
1866. *Schizodus chesterensis*. Meek and Worthen, Geol. Surv. Ill., Vol. II, p. 301, pl. 23, figs. 6a, b.
Chester group: Chester, Illinois.
1891. *Schizodus Chesterensis*. Whitfield, Ann. N. Y. Acad. Sci., Vol. V, p. 587, pl. 14, fig. 4.
Maxville limestone: Maxville, Ohio.
1895. *Schizodus Chesterensis*. Whitfield, Geol. Surv. Ohio, Vol. VII, p. 474, pl. 10, fig. 4.
Maxville limestone: Maxville, Ohio.

Description.—“Shell of medium size, transversely subovate, with moderately convex valves and large, strong, incurved, and projecting beaks. Anterior end forming one-third the length of the shell, inflated, and rapidly sloping from the beaks to the longest point, which is near the middle of the height, and rounding backward below; posterior end elongated

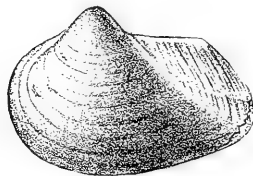


FIG. 16.—*Schizodus chesterensis*. A view of the left valve. (After Whitfield.)

and narrowed, obtusely pointed at the extremity; basal margin irregularly convex, most strongly arcuate opposite the beaks; postero-cardinal margin sloping somewhat rapidly from the beaks backward, and the cardinal slope rather abrupt. Surface of the shell smooth, except for the fine lines of growth [Whitfield, 1895].”

A few broken internal molds have been referred to this species.

Horizon and locality.—Maxville limestone.

Upper zone: Below Thompson Residence (?), White Cottage.

PINNA MAXVILLENSIS—Whitfield.

1882. *Pinna Maxvillensis*. Whitfield, Ann. N. Y. Acad. Sci., Vol. II, p. 221.
Maxville limestone: Maxville, Ohio.
1891. *Pinna Maxvillensis*. Whitfield, Ann. N. Y. Acad. Sci., Vol. V, p. 586, pl. 14, fig. 5.
Maxville limestone: Maxville, Ohio.
1895. *Pinna Maxvillensis*. Whitfield, Geol. Surv. Ohio, Vol. VII, p. 474, pl. 10, fig. 5.
Maxville limestone: Maxville, Ohio.

Description.—"Shell of about medium size, very acutely triangular in outline, with highly convex valves; the length along the hinge equal to nearly three times the greatest width. Hinge line straight, not quite as long as the shell below; anterior end acute; basal margin very slightly arcuate, and the posterior extremity rather broadly rounded; the point of greatest length

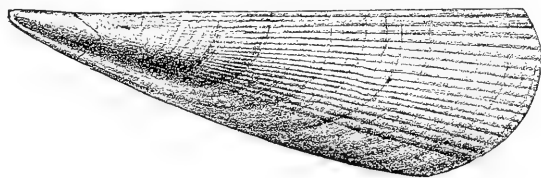


FIG. 17.—*Pinna maxvillensis*. A view of a left valve. (After Whitfield.)

being at about one-third of the width below the hinge-line. Surface of shell, except for a short distance within the basal margin, marked by moderately strong, simple radiating plications, about eighteen in number, as counted at the posterior end of the specimen figured, but increasing in number with increased growth; the additions being near the hinge. There are also numerous strong concentric lines of growth parallel to the mar-

gin, often forming undulations of the surface [Whitfield, 1895].”
Length 70 mm.

This species is readily distinguished by its triangular outline and radiating plications.

Horizon and locality. — Maxville limestone.

Upper zone: Thompson Residence, White Cottage.

Shale-nodular zone: Kroft Bridge, White Cottage.

ALLORISMA ANDREWSSI—Whitfield.

1882. *Allorisma Andrewsii*. Whitfield, Ann. N. Y. Acad. Sci., Vol. II, p. 222.

Maxville limestone: Newtonville, Ohio.

1888. *Allorisma Andrewsii*. Herrick, Bull. Denison Univ., Vol. IV, pl. 11, fig. 12.

Chester limestone: Ohio.

1891. *Allorisma Andrewsii*. Whitfield, Ann. N. Y. Acad. Sci., Vol. V, p. 588, pl. 14, fig. 6.

Maxville limestone: Newtonville, Ohio.

1895. *Allorisma Andrewsii*. Whitfield, Geol. Surv. Ohio, Vol. VII, p. 473, pl. 10, fig. 6.

Maxville limestone: Newtonville, Ohio.

Description. — Shell of medium size or larger, transverse outline obovate, longitudinal outline subrectangular. Valves ventricose, most so along a line extending diagonally from the

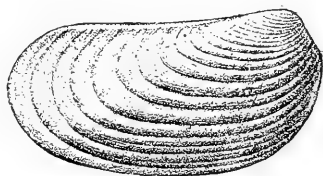


FIG. 18. — *Allorisma andrewsi*. A view of the right valve. (After Whitfield.)

beak to the postero-ventral angle, and with a slightly concave line parallel with and dorsal to the former. Ventral margin convexly curved and parallel with the dorsal margin. Posterior margin broadly rounded. Anterior margin more abruptly

rounded so that the greatest length of the shell is a little nearer to the ventral than it is to the dorsal margin. Beaks medium, projecting above the hinge line, incurved, and directed anteriorly. Surface covered with rather broad concentric ridges, which near the dorsal margin appear to be in pairs, due to interpolation.

Length 38-50 mm.; height 15-22 mm.; width 12-14 mm.

The species is characterized by its medium or larger size and by the broad, concentric ridges.

Horizon and locality. — Maxville limestone.

Upper zone: Gladstone Mills, Thompson Residence, White Cottage.

Shale-nodular zone: Stimmel Residence, Maxville.

Undetermined zone: Middle of Cut No. 6, Mt. Perry-Fultonham.

ALLORISMA MAXVILLENSIS—Whitfield.

1882. *Allorisma Maxvillensis*. Whitfield, Ann. N. Y. Acad. Sci., Vol. II, p. 222.

Maxville limestone: Newtonville, Ohio.

1891. *Allorisma Maxvillensis*. Whitfield, Ann. N. Y. Acad. Sci., Vol. V, p. 588, pl. 14, figs. 7, 8.

Maxville limestone: Newtonville, Ohio.

1895. *Allorisma Maxvillensis*. Whitfield, Geol. Surv. Ohio, Vol. VII, p. 475, pl. 10, figs. 7, 8.

Maxville limestone: Newtonville, Ohio.

Description. — “Shell small, the specimen used being a little less than one inch in length and the height less than half the length. Form of the shell transversely elongate, and cylindrically oval, the cardinal and basal margins parallel and very slightly curved, and the extremities very nearly equally rounded; beaks small, inrolled, barely projecting above the cardinal line, and situated at about one-fourth of the entire length from the anterior end. Body of shell very evenly and highly rounded from the cardinal to the basal margins, and almost as convex posteriorly as in front. Umbonal ridge scarcely perceptible, and the umbonal slope convex; escutcheon and lunule not defined; anterior slope abruptly rounded. Surface of the shell marked

by faint concentric undulations of unequal strength, but most strongly marked on the posterior end and on the umbonal slope [Whitfield, 1895].”

Length 22 mm.; height 11 mm.

The shell is readily distinguished from the other species of *Allorisma* by its smaller size and more transversely cylindrical outline.

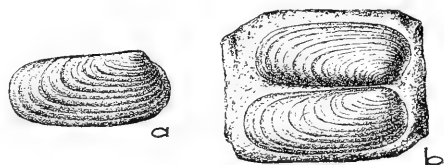


FIG. 19.—*Allorisma maxvillensis*.

a.—A view of the right valve of a specimen.

b.—A view of both valves of an individual. (After Whitfield.)

Horizon and locality.—Maxville limestone.

Upper zone: Below Thompson Residence, White Cottage.

Shale-nodular zone: Cut No. 5, Upper end Cut No. 6, Mt. Perry-Fultonham; Stimmel Residence, Maxville.

Lower zone: Cut No. 4, Mt. Perry-Fultonham.

Undetermined zone: Middle of Cut No. 6, Mt. Perry-Fultonham; Harper Shaft (?), Olive Furnace.

CYPRICARDELLA OBLONGA—Hall.

1856. *Cypricardella oblonga*. Hall, Trans. Albany Inst., Vol. IV, p. 18. St. Louis limestone: Spergen Hill and Bloomington, Indiana.

1882. *Microdon (Cypricardella) oblonga*. Whitfield, Bull. Am. Mus. Nat. Hist., Vol. I, p. 65, pl. 7, figs. 30-34.

St. Louis group: Spergen Hill and Bloomington, Indiana.

1883. *Cypricardella oblonga*. Hall, Ind. Geol. and Nat. Hist., 12th Rep., p. 340, pl. 30, figs. 30-34.

St. Louis group: Spergen Hill, Lanesville, and Bloomington, Indiana.

1906. *Microdon oblonga*. Beede, Ind. Dept. Geol. Nat. Res., 30th Rep., p. 1330, pl. 23, figs. 30-36.

Salem limestone: Spergen Hill and Bloomington, Indiana.

1909. *Cypricardella oblonga*. Grabau and Shimer, N. A. Index Foss., p. 535, fig. 728.
 St. Louis: Indiana.
 Ste. Genevieve: Kentucky.

Description. — "Shell oblong, sub-quadrangular anterior end, narrow, rounded; posterior end broader, flattened, and almost vertically truncate; cardinal margin nearly straight and horizontal behind, declining in front; base nearly parallel to the hinge-line; beaks small, somewhat prominent, gibbous below; posterior umbonal slope gibbous or sub-angular, and extending



FIG. 20. — *Cypricardella oblonga*. A view of a right valve, enlarged four times.

obliquely downward and backward to the base of the truncation; lunule small, ovate, deep in the center; escutcheon linear distinct.

"Length, .09 to .30; width, .06 to .20 of an inch [Hall, 1883]."

Horizon and locality. — Maxville limestone.
 Lower zone: Cut No. 4, Mt. Perry-Fultonham.

CLASS SCAPHOPODA.

DENTALIUM ILLINOIENSE—Worthen.

1883. *Dentalium Illinoiense*. Worthen, Geol. Surv. Ill., Vol. VII, p. 325.
 Chester limestone: Chester, Illinois.
 1890. *Dentalium illinoiense*. Worthen, Geol. Surv. Ill., Vol. VIII, p. 145, pl. 23, fig. 1.
 Chester limestone: Chester, Illinois.

Description. — "Shell above a medium size, long, straight, cylindrical, slightly tapering, scarcely inflated at the aperture. Surface apparently smooth originally, but slightly roughened by weathering in the specimen under examination.

"Length, 5 7/8 inches; width near the aperture, 7/16 inch [Worthern, 1890]."



FIG. 21.—*Dentalium illinoiense*. An imperfect specimen.

Horizon and locality.—Maxville limestone.

Lower zone: Cut No. 4, Mt. Perry-Fultonham.

CLASS GASTROPODA.

STRAPAROLLUS SIMILIS—Meek and Worthen.

1861. *Straparollus similis*. Meek and Worthen, Proc. Acad. Nat. Sci. Phil., p. 145.
St. Louis limestone: Waterloo, Illinois.
1866. *Straparollus similis*. Meek and Worthen, Geol. Surv. Ill., Vol. II, p. 285, pl. 19, figs. 4a, b.
St. Louis group: Waterloo, Illinois.
1891. *Straparollus similis*. Whitfield, Ann. N. Y. Acad. Sci., Vol. V, p. 589, pl. 14, figs. 9-11.
Maxville limestone: Newtonville and near Maxville, Ohio.
1895. *Straparollus similis*. Whitfield, Geol. Surv. Ohio, Vol. VII, p. 476, pl. 10, figs. 9-11.
Maxville limestone: Newtonville and near Maxville, Ohio.
1897. *Straparollus similis* (?) Weller, Trans. N. Y. Acad. Sci., Vol. XVI, p. 270.
Batesville sandstone: Batesville, Arkansas.

1909. *Euomphalus similis*. Grabau and Shimer, N. A. Index Foss., pp. 659, 660, fig. 909.
St. Louis: Illinois; Maxville, Ohio; Batesville, Arkansas.

Description.—Shell varies from smaller than medium to medium size, subdiscoidal or with a slightly elevated spire, and with a broad umbilicus. Whorls about four in number and gradually increasing in size. Whorls flattened on the upper surface with a sharp keel on the peripheral angle, abruptly descending from the keel to the median periphery and then gently rounded to the median basal line, and rounded from the latter line to the suture. A sharp angular keel occurs on the median-basal line of at least the body whorl. Surface of the shell covered with closely crowded transverse striæ.

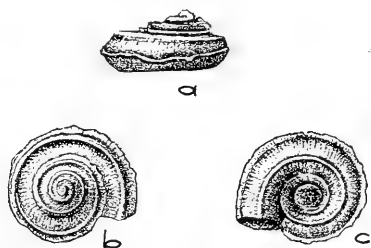


FIG. 22.—*Straparollus similis*.

a, b, and c.—Lateral, apical, and basal views of an individual.
(After Whitfield.)

Diameter 14 to 25 mm.

The shell is readily distinguished by its subdiscoidal outline, large umbilicus, flattened upper surface of the whorls, the keels of the upper and lower surfaces, and the crowded transverse striæ.

Most of the specimens have a horizontal lateral extension, which is given off from the median peripheral line of the last or body whorl. This extension always adheres more or less to the matrix and seems to be due to vertical crushing.

It is one of the four most abundant forms of the Maxville

limestone, and is found in great numbers in the shale-nodular zone.

Horizon and locality. — Maxville limestone.

Upper zone: Mouth of Buckeye Fork, Fultonham; Gladstone Mills, Below Thompson Residence?, White Cottage; Smith Chapel, Logan.

Shale-nodular zone: Cut No. 5, Mouth of Hough Hollow, Mt. Perry-Fultonham; Kroft Residence, Kroft Bridge, White Cottage; Stimmel Residence, Maxville; Smith Chapel, Logan.

Undetermined zone: Middle of Cut No. 6, Mt. Perry-Fultonham.

HOLOPEA NEWTONENSIS—Whitfield.

1882. *Holopea Newtonensis*. Whitfield, Ann. N. Y. Acad. Sci., Vol. II, p. 224.

Maxville limestone: Newtonville, Ohio.

1891. *Holopea Newtonensis*. Whitfield, Ann. N. Y. Acad. Sci., Vol. V, p. 591, pl. 14, fig. 12.

Maxville limestone: Newtonville, Ohio.

1895. *Holopea Newtonensis*. Whitfield, Geol. Surv. Ohio, Vol. VII, p. 477, pl. 10, fig. 12.

Maxville limestone: Newtonville, Ohio.

Description. — “Shell of medium size, ovate in outline and ventricose, with a moderately elevated spire and extremely ven-

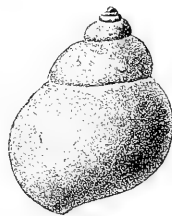


FIG. 23. — *Holopea newtonensis*. Lateral view. (After Whitfield.)

tricose volution, which increase very rapidly in bulk from the apex. Volution three and half to four in number, with strongly rounded surfaces and moderate sutures. Apical angle about

seventy degrees. Aperture broad ovate, modified on the inner side by the preceding volution, pointed at the upper end and broadly rounded at the base. Surface of the shell smooth and substance very thin [Whitfield, 1895].”

Length 30 mm.; diameter 20 mm.

The shell is characterized by its medium size and ventricose volutions.

Horizon and locality.—Maxville limestone.

Shale-nodular zone: Kroft Bridge, White Cottage.

BULIMORPHA MELANOIDES—Whitfield.

1882. *Polyphemopsis melanoides*. Whitfield, Ann. N. Y. Acad. Sci., Vol. II, p. 225.

Maxville limestone: Newtonville, Ohio.

1891. *Polyphemopsis melanoides*. Whitfield, Ann. N. Y. Acad. Sci., Vol. V, p. 592, pl. 14, fig. 13.

Maxville limestone: Newtonville, Ohio.

1895. *Polyphemopsis melanoides*. Whitfield, Geol. Surv. Ohio, Vol. VII, p. 478, pl. 10, fig. 13.

Maxville limestone: Newtonville, Ohio.

Description.—Shell below medium size, elongate, similar to a slender cone in outline. Spire elevated and pointed at the apex. Whorls gradually increase in size, about five and half



FIG. 24.—*Bulimorpha melanoides*. Lateral view. (After Whitfield.)

in number, moderately and evenly convex, with distinct sutures. Aperture ovate, rounded below, acute above. Columella indistinct.

Surface seems to be smooth in most specimens. One individual shows transverse growth lines parallel with the margin of the outer lip.

Length 26 mm.; width 12 mm.

The shell is hard to characterize except the agreement of the general outline with that of the figure.

Horizon and locality.—Maxville limestone.

Upper zone: Gladstone Mills (?), Below Thompson Residence, White Cottage.

Shale-nodular zone: Cut No. 5, Mt. Perry-Fultonham; Kroft Bridge, White Cottage; Stimmel Residence, Maxville.

Undetermined zone: Middle of Cut No. 6, Mt. Perry-Fultonham.

BULIMORPHA CANALICULATA—Hall.

1856. *Bulimella canaliculata*. Hall, Trans. Albany Inst., Vol. IV, p. 29
St. Louis limestone: Spergen Hill, Indiana.
1882. *Bulimorpha canaliculata*. Whitfield, Bull. Am. Mus. Nat. Hist.,
Vol. I, p. 74, pl. 8, fig. 41.
St. Louis group: Spergen Hill, Indiana.
1883. *Bulimorpha canaliculata*. Hall, Ind. Geol. and Nat. Hist., 12th
Rep., p. 367, pl. 31, fig. 41.
St. Louis group: Spergen Hill and Lanesville, Indiana.
1889. *Bulimorpha canaliculata*. Keyes, Proc. Acad. Nat. Sci. Phil., p.
300.
1906. *Bulimorpha canaliculata*. Cumings, Ind. Dept. Geol. Nat. Res.,
30th Ann. Rept., p. 1343, pl. 25, fig. 41.
Salem limestone: Spergen Hill, Indiana.

Description.—“Shell sub-fusiform, somewhat elongate; spire short, scarcely equaling the length of the last volution;



FIG. 25.—*Bulimorpha canaliculata*. A view of an imperfect specimen referred to this species, enlarged four times.

volutions about five, upper ones scarcely convex, rapidly diminishing to the apex; last volution longer than the spire above,

slightly ventricose; suture canaliculate, the groove margined by a slight sharp carination at the upper edge of the volution; aperture sub-ovate; surface smooth, or marked with fine lines of growth, which are abruptly bent backward at the carination on the upper edge of the volution, which marks the notch in the upper angle of the aperture.

Length, .18 of an inch [Hall, 1883]."

Horizon and locality. — Maxville limestone.

Lower zone: Cut No. 4, Mt. Perry-Fultonham.

SPHAERODOMA SUBCORPULENTA—Whitfield

1882. *Macrocheilus subcorpulentus*. Whitfield, Ann. N. Y. Acad. Sci., Vol. II, p. 224.
Maxville limestone: Newtonville, Ohio.
1889. *Sphaerodoma subcorpulenta*. Keyes, Proc. Acad. Nat. Sci. Phil., p. 306.
1891. *Macrocheilus subcorpulentus*. Whitfield, Ann. N. Y. Acad. Sci., Vol. V, p. 591, pl. 14, fig. 14.
Maxville limestone: Newtonville, Ohio.
1895. *Macrocheilus subcorpulentus*. Whitfield, Geol. Surv. Ohio, Vol. VII, p. 478, pl. 10, fig. 14.
Maxville limestone: Newtonville, Ohio.

Description. — Shell small, cone-shaped, with rounded base. Whorls three or three and a half in number, convex, and rapidly increase in size so that the body whorl is much larger than the



FIG. 26. — *Sphaerodoma subcorpulenta*. A view of a specimen showing the aperture. (After Whitfield.)

rest of the shell. Sutures distinct, but not deeply grooved. Aperture ovate, acute above and rounded below. Columella not prominently developed. Surface of the shell seemingly smooth.

Length 11-14 mm.; width 5-8 mm.

The shell is characterized by its small size and rapidly enlarging whorls.

Horizon and locality. — Maxville limestone.

Upper zone: Below Thompson Residence, White Cottage.

Undetermined zone: Middle of Cut No. 6, Mt. Perry-Fultonham.

NATICOPSIS ZICZAC—Whitfield.

1882. *Naticopsis ziczac*. Whitfield, Ann. N. Y. Acad. Sci., Vol. II, p. 223.
Maxville limestone: Newtonville, Ohio.

1891. *Naticopsis ziczac*. Whitfield, Ann. N. Y. Acad. Sci., Vol. V, p.
590, pl. 14, figs. 15, 16.

Maxville limestone: Newtonville, Ohio.

1895. *Naticopsis ziczac*. Whitfield, Geol. Surv. Ohio, Vol. VII, p. 477,
pl. 10, figs. 15, 16.

Maxville limestone: Maxville, Ohio.

1909. *Naticopsis ziczac*. Grabau and Shimer, N. A. Index Foss., p. 673,
fig. 933.

Maxville: Ohio.

Description. — Shell less than medium size with depressed spire. Whorls ventricose, about two and a half in number, rapidly increase in size. Aperture large, equal to about half the size of the whole shell, rounded. Suture prominent, subquadrate

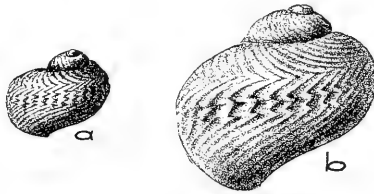


FIG. 27.—*Naticopsis ziczac*.

a and b.— Natural size and enlarged views of an individual. (After Whitfield.)

in cross section. Surface of the whorls of the spire crossed by transverse striæ, which are bent backward. Surface of the body whorl also ornamented with transverse striæ which bend backward in the sutural third of the whorl, then by acute bends

zigzag across the median peripheral third, and on the basal third bend abruptly forward.

Length 15 mm.; diameter 20 mm.

The shell is readily identified by its depressed spire, large aperture, and the zigzag striæ of the median portion of the body whorl.

Horizon and locality. — Maxville limestone.

Upper zone: Below Thompson Residence, White Cottage.

Shale-nodular zone: Cut No. 5, Upper end Cut No. 6, Mt. Perry-Fultonham; Kroft Bridge, White Cottage.

Lower zone: Bridge Gully, Mt. Perry-Fultonham.

Undetermined zone: Middle of Cut No. 6, Mt. Perry-Fultonham.

BELLEROPHON ALTERNODOSUS—Whitfield.

1882. *Bellerophon alternodosus*. Whitfield, Ann. N. Y. Acad. Sci., Vol. II, p. 225.

Maxville limestone: Newtonville, Ohio.

1891. *Bellerophon alternodosus*. Whitfield, Ann. N. Y. Acad. Sci., Vol. V, p. 593, pl. 14, figs. 17-19.

Maxville limestone: Newtonville, Ohio.

1895. *Bellerophon alternodosus*. Whitfield, Geol. Surv. Ohio, Vol. VII, p. 479, pl. 10, figs. 17-19.

Maxville limestone: Newtonville, Ohio.

Description. — “Shell of about a medium size, and somewhat subglobose in general form, with an appearance of being

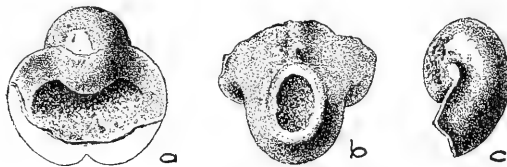


FIG. 28. — *Bellerophon alternodosus*.

a, b, and c. — Apertural, dorsal, and profile views of the same specimen. (After Whitfield.)

slightly flattened on the dorsum in immature specimens; while on the adult forms, the dorsum is marked on the outer half of

the body-volution by a double series of rounded nodes, those on one side of the center alternating with those of the other side, and the inner margins of the two series interlocking with each other. Aperture broadly elliptical, strongly modified by the projection of the preceding volution, on the inner margin. Auriculations largely developed and slightly reflected. Axis very distinctly perforate. Inner lip somewhat callous on the protruding inner volution. Surface of the shell, so far as can be ascertained, marked only by lines of growth, beyond the nodes mentioned [Whitfield, 1895].”

Horizon and locality. — Maxville limestone.

Unknown zone: White Cottage (Type specimen).

BELLEROPHON SUBLÆVIS—Hall.

1856. *Bellerophon sublævis*. Hall, Trans. Albany Inst., Vol. IV, p. 32. St. Louis limestone: Spergen Hill and Bloomington, Indiana; Alton, Illinois.
1858. *Bellerophon sublævis*. Hall, Geol. Surv. Iowa, Vol. 1, pt. II, p. 666, pl. 23, figs. 15a-c. Warsaw limestone: Above Alton, Illinois; Spergen Hill and Bloomington, Indiana.
1882. *Bellerophon sublævis*. White, Ind. Geol. Nat. Hist., 11th Ann. Rep., p. 359, pl. 40, figs. 5-7. St. Louis group: Ellettsville, Indiana.
1882. *Bellerophon sublævis*. Whitfield, Bull. Am. Mus. Nat. Hist., Vol. I, p. 89, pl. 8, figs. 6, 7. St. Louis group: Spergen Hill, Bloomington, Paynter's Hill and Ellettsville, Indiana; Alton, Illinois.
1883. *Bellerophon sublævis*. Hall, Ind. Geol. Nat. Hist., 12th Rep., p. 371, pl. 3, figs. 6-7. St. Louis group: Alton, Illinois; Spergen Hill, Lanesville and Bloomington, Indiana.
1886. *Bellerophon sublævis*. Claypole, Proc. and Coll. Wyo. Hist. and Geol. Soc., Vol. II, pt. II, p. 246. Lower Coal Measures: Wilkesbarre, Pennsylvania.
1891. *Bellerophon sublævis* ? Whitfield, Ann. N. Y. Acad. Sci., Vol. V, p. 592, pl. 14, figs. 20, 21. Maxville limestone: Newtonville and Maxville, Ohio.
1894. *Bellerophon sublævis*. Keyes, Mo. Geol. Surv., Vol. V, p. 148. St. Louis limestone: St. Louis, Missouri.

1895. *Bellerophon sublævis* ? Whitfield, Geol. Surv. Ohio, Vol. VII, p. 479, pl. 10, figs. 20, 21.
Maxville limestone: Newtonville and Maxville, Ohio.
1897. *Bellerophon sublævis*. Weller, Trans. N. Y. Acad. Sci., Vol. XVI, p. 269, pl. 21, fig. 10.
Batesville sandstone: Batesville, Arkansas.
1906. *Bellerophon sublævis*. Cumings, Ind. Dept. Geol. Nat. Res., 30th Ann. Rep., p. 1360, pl. 25, figs. 6, 7.
Salem limestone: Spergen Hill, Bloomington, Indiana; Alton, Illinois.
1909. *Bellerophon sublævis*. Grabau and Shimer, N. A. Index Foss., p. 620, fig. 832.
St. Louis and Chester group: Indiana, Illinois, Ohio, Missouri, Arkansas.
Lower Coal Measures: Pennsylvania.

Description. — Shell subglobose with three whorls of which the last or body whorl is moderately expanded. The inner whorl projects into and strongly modifies the aperture which is transversely kidney-shaped. Outer lip both thick and somewhat reflected at the junction with the body of the shell. Umbilicus not developed. Anterior portion of body whorl keeled in the best preserved specimens.



FIG. 29. — *Bellerophon sublævis*.

a and b. — Back and profile views of the same specimen from which the shell is mostly removed. (After Whitfield.)

Surface of nearly all of the Maxville specimens not preserved. However, one or two show the surface to be crossed by fine transverse striæ, which bend abruptly backward over the keel as described by Hall (1858).

Greatest diameter 15-26 mm.

The shell is characterized by its subglobose outline and

its manner of preservation. Practically all of the specimens are granular, calcite casts and when broken from the limestone matrix the internal molds are sprinkled with a thin coat of these crystals. These molds as a rule do not show the keel.

This is one of the four most common species of the Maxville limestone. It has a rather great vertical range and at certain horizons is found in large numbers.

Horizon and locality.—Maxville limestone.

Upper zone: North Bank of Jonathan Creek, Fultonham; Gladstone Mills, Kroft Bridge, Thompson Residence, Below Thompson Residence, White Cottage; Smith Chapel, Logan.

Shale-nodular zone: Cut No. 5, Upper end of Cut No. 6, Mouth of Hough Hollow, Mt. Perry-Fultonham; Kroft Residence, Kroft Bridge, White Cottage; Stimmel Residence, Maxville; Smith Chapel, Logan.

Lower zone: Cut No. 4, Cut No. 5, Mt. Perry-Fultonham.

Undetermined zone: Middle of Cut No. 6, Mt. Perry-Fultonham.

ORTHONYCHIA ACUTIROSTRE—Hall.

1856. *Capulus acutirostris*. Hall, Trans. Albany Inst., Vol. IV, p. 31.
St. Louis limestones: Spergen Hill and Bloomington, Indiana.
1858. *Capulus acutirostris*. Hall, Geol. Iowa, Vol. I, pt. II, p. 665, pl. 23, figs. 14a, b.
Warsaw limestone: Warsaw, Illinois; Spergen Hill and Bloomington, Indiana.
1866. *Platyceras unicum*. Meek and Worthen, Proc. Acad. Nat. Sci. Phil., p. 264.
Keokuk limestone: Nauvoo, Illinois.
1873. *Platyceras unicum*. Meek and Worthen, Geol. Surv. Ill., Vol. V, p. 516, pl. 17, fig. 1a, b.
Keokuk limestone: Nauvoo, Illinois.
1882. *Platyceras acutirostris*. Whitfield, Bull. Am. Mus. Nat. Hist., Vol. I, p. 67, pl. 8, figs. 13-15.
St. Louis group: Spergen Hill, Paynter's Hill, Ellettsville, Bloomington and Crawfordsville, Indiana; Warsaw, Illinois; Tusculumbia, Alabama.
1883. *Platyceras acutirostris*. Hall, Ind. Geol. Nat. Hist., 12th Rep., p. 370, pl. 31, figs. 13-15.
St. Louis group: Spergen Hill, Lanesville and Bloomington, Indiana.

1886. *Capulus acutirostris*. Claypole, Proc. and Coll. Wyo. Hist. and Geol. Soc., Vol. II, pt. II, p. 246.
Lower Coal Measures: Wilkesbarre, Pennsylvania.
1890. *Capulus acutirostris*. Keyes, Am. Geol., Vol. VI, p. 9.
1890. *Capulus acutirostris*. Keyes, Proc. Acad. Nat. Sci. Phil., p. 170.
Keokuk group: Warsaw and Nauvoo, Illinois.
St. Louis limestone: Spergen Hill and Bloomington, Indiana; Tuscumbia, Alabama.
1892. *Orthonychia acutirostre*. Keyes, Am. Geol., Vol. X, p. 276.
1894. *Orthonychia acutirostre*. Keyes, Mo. Geol. Surv., Vol. V, p. 190, pl. 54, figs. 2a-c.
Keokuk limestone and shale: Warsaw and Nauvoo, Illinois.
St. Louis limestone: Spergen Hill and Bloomington, Indiana; Tuscumbia, Alabama.
1897. *Capulus acutirostris*. Weller, Trans. N. Y. Acad. Sci., Vol. XVI, p. 268.
Batesville sandstone: Batesville, Arkansas.
1906. *Orthonychia acutirostre*. Cumings, Ind. Dept. Geol. Nat. Res., 30th Ann. Rep., p. 1335, pl. 23, figs. 14, pl. 25, figs. 5, 13-15.
Salem limestone: Spergen Hill, Bloomington, Indiana; Illinois; Alabama.
1909. *Orthonychia acutirostris*. Grabau and Shimer, N. A. Index. Foss., p. 688, figs. 976, 977.
Keokuk and Warsaw: Illinois, Indiana, Alabama.
St. Louis: Indiana, Illinois.
Chester: Arkansas.
Coal measures: Pennsylvania.

Description. — "Shell below medium size, rather slender, strongly arcuate, forming from one to one and one-half volu-

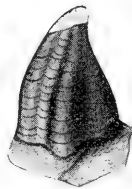


FIG. 30. — *Orthonychia acutirostre*. A slightly restored drawing of an individual, showing the prominent ridge on the dorsal side. Enlarged two diameters.

tions; posterior side for some distance from apertural margin nearly straight. Spire laterally more or less compressed; some-

times small and short, sometimes long, attenuate, simply incurved or enrolled. Aperture oval, or sub-circular; margin sharp, sinuous. Surface marked by somewhat imbricated lines of growth and several obscurely defined longitudinal plications, the anterior one being usually larger than the others, and often forming a prominent subangular ridge [Keyes, 1894]."

Length 12 mm.; diameter 7 mm.

The species is readily distinguished by its open coil, its suddenly expanded cone, and by its anterior ridge.

Horizon and locality.—Maxville limestone.

Lower zone: Cut No. 4, Mt. Perry-Fultonham.

STROPHOSTYLUS CARLEYANA—Hall.

1856. *Natica Carlyana*. Hall, Trans. Albany Inst., Vol. IV, p. 31.
St. Louis limestone: Spergen Hill and Bloomington, Indiana; Alton, Illinois.
1882. *Naticopsis Carleyana*. Whitfield, Bull. Am. Mus. Nat. Hist., Vol. I, p. 71, pl. 8, figs. 26, 27.
St. Louis group: Spergen Hill and Bloomington, Indiana; Alton, Illinois.
1883. *Naticopsis Carleyana*. Hall, Ind. Geol. and Nat. Hist., 12th Rep., p. 369, pl. 31, figs. 26, 27.
St. Louis group: Alton, Illinois; Spergen Hill and Bloomington, Indiana.
1894. *Strophostylus ? carleyana*. Keyes, Mo. Geol. Surv., Vol. V, p. 196.
St. Louis limestone: Alton, Illinois.
1906. *Strophostylus carleyana*. Cumings, Ind. Dept. Geol. Nat. Res., 30th Ann. Rept., p. 1340, pl. 25, figs. 26, 27.
Salem limestone: Spergen Hill and Bloomington, Indiana; Alton, Illinois.
1909. *Strophostylus carleyanus*. Grabau and Shimer, N. A. Index. Foss., p. 678, fig. 949.
St. Louis limestone: Illinois and Indiana.
1911. *Strophostylus aff. carleyanus*. Girty, U. S. Geol. Surv., Bull. 439, p. 94, pl. 7, fig. 6.
Moorefield shale: Batesville quadrangle, Arkansas.

Description.—"Shell sub-globose; spire short, consisting of about three volutions, which increase very rapidly, the last one extremely ventricose; suture not distinctly defined; aperture

ovate, straight on the columella side; outer lip sharp; inner lip thickened; columella with distinct groove near the base of the lip for the reception of the operculum; surface marked by fine, elevated striæ corresponding to the lines of growth.

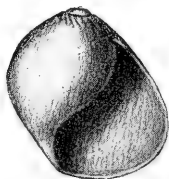


FIG. 31.—*Strophostylus carleyana*. A view of a partially exfoliated or worn specimen, referred to this species. Enlarged four times.

“Height, .10 to .30; diameter, .08 to .34 of an inch [Hall, 1883].”

Horizon and locality.—Maxville limestone.

Lower zone: Cut No. 4, Mt. Perry-Fultonham.

MURCHISONIA VERMICULA—Hall.

1856. *Murchisonia vermicula*. Hall, Trans. Albany Inst., Vol. IV, p. 27.
St. Louis limestone: Spergen Hill and Bloomington, Indiana.
1882. *Murchisonia vermicula*. Whitfield, Bull. Am. Mus. Nat. Hist., Vol. I, p. 87, pl. 9, fig. 11.
St. Louis group: Spergen Hill and Bloomington, Indiana.
1883. *Murchisonia vermicula*. Hall, Ind. Geol. and Nat. Hist., 12th Rep., p. 361, pl. 32, fig. 11.
St. Louis group: Spergen Hill, Lanesville and Bloomington, Indiana.
1906. *Solenospira vermicula*. Cumings, Ind. Dept. Geol. Nat. Res., 30th Ann. Rep., p. 1357, pl. 26, fig. 11.
Salem limestone: Spergen Hill, etc., Indiana.

Description.—“Shell cylindrical, abruptly tapering at the apex; volutionations from six to ten, moderately convex in the middle, and scarcely diminishing for the first four or five turns above the base, but becoming more abruptly contracted above; the surface of each volution marked by two very prominent

revolving striæ, having a space between them on the periphery and a single finer line below, and one above near the suture; the last volution not ventricose, and marked by a fifth revolving striation, which is a continuation of the suture line; aperture

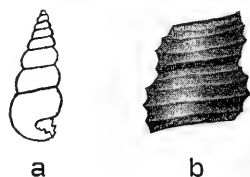


FIG. 32.—*Murchisonia vermicula*.

- a.—An outline drawing of an individual which has undergone much erosion, enlarged four diameters.
 b.—Two whorls of another specimen, enlarged to eight diameters in order to show the characteristic markings.

broadly oval, rounded below; columella imperforate. Shell minute.

“Length, .14 of an inch [Hall, 1883].”

Horizon and locality.—Maxville limestone.

Lower zone: Cut No. 4, Mt. Perry-Fultonham.

CLASS CEPHALOPODA.

ENDOLOBUS SPÆCTABILIS—Me. k and Worthen.

1860. *Nautilus spectabilis*. Meek and Worthen, Proc. Acad. Nat. Sci. Phil., p. 469.
 Chester limestone: Gravel Creek, Illinois.
1865. *Nautilus (Endolobus) peramplus*. Meek and Worthen, Proc. Acad. Nat. Sci. Phil., p. 259.
 Chester group: Randolph County, Illinois.
1866. *Nautilus (Endolobus) spectabilis*. Meek and Worthen, Geol. Surv. Ill., Vol. II, p. 308, pl. 25, figs. 1a, b.
 Chester group: Randolph County, Illinois.
1891. *Nautilus (Tennocheilus) spectabilis*. Whitfield, Ann. N. Y. Acad. Sci., Vol. V, p. 594, pl. 14, fig. 22.
 Maxville limestone: Near Rushville, Ohio.
1894. *Nautilus spectabilis*. Keyes, Mo. Geol. Surv., Vol. V, p. 222.
 Kaskaskia limestone: St. Louis County, Missouri.

1895. *Nautilus (Temnocheilus) spectabilis*. Whitfield, Geol. Surv. Ohio, Vol. VII, p. 480, pl. 10, fig. 22.

Maxville limestone: Near Rushville, Ohio.

Description.—“Shell of medium to large size, composed of several volutions, which increase rapidly in size, and are (transversely) elliptical in a transverse section; the diameter from side to side being about one-third greater than the dorso-ventral diameter at the same point; the lateral edges being obtusely angular, and the dorsal [ventral] portion of the sec-

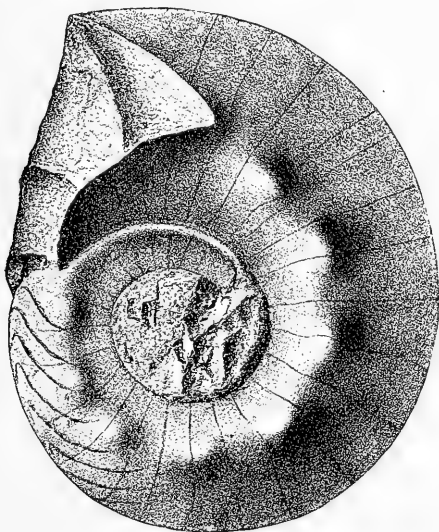


FIG. 33.—*Endolobus spectabilis*. Lateral view. (After Whitfield.)

tion larger and more convex than the inner part, strongly convex and subangular on the back. Inner surface of the volution strongly impressed by the one preceding, which it embraces to near the point of greatest diameter. Umbilicus very broad and deep, exposing each of the inner volutions to just beyond the point of greatest transverse diameter, the umbilical surface of the volutions being moderately convex but quite abrupt. The

sides of the volutions are marked by a series of nodes of considerable strength and size, arranged at regularly increasing distances, and occurring, as nearly as can be determined from the example on hand, at about every second septum. The nodes are situated on the crest of the side, and are obtusely rounded and prominent. Septa moderately distant and but slightly bent downward on the dorsum [venter?]. On a specimen measuring about three inches in its greatest diameter, the whole of which is septate, they are arranged at about one-third of an inch apart; near the outer extremity of the last volution. Siphuncle not observed, and the depth of the septa not ascertained. The surface of a portion of the specimen bears marks of a series of strong varices of growth, which have crossed the dorsum [venter?] and show a strong retral sinus or notch in the margin of the lip at this point. The varices are seen in the inner portion of the last volution and appear to have been arranged at distances nearly corresponding to the septa at the same place. No other markings of the surface are retained [Whitfield, 1895]."

As Whitfield points out, this species closely resembles the illustrations and description of the one originally named *Nautilus forbesianus* by McChesney. Apparently the only difference is the location of the line of lateral nodes. In the species *spectabilis* the line is so located that the greater portion of the volution lies on the peripheral side while in *forbesianus* the larger part occurs on the inner side. Why two species so nearly alike that they can scarcely be separated specifically, should subsequently be referred to two distinct genera (*Endolobus spectabilis* and *Tennocheilus forbesianus*) is rather hard to understand.

Horizon and locality.—Maxville limestone.

Unknown zone: Rushville (Andrew's collection).

NAUTILUS PAUPER—Whitfield.

1882. *Nautilus pauper*. Whitfield, Ann. N. Y. Acad. Sci., Vol. II, p. 226.
Maxville limestone: Near Rushville, Ohio.
1891. *Nautilus pauper*. Whitfield, Ann. N. Y. Acad. Sci., Vol. V, p. 595,
pl. 14, fig. 23.
Maxville limestone: Near Rushville, Ohio.
1895. *Nautilus pauper*. Whitfield, Geol. Surv. Ohio, Vol. VII, p. 481,
pl. 10, fig. 23.
Maxville limestone: Near Rushville, Ohio.

Description.—“Shell somewhat below the medium size, and consisting of about two and a half volutions, which increase rather rapidly in size, and are so coiled as to expose almost the entire diameter of the inner coils in the umbilical cavity; the outer one embracing only the dorsal [ventral] surface of the inner volution. Volutions quadrangular in form, with lateral diameter only about two-thirds as great as the dorso-ventral

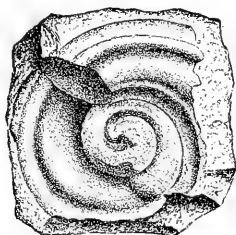


FIG. 34.—*Nautilus pauper*. A view of the outer chamber and the impression of the inner coils. (After Whitfield.)

diameter, while the dorsal and ventral surfaces are nearly vertical [perpendicular] to the plane of the sides, so far as can be determined from the specimen on hand; or possibly the dorsal [ventral?] surface may be slightly rounded. The sides of the shell are marked by a faint, narrow, revolving sulcus bordering the margin of the umbilicus, and by a correspondingly faint ridge close to the dorsal margin; while a much stronger rounded ridge occurs on the surface at about one-third of the

width of the volution from the dorsal [ventral?] border. Internal features of the shell not known.

"A single individual only of the species has been observed, and is altogether too imperfect to reveal all the features. It consists of the non-septate portion of the shell, in the condition of an internal cast, with the impression of one side of the entire shell; but gives no indications of the septa themselves. The only features indicating its cephalopodous nature, upon which one can rely, are its symmetrical form and the evidence of a similar ornamentation on the opposite sides; otherwise it might have been supposed to represent a form of *Euomphalus* [Whitfield, 1895]."

Horizon and locality. — Maxville limestone.

Upper zone: Mouth of Buckeye Fork (?), Fultonham; Below Thompson Residence (?), White Cottage.

Lower zone: Cut No. 4, Mt. Perry-Fultonham.

ORTHOCERAS RANDOLPHENSE—Worthen.

1861. *Orthoceras annulo-costatum*. Meek and Worthen, Proc. Acad. Nat. Sci. Phil., p. 147, (Not *O. annulato-costatum* Boll, 1857).
Chester limestone: Chester, Illinois.
1866. *Orthoceras annulato-costatum*. Meek and Worthen, Geol. Surv. Ill., Vol. II, p. 304, pl. 24, figs. 3a, b.
Chester group: Chester, Illinois.
1882. *Orthoceras Randolphensis*. Worthen, Ill. State Mus. Nat. Hist., Bull. No. 1, p. 38.
Chester group.
1884. *Orthoceras Randolphensis* ? Walcott, U. S. Geol. Surv., Mon. VIII, p. 265, pl. 18, fig. 17.
Lower Carboniferous: Eureka District, Nevada.

Description. — "Shell attaining a medium size, and having the form of an elongated, moderately compressed cone, the sides of which converge towards the apex at an angle of about 14° . Section elliptical, the greater transverse diameter being to the smaller as 100 to 80. Surface ornamented with slightly oblique, annular costæ, which are less than the depressions between, and rather sharply elevated on the smaller half of the shell, but

become gradually obsolete towards the aperture, where they are not more widely separated than near the smaller end. Traces of fine transverse striæ are also seen on well preserved specimens; both between and upon the costæ. (Septa and siphuncle unknown). The largest specimen we have seen is about five inches in length (both extremities being incomplete) and 1.83 inches in its greatest diameter at the larger end, while its greater diameter at the smaller end is near 0.70 inch."

".....Prof. Swallow has described, from the same horizon as this, a similar species under the name *O. chester-*

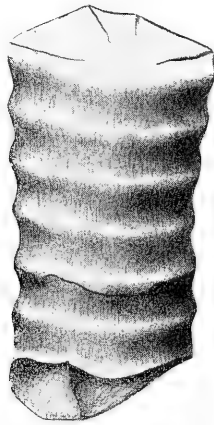


FIG. 35. — *Orthoceras randolphense*. A view of an imperfect specimen.

ensis (Trans. St. Louis Acad. Sci., Vol. II, p. 98, 1862), but our shell differs in having fewer and more distant costæ, there being generally about four of them in a space equalling the transverse diameter, while *O. chesterensis* has eight in the same space. [Meek and Worthen, 1866]."

Horizon and locality. — Maxville limestone.
Shale-nodular zone: Kroft Bridge, White Cottage.

ORTHO CERAS OKAWENSE?—Worthen.

1883. *Orthoceras Okawensis*. Worthen, Geol. Surv. Ill., Vol. VII, p. 324.
Chester limestone: Okaw Bluffs near Red Bud, Randolph County, Illinois.
1890. *Orthoceras okawense*. Worthen, Geol. Surv. Ill., Vol. VIII, p. 149, pl. 26, fig. 3.
Chester limestone: Near Red Bud, Randolph County, Illinois.

Description.—“Shell elongate, slender, very gradually tapering to the apex; septa concave, about four of them in the space of one diameter. Siphuncle sub-central; surface markings unknown.

“This shell has a general resemblance to *O. rushense*, Mc-



FIG. 36.—*Orthoceras okawense?* A view of a fragment of a shell referred to this species.

Chesney of the upper Coal Measures, but differs from it in the position of the siphuncle which in our species is decidedly sub-central [Worthen, 1890].”

Horizon and locality.—Maxville limestone.
Shale-nodular zone: Kroft Bridge, White Cottage.

INDEX.

	PAGE
Allorisma <i>andrewsi</i>	392-393
<i>maxvillensis</i>	393-394
Anthozoa	359-360
<i>Athyris hirsuta</i>	388
<i>subquadrata</i>	383, 384
Bellerophon <i>alternodosus</i>	403-404
<i>sublævis</i>	404-406
Blastoidea	360-361
Brachiopoda	366-389
Bryozoa	363-366
<i>Bulimella canaliculata</i>	400
Bulimorpha <i>canaliculata</i>	400-401
<i>melanoides</i>	399-400
<i>Capulus acutirostris</i>	406, 407
Central Area	357
Cephalopoda	410-416
Cleiothyris <i>hirsuta</i>	388-389
Cœlenterata	359-360
Crinoidea	361-363
Cyathocrinus <i>inequidactylus</i>	361
<i>maxvillensis</i>	361-363
Cypricardella <i>oblonga</i>	394-395
Dentalium <i>illinoiense</i>	395-396
Derbya <i>crassa</i>	366-370
<i>Diaphragmus elegans</i>	373
Dielasma <i>turgida</i>	377, 381-383
<i>turgidum</i>	382
Distribution, Table of	358
Echinodermata	360-363
Endolobus <i>spectabilis</i>	410-412
Eumetria <i>marcyi</i>	386-388
<i>vera</i>	386, 387
<i>vera</i> var. <i>costata</i>	386, 387
<i>verneuilliana</i>	386, 387

	PAGE
<i>Euomphalus similis</i>	397
<i>Fenestella serratula</i>	364-365
Gastropoda	396-410
<i>Hemipronites crassus</i>	367
<i>crenistris</i>	368
<i>lasallensis</i>	367
<i>Holopea newtonensis</i>	398-399
Localities	358
Lower zone	357
<i>Macrocheilus subcorpulentus</i>	401
<i>subcorpulentus</i>	401
<i>Martinia contracta</i>	375-377
<i>glabra</i> var. <i>contracta</i>	376
<i>Microdon oblonga</i>	394
Mollusca	390-416
Molluscoidea	363-389
Morse, W. C., forms discovered by.....	358
<i>Murchisonia vermicula</i>	409-410
<i>Natica carlyana</i>	408
<i>Naticopsis carleyana</i>	408
<i>ziczac</i>	402-403
<i>Nautilus forbesianus</i>	412
<i>pauper</i>	413-414
<i>peramplus</i>	410
<i>spectabilis</i>	410, 411
Northern Area	357
<i>Orthis arachnoidea</i>	367
<i>crenistris</i>	367
<i>lasallensis</i>	367
<i>pratteni</i>	367
<i>richmonda</i>	367
<i>umbraculum?</i>	366, 367
<i>Orthisina crassa</i>	367
<i>umbraculum?</i>	367
<i>Orthoceras annulato-costatum</i>	414
<i>annulo-costatum</i>	414
<i>chesterensis</i>	415
<i>okawense?</i>	416
<i>okawensis</i>	416
<i>randolphenses</i>	414-415
<i>randolphensis</i>	414

<i>Orthonychia acutirostre</i>	406-408
<i>acutirostris</i>	407
<i>Orthothetes crassus</i>	369
Pelecypoda	390-395
Pentremites elegans	360-361
Pinna maxvillensis	391-392
<i>Platyceras acutirostris</i>	406
<i>uncum</i>	406
<i>Polyphemopsis melanooides</i>	399
Productus cestriensis	372-375
<i>elegans</i>	372, 373
<i>pileiformis</i>	370-372, 374
<i>tenuicostus</i>	372
<i>Retzia vera</i>	386
<i>vera</i> var. <i>costata</i>	386
<i>verneuiliana</i>	386
Rhombopora armata	366
Scaphopoda	395-396
Seminula subquadrata	375, 377, 383-385
Schizodus chesterensis	390-391
Septopora rectistyla	363-364
Shale — nodular zone	357
<i>Solenospira vermicula</i>	409
Southern Area	357
Sphærodoma subcorpulenta	401-402
Spirifer attenuatus	377
<i>glaber</i>	375
<i>glaber</i> var. <i>contracta</i>	375
<i>increbescens</i>	380, 381
<i>increbescens</i>	377, 379
<i>keokuk</i>	377-381
<i>keokuk</i> var.	377, 378, 380
<i>opimus</i>	380
<i>rockymontana</i>	377
<i>rockymontani</i>	380
<i>rockymontanus</i>	380, 381
<i>Spirifera contracta</i>	375, 376
<i>contractus</i>	375
<i>glabra</i> var. <i>contracta</i>	375
<i>keokuk</i>	377, 378
<i>keokuk</i> var.	378
<i>opima</i>	378
<i>rockymontana</i>	378, 379

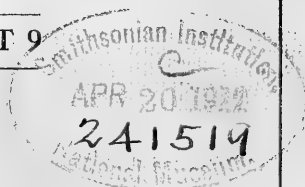
	PAGE:
<i>Spirigera hirsuta</i>	388.
<i>Straparollus similis</i>	396-398
<i>Streptorhynchus crassum</i>	368.
<i>crenistris</i>	368.
<i>richmondi</i>	368.
<i>unbraculum</i>	367.
<i>Strophostylus carleyana</i>	408-409.
<i>carleyanus</i>	408.
<i>Synocladia rectistyla</i>	363
Table of distribution.....	358.
<i>Temnocheilus forbesianus</i>	412.
<i>Terebratula marcyi</i>	386
<i>serpentaria</i>	386.
<i>turgida</i>	381, 382.
Thickness	357.
Upper zone	357.
Weller's Bibliography, use of.....	358.
Whitfield, R. P., fossils described by.....	358.
<i>Zaphrentis cliffordana</i>	359-360.

Proceedings
of the
Ohio State
Academy of Science

The Agaricaceae of Ohio

BY
WILMER GARFIELD STOVER, A. M.

VOLUME V, PART 9



Special Paper No. 18

12

The Agaricaceae of Ohio

A Preliminary Report, with Keys
to the Genera and Species.

Contributions from the Botanical Laboratory
of Miami University, VIII.

By

WILMER GARFIELD STOVER, A. M.

PUBLICATION COMMITTEE

J. C. HAMBLETON

E. L. RICE

C. G. SHATZER

COLUMBUS, OHIO:
The F. J. Heer Printing Co.
1912



Published by a grant from the
Emerson McMillin Research Fund.
Date of publication
March, 1912.

INTRODUCTION.

The Agaricaceae constitute a rather large family of the Basidiomycetae and are commonly known as the "gill fungi." The family is characterized by having the spores borne on club-shaped *basidia* arranged in a definite layer known as the *hymenium*, which covers a number of radiating plates, the *lamellae* or "gills", suspended from the lower surface of the *pileus*, or cap. A *stipe*, or stem, is usually present, but may be wanting.

Many of the species are edible, and some are considered a great delicacy. Others are poisonous, and may cause serious illness or even death. A few are parasitic upon certain higher plants, notably upon the roots or trunks of trees, when they may cause extensive injury to the timber. Many are beautifully colored, red, yellow, purple, brown, white, etc., or quite large, or otherwise striking in appearance. For these reasons and others these plants are interesting objects of study.

The present paper is essentially a preliminary report on the Agaricaceae of Ohio and consists of keys to the genera and species reported as occurring within the state. A glossary of descriptive terms and a bibliography of the literature pertaining to the Ohio species and other works, which will be found helpful to the student, are included.

The list of species has been made up from the works (see bibliography) of Lea, Morgan, Hard, Lloyd, Peck, Berkeley, Kellerman and Montagne. Besides the species thus published, the list has been augmented by reference to specimens in the herbarium of the New York Botanical Garden, the herbarium of the state botanist of New York, the herbarium of the Ohio State University and by the collections of the writer.

Thomas G. Lea collected in southwestern Ohio, 1834-1844, and sent his specimens to Rev. M. J. Berkeley, in England, who described a number of new species from them. Others were referred to existing species. Morgan, a number of years later

(1878-1907), collected in the same region. He greatly extended Lea's list (although he did not recognize all the species previously reported by Lea) and described a number of new species. W. S. Sullivant, an eminent bryologist of Columbus, sent a number of collections to Montagne in Paris during the early fifties, some of them with drawings by Mr. Sullivant or by Mr. Robinson who worked with him. Montagne described fifty-five new species from these specimens. It seems remarkable that none of these species have been certainly recognized since. Most of them are probably to be referred to other species, or at least are now recognized by other names.

Peck has described species based on specimens sent to him by Ohio collectors, Morgan, Lloyd, Kellerman and others. Some of Peck's New York species have also been found in Ohio. His types are all, or nearly all, preserved in the state herbarium at Albany. Hard collected in several parts of the state and published his results in a well illustrated book. Professor Atkinson, of Cornell University, also described several species from material sent to him by Kellerman and Hard.

The list at present includes approximately five hundred and forty (540) species. Some of these are of doubtful determination. In many cases the collections were not preserved, and it is impossible at this date to confirm or correct the determination. The type specimens of Montagne have not been available to the writer for study, and, except for a few species of *Marasmius*, Morgan's types were not preserved. Whether these will all prove to be valid species must be left for future study to determine.

Moreover, the list is not claimed to be complete. There are doubtless many species occurring in the state which have not yet been reported, for some sections have scarcely been worked over at all. Before it is possible to have a fairly complete and reasonably accurate state list, there must be a large number of specimens from different parts of the state assembled in accessible herbaria, preferably, the state herbarium. If notes on the fresh plants accompany each specimen, the collection will have much greater value.

In preparing the keys, the most apparent characters possible have been employed. The aim has been to produce accurate and usable keys, rather than to exhibit relationships of species. Some of the keys have been tested by use by mycology students at Miami University for several years and at the Ohio State University during the present year. Most of them have been revised several times as suggested by use.

The work is based largely on published descriptions, and in some cases altogether. These are sometimes so brief or so lacking in precise detail that it has been difficult to find reliable and well-marked characters upon which to separate species. This is especially true of species founded wholly upon dried specimens.

Notwithstanding such errors, misconceptions and incorrect conclusions as doubtless occur, it is believed that the paper will prove helpful to students, amateur mycologists and others in the determination of Ohio Agarics. It is offered as a summary of our present knowledge of the Ohio plants, and is to be regarded as only a preliminary study.

It is not within the scope of this paper to discuss the species in detail, so that many points of interest and of some importance must necessarily be omitted. With each species included, however, a list of references to the most available and useful works is given. One or more of these should always be consulted before reaching a decision as to the determination of any plant.

The matter of the classification and nomenclature of the Agaricaceae is still in an unsettled condition. It has seemed best in most instances to follow the arrangement given by Saccardo in his *Sylloge Fungorum* for two reasons: It is not the purpose to present a critical study of the nomenclature of the family, and most of the available works on this group will be found to follow a similar system.

The writer wishes here to acknowledge his many obligations to Dr. Bruce Fink under whose direction the work was undertaken. He is also indebted to Dr. W. A. Murrill for the privilege of examining specimens in the herbarium of the New York

Botanical Garden; to C. H. Peck for the determination of a number of species, and for the privilege of studying type specimens in the herbarium of the state botanist at Albany; to Mr. S. H. Burnham, his assistant; to Miss Gertrude S. Burlingham, of Brooklyn, for aid in the determination of species of *Russula* and *Lactaria*; to Mr. C. G. Lloyd for library privileges in the Lloyd Library at Cincinnati; to Mr. William Holden, librarian, for many courtesies while consulting literature; to Professor T. H. Macbride for the loan of the specimens of *Marasmius* in the Morgan collection, now at Iowa City, Iowa; to Mrs. Laura Vaile Morgan for the loan of Mr. Morgan's manuscript; and to others in various ways.

Columbus, Ohio, July, 1911.

BIBLIOGRAPHY.

- ATKINSON, G. F. Mushrooms, edible, poisonous, etc. I-VII. 1-323. f. 1-238. New York. Henry Holt & Co. 1903. The Agaricaceae are treated on pages 1 to 170.
- Two new species belonging to *Naucoria* and *Stropharia*. *Jour. Myc.* 12: 193-4. pl. 91. 1906.
- BEARDSLEE, H. C. The rosy-spored Agarics, or *Rhodosporae*. *Jour. Myc.* 11: 109-10. pl. 76, 77. 1905.
- BERKELEY, M. J. Outlines of British Fungology. I-XVII. 1-442. pl. 1-24. London. Lovell Reeve. 1860. The Agaricaceae are treated on pages 89 to 229.
- Decades of fungi. VIII-X, Australian and North American fungi; XII-XIV, Ohio fungi. *Lond. Jour. Bot.* 4: 298-315. pl. 11-12. 1845; 6: 312-326. 1847.
- BURLINGHAM, GERTRUDE SIMMONS. *Lactariaeae*. *N. Am. Flora* 9^o: 172-200. New York. The New York Botanical Garden. 1910. The genus *Lactaria* only.
- BURT, EDWARD A. Key to the genera of Basidiomycetes of Vermont. Contributions to the Botany of Vermont, VI. 1-18. Middlebury, Vt. Middlebury College. 1899.
- CLEMENTS, FREDERICK EDWARD. The genera of fungi. 1-227. Minneapolis. The H. W. Wilson Company. 1909. The Agaricaceae are treated on pages 110 to 115.
- Minnesota mushrooms. *Minn. Plant Studies* IV. 1-169. pl. 1-2. f. 1-124. Minneapolis, Minn. University of Minnesota. 1910.
- COOKE, M. C. Handbook of British fungi. 1-398. London. 1883.
- FRIES, ELIAS. *Hymenomycetes Europaei*. 1-775. Upsala. Ed. Berling. 1874. The Agaricaceae are treated on pages 1 to 495.
- FORSTER, EDWARD J. Agarics of the United States — Genus *Panus*. *Jour. Myc.* 4: 21-26. 1888.

- HARD, M. E. The mushroom, edible and otherwise. I-XII. 1-609. f. 1-504. Columbus. The Ohio Library Co. 1908. The Agaricaceae are treated on pages 1 to 349.
- HENNINGS, P. Hymenomycetinae. Engler, A., and Prantl, K., Die Natürlichen Pflanzenfamilien I. 1 **: 105-276. f. 66-125. Leipzig. Wilhelm Engelmann. 1900. The Agaricaceae are treated on pages 198 to 276.
- HERBST, WILLIAM. Fungal flora of the Lehigh Valley. 1-229. 25 plates (not numbered). Allentown, Pa. Berkenmeyer, Keck & Co. 1899. The Agaricaceae are treated on pages 19 to 115.
- KAUFFMAN, C. H. The genus Cortinarius. Bull. Torr. Bot. Club 32: 301-327. f. 1-7. 1905.
- The genus Cortinarius with key to the species. Jour. Myc. 13: 32-39. pl. 93-100. 1907.
- Michigan species of Russula. Eleventh Rept. Mich. Acad. Sci. 51-91. f. 1-3. 1909.
- KELLERMAN, W. A. and WERNER, W. C. Catalogue of Ohio plants. Rept. Geol. Surv. of Ohio. 7: part 2. 56-406. 1893. The Agaricaceae are treated on pages 300 to 317. Bibliography on pages 56 to 79.
- LEA, THOMAS G. Catalogue of plants, native and naturalized, collected in the vicinity of Cincinnati, Ohio, during the years 1834-1844. 1-77. Philadelphia. T. K. & P. G. Collins. 1849. The Agaricaceae are treated on pages 48 to 57. Reprinted in Jour. Cin. Soc. Nat. Hist. 5: 197-217. 1882.
- LLOYD, C. G. A compilation of the Volvae of the United States. 1-21. f. 1-9. Cincinnati. The Lloyd Library. 1898.
- The large Lepiotas. Myc. Notes 1: 4-8. 1898.
- The small Volvarias. Myc. Notes 1: 9-10. 1899.
- The genus Pluteus. Myc. Notes 1: 12-15. 1899.
- The genus Psalliota. Myc. Notes 1: 25-30. 1899.
- Collybias of Cincinnati. Myc. Notes 1: 33-44. f. 3-18. 1900.
- MACADAM, ROBERT K. North American Agarics — The genus Russula. Jour. Myc. 5: 58-64, 135-141. 1889.

- See McIlvaine, Charles, and Macadam, Robert K.
- MARSHALL, NINA L. *The mushroom book.* I-XXVI. 1-167. pl. 1-48. f. 1-170. New York. Doubleday, Page & Co. 1901. Plates and figures not numbered. The Agaricaceae are treated on pages 46 to 93.
- McILVAINE, CHARLES, and MACADAM, ROBERT K. *One thousand American fungi.* I-XXXVII. 1-727. f. 1-181+1-6. Indianapolis. The Bowen-Merrill Co. 1902. The Agaricaceae are treated on pages 1 to 395.
- MONTAGNE, J. F. C. *Sylloge generum specierumque cryptogamarum.* Parisiis, sumptibus J. B. Bailliere; I-XXIV. 1-498. 1856.
- MORGAN, A. P. *The mycologic flora of the Miami Valley.* Jour. Cin. Soc. Nat. Hist. 6: 54-81, 97-115, 173-199. pl. 2-5, 8-9. 1883. This series was continued until 1888 but the other papers do not treat the Agaricaceae.
- *North American Agarics. The subgenus Amanita.* Jour. Myc. 3: 25-33. 1887.
- *New North American fungi.* Jour. Cin. Soc. Nat. Hist. 18: 36-45. pl. 1-3. 1896.
- *North American species of Marasmius.* Jour. Myc. 11: 201-212, 233-267. 1905. 12: 1-9, 92-95. 1906.
- *North American species of Lepiota.* Jour. Myc. 12: 154-159, 195-203, 242-248. 1906. 13: 1-17. 1907.
- *North American species of Agaricaceae.* Jour. Myc. 13: 53-62, 143-153, 246-255. 1907. 14: 27-32, 64-75. 1908. *Psathyrella, Panaeolus, Deconica, Psathyra, Psilocybe, Pilosace, Hypholoma and Stropharia* are treated.
- MURRILL, WILLIAM A. *Agaricaceae.* N. Am. Flora 9³: 163-172. New York. The New York Botanical Garden. 1910. *Chanterelleae* only are treated.
- PECK, CHARLES HORTON. *Reports of the State Botanist 1870-1910.* Published in the Annual Reports of the New York State Museum of Natural History, 1873-1911. Contain descriptions of many Agarics which have also been reported for Ohio; also many valuable plates illustrating a large

- number of species. The reports also include monographs of several genera which are especially cited below.
- Agaricini. N. Y. State Cab. Rept. **23**: 66-127. pl. 1-6. 1873.
- New York species of *Amanita*. N. Y. State Mus. Rept. **33**: 38-49. 1880. This paper includes the genus *Amanitopsis*.
- New York species of *Psalliota*. N. Y. State Mus. Rept. **36**: 41-49. 1883.
- New York species of *Lepiota*. N. Y. State Mus. Rept. **35**: 150-164. 1884.
- New York species of *Lactarius*. N. Y. State Mus. Rept. **38**: 111-133. 1885.
- New York species of *Pluteus*. N. Y. State Mus. Rept. **38**: 133-138. 1885.
- New York species of *Pleurotus*, *Claudopus*, *Crepidotus*. N. Y. State Mus. Rept. **39**: 58-73. 1886.
- New York species of *Paxillus*. N. Y. State Mus. Bull. **1**²: 29-33. 1887.
- New York species of *Cantharellus*. N. Y. State Mus. Bull. **1**²: 34-43. 1887.
- New York species of *Clitopilus*. N. Y. State Mus. Rept. **42**: 39-46. 1889.
- New York species of *Armillaria*. N. Y. State Mus. Rept. **43**: 40-45. 1890.
- New York species of *Tricholoma*. N. Y. State Mus. Rept. **44**: 38-64. 1891.
- New York species of *Omphalia*. N. Y. State Mus. Rept. **45**: 32-42. 1893.
- New York species of *Pluteolus*. N. Y. State Mus. Rept. **46**: 58-61. 1893.
- New York species of *Galera*. N. Y. State Mus. Rept. **46**: 61-69. 1893.
- Edible and poisonous fungi of New York. N. Y. State Mus. Rept. **48**: 203-316. pl. 6-32. 1895.
- New York species of *Collybia*. N. Y. State Mus. Rept. **49**: 32-55. 1896.

- New York species of *Flammula*. N. Y. State Mus. Rept. **50**: 133-142. 1898.
- New species of fungi. Bull. Torr. Bot. Club **26**: 63-71. 1899. The following new species from Ohio are described: *Lepiota coerulescens*, *Volvaria umbonata*, *Galera capillari-ripes*, *Crepidotus latifolius*, *Coprinus laceratus*, *Psathyra microsperma*.
- Report of the state botanist on the edible fungi of New York. N. Y. State Mus. Memoir **4**: 133-234. pl. 44-68. 1900.
- A new species of *Galera*. Jour. Myc. **12**: 148. pl. 89. 1906.
- New York species of *Hygrophorus*. N. Y. State Mus. Bull. **116**: 45-67. 1907.
- New York species of *Russula*. N. Y. State Mus. Bull. **116**: 67-98. 1907.
- New York species of *Pholiota*. N. Y. State Mus. Bull. **122**: 141-158. 1908.
- New York species of *Lentinus*. N. Y. State Mus. Bull. **131**: 42-47. 1909.
- New York species of *Entoloma*. N. Y. State Mus. Bull. **131**: 47-58. 1909.
- List of species and varieties of fungi described by C. H. Peck. N. Y. State Mus. Bull. **131**: 59-190. 1909. A valuable compilation of all the fungi described by C. H. Peck to 1908, with citations of the original and subsequent publications.
- New York species of *Inocybe*. N. Y. State Mus. Bull. **139**: 48-67. 1910.
- New York species of *Hebeloma*. N. Y. State Mus. Bull. **139**: 67-77. 1910.
- List of edible, poisonous and unwholesome mushrooms hitherto figured and described by C. H. Peck. N. Y. State Mus. Bull. **139**: 78-86. 1910.
- New York species of *Hypholoma*. N. Y. State Mus. Bull. **150**: 73-84. 1911.

- New York species of *Psathyra*. N. Y. State Mus. Bull. 150: 84-86. 1911.
- PERRY, ELMA BROOKS. Preliminary list of the edible fungi of Ohio. University [Ohio State] Bull. 4. 30: 1-8. 1900.
- SACCARDO, P. A. Sylloge fungorum. 5: 1-1146. Typis Seminarii. Patavia. 1887. Occasional references are also made to supplemental lists in later volumes.
- SMITH, WORTHINGTON G. Synopsis of the British Basidiomycetes. 1-531. pl. 1-5. f. 1-145. London. British Museum. 1908. The Agaricaceae are treated on pages 11 to 316.
- STEVENSON, JOHN. British Fungi. Vol. 1. I-VII. 1-372. f. 1-39. Vol. 2. 1-336. f. 1-52. Edinburg and London. William Blackford and Sons. 1886. The Agaricaceae are treated on pages 1 to 372 of Vol. 1, and pages 1 to 165 of Vol. 2.
- STOVER, WILMER G. Notes on new Ohio Agarics. Ohio Nat. 10: 177-178. 1910.
- Notes on Ohio Agarics II. Ohio Nat. 11: 247. 1910.
- Notes on new Ohio Agarics III. Ohio Nat. 11: 349-350. 1911.
- SWANTON, E. W. Fungi and how to know them. I-XI. 1-210. pl. 1-48. London. Methuen & Co. 1909. The Agaricaceae are treated on pages 107 to 181.
- UNDERWOOD, L. M. Moulds, mildews and mushrooms. I-V. 1-236. pl. 1-9. New York. Henry Holt & Co. 1899. The Agaricaceae are treated on pages 109 to 132.
- WERNER, WM. C. See Kellerman, W. A. and Werner, W. C.
- WHITE, EDWARD ALBERT. A preliminary report on the Hymeniales of Connecticut. Conn. State Geol. and Nat. Hist. Surv. Bull. 3: 1-81. pl. 1-40. 1905. The Agaricaceae are treated on pages 13 to 53.
- Second report on the Hymeniales of Connecticut. State Geol. and Nat. Hist. Surv. Bull. 15: 1-70. pl. 1-28. 1910.

ABBREVIATIONS.

(*See bibliography for full titles.*)

- A.—Atkinson: Mushrooms.
B. T.—Bulletin of the Torrey Botanical Club.
H.—Hard: The mushroom edible and otherwise.
J. M.—Journal of Mycology.
K.—Kauffman: Russulas of Michigan.
M.—Morgan: Mycologic flora of the Miami Valley.
M. B.—New York State Museum Bulletin. (See bibliography: Peck, C. H.)
Mc.—McIlvaine: One thousand American fungi.
M. S. M.—Memoir of the New York State Museum. (See bibliography: Peck, C. H.)
N. A. F.—North American Flora, Vol. 9, Part 3.
Oh. Nat.—Ohio Naturalist.
P. R.—Peck: Reports of the state botanist of New York.
S.—Saccardo: Sylloge Fungorum (volume 5, unless otherwise stated.)
St.—Stevenson: British fungi (volume 1, unless otherwise stated.)

KEY TO THE GENERA.

- Spores white (sometimes yellow or ochraceous, lilac or pale pink; cinnabar-red in one species and *green* in another)
Leucosporae (473)
- Spores rosy, salmon-colored or rosy-rust-colored
Rhodosporae (475)
- Spores ochraceous, yellowish-brown or brown-rust-colored
Ochrosporae (476)
- Spores purple, purple-brown or black... **Melanosporae** (478)

LEUCOSPORAE.

- A.¹ Plants corky, tough, leathery or fleshy-leathery; persistent or reviving when moistened.
- B.¹ Plants corky; hymenium often porose at first, becoming lamellate; lamellae often branched and anastomosing.
Lenzites (543)
- B.² Plants not corky, lamellae never porose.
- C.¹ Edge of lamellae split into two laminae.
Schizophyllum (543)
- C.² Lamellae not as above.
- D.¹ Pileus differing from stipe in texture, or easily separable from it.
- E.¹ Pileus gelatinous-leathery.
Heliomyces (532)
- E.² Pileus fleshy and tough or thin and leathery **Marasmius** (533)
- D.² Stipe, if present, continuous with pileus, but may be absent.
- E.¹ Lamellae obtuse and fold-like.
Trogia (543)
- E.² Edge of lamellae acute.
- F.¹ Edge of lamellae serrate or notched.
Lentinus (539)
- F.² Edge normally entire... **Panus** (541)

A.² Plants fleshy or somewhat so; soon putrescent, not reviving when moistened.

B.¹ Stipe eccentric, lateral or wanting. . . . **Pleurotus** (513)

B.² Stipe central or subcentral.

C.¹ Edge of lamellae obtuse; lamellae thick or vein-like.

D.¹ Lamellae decurrent, usually dichotomous.

Cantharellus (531)

D.² Lamellae not decurrent; plants parasitic on other Hymenomycetes. . . . **Nyctalis** (532)

C.² Edge of lamellae acute.

D.¹ Universal veil membranous, usually leaving a volva at base of stipe, or more rarely breaking up into patches or scales which are evident on surface of pileus.

E.¹ Annulus present as a ring about the stipe.

Amanita (480)

E.² Annulus wanting. . . . **Amanitopsis** (482)

D.² Volva wanting.

E.¹ Annulus present.

F.¹ Pileus confluent with stipe; lamellae attached **Armillaria** (491)

F.² Pileus distinct and easily separating from stipe; lamellae usually free.

Lepiota (482)

E.² Annulus wanting.

F.¹ Trama floccose (of interwoven fibers).

G.¹ Lamellae waxy, not easily splitting into two layers.

Hygrophorus (516)

G.² Lamellae fleshy, readily splitting into two layers.

H.¹ Stipe fleshy or fibrous elastic, confluent with pileus and of same texture.

I.¹ Lamellae sinuate.

Tricholoma (492)

I.² Lamellae usually decurrent, sometimes adnate at least when young.

Clitocybe (497)

II.² Stipe cartilaginous, confluent with pileus but of different texture.

I.¹ Lamellae decurrent; pileus umbilicate.

Omphalia (511)

I.² Lamellae not truly decurrent; pileus not umbilicate or rarely so.

J.¹ Pileus typically campanulate; margin straight from the first; lamellae adnate or unciniate.

Mycena (508)

J.² Pileus not campanulate, usually convexo-plane; margin at first inrolled; lamellae free or obtusely attached.

Collybia (502)

F.² Trama vesiculose (hyphae often enlarged, in sections giving the appearance of rounded cells).

G.¹ Plants with a milky or colored juice.

Lactaria (519)

G.² Plants with watery juice.

Russula (525)

RHODOSPORAE.

A.¹ Stipe eccentric or wanting.

B.¹ Pileus large, usually glabrous; lamellae white or whitish.

Pleurotus (513)

B.² Pileus medium, downy to hairy; lamellae orange-yellow.
Claudopus (548)

A.² Stipe central or subcentral.

B.¹ Edge of lamellae obtuse; thick and veinlike.
Cantharellus (531)

B.² Edge of lamellae acute.

C.¹ Universal veil leaving a volva at base of stipe.
Volvaria (543)

C.² Volva wanting.

D.¹ Lamellae free; pileus easily separating from
stipe..... **Pluteus** (544)

D.² Lamellae normally attached (in some becoming
nearly free); pileus confluent with stipe.

E.¹ Lamellae decurrent.

F.¹ Stipe fleshy-fibrous... **Clitopilus** (546)

F.² Stipe cartilaginous; pileus umbilicate.
Eccilia (547)

E.² Lamellae not decurrent.

F.¹ Lamellae sinuate; stipe fleshy-fibrous.
Entoloma (545)

F.² Lamellae not sinuate; stipe cartilaginous.

G.¹ Pileus campanulate; margin straight
from the first... **Nolanea** (547)

G.² Pileus convexo-plane; margin at first
inrolled **Leptonia** (547)

OCHROSPORAE.

A.¹ Lamellae dissolving at maturity into a gelatinous or powdery
condition **Bolbitius** (561)

A.² Lamellae not dissolving.

B.¹ Lamellae readily separating from substance of pileus;
margin of pileus inrolled..... **Paxillus** (560)

B.² Lamellae not readily separating from pileus.

C.¹ Edge of lamellae obtuse; thick and vein-like.
Cantharellus (531)

- C.² Edge of lamellae acute.
 - D.¹ Arachnoid (cobwebby) veil present; often disappearing with age. **Cortinarius** (557)
 - D.² Arachnoid veil absent.
 - E.¹ Stipe lateral, eccentric or wanting.
Crepidotus (556)
 - E.² Stipe central or subcentral.
 - F.¹ Partial veil normally leaving an annulus.
Pholiota (548)
 - F.² Annulus wanting.
 - G.¹ Trama vesiculose; pileus usually bright-colored, yellow, red or purple **Russula** (525)
 - G.² Trama floccose; pileus variously colored.
 - H.¹ Lamellae free.
Pluteolus (554)
 - H.² Lamellae normally attached, sometimes becoming nearly free with age.
 - I.¹ Stipe fleshy or fleshy-fibrous.
 - J.¹ Lamellae adnate or decurrent.
Flammula (553)
 - J.² Lamellae sinuate or mostly so.
 - K.¹ Pileus glabrous, often viscid.
Hebeloma (552)
 - K.² Pileus fibrillose, silky or scaly, dry.
Inocybe (550)
 - I.² Stipe cartilaginous.
 - J.¹ Lamellae adnate or adnixed.

K.¹ Pileus conical or campanulate, margin straight from the first.

Galera (555)

K.² Pileus convexo-plane, margin at first inrolled.

Naucoria (554)

J.² Lamellae decurrent.

Tubaria (556)

MELANOSPORAE.

A.¹ Spores purple or purple-brown.

B.¹ Partial veil present.

C.¹ Veil forming an annulus.

D.¹ Lamellae free; pileus easily separating from stipe**Agaricus** (562)

D.² Lamellae attached; pileus continuous with stipe.
Stropharia (564)

C.² Veil mostly appendiculate to margin of pileus, slight annulus rarely formed.....**Hypholoma** (565)

B.² Partial veil absent, or soon evanescent.

C.¹ Lamellae free from stipe.....**Pilosace** (566)

C.² Lamellae attached.

D.¹ Lamellae decurrent**Deconica***

D.² Lamellae not decurrent.

E.¹ Pileus conic to campanulate, margin straight from the first; stipe fragile.

Psathyra (567)

E.² Pileus usually becoming convex or expanded, margin at first inrolled; stipe more or less rigid**Psilocybe** (566)

A.² Spores black or blackish-brown.

B.¹ Lamellae deliquescent at maturity into an inky fluid or into fine lines.....**Coprinus** (567)

B.² Lamellae not deliquescent.

C.¹ Spores globose to elliptic; lamellae not decurrent.

D.¹ Annulus present; variegated lamellae exceeding the margin **Anellaria** (570)

D.² Annulus wanting.

E.¹ Pileus striate, membranous; lamellae uniform in color..... **Psathyrella** (571)

E.² Pileus not striate, fleshy; lamellae variegated in color, extending beyond margin of pileus **Panaeolus** (570)

C.² Spores fusiform; lamellae decurrent; plants glutinous or viscid **Gomphidius***

* No Ohio species reported.

KEY TO THE SPECIES.

AMANITA PERS.

A.¹ Volva persistent as a loose cup about base of stipe; pileus not scaly from remnants of volva.

B.¹ Pileus orange-red or yellow; lamellae yellow. S. 8; H. 40; M. 57; Mc. 12; A. 70; P. R. 33:41.

A. caesarea Scop

B.² Pileus white, rarely yellow or brownish, never orange-red; lamellae white.

C.¹ Stipe bulbous; margin of pileus even.

D.¹ Stipe rooting; spores elliptical. S. 14:64; H. 28; Mc. 10; P. R. 50:96.

A. magnivelaris Peck

D.² Stipe not rooting; spores globose or subglobose.

E.¹ Pileus dry; lamellae adnexed; volva circularly split. S. 10; H. 35; Mc. 10; St. 4.

A. mappa Fr.

E.² Pileus viscid or slightly so when moist; lamellae free; volva bursting at top, not circularly split.

F.¹ Lamellae broad; stipe nearly smooth.

S. 9; H. 20; Mc. 7; A. 55; St. 4;

P. R. 33:42.....*A. phalloides* Fr.

F.² Lamellae linear-lanceolate; surface of stipe torn into scales; pileus often lobed. S. 9; H. 23; Mc. 6; A. 61;

St. 3.....*A. virosa* Fr.

C.² Stipe not bulbous; margin of pileus narrowly striate.

S. 12; H. 43; Mc. 11; P. R. 33:42; A. 69.

A. sprcta Peck

A.² Volva forming a closely fitting or adnate sheath, or concentric rings about base of stipe, or wholly friable; pileus usually with warty scales.

B.¹ Flesh becoming reddish when wounded; pileus dingy reddish to tan; volva wholly friable. S. 16; M. 58; Mc. 21; H. 38, 39; A. 71; St. 8; P. R. 33:44.

A. rubescens Fr.

B.² Flesh not so changing.

C.¹ Stipe stuffed or hollow.

D.¹ Pileus orange or yellow, rarely white.

E.¹ Margin of pileus widely tuberculate-striate; pileus yellow or straw-yellow. S. 13; P.

R. 33:43; Mc. 18....*A. russuloides* Peck

E.² Margin narrowly striate or striatulate.

F.¹ Pileus more than 6 cm. broad; spores elliptical. S. 13; H. 23; M. 58; Mc. 14; A. 52; P. R. 33:43.

A. muscaria Linn.

F.² Pileus less than 6 cm. broad; spores globose. S. 14; H. 26; Mc. 16; A. 54; P. R. 33:44....*A. frostiana* Peck

D.² Pileus white to brownish, or rarely with tinge of yellow.

E.¹ Margin of pileus even; stipe rooting. S. 14:64; H. 28; Mc. 10; P. R. 50:95.

A. magnivelaris Peck

E.² Margin striate or striatulate; stipe not rooting.

F.¹ Pileus white; stipe bulbous; spores globose. A. 66; H. 37.

A. cothurnata Atk.

F.² Pileus olive-brown to livid; stipe nearly equal, spores elliptical. S. 14; M. 58; Mc. 17; St. 6.....*A. pantherina* Dc.

C.² Stipe solid.

D.¹ Stipe deeply rooting.

E.¹ Lamellae free. S. 16:2; H. 31, 33; B. T. 27: 609-10.....*A. radicata* Peck

E.² Lamellae adnexed. S. 15; Mc. 19; H. 28-30; A. 72.....*A. solitaria* Fr.

D.² Stipe not rooting; bulb massive. S. 15; H. 32, 33, 36; St. 7; Mc. 19; P. R. 33:46.

A. strobiliformis Vitt.

DOUBTFUL SPECIES.

A. flavo-rubens B. & M., described from specimens collected at Columbus by Sullivant, has not been since reported. As suggested by Lloyd, it is doubtless a form of *A. muscaria*. S. 17.

A. daucipes B. & M., also described from Sullivant's material, is placed in *Amanitopsis* by Saccardo, and in *Lepiota* by Morgan. It is probably a variety of *A. solitaria*. Not reported since Sullivant's time. S. 26.

A. polypyramis B. & C. is placed in *Lepiota* by Morgan who reports it from Preston, O. As stated by Morgan and suggested by Atkinson, it is probably a form of *A. solitaria*. S. 18.

Morgan regards *A. radicata* as a form of *A. solitaria* but places it in *Lepiota*. J. M. 13:12.

A. verna is regarded by most writers as a variety of *A. phalloides*. *A. virosa* is also so regarded by some.

AMANITOPSIS ROZ.

Volva persistent; pileus not mealy, more than 4 cm. broad.

Pileus sulcate on margin, glabrous; spores globose or subglobose. S. 21; H. 43; M. 58; Mc. 28; P. R. 33: 47; A. 74; St. 11.....*A. vaginata* (Bull.) Roz.

Pileus striate only, floccose-scaly; spores elliptical. S. 23; M. 58; Mc. 31; P. R. 33:47.....*A. volvata* (Peck) Sacc.

Volva breaking up into floccose scales; pileus mealy, less than 4 cm. broad. Mc. 31; A. 76; P. R. 33: 49.

A. farinosa (Schw.)

LEPIOTA FR.

A.¹ Pileus viscid or glutinous.

B.¹ Pileus 3-4 cm. broad; stipe solid; lamellae broad. J. M. 12:203*L. glischra* Morg.

B.² Pileus 1-3 cm. broad; stipe fistulous; lamellae narrow. J. M. 12:202.....*L. candida* Morg.

A.² Pileus dry; not viscid.

B.¹ Plants changing color when bruised, or markedly so in drying.

C.¹ Plants becoming bluish; pileus usually less than 3 cm. broad. S. 16:9; J. M. 12:246; B. T. 26:63.

L. coeruleescens Peck

C.² Plants not becoming bluish; pileus more than 3 cm. broad.

D.¹ Pileus 3-5 cm. broad; flesh becoming reddish when bruised, whole plant reddish when handled and finally blackish when dried; stipe not bulbous or clavate. J. M. 12:246.

L. rufescens Morg.

D.² Pileus 5-10 cm. or more broad; plants not becoming blackish; stipe bulbous or clavate.

E.¹ Flesh only becoming reddish when broken; pileus not umbonate; margin even. S. 29; M. 61; J. M. 13:8; St. 14; Mc. 35.

L. rhacodes Vitt.

E.² Whole plant becoming reddish or reddish-brown; pileus broadly umbonate; margin more or less striate. S. 43; H. 49, 50; Mc. 48; M. 62; A. 80; P. R. 35:159; J. M. 13:9 *L. americana* Peck

B.² Plants not changing color as above.

C.¹ Pileus with *erect, pointed* scales; annulus somewhat cobwebby.

D.¹ Pileus brown. S. 34; H. 55; M. 62; J. M. 12:200, 201; A. 81, 82; Mc. 40; P. R. 35:154.

L. acutesquamosa Weinm. *L. asperula* Atk.

D.² Pileus white. J. M. 12:202. *L. gemmata* Morg.

C.² Pileus and annulus not as above.

D.¹ Pileus usually more than 8 cm. broad.

E.¹ Lamellae and spores green. S. 31; H. 50, 51; Mc. 37; A. 80; M. 61; J. M. 13:8.

L. morgani Peck

E.² Lamellae usually white or yellow, spores white; never green.

F.¹ Lamellae narrow, adnate; pileus granu-
lose. S. 48; H. 52, 53; M. 63, pl. 3;
J. M. 12:196... *L. granosa* Morg.

F.² Lamellae broad, free; surface of pileus
breaking up into large scales; annulus
movable.

G.¹ Pileus umbonate; stipe furfuraceous-
scaly. S. 27; H. 46; M. 60; St.
13; A. 79; Mc. 35; J. M. 13:7; P.
R. 35:152.....*L. procera* Scop.

G.² Pileus not umbonate; stipe smooth or
nearly so. S. 29; M. 61; St. 14;
Mc. 35; J. M. 13: 8.

L. rhacodes Vitt.

D.² Pileus less than 8 cm. broad.

E.¹ Pilei mostly more than 2 cm., and less than
8 cm. broad.

F.¹ Pileus glabrous.

G.¹ Flesh thick; lamellae white, soon
dingy or smoky-brown; annulus
movable. S. 43; H. 48, 49; M.
63; St. 21; A. 77; Mc. 44, 45; J.
M. 13: 10; P. R. 35: 160.

L. naucina Fr.

L. naucinoides Peck

G.² Flesh thin; lamellae white.

H.¹ Pileus bright brownish red. M.
62; J. M. 12:245; P. R. 35:
155.....*L. rubrotincta* Peck

H.² Pileus not as above.

I.¹ Stipe mealy. S. 50; St. 25;
J. M. 12: 157.

L. seminuda Lasch

- I.² Stipe more or less fibrillose.
 - J.¹ Pileus buff or umber; margin even; lamellae broad. J. M. 12: 248.
L. neophana Morg.
 - J.² Pileus white or rufous in the center; margin striatulate; lamellae rather narrow. S. 49; J. M. 12: 157.
L. noscitata Britz.
- F.² Pileus granulose, furfuraceous or more or less scaly .
 - G.¹ Pileus deeply striate, sulcate or plicate.
 - H.¹ Flesh thick; lamellae adnate. S. 48; H. 52, 53; J. M. 12: 196; M. 63, pl. 3.
L. granosa Morg.
 - H.² Flesh thin; lamellae free or adnexed only.
 - I.¹ Pileus granulose; lamellae adnexed. S. 47; H. 52; J. M. 12: 196; St. 23; Mc. 49; P. R. 35: 161.
L. granulosa Batsch
 - I.² Pileus scaly; lamellae free.
 - J.¹ Lamellae subdistant; veil yellow. J. M. 13: 5.
L. flavescens Morg.
 - J.² Lamellae very close.
 - K.¹ Annulus movable. S. 33; St. 16; Mc. 37; J. M. 13: 2; M. 61.
L. mastoidea Fr.

K.² Annulus fixed (not movable).

L.¹ Stipe enlarged above the base. S. 43; St. 22; Mc. 46; P. R. 35: 158; H. 54.

L. cepaestipes
Sow.

L.² Stipe not so enlarged. S. 38; J. M. 12:198; St. 19; Mc. 43; P. R. 35: 157.

L. metulispora B. & Br.

G.² Pileus even or only striatulate.

H.¹ Flesh thick; lamellae white, soon dingy-brown; annulus movable. S. 43; H. 48, 49; St. 21; J. M. 13:10; A. 77; Mc. 44; P. R. 35:160.

L. naucina F.

L. naucinoides Peck

H.² Flesh thin.

I.¹ Pileus mealy or granulose; lamellae adnexed or reaching stipe.

J.¹ Pileus reddish-brown or reddish yellow. S. 47; H. 42; St. 23; J. M. 12:196; P. R. 35:161.

L. granulosa Batsch

J.² Pileus whitish or flesh color.

- K.¹ Stipe squamulose. S. 46; St. 22; M. 63; J. M. 12: 196.
L. carcharias Pers.
- K.² Stipe mealy. S. 50; St. 25; J. M. 12: 157.
L. seminuda
Lasch
- I.² Pileus minutely or appressed scaly; lamellae free.
- J.¹ Stipe glabrous or slightly fibrillose.
- K.¹ Pileus white or whitish. S. 40; M. 63, pl. 3; J. M. 12: 242.
L. miamensis
Morg.
- K.² Pileus with reddish or reddish-brown scales.
- L.¹ Pileus bright brownish-red, scales persistent on margin; annulus persistent, often reddish on the margin. P. R. 35: 155; M. 62; J. M. 12: 245.
L. rubro-tincta Peck
- L.² Pileus paler, scales soon

dis appearing
from margin;
annulus usu-
ally evanes-
cent. S. 39;
St. 20; P. R.
35: 155; Mc.
42.

L. cristata

A. & S.

J.² Stipe more or less scaly.
K.¹ Pileus pale tan to
umber. J. M. 12:
198.

L. spanista Morg.

K.² Pileus tawny-brown
or blackish-brown.

L.¹ Plants growing
on wood; pi-
leus with
tawny - brown
scales. S. 16:
8; J. M. 12:
201; P. R. 51;
283.

L. accrina

Peck

L.² Plants growing on
the ground;
pileus with
blackish-brown
scales. S. 37;
M. 62; J. M.
12:199; Mc.
41; P. R. 35:
156.

L. felina Pers.

E.² Plants very small; pilei mostly less than 2 cm. broad.

F.¹ Pileus floccose, granulose or minutely scaly.

G.¹ Pileus widely striate or plicate-sulcate.

H.¹ Lamellae rather broad, subdistant; plant whitish to rose color; annulus pale yellow. J. M. 13:6.

L. rhodopepla Morg.

H.² Lamellae narrow, close; plants not rose color; annulus not yellow.

I.¹ Stipe silky; spores elliptical; pileus rugulose. S. 16:15; Mc. 51; J. M. 13:2; B. T. 27:15.

L. rugulosa Peck

I.² Stipe not silky; spores subfusiform. S. 38; St. 19; Mc. 43; J. M. 12:198; P. R. 35:157.

L. metulispora B. & Br.

G.² Pileus even.

H.¹ Stipe clavate, solid; pileus with minute blackish scales. J. M. 12:248. *L. phaeosticta* Morg.

H.² Stipe nearly equal, stuffed or hollow.

I.¹ Plants growing on wood; pileus with tawny-brown scales. S. 16:8; J. M. 12:201; P. R. 51:283.

L. acerina Peck

I.² Plants growing on the ground.

- J.¹ Stipe granular - mealy;
lamellae broad. S. 48;
J. M. 12:158; P. R.
35:162.
L. pusillomyces Peck
- J.² Stipe fibrillose or scaly;
lamellae narrow. J.
M. 12:199.
L. umbrosa Morg.
- F.² Pileus glabrous or silky, not as above.
G.¹ Pileus rugose-plicate. S. 16:15; J.
M. 13:2; Mc. 51; B. T. 27:15.
L. rugulosa Peck
- G.² Pileus even or nearly so.
H.¹ Pileus and stipe glabrous. S. 51;
J. M. 12:156; St. 25.
L. mesomorpha Bull.
L. rufipes Morg.
- H.² Pileus silky; stipe fibrillose. S.
49; J. M. 12:157.
L. parvannulata Lasch

NOTES.

L. porrigens Viv., listed by Morgan (Jour. Myc. 13:6) is probably to be considered a white form of *L. procera*.

L. lutea Bolt., listed by Morgan (Jour. Myc. 13:4), is usually regarded as a yellow form of *L. cepaestipes*.

L. rufipes Morg. Jour. Myc. 12:156, is probably not specifically distinct from *L. mesomorpha* Bull.

The occurrence of *L. farinosa* Peck in Ohio is doubtful. Peck separated it from *L. cepaestipes* on account of the even margin and the larger spores (Report 43, p. 35), Morgan (Jour. Myc. 13:1, 3) in reporting the former, says that the chief difference is in the color of the pileus. He gives the same spore measurements for both species.

Several writers state that *L. americana* is *L. badhami* B. & Br. of Europe.

The occurrence of *L. pelidna* B. & M., described from Sullivant's material, is doubtful. It is said to have a greenish-livid, rugose pileus, a solid, bulbous stipe and to grow on fallen logs. S. 67.

Fries (Hym. Eur. 31) regarded *L. acutesquamosa* as a variety of *L. Friesii* Lasch, from which it differs in having the scales of the pileus erect and the lamellae simple. In this country the plants are usually known as *L. acutesquamosa*. Morgan lists the species as *L. aspera* Pers. His plants referred to *L. hemisclera* B. & C. and to *L. asperula* Atk. were probably only forms of *L. acutesquamosa*.

L. glischra Morg. Jour. Myc. 12:203 is based on plants referred to *L. oblita* Peck in the Mycologic Flora (p. 64).

The plants referred by Morgan to *L. felinoides* Peck should probably be referred to *L. rubrotincta*.

L. coerulescens Peck = *L. virescens* (Speg.) Morg.

L. rufescens Morg. Jour. Myc. 12:246, is based on plants which he had previously reported as *L. fuscosquamea* Peck (Mycologic Flora, p. 62).

L. naucinoides Peck is said by its author to differ from *L. naucina* Fr. principally in having the spores subelliptic, while those of the latter were said to be globose. The two species are probably not distinct, for the spores of the American plant, at least, are variable in shape.

ARMILLARIA FR.

A.¹ Lamellae adnate or subdecurrent; pileus with pointed tufts of blackish or brownish hairs, margin striate. S. 80;

M. 64; H. 57; Mc. 55; A. 83.....*A. mellea* Vahl

A.² Lamellae sinuate or adnexed; pileus without hairy scales; margin not striate.

B.¹ Stipe not bulbous; whitish pileus variegated with brown spots. S. 86; H. 59; Mc. 57; P. R. 43:41.

*A. nardosmia** Ellis

*The lamellae of *A. nardosmia* are described as emarginate (sinuate) but Peck says he finds the plants with lamellae adnate or subdecurrent. He regards this name as a synonym for *A. rhagadiosa* Fr., a European species. P. R. 43:42.

B.² Stipe bulbous; pileus not brown-spotted.

C.¹ Pileus white or whitish; stipe solid; bulb not marginate. S. 14:70; H. 60; Mc. 54; B. T. 24:140.

A. appendiculata Peck

C.² Pileus yellow-brown or pale brick-color; stipe stuffed or hollow; bulb marginate. S. 73; St. 28; H. 59.

A. bulbigera Alb. & Schw.

TRICHOLOMA FR.

A.¹ Pileus viscid when moist.

B.¹ Pileus white, shining when dry.

C.¹ Stipe solid, somewhat bulbous, lamellae close. S. 90; H. 600; St. 37; Mc. 63; P. R. 44:42.

T. resplendens Fr.

C.² Stipe stuffed or hollow, not bulbous; lamellae subdistant. S. 90; M. 65; St. 38...*T. spermaticum* Fr.

B.² Pileus not white.

C.¹ Lamellae not becoming reddish or reddish-spotted.

D.¹ Lamellae sulphur-yellow. S. 87; H. 61; Mc. 61; P. R. 44:40.....*T. equestre* L.

D.² Lamellae not yellow.

E.¹ Pileus umbonate, with blackish fibrils; lamellae subdistant. S. 88; H. 82; Mc. 63; St. 35; P. R. 44:41.

T. sejunctum Sow.

E.² Pileus not as above; lamellae close.

F.¹ Pileus pale tan, not rivulose or spotted; lamellae white. S. 9:13; H. 74; Mc. 64; P. R. 44:41.

T. terrificum Peck

F.² Pileus reddish-brown, becoming rivulose and spotted in drying; lamellae cinereous. S. 9:10; H. 79; P. R. 44:41.

T. maculatescens Peck

C.² Lamellae becoming reddish or reddish-spotted.

D.¹ Pileus incarnate-red. S. 94; H. 70; Mc. 65;
P. R. 44:42.....*T. russula* Schaeff.

D.² Pileus not as above.

E.¹ Stipe bulbous. S. 95.

T. muciferum B. & Mont.

E.² Stipe not bulbous.

F.¹ Pileus becoming rivulose and spotted;
stipe solid; lamellae cinereous. S.
9: 10; H. 79; P. R. 44:41.

T. maculatescens Peck

F.² Pileus not as above; stipe stuffed or hol-
low; lamellae at first whitish or yel-
lowish. S. 91; H. 61; P. R. 44:43.

T. transmutans Peck

A.² Pileus not viscid.

B.¹ Lamellae sulphur-yellow. S. 112; H. 65; Mc. 74; St.
52*T. sulphureum* Bull.

B.² Lamellae not yellow.

C.¹ Flesh becoming reddish when broken; plants with
odor of soap. S. 106; H. 77; Mc. 74; St. 48.

T. saponaceum Fr.

C.² Flesh and odor not as above.

D.¹ Pileus scaly, fibrillose or silky or becoming so.

F.¹ Pileus some shade of brown or blackish.

F.¹ Lamellae not changing color or becoming
spotted; pileus blackish-punctate;
stipe stuffed or hollow. S. 107; H.
78; St. 48.....*T. cartilagineum* Fr.

F.² Lamellae changing color or becoming
spotted.

G.¹ Lamellae whitish becoming cinereous,
sub-distant; stipe white or whit-
ish. S. 104; H. 76; M. 65; Mc.
71; P. R. 44:50.

T. terreum Schaeff.

G.² Lamellae becoming reddish or reddish-spotted, close; stipe not white.

H.¹ Stipe stuffed or hollow, subbulbous; pileus umbonate. S. 16:21; H. 78.

T. squarrulosum Bres.

H.² Stipe solid, not bulbous, pileus not umbonate. S. 101; H. 73; Mc. 73; St. 45; P. R. 44:49.

T. imbricatum Fr.

E.² Pileus white to pale tan.

F.¹ Lamellae becoming smoky-blue or blackish when bruised. S. 119; Mc. 72; H. 75; P. R. 44:51.

T. fumescens Peck

F.² Lamellae not so changing.

G.¹ Pileus silky, soon glabrous, 3-5 cm. broad; stipe rather slender, rooting, tomentose at base. S. 112; H. 70; St. 53; P. R. 44:53.

T. lascivum Fr.

G.² Pileus squamulose or fibrillose, usually more than 5 cm. broad; stipe stout, not tomentose.

H.¹ Pileus usually less than 10 cm. broad, fibrillose or slightly squamulose; without farinaceous taste; spores 6-8 mic. S. 99; H. 68; St. 44; Mc. 68; P. R. 44:47

T. columbetta Fr.

H.² Pileus usually more than 10 cm. broad, squamulose; taste farinaceous; spores larger. S. 11:9; H. 81; Mc. 68; P. R. 44:16, 47. . . *T. grande* Peck

- D.² Pileus glabrous or soon becoming so, or pruinately only.
 - E.¹ Lamellae violaceous or lilac; pileus of same color or with brownish tinge.
 - F.¹ Stipe solid, bulbous. S. 130; H. 84; A. 87; Mc. 79; M. 65; St. 61; P. R. 44:60 *T. personatum* Fr.
 - F.² Stipe stuffed or hollow, equal or nearly so.
 - G.¹ Pileus hygrophanous, brownish or brownish-violaceous; flesh whitish. S. 139; H. 62; St. 66; M. B. 131: 14; P. R. 44:61.. *T. sordidum* Fr.
 - G.² Pileus not hygrophanous, violaceous when young; flesh violaceous. S. 131; H. 86; St. 62; Mc. 80; M. B. 116:39 *T. nudum* Bull.
 - E.² Lamellae not violaceous or lilac.
 - F.¹ Margin of pileus striate or rugose-sulcate.
 - G.¹ Pileus umbonate, pale lilac, margin striate only; stipe becoming hollow. S. 126.
T. consobrinum B. & Mont.
 - G.² Pileus not umbonate, margin rugose or sulcate; stipe solid.
 - H.¹ Taste mild; stipe white; pileus pruinately. S. 101; M. 65; H. 67; P. R. 44:58.
T. laterarium Peck
 - H.² Taste bitter; stipe yellowish; pileus glabrous. S. 129; St. 60; H. 70.. *T. acerbum* Bull.
 - F.² Margin of pileus even.
 - G.¹ Pileus sooty-black or becoming paler; stipe stuffed or hollow. S. 134; H. 69; M. 66; St. 64.
T. melaleucum Pers.

- G.² Pileus not as above; stipe solid.
H.¹ Lamellae gray to sordid-rufescent; pileus grayish, pruinose, often spotted. S. 132; St. 63; H. 67. *T. panaeolum* Fr.
H.² Lamellae white or whitish, unchanging; pileus glabrous, unspotted.
I.¹ Plants caespitose, stipes rising from common fleshy mass. M. B. 105:36; H. 83.
T. unifactum Peck
I.² Plants not as above.
J.¹ Stipe tomentose at the base, rooting. S. 112; H. 70; P. R. 44:53; St. 53.
T. lascivum Fr.
J.² Stipe glabrous, not rooting.
K.¹ Pileus sub-umbonate usually smoky-brown, 2-5 cm. broad; taste mild. S. 128; H. 74; P. R. 44:58; Mc. 78.
T. fumidellum Peck
K.² Pileus depressed, usually white, 5-10 cm. broad; taste acid or bitter. S. 127; H. 72; P. R. 44:57; Mc. 79.
T. album Schaeff.

NOTES.

Morgan (Myc. Flora, p. 66) reported *T. cerinum* Pers. for the Miami Valley, but later referred the plants to *Collybia amabilipes* Peck.

CLITOCYBE FR.

- A.¹ Pileus viscid when moist.
- B.¹ Pileus umbonate, white tinged with red; lamellae 3 mm. broad. S. 150.....*C. crubescens* Mont.
- B.² Pileus not umbonate, reddish-brown; lamellae .5 mm. broad (?). S. 196.....*C. angustilamellata* Mont.
- A.² Pileus moist, hygrophanous or dry; not viscid.
- B.¹ Whole plant deep yellow or reddish-yellow; cespitose; pileus 8-20 cm. broad. S. 162; H. 91; M. 69; A. 90; Mc. 96.....*C. illudens* Schw.
- B.² Plant not colored as above.
- C.¹ Lamellae purplish, lilac or flesh-colored.
- D.¹ Plants cespitose. S. 164; H. 102; M. 69; Mc. 89*C. monadelpha* Morg. S. 352, 587.....*C. caespitosa* (Berk.)
- D.² Plants not cespitose.
- E.¹ Stipe usually 1-2 cm. thick; lamellae purplish. S. 148; H. 97; M. 67; Mc. 108.
C. ochropurpurea Berk.
- E.² Stipe slender, usually less than 5 mm. thick; lamellae flesh-colored to violaceous. S. 197; H. 105; M. 67; A. 89; Mc. 107.
C. laccata Scop.
- C.² Lamellae white, yellowish or cinereous.
- D.¹ Pileus convexo-plane or depressed only.
- E.¹ Pileus green or sordid green. S. 153; H. 90; Mc. 90; St. 74.....*C. odora* Bull.
- E.² Pileus not green.
- F.¹ Pileus white or whitish to pale tan.
- G.¹ Pileus more than 10 cm. broad. S. 166*C. leiphaemia* Mont.
- G.² Pileus usually less than 10 cm. broad.
- H.¹ Plants growing on wood as trunks of trees. S. 184; M. 68; Mc. 94.
C. trunkicola Peck

H.² Plants not growing on wood.

I.¹ Pileus mostly 3 cm. or more broad; stipe 4 cm. or more high.

J.¹ Pileus subumbonate, white, or margin tinged with blue. S. 197; M. 67; Mc. 97.
C. connexa Peck

J.² Pileus not umbonate, whitish when young but soon brownish or grayish-brown. S. 9: 25; A. 91; H. 93.
C. multiceps Peck

I.² Pilei mostly less than 3 cm. across; stipe 2-3 cm. high.

J.¹ Pileus usually regular, at first silky; stipe sub-fistulous, waxy; lamellae soon decurrent; plants growing among leaves. S. 157; H. 100; Mc. 92; M. 68; St. 77.

C. candicans Pers.

J.² Pileus usually revolute, often wavy, glabrous; stipe stuffed; lamellae adnate; plants growing in grassy grounds. S. 157; Mc. 93; H. 104; M. 68; St. 78.

C. dealbata Sowerb.

I.² Pileus cinereous or yellow to brown or brownish.

G.¹ Lamellae white or whitish.

H.¹ Plants cespitose.

I.¹ Stipe slender, brown or brownish; pileus becoming scaly. S. 164; H. 102; M. 69; Mc. 89; S. 587, 352.

C. monadelpha Morg.

C. caespitosa (Berk.)

I.² Stipe rather thick, whitish; pileus glabrous or slightly silky. S. 9:25; H. 93; A. 91; Mc. 95.

C. multiceps Peck

H.² Plants not cespitose.

I.¹ Lamellae close, rather narrow. S. 142; Mc. 85; M. 67; St. 70.

C. nebularis Batsch

I.² Lamellae subdistant, rather broad.

J.¹ Stipe tapering upward. S. 143; H. 94; Mc. 85.

C. clavipes Pers.

J.² Stipe nearly equal. S. 9:20; H. 88; Mc. 88.

C. media Peck

G.². Lamellae yellow to ochraceous or cinereous.

H.¹ Lamellae adnate; pileus not hygrophanous.

I.¹ Plants cespitose; lamellae yellow; stipe hollow. S. 142.

C. columbana Mont.

I.² Plants not cespitose; lamellae pallid ochraceous; stipe solid. S. 170; H. 101; Mc. 101...*C. gilva* Pers..

II.² Lamellae decurrent; pileus hygrophanous.

I.¹ Stipe pruinose-pulverulent above; plants with farinaceous odor. S. 185; H. 95; Mc. 109; St. 91.

C. metachroa Fr.

I.² Stipe glabrous, plants without odor.

J.¹ Margin of pileus even. S. 186; Mc. 109; H. 99... *C. ditopoda* Fr.

J.² Margin striate when moist. S. 9:26; H. 99; P. R. 42:18.

C. subditopoda Peck

D.² Pileus umbilicate to infundibuliform.

E.¹ Pileus white or whitish.

F.¹ Plants growing on wood; stipe often eccentric; pileus lobed and irregular. S. 16:24; B. T. 25:321; Oh. Nat. 10:178.....*C. eccentrica* Peck

F.² Plants growing among leaves or grass.

G.¹ Lamellae adnate; pileus less than 3 cm. broad. S. 157; H. 104; St. 78; Mc. 93...*C. dealbata* Sowerb.

G.² Lamellae soon decurrent; pileus usually 4 cm. or more broad.

H.¹ Lamellae narrow. S. 180; P. R. 54:174; H. 95.

C. adirondackensis Peck

H.² Lamellae rather broad.

I.¹ Lamellae close, always white; plants growing on pine leaves. S. 155; H. 99; Mc. 91; St. 77.

C. pithyophila Fr.

I.² Lamellae subdistant, becoming yellowish; plants growing on deciduous leaves. S. 155; H. 104; M. 68; Mc. 91; St. 76.

C. phyllophila Fr.

E.² Pileus not white when fresh; sometimes fading to whitish when old.

F.¹ Pileus hygrophanous.

G.¹ Lamellae rather distant.

H.¹ Plants usually growing on wood, as old logs; pileus dark watery-brown when moist; lamellae sordid; stipe fibrillose. S. 176; H. 105; M. 70; Mc. 104; St. 88.

C. cyathiformis Fr.

H.² Plants growing on the ground; pileus blackish-brown when moist; lamellae brown-cinereous; stipe glabrous. S. 177; H. 101; St. 90.

C. obbata Fr.

G.² Lamellae close.

H.¹ Pileus pruinose with a leaden bloom; margin even; lamellae narrow. S. 178; St. 90; M. 70 *C. pruinosa* Lasch

H.² Pileus glabrous; margin striate when moist; lamellae broad. S. 9:26; H. 99; P. R. 42:18.

C. subditopoda Peck

F.² Pileus moist or dry, not truly hygrophanous.

G.¹ Pileus innate-silky, umbonate when young, umbo often persisting; red-

dish-tan to paler. S. 165; St. 82;
H. 90; M. 69; Mc. 100.

C. infundibuliform Schaeff.

G.² Pileus glabrous, not umbonate, yellowish-brown. S. 172; St. 86; H. 101; Mc. 103.

C. flaccida Sowerb.

NOTES.

C. ohiensis Mont. Syll. Crypt. 100, S. 181, is probably *C. nebularis* Batsch. although the description does not quite agree in some respects.

C. reticeps Mont. Syll. Crypt. 101, S. 150, is probably *C. laccata* Scop.

Saccardo publishes *C. subditopoda* Peck as "umbonate." Peck described it as umbilicate and says he separated it from *C. ditopoda* Fr. on account of the paler lamellae, striate margin and longer spores. *C. ditopoda*, however, is not umbilicate.

C. pruinosa Lasch was first reported by Lea, but does not seem to have been found since. None of Montagne's species have been identified since their publication.

According to Bresadola *C. monadelphæ* is the same as *C. tabescens* (Scop.) Bres. of Europe (Lloyd Myc. Notes 1:54).

Lentinus caespitosus Berk. and *Pleurotus caespitosus* B. & C. are names of the same plant. The description fits the plant now known as *C. monadelphæ* Morg.

COLLYBIA FR.

A.¹ Pileus usually more than 1 cm. broad.

B.¹ Stipe glabrous or nearly so, except at base.

C.¹ Lamellae usually more than 4 mm. broad, distant, always white.

D.¹ Pileus glabrous, viscid when moist; stipe usually long-rooting. S. 200; H. 107-8; St. 97; A. 92; Mc. 113; P. R. 49:35, M. 70.

C. radicata Relh.

D.² Pileus more or less streaked with dark-colored fibrils, not viscid; stipe not long rooting. S. 203; H. 109; Mc. 114; St. 98; A. 93; P. R. 49: 35; M. 71.....*C. platyphylla* Fr.

C.² Lamellae narrow and close or crowded.

D.¹ Whole plant purplish- or brownish-lilac. S. 236; H. 115; P. R. 49: 50..*C. myriadophylla* Peck

D.² Plant not as above.

E.¹ Plants usually caespitose.

F.¹ Lamellae brownish or tawny. S. 203; M. 73; P. R. 49:49; S. 214.

C. lachnophylla Berk.

C. pilularia Mont.

F.² Lamellae whitish or yellow.

G.¹ Stipe prominently bulbous at base. S. 240.....*C. physcopodia* Mont.

G.² Stipe equal or only slightly thickened at base.

H.¹ Lamellae long decurrent. S. 9: 29.....*C. tagetes* B. & Mont.

H.² Lamellae not decurrent.

I.¹ Stipe reddish, red-brown, or brown, usually long and slender. S. 234; H. 117; St. 110; Mc. 122; P. R. 49:48....*C. acervata* Fr.

I.² Stipe whitish, yellowish, or rufescent. S. 234; St. 111; H. 110; Mc. 120; M. 71; P. R. 49:44.

C. dryophila Bull

E.² Plants commonly solitary or gregarious, occasionally somewhat caespitose.

F.¹ Pileus white, yellow, light brown or red-brown.

G.¹ Stipe white.

H.¹ Pileus fleshy, white, often with reddish spots; stipe striate. S. 207; St. 100; H. 112; Mc. 116; P. R. 49:37.

C. maculata Alb. & Schw.

H.² Pileus thin, white or yellow, not spotted; stipe usually not striate. S. 9:30; P. R. 49:44.

C. strictipes Peck

G.² Stipe some shade of yellow or brown or occasionally pallid.

H.¹ Stipe striate, usually considerably tapering upward, pileus soft to the touch. S. 209; H. 109; St. 101; M. 71; Mc. 117; P. R. 49:37.

C. butyracea Bull.

H.² Stipe not striate, nearly equal or slightly thickened below.

I.¹ Lamellae yellowish or reddish-yellow, becoming brownish-red in drying. S. 230; M. 72; P. R. 49:50.

C. colorea Peck

I.² Lamellae not becoming brownish-red.

J.¹ Pileus usually reddish-brown to tan, sometimes pallid or yellowish. S. 234; H. 110; St. 111; Mc. 120; M. 71...

C. dryophila Bull.

J.² Pileus yellow (see notes).

K.¹ Lamellae pallid; stipe not rooting; pileus at first conic-cam-

panulate. S. 236;
M. 71.

C. estensis Morg.

K.² Lamellae flesh color;
stipe rooting. S.

232.

C. xanthopila Mont.

F.² Pileus blackish, blackish-brown or smoky-
brown.

G.¹ Pileus 3-6 cm. broad, lamellae ad-
nexed, close. S. 9:27; P. R. 49:36.

C. fuliginella Peck

G.² Pileus 2.5 cm. or less; lamellae ad-
nate, subdistant.

H.¹ Plants growing on ground;
lamellae not venose-connected.
S. 246; H. 113; St. 116.

C. atrata Fr.

H.² Plants growing on wood; la-
mellae venose-connected. H.
116; P. R. 49:53.

C. atratoides Peck

B.² Stipe velvety, fibrillose, downy, furfuraceous or pulveru-
lent.

C.¹ Stipe densely velvety.

D.¹ Pileus fleshy, viscid when moist, margin even. S.
212; H. 118; St. 102; A. 93; Mc. 118; P. R.
49:38.....*C. velutipes* Curt.

D.² Pileus thin, not viscid, margin more or less
striate. S. 212, 213; Myc. Notes 1:42.

C. amabilipes Peck

C. tenuipes Schw.

C.² Stipe not velvety.

D.¹ Lamellae broad, distant; plants large.

E.¹ Pileus glabrous, viscid when moist; stipe
usually long-rooting. S. 200; H. 107-8;
St. 97; Mc. 113; P. R. 49:35; M. 70.

C. radicata Relh.

E.² Pileus more or less streaked with blackish fibers, not viscid; stipe not rooting. S. 203; H. 109; Mc. 114; St. 98; P. R. 49:35; M. 71.....*C. platyphylla* Fr.

D.² Lamellae narrow, close.

E.¹ Pileus glabrous or not hairy or fibrillose.

F.¹ Plants commonly cespitose.

G.¹ Lamellae brownish or tawny. S. 203; M. 73; P. R. 49:49.

C. lachnophylla Berk.

G.² Lamellae not as above.

H.¹ Lamellae free, soon remote from stipe; pileus reddish to red-brown, paler when dry. S. 222; St. 104; H. 114; Mc. 119; P. R. 49:47.

C. confluens Pers.

H.² Lamellae adnexed or free but reaching stipe; pileus whitish to pale reddish-brown. S. 221; St. 103; M. 73; P. R. 49:43.

C. hariolorum DC.

F.² Plants solitary or gregarious, occasionally subcespitose.

G.¹ Pileus sooty-brown; stipe more or less fibrillose. S. 9:27; P. R. 49:36.....*C. fuliginella* Peck

G.² Pileus white to red-brown; stipe white-downy or tomentose. S. 221; St. 103; P. R. 49:43.

C. hariolorum DC.

E.² Pileus hairy or tomentose.

F.¹ Lamellae adnexed or becoming free, subdistant; plants not cespitose. S. 216; St. 103; M. 72; P. R. 49:42.

C. stipitaria Fr.

- F.² Lamellae free, close; plants mostly cespitose. S. 216; H. 112; M. 72; P. R. 49:42.....*C. zonata* Peck
- A.² Pileus 1 cm. or less broad.
- B.¹ Pileus and stipe fibrillose or tomentose. S. 216; St. 103; M. 72; P. R. 49:42.....*C. stipitaria* Fr.
- B.² Pileus and stipe not as above.
- C.¹ Stipe arising from a sclerotoid tuber. S. 224; St. 106; P. R. 49:41; M. 73; Oh. Nat. 11:247.
C. tuberosa Bull.
- C.² Stipe with long, fibrillose, rooting base; no tuber present. S. 224; St. 105; P. R. 49:41.
C. cirrata Schum.

NOTES.

C. pilularia, *C. xanthopila*, *C. physcopodia* and *C. tagetes* were described from specimens sent to Montagne by Sullivan and have not been recognized since.

Morgan's description of *C. estensis* is rather meager. It is probably a form of *C. dryophila* or perhaps is identical with *C. strictipes*.

The plants referred by Hard (p. 108) to *C. ingrata* Schum. should probably be considered a form of *C. confluens*. According to Berkeley (Outlines of British Fungology, p. 117), the principal difference between the two species is that in the former the lamellae more nearly approach the stipe.

Some writers believe that *C. tenuipes* and *C. amabilipes* are identical. Schweinitz described the former as having a stipe 15-30 cm. long, pileus depressed and subumbonate, plants growing among decaying leaves. The Ohio plants grow on decayed wood, the pileus is convex-expanded, and the stipe is variable in length, but seldom more than 8-10 cm. long. Peck's description of *C. amabilipes* fits our plants more closely, and unless we assume that Schweinitz had very exceptional specimens, they should be known by Peck's name. Lloyd says the pileus is slightly viscid, but we have never found it so. (Myc. Notes 1: 199.)

MYCENA FR.

A.¹ Whole plant, especially stipe, with dark red juice. S. 291;
St. 141; H. 122; A. 98; Mc. 130; M. 75.

M. haematopoda Pers.

A.² Plants without red juice.

B.¹ Whole plant bright orange red, or fading to yellow;
pileus viscid. S. 9: 38; H. 127; M. 74.

M. leaiana Berk.

B.² Plant not orange-red or bright yellow.

C.¹ Stipe inserted. S. 302; St. 149; H. 125.

M. corticola Schum.

C.² Stipe not inserted.

D.¹ Lamellae violaceous, edge blackish denticulate;
pileus livid-purple to paler; stipe concolorous.
S. 251; St. 121; Berk. Out. 121.

M. pelianthina Fr.

D.² Edge of lamellae not darker than the rest of
their surface, not denticulate.

E.¹ Base of stipe with blue fibrils; pileus often
blue or bluish. S. 16: 29; P. R. 51: 284;
Oh. Nat. 11: 350...*M. cyaneobasis* Peck

E.² Pileus and stipe not as above.

F.¹ Neither stipe nor pileus viscid.

G.¹ Pilei mostly 2.5 cm. or more broad.

H.¹ Plants pinkish-purple or lilac, or
becoming paler; with odor of
radishes. S. 256; St. 125; H.
128; A. 95; M. 74.

M. pura Pers.

H.² Pileus usually some shade of
gray, yellow or brown; some-
times whitish.

I.¹ Stipe firm, rigid, pileus not
hygrophanous.

J.¹ Lamellae adnate-uncinate,
flesh-colored or whit-
ish; pileus striate, usu-

ally some shade of gray or brown; stipe not striate. S. 268; H. 120; St. 130; A. 94; Mc. 127; M. 74.

M. galericulata Scop.

J.² Lamellae adnexed, white or whitish; pileus striatulate only, paler than the above; stipe striatulate. S. 267; St. 128; H. 120; Mc. 126.

M. prolifera Fr.

I.² Stipe more or less fragile; pileus hygrophanous.

J.¹ Pileus cinereous or some shade of brown, broadly umbonate; lamellae adnate. S. 277; St. 134; H. 123.

M. alcalina Fr.

J.² Pileus gray when moist to tin-colored when dry, not umbonate; lamellae adnate-uncinate. S. 280; St. 137; H. 124.

M. stannea Fr.

G.² Pilei mostly less than 2.5 cm. broad.

H.¹ Stipe filiform, with rooting hairy base; pileus grayish to brownish. S. 283; St. 138; H. 124;

M. 75. *M. filipes* Bull.

H.² Stipe not filiform.

I.¹ Lamellae broad.

J.¹ Lamellae adnate-uncinate, flesh-colored or whitish; pileus striate;

stipe not striate. S.
268; H. 120; A. 94;
St. 130; Mc. 127; M.
74.

M. galericulata Scop.
J.² Lamellae adnexed, white
or whitish; pileus stri-
atulate only; stipe stri-
atulate. S. 267; St.
128; H. 120; Mc. 126.

M. prolifera Fr.
I.² Lamellae linear or rather
narrow.

J.¹ Lamellae adnate, pileus
livid, or bluish-gray,
not umbonate. S. 280;
St. 137; H. 125.

M. vitrea Fr.
J.² Lamellae not adnate;
pileus umbonate or
subumbonate.

K.¹ Pileus white to gray;
stipe fusiform,
fibrillose and root-
ing. S. 273.

M. cymbalifera Mont.
K.² Pileus purplish to
yellow, stipe neither
fusiform, fibril-
lose nor rooting.
S. 258.

M. conferruminata Berk. & Mont.
F.² Pileus or stipe or both viscid.

G.¹ Stipe yellowish or paler; lamellae ad-
nate-uncinate. S. 294; St. 144;
H. 129; A. 96.

M. epipterygia Scop.

G.² Stipe cinereous; lamellae somewhat decurrent. S. 295; St. 145; H. 129; A. 97. *M. vulgaris* Pers.

NOTES.

M. lilacina Mont., described from Sullivant's material (S. 257), is a doubtful *Mycena*. The pileus is said to be lilac-colored and umbilicate; the lamellae remote (when dry) and rosyo-chraceous. The plants may possibly have been *M. pura*, the abnormal character appearing in drying.

Neither the above nor *M. cymbalifera* nor *M. conferruminata* have been recognized since described.

M. vitrea and *M. vulgaris* have not been definitely reported from Ohio but probably occur here and so are included.

OMPHALIA FR.

A.¹ Lamellae yellow or yellowish.

B.¹ Pilei mostly 2.5 cm. or more broad; stipe yellow.

C.¹ Pileus flocculose or squamulose; lamellae and stipe bright yellow. S. 312; P. R. 45:35; St. 153; H. 135. *O. chrysophylla* Fr.

C.² Pileus glabrous; lamellae and stipe paler, at first whitish. S. 327; H. 135; M. 76.

O. alboflava Morg.

B.² Pilei less than 2.5 cm. broad; stipe not yellow.

C.¹ Stipe tawny-strigose at base, brown; plants on decayed wood. S. 327; H. 130; M. 77; A. 101; Mc. 134; St. 160; P. R. 45:38.

O. campanella Batsch.

C.² Stipe not strigose at base, pallid or rufescent; plants on ground. S. 313; H. 133; St. 154; P. R. 45:36.

O. pyxidata Bull.

A.² Lamellae white, whitish, gray or cinereous.

B.¹ Pileus depressed only, not umbilicate or infundibuliform.

C.¹ Lamellae broad, subtriangular; plants on ground. S. 321; St. 158; Mc. 133; H. 132; M. 76; P. R. 45:38 *O. umbellifera* Linn.

- C.² Lamellae narrow; plants on wood, white. S. 337;
St. 164; M. 77.....*O. integrella* Pers.
- B.² Pileus umbilicate or infundibuliform.
- C.¹ Pileus sulcate, yellowish or fading. S. 315; St. 156;
H. 132.....*O. caespitosa* Bolt.
- C.² Pileus even or striatulate only.
- D.¹ Pileus sooty-gray or reddish-brown, usually silky
or flocculose or becoming so.
- E.¹ Pilei usually less than 1 cm. broad; plants on
ground. S. 316; St. 156; M. 76.
O. rustica Fr.
- E.² Pilei usually more than 1 cm. broad; plants
on wood. S. 314; H. 130; M. 76; A. 101;
P. R. 45:37.....*O. epichysium* Fr.
- D.² Pileus not as above.
- E.¹ Pileus yellow to orange or paler, 4-10 mm.
broad; stipe 2-5 cm. long. S. 331; St. 163;
P. R. 45:40; H. 134; M. 77.
O. fibula Bull.
- E.² Pileus reddish-brown or grayish-red, 8-25
mm. broad.
- F.¹ Lamellae pallid; stipe reddish-brown, 6-
12 mm. long. S. 321; St. 158; M.
76.....*O. muralis* Sow.
- F.² Lamellae flesh color, grayish-red, or pale
yellow; stipe pallid to rufescent, usu-
ally longer. S. 313; St. 154; H. 133;
P. R. 45:36.....*O. pyxidata* Bull.

NOTES.

O. alboflava is closely related to *O. chrysophylla* and is prob-
ably a variety of the latter. The plants figured by Hard (p. 135,
f. 100) as *O. alboflava* agree more closely with the description of
O. chrysophylla.

O. chrysea Peck, reported by Morgan (p. 75), is now re-
garded by its author as a variety of *O. chrysophylla*.

O. rhyssospora Mont. and *O. strombodes* B. & Mont., de-

scribed from Sullivant's material, do not seem to agree with the characters of the genus. The former is described as having the lamellae adnexed and decurrent by a tooth; the latter, as having the edge of the lamellae obtuse. In *Omphalia* the lamellae are truly decurrent and the edge acute. (See S. 318 and S. 333.)

PLEUROTUS FR.

A.¹ Partial veil present, usually appendiculate about margin of pileus, pileus usually 5-15 cm. broad, lamellae broad. S. 339-340; M. 79; Mc. 137; St. 166; A. 105-107.

P. dryinus Pers.

P. corticatus Fr.

A.² Veil wanting.

B.¹ Stipe present; sometimes short or even suppressed but pileus never resupinate.

C.¹ Lamellae long decurrent.

D.¹ Pileus white, silky-villous. S. 360; St. 173.

P. acerinus Fr.

D.² Pileus some shade of yellow or brown.

E.¹ Pileus thin; lamellae close, linear; stipe lateral. S. 361; P. R. 39:64; H. 157; A. 107; Mc. 144; St. 174....*P. petaloides* Fr.

E.² Pileus thick; lamellae broad, subdistant.

F.¹ Spores lilac in mass. S. 348; P. R. 39:61; H. 159; M. 79; A. 104; Mc. 141.....*P. sapidus* Kalchb.

F.² Spores white.

G.¹ Lamellae entire, anastomosing at base; pileus glabrous. S. 355; P. R. 39:62; H. 153; A. 104; Mc. 142.....*P. ostreatus* Jacq.

G.² Lamellae eroded, distinct at base; pileus substrigose. S. 359; H. 156; M. 79; Mc. 143; St. 173; P. R. 39:62.....*P. salignus* Schrad.

- C.² Lamellae not long decurrent; (sometimes uncinately or subdecurrent).
- D.¹ Pileus viscid when moist; stipe with minute blackish tomentum. S. 363; M. 80; Mc. 145; A. 109; St. 175; P. R. 39:62
P. serotinus Schrad.
- D.² Pileus and stipe not as above.
- E.¹ Lamellae broad, sinuate; pileus glabrous; stipe thick, solid. S. 341; P. R. 39:60; H. 157; M. 78; Mc. 138; A. 102; St. 167.
P. ulmarius Bull.
- E.² Lamellae rather narrow, adnate to subdecurrent.
- F.¹ Pileus grayish to brownish, glabrous; stipe solid. S. 343; M. 78; St. 169.
P. craspedius Fr.
- F.² Pileus white, pruinately or floccose; stipe stuffed or hollow.
- G.¹ Lamellae adnate to emarginate; stipe subvillous; pileus somewhat irregular. S. 344; St. 170; M. 78; P. R. 39:60; Mc. 140.
P. lignatilis Fr.
- G.² Lamellae adnate to subdecurrent; stipe glabrous, pileus orbicular. S. 344; H. 163; Mc. 140; St. 171.
P. circinatus Fr.
- B.² Stipe wanting; pileus definitely sessile or resupinate.
- C.¹ Pileus less than 8 mm. broad, cup-shaped when young, gray, bluish-gray or nearly black. S. 379; H. 161; A. 109; St. 180. . . . *P. applicatus* Batsch
- C.² Pileus usually 2 cm. or more broad.
- D.¹ Pileus glabrous or nearly so.
- E.¹ Lamellae very narrow; pileus somewhat spatulate, not viscid when moist. S. 361; P. R. 39:64; H. 157; Mc. 144; St. 174, A. 107. . . . *P. petaloides* Fr.

- E.² Lamellae rather broad; pileus at first resupinate, becoming somewhat reniform, viscous when moist. S. 378; St. 180; M. 80.
P. algidus Fr.
- D.² Pileus silky, villous or with somewhat pointed scales when fresh; not glabrous.
- E.¹ Pileus white or whitish, silky. S. 374; M. 80.....*P. pinsitus* Fr.
- E.² Pileus darker in color when fresh.
- F.¹ Pileus mouse-gray, usually with tufted scales. S. 376; M. 80; Mc. 146; St. 179.....*P. mastrucatus* Fr.
- F.² Pileus blackish-blue or brownish-gray, villous, not scaly. S. 377; P. R. 39: 65; St. 179.....*P. atrocoeruleus* Fr.

NOTES.

P. nidulans Pers. is now usually placed in the genus *Claudopus* on account of its salmon-colored or pink spores. *P. sapidus*, which has pale lilac spores, is usually regarded as a *Pleurotus* because of its obvious relations with some species of that genus.

Plants formerly referred to *P. serotinoideus* Peck and *P. abscondens* Peck, and so listed by Hard, are now regarded by Peck as varieties of *P. serotinus* and *P. lignatilis* respectively.

Kellerman and Werner (p. 305) include *P. acerinus* in the list of Ohio plants. This seems to be the only reference to this species in Ohio literature.

Plants referred by Morgan to *P. niger* Schw. were probably *P. applicatus*, which is a rather common species in southwestern Ohio.

The plants referred to *P. circinatus* by Hard were probably *P. lignatilis*. He says it may be known by the white gills. The lamellae of *P. lignatilis* are white.

The occurrence of *P. pinsitus* in Ohio is rather doubtful.

P. caespitosus B. & C. was first published as a *Lentinus*, then as a *Pleurotus*. It is probably the plant now known as *Clitocybe monadelphæ* Morg.

P. corticatus is very close to *P. dryinus* Pers. It should probably be regarded as a variety of the latter as Atkinson does.

HYGROPHORUS FR.

A.¹ Plants becoming black when bruised or dried; pileus conic; red, orange or yellow or with these colors blended. S. 418; St. 2:89; Mc. 160; H. 209; M. 181; M. B. 116:62.

H. conicus (Scop.) Fr.

A.² Plants not becoming black.

B.¹ Stipe solid.

C.¹ Pileus and stipe glutinous.

D.¹ Stipe punctate or scabrous at top with small scales.

E.¹ Pileus pale brownish or reddish brown to whitish, center usually darker. S. 388; M. B. 116:48; H. 213; Mc. 716; M. 180.

H. laurae Morg.

E.² Whole plant white; (the stipe usually stuffed or becoming hollow). S. 388; M. B. 116:47; St. 2:71; H. 206; Mc. 149; A. 111; M. 180.

H. eburneus (Bull.) Fr.

D.² Stipe not punctate or scabrous.

E.¹ Pileus white, yellow or reddish-yellow in the center. S. 398; H. 210; Mc. 157; M. B. 116: 50 *H. flavodiscus* Frost

E.² Pileus grayish-brown or smoky-brown, often darker in the center. S. 398; H. 212; Mc. 158; A. 113; M. B. 116:52.

H. fuliginosus Frost

C.² Pileus and stipe not glutinous; pileus may be viscid or moist only.

D.¹ Lamellae distant or subdistant; pileus convexo-plane or somewhat depressed.

E.¹ Pileus white or whitish.

F.¹ Pileus somewhat viscid; lamellae rather close or subdistant, mostly adnate. S. 16:39; H. 220; B. T. 25:322.

H. sordidus Peck

F.² Pileus not viscid; lamellae distant, decurrent. S. 402; St. 2:79; Mc. 153; H. 219; M. B. 116:55.

H. virgineus (Bull.) Fr.

E.² Pileus not white.

F.¹ Pileus variable in color, not viscid, usually more than 2.5 cm. broad; plants growing on ground. S. 401; H. 205, 206; St. 2:79; Mc. 152; A. 113; M. B. 116:56.

H. pratensis (Pers.) Fr.

F.² Pileus yellow becoming purplish, viscid, 2.5 cm. or less in breadth; plants growing on wood. S. 422.

H. ohioensis Mont.

D.² Lamellae crowded, narrow, pileus soon infundibuliform. S. 403.

H. stenophyllus Mont.

B.² Stipe stuffed or soon hollow.

C.¹ Stipe scabrous or punctate at apex with small scales; whole plant white, viscid. S. 388; M. B. 116:47; St. 2:71; H. 206; Mc. 149; A. 111; M. 180. *H. eburneus* (Bull.) Fr.

C.² Stipe glabrous.

D.¹ Plants covered with greenish slime, at least when rather young. S. 420; A. 114; M. B. 116: 64; St. 2: 90.

H. psittacinus (Schaeff.) Fr.

D.² Plants without greenish slime.

E.¹ Plants bright red, orange or yellow; pileus thin and fragile.

F.¹ Pileus viscid when moist.

G.¹ Plants yellow; without red or with only slight tinge of red at center.

H.¹ Stipe viscid; lamellae emarginate-adnexed. S. 419; St. 2:90; Mc. 160; H. 208; M. B. 116:66; M. 181.

H. chlorophanus Fr.

H.² Stipe not viscid; lamellae adnate or subdecurrent. S. 412; St. 2:86; M. B. 116:61; H. 218; Mc. 155; M. 181.

H. ceraceus (Wulf.) Fr.

G.² Pileus red.

H.¹ Lamellae adnexed or emarginate; stipe whitish at the base, rather stout. S. 416; St. 2:88; M. B. 116:63; Mc. 159; M. 181. *H. puniceus* Fr.

H.² Lamellae adnate or subdecurrent; stipe yellow at the base, rather slender. S. 412; St. 2:86; Mc. 156; H. 209; M. 181; M. B. 116:63.

H. coccineus Schaeff.

F.² Pileus not viscid.

G.¹ Lamellae quite decurrent. S. 414; M. B. 116:59; H. 208; Mc. 156.

H. cantharellus Schw.

G.² Lamellae normally adnate or sinuate; sometimes becoming somewhat decurrent by the expansion of the pileus. S. 413; St. 2:87; M. B. 116:61; H. 215; Mc. 159; A. 113 *H. miniatus* Fr.

E.² Plants not bright red, etc., as above; more or less firm and fleshy; pileus not viscid.

F.¹ Whole plant white or whitish; stipe usually less than 5 cm. long. S. 402; St. 2:79; Mc. 153; M. B. 116:55; H. 219.....*H. virginicus* (Bull.) Fr.

F.² Pileus tawny, buff, cinereous; occasionally varying to whitish or with tinge of red; stipe usually more than 5 cm. long. S. 401; H. 205,206; St. 2:79; Mc. 152; A. 113; M. B. 116:56.

H. pratensis (Pers.) Fr.

LACTARIA PERS.

A.¹ Latex colored from the first.

B.¹ Latex and plant indigo-blue. S. 438; N. A. F. 187; H. 167; Mc. 171; A. 125; P. R. 38:115.

L. indigo (Schw.) Fr.

B.² Latex and plant saffron-red or orange. S. 438; N. A. F. 186; H. 179; Mc. 170; A. 123; M. 184; P. R. 38:116.

L. deliciosus (L.) Fr.

A.¹ Latex white or whitish at first.

B.¹ Latex very acrid.

C.¹ Pileus dry or only moist; not viscid.

D.¹ Latex becoming golden-yellow; pileus zonate. S. 433; H. 181; P. R. 38:117; N. A. F. 188; A. 122; St. 2:101.....*L. chrysorhea* Fr.

D.² Latex unchanging; pileus azonate except in *L. rusticana*.

E.¹ Pileus white, whitish or yellowish.

F.¹ Pileus tomentose; lamellae broad, distant. S. 437; N. A. F. 177; H. 181; Mc. 169; M. 183; St. 2:102; P. R. 38:124.

L. vellerea Fr.

F.² Pileus glabrous; lamellae close, narrow.

G.¹ Flesh thick; lamellae usually decurrent, not straw colored, 2 mm. broad; stipe solid. S. 436; N. A.

F. 176; H. 165; Mc. 168; A. 120;
M. 183; St. 2: 102; P. R. 38: 125.

L. piperata (Scop.) Fr.

G.² Flesh thin; lamellae adnate, becoming
straw-colored, 1 mm. broad; stipe
stuffed; latex often drying sulfur-
yellow. S. 436; H. 166; N. A. F.
176; Mc. 167; M. 183; St. 2: 101.

L. pergamenae (Sw.) Fr.

E.² Pileus dark colored.

F.¹ Pileus olivaceous; azonate, scabrous-
hairy; lamellae close, narrow, staining
green. S. 9: 56; H. 175; N. A. F.
178; P. R. 42: 23. *L. atroviridis* Peck

F.² Pileus grayish to brown, or with lurid
tints, somewhat zoned, glabrous; lam-
ellae subdistant, rather broad, not
staining green. S. 432; St. 2: 100;
N. A. F. 178; P. R. 38: 128.

L. pyrogala Fr.

L. rusticana (Scop.) Burl.

C.² Pileus viscid.

D.¹ Plants becoming blackish in age or with injury;
stipe viscid when moist. S. 426; St. 2: 94;
N. A. F. 183; P. R. 38: 120.

L. turpis (Weinm.) Fr.

D.² Plants not becoming blackish.

E.¹ Margin of pileus woolly or tomentose, at least
in young plants.

F.¹ Stipe scrobiculate-pitted; latex becoming
yellow; margin often naked at matur-
ity. S. 424; H. 169-170; M. 182; St.
2: 93; N. A. F. 179; P. R. 38: 118.

L. scrobiculata (Scop.) Fr.

F.² Stipe not pitted; latex unchanging.

G.¹ Center of pileus glabrous, usually
zonate. S. 424; N. A. F. 178; H.

164-5; Mc. 163; St. 2:93; P. R. 38:120.

L. torminosa (Schaeff.) Pers.

G.² Whole pileus tomentose, azonate. S. 425; M. 182; St. 2:94; N. A. F. 179; P. R. 38:119.

L. cilicioides Fr.

E.² Pileus glabrous; margin naked or only pruinose.

F.¹ Latex becoming yellow; pileus zonate, white to yellowish. S. 433; H. 181; A. 122; N. A. F. 188; St. 2:101; P. R. 38:117..... *L. chrysorhea* Fr.

F.² Latex unchanging (or drying greenish in *L. trivialis*).

G.¹ Pileus some shade of yellow or orange.

H.¹ Pileus zonate; lamellae about 2 mm. broad.

I.¹ Spores white; stipe usually longer than 5 cm., solid or spongy within, unspotted; pileus usually depressed only. S. 428; M. 183; St. 2:96.

L. sonaria (Bull.) Fr.

I.² Spores yellow; stipe usually less than 5 cm. long, stuffed or hollow, sometimes spotted; pileus usually infundibuliform. S. 427; N. A. F. 180; H. 171; P. R. 38:122; Mc. 165; St. 2:96.

L. insulsa Fr.

H.² Pileus azonate; lamellae 4-10 mm. broad. S. 428; M. 184; N. A. F. 180; P. R. 38: 121.

L. affinis Peck

G.² Pileus lurid to ash-gray or snuff-brown.

H.¹ Pileus usually more than 8 cm. broad; viscosity slimy, persistent; lamellae rather broad; stipe cream-yellow. S. 430; M. 183; H. 170; P. R. 38: 120; N. A. F. 181; St. 2: 98.

L. trivialis Fr.

H.² Pileus usually less than 8 cm. broad; viscosity thin, disappearing; lamellae rather narrow; stipe cinereous. S. 428; M. 184; P. R. 38: 122; N. A. F. 190; H. 173.

L. cinerea Peck

B.² Latex mild or only slightly acrid.

C.¹ Pileus ash-gray, somewhat viscid. . . . *L. cinerea* Peck

C.² Pileus some shade of yellow or brown, dry.

D.¹ Lamellae distant; pileus yellow to fulvous. S. 448; N. A. F. 196; P. R. 38: 129; H. 174; M. 184; Mc. 180. . . . *L. hygrophoroides* B. & C.

D.² Lamellae close.

E.¹ Pileus zonate; fulvous to brownish. S. 449; N. A. F. 176; St. 2: 110. . . *L. ichorata* Fr.

E.² Pileus azonate.

F.¹ Pileus glabrous.

G.¹ Flesk thick, becoming brownish on exposure to air; stipe stout. S. 447; H. 178; P. R. 38: 130; N. A. F. 195; Mc. 180; A. 115; M. 184; St. 2: 109.

L. volema Fr.

L. lactiflua (L.) Burl.

G.² Flesh thin, not becoming brownish; stipe slender.

H.¹ Margin striatulate when moist; (pileus slightly viscid but this character may not be apparent); plants growing among Sphagnum, other mosses and old leaves. S. 451; N. A. F. 189; P. R. 38: 133.

L. paludinella Peck

H.² Margin even; pileus not viscid.

I.¹ Pileus rimose-areolate, reddish-brown, with faint aromatic odor; lamellae 4-6 mm. broad; latex somewhat watery. N. A. F. 198; Oh. Nat. 10; 177-8; M. B. 105: 37.

L. rimosella Peck

I.² Pileus smooth, fulvous to reddish-fulvous, odorless; lamellae 3 mm. broad; latex white, not watery. S. 450; H. 176; N. A. F. 198; Mc. 182; M. 184; P. R. 38: 132.

L. subdulcis (Bull.) Fr.

F.² Pileus velvety or pruinose-velvety.

G.¹ Pileus sooty or smoky-brown, usually umbonate; latex becoming salmon-pink. S. 445; P. R. 38: 129; H. 173; Mc. 177; N. A. F. 194; A. 117.....*L. ligniota* Fr.

G.² Pileus yellow to reddish-brown, plane or depressed; latex not becoming pink.

H.¹ Flesh and lamellae staining brown where injured.

I.¹ Pileus reddish-brown; usually much corrugated. S. 449; N. A. F. 197; H. 177-178; Mc. 178; A. 116; P. R. 38: 130.

L. corrugis Peck

I.² Pileus yellowish-buff, even or slightly rugose. S. 14: 94; N. A. F. 197; Mc. 178; B. T. 23: 412.

L. luteola Peck

H.² Flesh and lamellae not staining brown; pileus golden-fulvous. N. A. F. 197; M. B. 75; 18.

L. subvelutina Peck

NOTES.

The nomenclature in the above key is that employed by Miss Burlingham in her monograph of the genus in the North American Flora. The genus is commonly known as *Lactarius*, which Miss Burlingham regards as merely a variation in spelling. *L. lactiflua* is commonly known as *L. volema*, and *L. rusticana* is usually published as *L. pyrogala*. In these cases both names are given.

L. distans Peck, reported by Morgan and Hard, is now regarded by Peck as a synonym for *L. hygrophoroides*. *L. sordida* Peck is a synonym for *L. turpis*.

L. vieta Fr., *L. calceola* Berk. and *L. zonaria* (Bull.) Fr. were reported by Lea and included in Morgan's list. The first has not been otherwise reported from North America. *L. calceola* was probably an abnormal form of *L. hygrophoroides*. Of the three only *L. zonaria* is included in the key and its occurrence in Ohio is doubtful.

L. torminosa has not been reported for Ohio but its range is such as to indicate that it will likely be found here.

RUSSULA PERS.

- A.¹ Lamellae conspicuously unequal, short and long alternating; pileus firm, margin even, flesh thick.
- B.¹ Pileus changing color in age or in drying.
- C.¹ Pileus becoming smoky-brown or blackish.
- D.¹ Lamellae distant or subdistant, broad, thick; pileus somewhat viscid; flesh turning reddish then blackish. S. 453; M. B. 116: 68; K. 65; Mc. 187; H. 184; St. 2: 114.
R. nigricans (Bull.) Fr.
- D.² Lamellae close, rather narrow, thin.
- E.¹ Pileus viscid when moist. M. B. 116: 69; Oh. Nat. 10: 177-8. . . *R. subsordida* Peck
- E.² Pileus not viscid.
- F.¹ Flesh of pileus not changing color when wounded. S. 454; M. B. 116: 70; K. 66; Mc. 188; H. 183; St. 2: 114.
R. adusta (Pers.) Fr.
- F.² Flesh changing color when wounded.
- G.¹ Flesh becoming reddish then blackish when wounded. S. 454; M. B. 116: 70; K. 67; H. 197.
R. densifolia Secr.
- G.² Flesh becoming blackish without assuming reddish tint. S. 459; M. B. 116: 69; K. 66; Mc. 190; M. 186. *R. sordida* Peck
- C.² Pileus becoming tawny or ochraceous. S. 9: 59; M. B. 116: 71. *R. compacta* Frost
- B.² Pileus not changing color in age or in drying.
- C.¹ Pileus white, glabrous; lamellae white. S. 455; M. B. 116: 72; K. 64; H. 182; Mc. 190; St. 2: 115.
R. delica Fr.
- C.² Pileus sordid to brown, flocculose; lamellae becoming somewhat flesh-color. S. 468; M. 187.
R. morgani Sacc.

A.² Lamellae equal or with a few shorter ones.

B.¹ Stipe yellow, at least at base.

C.¹ Pileus red, becoming yellowish at center or entirely so; stipe orange-yellow at base; lamellae pale ochraceous. S. 17: 34; B. T. 31: 179; Oh. Nat. 10: 177.....*R. luteobasis* Peck

C.² Pileus wholly yellow, sometimes mealy; stipe wholly yellow; lamellae white. M. B. 116: 78; K. 72; Mc. 197; S. 9: 60.....*R. flavida* Frost

B.² Stipe white or whitish, red or reddish.

C.¹ Lamellae forking much throughout.

D.¹ Lamellae close; pileus purplish, umber or green or with these colors mingled. M. B. 105: 41; K. 73; H. 190..... *R. variata* Bann.

D.² Lamellae subdistant; pileus yellowish-green or umber-green. S. 456; M. B. 116: 74; K. 73; Mc. 191; H. 194; St. 2: 116.

R. furcata (Pers.) Fr.

C.²Lamellae not often forking or only near stipe.

D.¹ Lamellae or spores, usually both, white or whitish to cream color.

E.¹ Pileus some shade of red or purple.

F.¹ Taste acrid.

G.¹ Pileus dry, margin even. S. 462; M. B. 116: 79; St. 2: 120; K. 67; Mc. 196; H. 195....*R. rubra* Fr.

G.² Pileus viscid or subviscid; margin striate or sulcate, tuberculate.

H.¹ Pileus 2-5 cm. broad; lamellae close. S. 472; St. 2: 126; M. B. 116: 88; Mc. 203; H. 192; St. 2: 126.

R. fragilis (Pers.) Fr.

H.² Pileus usually 5-10 cm. broad; lamellae subdistant. S. 469; M. B. 116: 87; K. 78; Mc. 201; H. 193; St. 2: 125.

R. emetica Fr.

F.² Taste mild.

G.¹ Stipe becoming blackish when bruised or dried; pileus glabrous, bright red, margin striate. B. T. 33: 214...*R. nigrescentipes* Peck

G.² Stipe not becoming blackish.

H.¹ Pileus tuberculose-striate on margin, less than 3.5 cm. broad. S. 479; K. 85; M. B. 116: 95; Mc. 208.

R. puellaris Fr.

H.² Pileus even on margin, more than 3.5 cm. (except sometimes *R. purpurina*.)

I.¹ Pileus dry, subvelvety or with velvety appearance, rimose-areolate, sometimes becoming yellowish; stipe usually red or tinged with red. S. 461; St. 2: 119; K. 68; M. B. 116: 79; Mc. 195; H. 187.

R. lepida Fr.

I.² Pileus glabrous, viscid, not rimose; stipe white (except in *R. purpurina*).

J.¹ Pileus rugose-wrinkled; cuticle not reaching margin; stipe solid. S. 465; St. 2: 122; K. 74; M. B. 116: 82; Mc. 198; H. 189.

R. vesca Fr.

J.² Pileus not rugose; stipe stuffed or spongy within, sometimes hollow when old.

K.¹ Pileus deep red; lamellae rather narrow, floccose-crenulate on edge. S. 474; M. B. 116: 89; Mc. 188; K. 83; H. 196.

R. purpurina Q. & S.

K.² Pileus variable in color, purplish, bluish, yellowish, etc.; lamellae broad. S. 465; M. B. 116: 82; St. 2: 122; K. 74; H. 188; Mc. 198.

R. cyanoxantha (Schaeff.) Fr.

E.² Pileus without red or purple.

F.¹ Pileus white to yellow or brownish.

G.¹ Margin of pileus even or nearly so; lamellae distant.

H.¹ Pileus very viscid. S. 17: 33; M. B. 116: 83; Oh. Nat. 10: 177.....*R. earlei* Peck

H.² Pileus not viscid, white. S. 459; St. 2: 118; Mc. 194; M. 186.

R. lactca (Pers.) Fr.

G.² Margin of pileus deeply striate and tuberculate; lamellae rather close.

H.¹ Pileus glutinous at least when young, usually more than 6 cm. broad; plants with amygdaline odor. S. 467; M. B. 116: 85; St. 2: 124; K. 78; Mc. 199; H. 186; M. 187.

R. foetens (Pers.) Fr.

H.² Pileus viscid but not glutinous, usually less than 6 cm. broad; odor not marked. S. 470; Mc. 202; St. 2: 126.

R. pectinata (Bull.) Fr.

F.² Pileus some shade of green, sometimes fading to ochraceous-green or umber.

G.¹ Pileus areolate except center; margin striate; sometimes subviscid. M. B. 116:77; K. 72; Oh. Nat. 10: 177-8; S. 9:61.

R. crustosa Peck

G.² Pileus with flocculent patches or warts, dry; margin even. S. 460; K. 72; M. B. 116:76; Mc. 194; H. 190; St. 2: 119.

R. virescens (Schaeff.) Fr.

D.² Lamellae and spores yellow or ochraceous.

E.¹ Pileus viscid, at least slightly, more or less polished, glabrous, margin usually striate.

F.¹ Pileus less than 5 cm. broad; stipe rosy-mealy. S. 474; M. B. 116:96; K. 86; Mc. 209; H. 191.

R. roseipes (Secr.) Bres.

F.² Pileus broader than 5 cm.; stipe not rosy-mealy.

G.¹ Pileus orange-red, becoming paler; flesh becoming cinereous with age or when broken. S. 476; M. B. 116:94; K. 88; Mc. 205; St. 2: 128. *R. decolorans* Fr.

G.² Pileus red, purplish-red, or brownish red, or with green shades, not orange-red; flesh not becoming cinereous.

H.¹ Lamellae close, rather narrow, pulverulent; spores yellow;

pileus bay-brown-purplish. S.
477; M. 187; St. 2: 129.

R. nitida (Pers.) Fr.

H.² Lamellae distant or sub-distant,
broad.

I.¹ Spores ochraceous; lamellae
not pulverulent; stipe usu-
ally variegated reddish.
S. 479; M. B. 116:98;
K. 69; Mc. 207; H. 186;
St. 2: 129.

R. alutacea Fr.

I.² Spores yellow; lamellae pul-
verulent; stipe white. S.
475; H. 191; M. B. 116:
93; K. 84; Mc. 204; St.
2: 127.

R. integra (L.) Fr.

E.² Pileus dry, unpolished or pruinose; margin
usually even.

F.¹ Pileus with whitish pruinose bloom;
spores pale yellow. S. 464; M. B.
116:81; K. 70; Mc. 209.

R. mariae Peck

F.² Pileus without whitish bloom.

G.¹ Pileus subvelvety, often rimose;
spores yellowish; lamellae not
powdery. S. 461; M. B. 116:79;
K. 68; Mc. 195; H. 187.

R. lepida Fr.

G.² Pileus unpolished merely, not rimose;
spores ochraceous, dusting the
lamellae. S. 14:98; M. B. 116:
80; K. 68; Mc. 193; H. 187.

R. ochrophylla Peck

NOTES.

R. cyanoxantha, *R. integra*, *R. roseipes*, *R. adusta*, *R. purpurina*, *R. fragilis* and *R. nigricans* have not been definitely reported from Ohio as yet. Their range, however, makes it likely that they occur here and they are included in the key for convenience in determination.

Morgan reports *R. lutea* Fr. but from his notes it is evident that his plants should be referred to *R. flavida* which is rather frequent in southwestern Ohio during some seasons. *R. lutea* has not been otherwise reported and is omitted.

Most American plants formerly referred to *R. furcata* are now more properly referred to *R. variata*. It is uncertain at present whether the true *R. furcata* occurs in Ohio.

CANTHARELLUS ADANS.

A.¹ Whole plant bright cinnabar-red when fresh. S. 414; M. B. 1²:39; N. A. F. 170; M. 189; H. 203.

C. cinnabarinus Schw.

A.² Plants not as above.

B.¹ Pileus deeply infundibuliform.

C.¹ Lamellae close; pileus more than 5 cm. broad. S. 491; M. B. 1²:37; H. 200; N. A. F. 168; Mc. 218*C. floccosus* Schw.

C.² Lamellae distant; pileus less than 5 cm. broad. S. 490; N. A. F. 168; M. B. 1²:41; H. 203.

C. infundibuliformis (Scop.) Fr.

B.² Pileus plane or depressed, not infundibuliform.

C.¹ Pileus cinereous or grayish brown. S. 485; N. A. F. 170; Mc. 217; M. B. 1²:36.

C. umbonatus Fr.

C.² Pileus yellow or orange, rarely ochraceous.

D.¹ Lamellae close; plants orange. S. 483; N. A. F. 169; M. B. 1²:35; H. 200; Mc. 216; A. 129; M. 189.....*C. aurantiacus* Fr.

D.² Lamellae distant; plants usually yellow.

E.¹ Pileus thick, 3 cm. or more broad when mature. S. 482; N. A. F. 169; M. B. 1²:38; H. 198; Mc. 215; A. 128; M. 188 *C. cibarius* Fr.

E.² Pileus thin, 1-2.5 cm. broad. S. 483; N. A. F. 169; M. B. 1²:40; Mc. 216; M. 188
C. minor Peck

NOTES.

Murrill regards the name *Cantharellus* as a variant in spelling of *Chanterel* and discusses the genus under the latter name (*N. Am. Flora* 9³:167). He describes *C. umbonatus*, *C. aurantiacus* and *C. cibarius* respectively as *Chanterel muscoides* (Wulf.) Murrill, *Chanterel alectorolophoides* (Schaeff.) Murrill, and *Chanterel Chanterellus* (L.) Murrill.

Plants referred by Hard to *C. brevipes* Peck were probably young specimens of *C. floccosus*.

Fries, followed by Saccardo, placed *C. cinnabarinus* in the genus *Hygrophorus*. American writers regard this species as a good *Cantharellus*.

NYCTALIS FR.

Pileus white to brownish, usually powdered with brownish, stellate conidia; lamellae distant; plants on decaying Agarics. S. 501; N. A. F. 9³:166; H. 204; St. 2:138.

N. asterophora Fr.

This species is published in the *North American Flora* as *Asterophora clavus* (Schaeff) Murrill.

HELIOMYCES LEV.

Marasmius nigripes (Sch.) Fr. is placed in this genus by Morgan (*Jour. Myc.* 12:93). It will be easily recognized by the thin, white pileus and the black stipe which has a white pruinose covering. In dried specimens the stipe becomes pale brownish. S. 534; M. 193; H. 152.

MARASMIUS FR.

- A.¹ Stipe glabrous (except perhaps at base), horny, polished.
- B.¹ Pileus radiate-sulcate or deeply striate.
- C.¹ Lamellae joined behind in a collar encircling the stipe and free from it.
- D.¹ Pileus umbonate. S. 542; H. 146; St. 2:150; J. M. 12:1.....*M. graminum* (Lib.) Berk.
- D.² Pileus umbilicate, but often with a small umbo within the depression.
- E.¹ Stipe capillary, scarcely thicker than a hair; pileus pale tan; lamellae subdistant. S. 541; M. 194; J. M. 11:247.
M. capillaris Morg.
- E.² Stipe somewhat thicker; lamellae distant; pileus white or whitish. S. 541; P. R. 23:125; H. 143; St. 2:149; J. M. 11:247.
M. rotula (Scop.) Fr.
- C.² Lamellae not joined in a collar.
- D.¹ Pileus ochraceous or ochraceous-red; stipe without purple tints, blackish-brown below, paler above. S. 535; M. 193; J. M. 11:241; P. R. 23:126*M. campanulatus* Peck
- D.² Pileus purplish to purplish-brown; stipe purplish when young, becoming brown. S. 535; H. 146,148; J. M. 11:240.....*M. siccus* Schw. J. M. 11:207.....*M. bellipes* Morg.
- B.² Pileus not sulcate.
- C.¹ Plants with odor of garlic.
- D.¹ Pileus grayish-brown, reddish-brown or paler; stipe entirely glabrous. S. 525; H. 144; Mc. 226; St. 2:146; J. M. 11:234.
M. scorodonius Fr.
- D.² Pileus white or whitish; stipe subtomentose at base. S. 515; H. 145; M. 192; J. M. 11:206.
M. prasiosmus Fr.

C.² Plants without alliaceous odor.

D.¹ Pileus white or whitish.

E.¹ Stipe arising from a more or less abundant mycelium, not inserted.

F.¹ Lamellae rather distant, sinuate; stipe entirely glabrous. H. 151; J. M. 11:206 *M. delectans* Morg.

F.² Lamellae rather close, nearly free; stipe subpruinose when dry, strigose at base. S. 520; St. 2:144; J. M. 11:207 . . . *M. erythropus* (Pers.) Fr.

E.² Stipe inserted, mycelium within substratum and invisible. S. 525; H. 145; Mc. 226; M. 192; St. 2:146; J. M. 11:235.

M. calopus (Pers.) Fr.

D.² Pileus some shade of brown, yellow, reddish or purplish.

E.¹ Pileus umbonate; plants growing in a tuft with stipes more or less united. S. 522; J. M. 11:238 *M. cucurbitula* Mont.

E.² Pileus not umbonate; stipes not united.

F.¹ Lamellae united behind but free from stipe; pileus reddish-gray. S. 511; H. 145; M. 192; J. M. 11:208; P. R. 24:76 *M. anomalus* Peck

F.² Lamellae not united behind, attached to stipe.

G.¹ Lamellae whitish, close; pileus about 1 cm. broad, striatulate; stipe white at top. S. 543; H. 138; P. R. 23:126; J. M. 11:245.

M. androsaceus (L.) Fr.

G.² Lamellae purplish-gray, subdistant; pileus 4-6 mm. broad, not striate; stipe not white at top. S. 14:104;

J. M. 11: 245; Jour. Cin. Soc. Nat. Hist. 18: 36, (pl. 1 f. 2).

M. melanopus Morg.

A.² Stipe pruinatè, pubescent, velvety-tomentose, etc., not glabrous.

B.¹ Stipe solid or stuffed, not hollow at least when young, not horny.

C.¹ Taste mild; stipe not strigose or downy at the base.

D.¹ Lamellae broad, whitish or yellowish. S. 510; Mc. 224; A. 131; H. 136; St. 2: 142; J. M. 11: 205; M. 190; P. R. 23: 124.

M. oreades Fr.

D.² Lamellae narrow, brown or brownish. S. 511; M. 190; J. M. 11: 205; P. R. 23: 125.

M. plancus Fr.

C.² Taste acrid or bitter; base of stipe strigose or conspicuously downy.

D.¹ Margin of pileus not striate; lamellae free, distant. S. 504; St. 2: 140; H. 138; Mc. 223; M. 189; J. M. 11: 202. *M. urens* Fr.

D.² Margin striate; lamellae attached or seceding, close or subdistant.

E.¹ Lamellae rather broad, close; stipe yellow or rufescent. S. 504; J. M. 11: 204; St. 2: 141; H. 148, 149; M. 190; Mc. 223.

M. peronatus Fr.

E.² Lamellae narrow, subdistant; stipe reddish-brown above, to blackish-brown at base. S. 16: 57; P. R. 51: 287; J. M. 11: 202.

M. subnudus (Ellis) Peck

B.² Stipe hollow.

C.¹ Pileus white, whitish or pallid.

D.¹ Lamellae decurrent.

E.¹ Pileus usually less than 6 mm. broad. J. M. 12: 6; M. 193. *M. clavaeformis* Berk.

E.² Pileus 6-15 mm. broad. S. 561; J. M. 12: 5. *M. leucocephalus* Mont.

D.² Lamellae not decurrent.

E.¹ Lamellae close.

F.¹ Plants with odor of garlic; margin not striate. S. 515; M. 192; J. M. 11: 206; H. 145. . . . *M. prasioemus* Fr.

F.² Plants without alliaceous odor; margin striate. S. 517; J. M. 11: 206.

M. semisquarrosus B. & C.

E.² Lamellae distant or subdistant.

F.¹ Margin of pileus more or less striate or plicate-sulcate; stipe brownish or blackish beneath the covering.

G.¹ Lamellae adnexed. S. 533; H. 142; J. M. 11: 212.

M. candidus (Bolt.) Fr.

G.² Lamellae adnate.

H.¹ Pileus about 1 cm. or more broad; lamellae rather broad and numerous; stipe dilated at base. S. 534; M. 193; H. 152; J. M. 12: 93.

M. nigripes (Schw.) Fr.

H.² Pileus usually much less than 1 cm. broad; lamellae narrow, veinlike, few, very distant; stipe inserted. S. 559;

J. M. 12: 3. *M. epiphyllus* Fr.

J. M. 12: 2. *M. felix* Morg.

F.² Pileus not striate or sulcate; stipe whitish or rufescent.

G.¹ Lamellae adnate; stipe usually less than 2 cm. long, rufescent toward the base. S. 531; St. 2: 148; J. M. 11: 211; H. 149.

M. ramealis (Bull.) Fr.

G.² Lamellae adnexed; stipe usually

longer, entirely white. S. 532; J. M. 11: 237; M. 192.

M. opacus B. & C.

C.² Pileus yellowish, brownish, reddish-brown, etc.

D.¹ Lamellae free or seceding.

E.¹ Lamellae brown or brownish; stipe not strigose at base. S. 511; P. R. 23: 125; J. M. 11: 205; M. 190.....*M. plancus* Fr.

E.² Lamellae whitish; stipe strigose at base. S. 538; J. M. 11: 208...*M. sullivantii* Mont.

D.² Lamellae adnate or adnexed.

E.¹ Stipe distinctly velvety, tomentose or hairy.

F.¹ Lamellae distant or subdistant.

G.¹ Plants growing on old wood; stipe long rooting. S. 537; J. M. 11: 239.....*M. macrorrhizus* Mont.

G.² Plants growing on ground among leaves, etc.; stipe not definitely rooting.

H.¹ Pileus plicate-striate. M. 191; J. M. 11: 239.

M. pyrrocephalus Berk.

H.² Pileus not plicate-striate.

I.¹ Stipe glabrous toward the top, not thickened at the base. S. 517; P. R. 25: 79-80; J. M. 11: 206; H. 145.

M. semihirtipes Peck

I.² Stipe thickened at the base, not glabrous at the top. S. 513; J. M. 11: 203.

M. spongiosus B. & C.

F.² Lamellae close.

G.¹ Pileus striate when moist.

H.¹ Pileus not more than 12 mm. broad; stipe rooting, usually

more than 5 cm. long. S. 517; P. R. 26: 66; H. 146; J. M. 11: 240.

M. elongatipes Peck

H.² Pileus more than 12 mm. broad; stipe usually less than 5 cm. long, not rooting. S. 541; J. M. 11: 203.

M. rigidus Mont.

G.² Pileus not striate.

H.¹ Lamellae rather broad; stipe thickened below. S. 513; J. M. 11: 203.

M. spongiosus B. & C.

H.² Lamellae rather narrow; stipe not thickened at base. S. 521; H. 140; P. R. 23: 124; J. M. 11: 209. *M. velutipes* B. & C.

E.² Stipe pruinose or minutely pubescent, not tomentose or velvety.

F.¹ Lamellae narrow; pileus becoming umbilicate, not more than 12 mm. broad. S. 14: 108; B. T. 23: 413; J. M. 11: 236 *M. gregarius* Peck

F.² Lamellae rather broad; pileus not umbilicate, usually more than 1.5 cm. broad.

G.¹ Lamellae distant; margin of pileus slightly or not at all rugose-sulcate. S. 565; J. M. 11: 203.

M. viticola B. & C.

G.² Lamellae rather close; margin rugose-sulcate. S. 524; H. 148; M. 192; J. M. 11: 204.

M. fagineus Morg.

NOTES.

Remarkably cespitose plants referred to this genus by the student should usually be looked for in the genus *Collybia*. Ohio plants usually known as *Collybia lachnophylla* are called *Marasmius cohaerens* (Fr.) Bres. by some writers.

Montagne's species have not been recognized by collectors since their publication.

The plants reported by Morgan in the *Mycologic Flora* as *M. fusco-purpureus* Pers. were later referred to *M. semihirtipes*.

M. elongatipes was first published as *M. longipes*. The latter name was preoccupied.

M. siccus, *M. bellipes*, *M. campanulatus* and several other species not reported from Ohio are very closely related. The pileus of *M. siccus* is described as "roseo-pallido"; that of *M. campanulatus* as ochraceous-red. A plant with the pileus bright ochraceous is frequent in Ohio. Another with the pileus pinkish to purplish also occurs. In very young plants the stipe is of the same color, but becomes blackish-brown as it matures, beginning at the base, the apex remaining purplish for some time. Morgan has described this plant as *M. bellipes*. Even in dried specimens (at least if not too old) the plants can be readily distinguished. In this paper the plants with ochraceous pileus are regarded as *M. campanulatus*, while those with pinkish or purplish pileus are regarded as *M. siccus* with *M. bellipes* as a synonym.

LENTINUS FR.

A.¹ Plants with distinct stipe.

B.¹ Pileus scaly or squamulose.

C.¹ Pileus umbilicate to infundibuliform, with blackish, hairy scales. S. 580; St. 2: 154; Mc. 229; M. B. 131: 43; M. 194. *L. tigrinus* Fr.

C.² Pileus convex to plane.

D.¹ Margin of pileus sulcate. S. 584; M. B. 131: 44; M. 194. *L. sulcatus* Berk.

- D.² Margin even.
 - E.¹ Lamellae sinuate-decurrent, broad. S. 581; M. B. 131:42; H. 228; St. 2:155; A. 135; Mc. 230.....*L. lepideus* Fr.
 - E.² Lamellae decurrent, not sinuate, rather narrow. M. B. 131:43.....*L. spretus* Peck
- B.² Pileus glabrous, depressed to infundibuliform.
 - C.¹ Stipe sulcate, glabrous; lamellae broad. S. 594; M. B. 131:45; St. 2:156; M. 195; H. 229; Mc. 239; *L. cochleatus* Fr.
 - C.² Stipe not sulcate, fibrillose; lamellae narrow. S. 595; M. 195.....*L. curtisii* Sacc. & Cub.
- A.² Plants sessile, without distinct stipe.
 - B.¹ Pileus costate-corrugate.
 - C.¹ Pileus reddish-brown, tomentose at maturity. S. 608; M. B. 131:45; M. 196.....*L. ursinus* Fr.
 - C.² Pileus tan or alutaceous, surface broken up into scales or fibrous teeth at maturity. S. 609; M. 196; St. 2:157; H. 226-7.....*L. vulpinus* Fr.
 - B.² Pileus even, not costate.
 - C.¹ Pileus densely strigose, brown-tawny. S. 611; M. 196.....*L. pelliculosus* Schw.
 - C.² Pileus tomentose only, reddish-brown. S. 608; M. B. 131:45; M. 196.....*L. ursinus* Fr.

NOTES.

Morgan lists *L. lecomtei* Fr. and *L. strigosus* Fr. He later decided that the plants so referred were species of *Panus* (*P. rudis* Fr.).

L. caespitosus Berk., reported by Lea and Morgan is not a *Lentinus*. *Pleurotus caespitosus* B. & C. is another name for the same plants. Lloyd believes it is the plant now known as *Clitocybe monadelpha* Morg. and the description bears out the opinion.

Peck separated *L. spretus* from *L. lepideus* because the lamellae are not sinuate and the spores are smaller. A collection was made at Oxford in 1910.

L. sullivantii Mont. is probably the same as *Clitocybe illudens* Schw. *L. robinsonii* Mont. is certainly not a *Lentinus*. The pileus is said to be tubular at first, then cubshaped, the lamellae are close, linear, long-decurrent. Probably a *Cantharellus*.

L. curtisii is *L. omphalodes* B. & C., not *L. omphalodes* Fr.

L. ursinus and *L. vulpinus* have doubtless been confused in America. Peck describes the former as being sometimes costate-corrugate. This character is, in Europe, ascribed to *L. vulpinus* only.

With the meager description of *L. pelliculosus* it is difficult to separate it from *L. ursinus*. It may be only a more hairy form of that species — at least the Ohio plants referred to it.

Lentodium squamulosum Morg. is often regarded as an abnormal form of *L. tigrinus*. It may be recognized by the mycelium or compact tomentum which grows over the hymenium sometimes obliterating the lamellae. Peck says that both forms are sometimes found growing on the same stump (M. B. 131:44).

PANUS FR.

A.¹ Pileus scaly, pubescent, strigose or furfuraceous.

B.¹ Lamellae broad, distant, pileus white.

C.¹ Pileus 5-8 cm. broad, with a matted covering of rather delicate hairs. S. 620; H. 226; Mc. 234.

P. levis B. & C.

C.² Pileus 10-20 cm. broad, with a coarse strigose pubescence. S. 620; H. 223; Mc. 234.

P. strigosus B. & C.

B.² Lamellae narrow, close.

C.¹ Stipe lateral; pileus 2-4 cm. broad.

D.¹ Pileus and lamellae cinnamon; pileus furfuraceous-scaly; lamellae determinate. S. 622; M. 197; H. 223; A. 135; Mc. 236.

P. stipticus (Bull.) Fr.

D.² Pileus and lamellae white to yellowish; pileus pubescent; lamellae decurrent. M. 197.

P. angustatus Berk.

C.² Stipe eccentric; pileus 3 cm. or more broad.

D.¹ Pileus strigose, depressed to infundibuliform, rufescent-tan, purplish when young; stipe hirsute. S. 616; H. 224; A. 135.

P. rudis Fr.

D.² Pileus becoming scaly, conchate, cinnamon or paler; stipe pubescent at the base. S. 615; H. 223; M. 196; Mc. 232.

P. conchatus Fr.

A.² Pileus glabrous.

B.¹ Lamellae decurrent or sub-decurrent.

C.¹ Stipe lateral; pileus striate on the margin, less than 3 cm. broad. M. 197.....*P. dealbatus* Berk.

C.² Stipe eccentric; pileus usually more than 5 cm. broad, margin not striate.

D.¹ Stipe solid, pubescent or tomentose.

E.¹ Pileus cinnamon to paler; stipe pubescent at the base. S. 615; H. 223; M. 196; Mc. 232*P. conchatus* Fr.

E.² Pileus flesh-colored to violaceous; stipe with gray or violaceous down. S. 615; H. 225; Mc. 233.....*P. torulosus* Fr.

D.² Stipe spongy-stuffed, glabrous. S. 617.

P. robinsonii B. & Mont.

B.² Lamellae free. S. 620.....*P. sullivantii* Mont.

NOTES.

Berkeley's description of *P. angustatus* agrees well with the plant we know as *Pleurotus petaloides* Fr. Berkeley says: "Lea describes it as tough when fresh, and it is therefore placed in the genus *Panus*."

The plants now known as *P. rudis* have been reported also as *Lentinus strigosus* Fr., and *Lentinus lecomtei* Fr.

Neither *P. robinsonii* nor *P. sullivantii* have been identified since Sullivant's time.

TROGIA FR.

Lamellae white; pileus sessile, margin sterile. S. 636; N. A. F. 9³: 164; St. 2: 162; M. 198; H. 234; A. 137.

T. crispa (Pers.) Fr.

This species is described in the North American Flora as *Plicatura faginea* (Schrad.) P. Karst.

SCHIZOPHYLLUM FR.

Pileus white or whitish; lamellae gray to pale brownish. S. 655; St. 2: 162; M. 198; H. 232; A. 136.

S. commune Fr.

This species is sometimes published as *S. alneum* (L.) Schroet.

LENZITES FR.

Context and hymenium, white or whitish. S. 638; St. 2: 163; N. A. F. 9²: 127; H. 231; M. 197.....*L. betulina* (L.) Fr.

Context and hymenium brown or brownish.

Lamellae thick, distant (about 1 mm.). S. 639; N. A. F. 9²: 130; H. 232; M. 197; St. 2: 164....*L. sepiaria* (Wulf.) Fr.

Lamellae thin, rather close (about 0.5 mm.). S. 638, 640; N. A. F. 9²: 129; H. 232; M. 197; P. R. 26: 67.

L. trabea (Pers.) Fr.

NOTE.

On account of the woody texture and the fact that the hymenium is often porose when young, Murrill places this genus in the Polyporaceae. He places the last two species in the genus *Gloeophyllum* under the names *G. hirsutum* (Schaeff.) Murrill and *G. trabeum* (Pers.) Murrill. The latter was reported from Ohio as *L. vialis* Peck.

VOLVARIA FR.

A.¹ Plants growing on wood; pileus 7-12 cm. broad, silky, white. S. 656; St. 183; A. 140; Mc. 240; H. 238; M. 97.

V. bombycina (Pers.) Fr.

A.² Plants not growing on wood.

B.¹ Pileus usually more than 5 cm. broad.

C.¹ Pileus not distinctly viscid, streaked with blackish fibrils. S. 657; St. 183; H. 242; Mc. 240.

V. volvacea Bull.

C.² Pileus viscid, glabrous.

D.¹ Margin even; pileus whitish or grayish. S. 661; St. 185; Mc. 242*V. speciosa* Fr.

D.² Margin striate; pileus smoky-brown. S. 662; St. 185; Mc. 242*V. gloiocephala* Fr.

B.² Pileus less than 4 cm. broad.

C.¹ Stipe pubescent with spreading hairs; pileus with minute hairy scales. S. 658; P. R. 29:39.

V. pubescentipes Peck

C.² Stipe without erect, spreading hairs; pileus silky.

D.¹ Margin of pileus striate; stipe solid. S. 16:70; H. 241; B. T. 26: 64....*V. umbonata* Peck

D.² Margin even.

E.¹ Pileus umbonate; stipe stuffed. S. 663; St. 186.....*V. parvula* Weinm.

E.² Pileus not umbonate; stipe solid. Berk. Out. 140; H. 242*V. pusilla* Pers.

NOTE.

V. parvula and *V. pusilla* are regarded as synonyms by some mycologists.

PLUTEUS FR.

A.¹ Pileus glabrous.

B.¹ Pileus fleshy, more than 5 cm. broad, whitish to brown or brownish; margin even. S. 665; St. 187; P. R. 38:134; H. 237; Mc. 243; A. 138; M. 98.

P. cervinus Schaeff.

B.² Pileus thin, usually less than 5 cm. broad; margin striate.

C.¹ Pileus cinnamon-brown. S. 676; Mc. 249; St. 190; M. 98*P. chrysophacus* Schaeff.

- C.² Pileus yellow or reddish-yellow.
 D.¹ Pileus rugose-reticulate; stipe hollow. S. 679;
 P. R. 38: 137; Mc. 248. *P. admirabilis* Peck
 S. 678 ? *P. chrysophlebius* B. & Rav.
 D.² Pileus not as above; stipe solid. S. 675; P. R.
 38:137; St. 190; M. 98.
P. leoninus Schaeff.

- A.² Pileus not glabrous.
 B.¹ Pileus pruinately or granular and rugose-wrinkled.
 C.¹ Stipe granular or velvety-pubescent, brown or yellowish-brown. S. 673; P. R. 38:135; Mc. 247;
 H. 238; M. 98. *P. granularis* Peck
 C.² Stipe glabrous, whitish or pale yellowish. S. 672;
 St. 189; P. R. 38:136 *P. nanus* Pers.
 B.² Pileus fibrillose, hairy or squamulose, not rugose-wrinkled.
 C.¹ Pileus thin, prominently striate, not over 4 cm. broad. S. 670; P. R. 38:137.
P. longistriatus Peck
 C.² Pileus fleshy, not striate, usually more than 5 cm. broad. (See references above.)
P. cervinus Schaeff.

NOTES.

P. granularis is given in Saccardo as *P. regularis*, probably through error.

P. chrysophlebius has not been reported for Ohio. It is here included in order to call attention to its close relationship to *P. admirabilis*.

ENTOLOMA FR.

- A.¹ Pileus minute-scaly, dry, 1-2 cm. broad, dark brown. S. 693; M. B. 131: 53. *E. scabrinellum* Peck
 A.² Pileus glabrous or somewhat fibrillose, not dry, usually more than 2 cm. broad.
 B.¹ Pileus hygrophanous, becoming paler in drying.
 C.¹ Pileus white or yellowish; stipe solid. S. 698; M. B. 131: 56; H. 244; A. 144. . . . *E. grayanum* Peck

C.² Pileus some shade of brown, or gray; stipe stuffed or hollow.

D.¹ Pileus not umbonate; stipe pruinose. S. 694; M. B. 131: 56; M. 99; St. 198; H. 244; Mc. 153*E. rhodopolium* Fr.

D.² Pileus umbonate; stipe fibrillose or glabrous.

E.¹ Stipe brown or brownish, 2-4 mm. thick. S. 698; A. 145; M. B. 131: 57; M. 99.

E. strictius Peck

E.² Stipe white or grayish, 4-8 mm. thick. S. 694; St. 198; Mc. 252; H. 247; M. B. 131: 57; M. 99.....*E. clypeatum* Linn.

B.² Pileus moist or subviscid, not hygrophanous.

C.¹ Stipe brown or brownish; pileus of same color, streaked with darker lines. H. 245-6; J. M. 12: 236-7*E. subcostatum* Atk.

C.² Stipe white to rufescent.

D.¹ Stipe solid; pileus subumbonate; plants not growing on wood. S. 682.

E. demetriacum B. & Mont.

D.² Stipe hollow; pileus plane or depressed; plants growing on decaying wood. S. 683.

E. robinsonii B. & Mont.

CLITOPILUS FR.

A.¹ Stipe stuffed or hollow; pileus hygrophanous, brown to grayish-brown, usually umbilicate, striatulate when moist. S. 9: 86; H. 251; P. R. 42: 43; Mc. 260.

C. subvilis Peck

A.² Stipe solid; pileus not hygrophanous, not umbilicate, not striatulate.

B.¹ Pileus thin, rimose-areolate; taste bitter. S. 702; P. R. 42: 45; H. 252; Mc. 264.....*C. noveboracensis* Peck

B.² Pileus rather thick, not rimose; taste mild.

C.¹ Pileus pruinose or mealy; lamellae subdistant; stipe glabrous or villous at the base. S. 699; St. 202; Mc. 255; P. R. 42: 41; H. 249; A. 143.

C. prunulus Scop.

C.² Pileus glabrous or slightly silky; lamellae close; stipe flocculose.

D.¹ Pileus slightly viscid when moist, whitish or yellowish; stipe short. S. 699; St. 203; H. 249; P. R. 42: 41; Mc. 256. *C. orcella* Bull.

D.² Pileus dry, grayish to grayish-brown. S. 701; P. R. 42: 42; H. 248; Mc. 257; M. 99.

C. abortivus B. & C.

LEPTONIA FR.

Pileus not striate; edge of lamellae serrate, blackish. S. 710; H. 255; St. 208. *L. serrulata* Pers.

Pileus striate; lamellae unicolorous, edge entire.

Pileus and stipe brownish-green; lamellae greenish-white then flesh-color. S. 713; St. 210; H. 254. *L. incana* Fr.

Pileus at length scaly in the center, fuliginous or paler; stipe usually livid but variable in color; lamellae grayish-white. S. 714; St. 211; A. 147; M. 100. *L. asprella* Fr.

Morgan reported *L. asprella* from the Miami valley. Hard lists the other two species but without a statement as to their collection.

NOLANEA FR.

Pileus cinnamon-brown; lamellae bright flesh-color; stipe even. S. 723; P. R. 24: 66; H. 255. *N. conica* Peck

Pileus smoky-brown; lamellae grayish; stipe striate. S. 716; St. 212; H. 255. *N. pasqua* Pers.

Hard describes these species but does not state that they were collected in Ohio.

ECCILIA FR.

Lamellae distant. S. 730; St. 218; H. 252; Mc. 265.

E. carneo-grisca B. & Br.

Lamellae close. S. 729; H. 253; A. 148. *E. polita* Pers.

Both species are listed by Hard but no statement is made as to the occurrence of *E. polita* in Ohio.

CLAUDOPUS W. SMITH.

Plant yellow or buff; lamellae close, orange-yellow. S. 375; A. 149; H. 256; Mc. 267; M. 198; P. R. 39:67.

C. nidulans Pers.

Plant white; lamellae distant, white then flesh-color. S. 733; H. 256; St. 220; P. R. 39:68. *C. variabilis* Pers.

C. nidulans is sometimes known as *Pleurotus nidulans* and is sometimes known in America as *Panus dorsalis* Bosc.

Hard includes *C. variabilis* in his book but without a statement as to its collection in Ohio.

PHOLIOTA FR.

A.¹ Plants growing on the ground.

B.¹ Stipe solid; lamellae serrulate; pileus wrinkled. S. 736; H. 260; St. 223; Mc. 270; M. B. 122:143.

P. caperata Pers.

B.² Stipe stuffed or hollow; edge of lamellae entire; pileus not wrinkled.

C.¹ Lamellae very broad; pileus dry, finally cracked; stipe stout, about 1 cm. in diameter. S. 738; St. 225; Mc. 271; H. 258; M. 101. *P. dura* Bolt.

C.² Lamellae narrow; pileus moist, not cracking; stipe slender, not more than 5 mm. in diameter. S. 738; St. 226; Mc. 274; H. 257; A. 150; M. B. 122:148; M. 101. *P. praecox* Pers.

A.² Plants growing on wood, rarely on the ground and then near decaying logs, etc.

B.¹ Pileus viscid.

C.¹ Lamellae narrow; pileus lemon-yellow. S. 753; M. B. 122:150; M. 102. *P. limonella* Peck

C.² Lamellae broad.

D.¹ Stipe very stout, 1-2.5 cm. in diameter, solid, not scaly; pileus scarcely viscid. S. 747; St. 229; H. 263. *P. heteroclita* Fr.

D.² Stipe usually less than 1 cm. in diameter, prominently scaly.

E.¹ Pileus white except for the tawny, erect, pointed scales; lamellae sinuate, at first whitish. S. 750; M. B. 122:150; A. 152; Mc. 274; H. 266; M. 102.

P. squarrosoides Peck

E.² Pileus yellow or yellowish-brown.

F.¹ Lamellae at first yellow, close; stipe yellow to tawny-brown. S. 752; St. 232; M. B. 122:150; Mc. 276; A. 151; M. 103.....*P. adiposa* Fr.

F.² Lamellae at first whitish or gray, subdistant, edge white-crenulate; stipe pallid or brownish. S. 760; M. B. 122:149; M. 102.....*P. albocrenulata* Peck

B.² Pileus not viscid.

C.¹ Pileus and stipe with prominent scales; lamellae rather narrow; stipe 6-12 mm. in diameter. S. 749; M. B. 122:152; A. 152; St. 230; Mc. 273; H. 268.....*P. squarrosa* Müll.

C.² Pileus and stipe with small or appressed scales or not scaly.

D.¹ Pileus more than 5 cm. broad; stipe more than 1 cm. in diameter.

E.¹ Lamellae very broad, sinuate-adnexed; pileus white or slightly yellow; stipe white. S. 747; St. 229; H. 263....*P. heteroclita* Fr.

E.² Lamellae narrow, adnate or slightly decurrent; pileus tawny or orange-yellow; stipe yellow. S. 751; St. 231; M. B. 122:154; H. 265; M. 103.....*P. spectabilis* Fr.

D.² Pileus less than 5 cm. broad; stipe slender.

E.¹ Pileus dry, not hygrophanous.

F.¹ Stipe bulbous or tuberculate, lamellae sinuate-adnexed. S. 754; St. 233; M. 103.

P. tuberculosa (Schaeff) Fr.

P. hormophora Mont.

- F.² Stipe not as above; lamellae adnate. S. 755; St. 233; H. 264; M. B. 122: 154.
P. curvipes (A. & S.) Fr.
- E.² Pileus hygrophanous, glabrous.
 - F.¹ Pileus less than 2 cm. broad; lamellae very broad for size of pileus; stipe subglabrous. S. 759; St. 235; H. 262; M. 104.....*P. unicolor* Vahl.
 - F.² Pileus usually more than 2 cm. broad; stipe fibrillose or somewhat scaly.
 - G.¹ Margin of pileus even; lamellae rather broad; stipe blackish-brown below. S. 758; St. 235; Mc. 278; H. 263; M. 103.
P. mutabilis (Schaeff) Fr.
 - G.² Margin striate; lamellae narrow; stipe concolorous or paler. S. 758; St. 235; M. 104; H. 265; Mc. 279*P. marginata* Batsch

INOCYBE FR.

- A.¹ Pileus and stipe squarrose- or tomentose-scaly, some shade of brown; stipe concolorous or nearly so.
 - B.¹ Pileus hemispherical to expanded, obtuse, floccose-scaly, scales of disk pointed; spores nodulose or angular. S. 765; M. 105; M. B. 139: 51; St. 240.
I. lanuginosa Bull.
 - B.² Pileus convex to expanded, spores even or slightly irregular.
 - C.¹ Pileus umbonate; stipe soon hollow. S. 763; H. 271; M. 105; St. 240.....*I. dulcamara* Alb. & Schw.
 - C.² Pileus not umbonate; stipe solid. S. 764; H. 271; St. 241*I. cincinnata* Fr.
- A.² Pileus and stipe not squarrose-scaly, usually fibrillose; stipe paler than pileus or pileus at first whitish or pallid.
 - B.¹ Whole plant becoming red or reddish; flesh white. S. 776; M. 106; St. 249.....*I. dstricta* Fr.

- B.² Plant not becoming red.
- C.¹ Flesh of pileus and stipe reddish; with odor of pears.
S. 766; H. 272; M. 105; St. 242.
I. piriodora Pers.
- C.² Flesh and odor not as above.
- D.¹ Pileus not umbonate; stipe somewhat bulbous.
S. 775; M. 105; H. 272; St. 248; M. B. 139:
56 *I. rimosa* Bull.
- D.² Pileus umbonate; stipe not bulbous.
- E.¹ Cuticle of pileus torn or cracked; lamellae
adnate, whitish-crenulate on edge. S. 776;
M. 106; St. 248; M. B. 139: 56.
I. eutheles B. & Br.
- E.² Pileus fibrillose, cuticle not torn or cracked;
lamellae adnexed or sinuate-adnexed, edge
not whitish-crenulate.
- F.¹ Pileus white or whitish or rarely vio-
laceous; stipe stuffed. S. 784; H.
270; M. 106; St. 252; M. B. 139: 61.
I. geophylla Sowerb.
- F.² Pileus ochraceous-yellow, stipe solid. S
796; H. 270; M. B. 139: 62.
I. subochracea (Peck) Mass.

NOTES.

I. auricoma Batsch, listed by Lea, is regarded by Fries as a variety of *I. descissa*. Morgan, who worked in the same region as Lea, did not collect it. It is possible that Lea's plants were incorrectly determined. The species is omitted from the list.

It is worthy of note here that Peck enumerates 39 species for the state of New York. Of the 9 species reported from Ohio only 5 occur in Peck's list. It is remarkable that such a disparity should occur in states no more widely separated. It is probable, however, that further study of Ohio plants will add a number of species to the Ohio list.

HEBELOMA FR.

- A.¹ Pileus glutinous, with whitish superficial squamules, yellowish-white. S. 793; St. 273; M. B. 139:68; H. 273; Mc. 285 *H. glutinosum* (Lind.) Fr.
- A.² Pileus moist or more or less viscid but not glutinous, not squamulose.
 - B.¹ Lamellae very narrow; pileus whitish-tan or brick-color. S. 799; St. 260; M. B. 139:73; Mc. 286; H. 273; A. 158..... *H. crustiliniforme* (Bull.) Fr.
 - B.² Lamellae broad.
 - C.¹ Stipe solid.
 - D.¹ Pileus yellow or tan; lamellae subdistant. S. 792; M. B. 139:70; Mc. 284; H. 273; St. 255; M. 107..... *H. fastibile* Fr.
 - D.² Pileus brownish-clay; lamellae close. S. 16:92, 17:67; M. B. 139:71; H. 274.
H. pascuense Peck.
 - C.² Stipe stuffed or hollow.
 - D.¹ Pileus and stipe brown; plants growing on wood. S. 806; M. 107; M. B. 139:76.
H. illicitum Peck
 - D.² Pileus pallid or clay-colored; stipe white; plants with odor of radishes. S. 799; St. 259.
H. sinapizans Fr. *H. repandum* Schum.

NOTES.

Plants collected by W. A. Kellerman were determined by A. P. Morgan as *H. repandum* which is given by Fries and Saccardo as a variety of *H. sinapizans*. Kellerman's photograph (Mycological Bulletin 5: 364) shows the stipe to be stuffed and hollow. In the European plant the stipe is said to be somewhat solid.

H. glutinosum and *H. crustiliniforme* have not been definitely reported for Ohio but probably occur here. They are included in the key for convenience.

H. latericolor Mont. (S. 803), described from Sullivant's material, is probably *Hypholoma sublateritium*. The color of the pileus, habitat, season and other characters point to this conclusion. H. erysibodes Mont. (S. 795) and H. pyrrolepidum Mont. (S. 798) are doubtless species of *Inocybe*.

FLAMMULA FR.

A.¹ Stipe spindle-shaped, rooting; pileus reddish-brown. S. 818; St. 269; H. 286.....*F. fusus* Batsch.

A.² Stipe not spindle-shaped.

B.¹ Pileus viscid.

C.¹ Pileus with purple and bluish-green, often with other shades. S. 824; A. 156; M. 107.

F. polychroa Berk.

C.² Pileus yellow, buff or tawny.

D.¹ Flesh yellow; pileus smooth; plants growing on burnt ground or charcoal. S. 817; St. 268; H. 285; P. R. 50: 138.....*F. carbonaria* Fr.

D.² Flesh whitish; pileus appressed scaly, floccose or fibrillose; plants with different habitat.

E.¹ Stipe solid. S. 815; St. 266; P. R. 50: 138.

F. lubrica Fr.

E.² Stipe stuffed or hollow. B. T. 34: 100.

F. betulina Peck

B.² Pileus not viscid.

C.¹ Stipe solid; pileus more than 8 cm. broad. S. 14: 139; P. R. 50: 142; Mc. 292....*F. magna* Peck

C.² Stipe stuffed or hollow; pileus less than 8 cm. broad.

D.¹ Pileus glabrous, light yellow. S. 820; St. 270; H. 284; P. R. 50: 140; Mc. 291.

F. flavida Pers.

D.² Pileus floccose-squamulose, golden-tawny; lamellae broad; stipe often sulcate. S. 824; St. 272; P. R. 50: 142; M. 107.

F. sapinea Fr.

NOTES.

F. anepsia Mont. (S. 812), was described from Sullivan's material. The pileus is said to be reddish-cinnamon; lamellae distant, adnate-decurrent, and stipe fistulous.

F. flavida has not been reported for Ohio but probably occurs.

F. fusus was collected by Hard at Chillicothe; *F. betulina* at Wooster by Van Hook; *F. magna* at Cleveland by Beardslee, and *F. lubrica* at Wooster by Selby. The first three are in the herbarium of the state botanist at Albany, and the last at the N. Y. Bot. Garden in New York City.

NAUCORIA FR.

A.¹ Pileus viscid or somewhat so when moist; lamellae adnate, adnate-decurrent or emarginate-adnate.

B.¹ Pileus usually appressed-scaly; plants growing on or among mosses. H. 282; J. M. 12: 193.

N. paludosella Atk.

B.² Pileus glabrous; plants growing among grass.

C.¹ Pileus yellow or yellowish; stipe usually more than 4 mm. thick, and less than 5 cm. long. S. 843; M. 108; St. 283.....*N. vervacti* Fr.

C.² Pileus tawny-brown or ochraceous; stipe less than 4 mm. thick and usually more than 5 cm. long. S. 844; M. 108; St. 284; A. 153; Mc. 297.

N. semiorbicularis Bull.

A.² Pileus dry; lamellae adnexed. S. 844; H. 281; Mc. 296; St. 284.....*N. pediades* Fr.

PLUTEOLUS FR.

Plants growing on dung, often cespitose; pileus pinkish-gray S. 11: 60; P. R. 46: 59.....*P. coprophilus* Peck

Plants growing on wood, not cespitose.

Pileus livid-gray, rugose-reticulate. S. 859; P. R. 46: 60; Mc. 282; St. 289; H. 275.....*P. reticulatus* Pers.

Pileus smoky-brown, not rugose.

Stipe brownish-fibrillose; pileus more or less lobed, 5-7 cm. S. 867; M. 108....*P. mucidolens* Berk.

Stipe pallid, fibrillose; pileus not lobed, 3-4 cm. S. 11: 60.....*P. leaianus* B. & C.

NOTES.

P. mucidolens and *P. leaianus* were both collected by Lea near Cincinnati. They may represent one species.

Lloyd regards *P. coprophilus* the same plant as *Bolbitius radians*.

GALERA FR.

A.¹ Plants growing on or among Sphagnum. S. 869; P. R. 46: 66*G. sphagnorum* Pers.

A.² Plants not growing among mosses.

B.¹ Lamellae much crisped; margin of pileus finally upturned. S. 16: 103; Bot. Gaz. 28: 272; H. 278.

G. crispa Longyear

B.² Lamellae straight and regular, not crisped in fresh plants.

C.¹ Pileus mealy or granular, finally expanded, margin persistently striate. H. 277; J. M. 12: 148.

G. kellermani Peck

C.² Pileus not distinctly mealy, seldom fully expanded.

D.¹ Stipe usually straight or nearly so; lamellae broad or pileus more than 1 cm. across.

E.¹ Pileus even or very faintly striatulate, usually 2 cm. or more across, ovate-campanulate; lamellae very broad; stipe usually more than 8 cm. tall. S. 862; P. R. 46: 64; St. 292; H. 279.....*G. ovalis* Fr.

E.² Pileus striate, usually less than 2 cm. broad; stipe usually less than 7 cm. tall.

F.¹ Stipe glabrous; pileus broadly conic-campanulate; lamellae rather broad.

S. 860; St. 291; H. 276; P. R. 46;
63; M. 109; Mc. 300.

G. tenera Schaeff.

F.² Stipe not glabrous.

G.¹ Stipe pruinata; lamellae very narrow; pileus narrowly conical. S. 860; P. R. 46: 62; H. 276; St. 291; Mc. 299. . . . *G. lateritia* Fr.

G.² Stipe and usually pileus with minute, erect pubescence when moist.

G. tenera pilosella Pers.

D.² Stipe flexuous; lamellae narrow or pileus less than 1 cm. broad.

E.¹ Pileus grayish or ferruginous, less than 1 cm. broad.

F.¹ Pileus striatulate when moist; lamellae subdistant; stipe pale brownish. S. 16: 105; B. T. 26: 66.

G. capillaripes Peck

F.² Pileus even; lamellae close; stipe pallid. S. 862; M. 109. . . . *G. siliginea* Fr.

E.² Pileus yellowish, about 4 cm. broad, margin deeply striate. S. 867. *G. tortipes* Mont.

TUBARIA W. SMITH.

Pileus somewhat viscid, margin striate when moist, glabrous; stipe dark brown. S. 876; M. 109; St. 300.

T. inquilina Fr.

Pileus hygrophanous, margin furfuraceous from seceding veil; stipe pallid. S. 872; M. 109; St. 297.

T. furfuracea Pers.

CREPIDOTUS FR.

A.¹ Pileus bright cinnabar-red; edge of lamellae red. B. T. 22: 489; Oh. Nat. 10: 178. . . . *C. cinnabarinus* Peck

- A.² Pileus not bright red; edge of lamellae not reddish.
- B.¹ Pileus glabrous; or villous at base only.
- C.¹ Lamellae broad, rounded behind. S. 883; P. R. 39:71*C. malachus* B. & C.
- C.² Lamellae linear, subdecurrent. S. 877; M. 110; H. 280; St. 301*C. mollis* Schaeff.
- B.² Pileus pubescent, tomentose or somewhat scaly.
- C.¹ Pileus white.
- D.¹ Pileus 3-6 mm. broad, slightly pubescent, striatulate when moist; lamellae very broad, extending beyond margin of pileus; spores globose. B. T. 26:66.....*C. latifolius* Peck
- D.² Pileus 8-20 mm. broad, villous, not striatulate; lamellae rather broad, not extending beyond margin of pileus; spores subelliptic. S. 888; P. R. 39:72; M. 110; H. 279; A. 160.
C. versutus Peck
- C.² Pileus not white.
- D.¹ Pileus appressed-scaly, ochraceous-brown; lamellae bright buff or orange then ochraceous. S. 886; M. 110.....*C. crocophyllus* Berk.
- D.² Pileus fibrillose-tomentose, reddish-yellow; lamellae yellowish then brownish-ochraceous. S. 883, P. R. 39:73; M. 110....*C. dorsalis* Peck

CORTINARIUS FR.

- A.¹ Pileus viscid or glutinous.
- B.¹ Stipe solid.
- C.¹ Stipe equal or nearly so, not bulbous.
- D.¹ Stipe viscid or glutinous; pileus orange-tawny; lamellae at first bluish-gray. S. 916; H. 293; St. 2:17; A. 161; Mc. 313.
C. collinitus (Pers.) Fr.
- D.² Stipe dry; pileus yellow or tan; lamellae at first whitish. S. 890; H. 291; Mc. 309; St. 2:3.
C. turmalis Fr.

C.² Stipe bulbous.

D.¹ Flesh violaceous, blue or bluish.

E.¹ Flesh and lamellae becoming purplish when bruised; pileus usually 10 cm. or more broad. S. 902; H. 291; Mc. 311; St. 2:10*C. purpurascens* Fr.

E.² Flesh and lamellae not changing color when bruised; pileus less than 10 cm. broad.

F.¹ Pileus at first blue, becoming in part yellowish or tan; spores less than 12 microns long, even. S. 902; H. 292; M. 178; Mc. 311; St. 2:9.

C. coerulescens Fr.

F.² Pileus yellow to tawny; spores more than 12 microns long, tuberculate. H. 302*C. atkinsonianus* Kauff.

D.² Flesh white or whitish.

E.¹ Bulb of stipe marginate, depressed; lamellae serrate; stipe white. S. 902; M. 178; St. 2:9 ..*C. calochrous* (Pers.) Fr.

E.² Bulb not marginate; lamellae entire; stipe yellowish. S. 892; H. 292; M. 178; Mc. 309; St. 2:4 ...*C. varius* (Schaeff.) Fr.

B.² Stipe stuffed or hollow; pileus yellow or olivaceous, flesh paler; lamellae whitish to pale cinnamon. H. 291*C. olivaceo-stramineus* Kauff.

A.² Pileus dry or moist only; not viscid or glutinous.

B.¹ Margin of pileus even.

C.¹ Stipe solid.

D.¹ Plants (pileus or lamellae, or both,) some shade of violaceous, purple or lilac, at least when young.

E.¹ Lamellae distant or subdistant.

F.¹ Stipe always distinctly bulbous; whole plant dark violet; pileus with persistent hairy scales. S. 924; H. 296; M. 178; A. 161; Mc. 314; St. 2:23.

C. violaceus (Linn.) Fr.

F.² Stipe becoming clavate or attenuate, not distinctly bulbous; pileus silky or squamulose.

G.¹ Lamellae rather narrow; stipe not sheathed; pileus whitish, tinged with lilac. S. 925; H. 295; M. 178; Mc. 316; St. 2:24.

C. albo-violaceus (Pers.) Fr.

G.² Lamellae broad; stipe sheathed with universal veil; pileus brick-color or purplish-brown to paler. S. 950; St. 2:40. *C. torvus* Fr.

E.² Lamellae close.

F.¹ Whole plant lilac. S. 926; H. 296; Mc. 316; P. R. 26:61.

C. lilacinus Peck

F.² Pileus ferruginous or tawny; stipe whitish; pileus slightly viscid. S. 892; St. 2:4; H. 292; Mc. 309; M. 178 *C. varius* (Schaeff.) Fr.

D.² Plants without purple, lilac or violet shades.

E.¹ Stipe not bulbous; pileus yellowish to whitish; lamellae clay-colored. S. 935; H. 299; A. 163; St. 2:29.

C. ochroleucus (Schaeff.) Fr.

E.² Stipe bulbous.

F.¹ Pileus brick-colored; stipe reddish with one to four zones from universal veil; plants with odor of radish. S. 952; H. 311; Mc. 323; St. 2:43.

C. armillatus (Alb. & Schw.) Fr.

F.² Plant some shade of yellow; stipe not zoned; inodorous.

G.¹ Pileus saffron-yellow, with erect brown squamules; stipe sheathed by universal veil. H. 304.

15. *C. croceocolor* Kauff.

G.² Pileus rusty-yellow, fibrillose only;
stipe not sheathed. S. 932; H.
294; Mc. 319; P. R. 23:109.

C. autumnalis Peck

C.² Stipe stuffed or hollow.

D.¹ Lamellae close.

E.¹ Whole plant blood-red; with odor of rad-
ish. S. 940; Mc. 321; St. 2:24.

C. sanguineus (Wulf.) Fr.

E.² Plants not as above.

F.¹ Stipe yellow, slender; pileus umbonate
or obtuse. S. 941; H. 297; A. 162;
Mc. 322; St. 2:35.

C. cinnamomeus (Linn.) Fr.

F.² Stipe lilac-tinged at apex, white below,
rather stout; pileus convexo-plane. S.
971; H. 305-6; Mc. 325; St. 2:55.

C. castaneus (Bull.) Fr.

D.² Lamellae distant; pileus reddish-yellow. S. 974.

C. rubidus Mont.

B.² Margin of pileus sulcate. S. 957. . . . *C. robinsonii* Mont.

PAXILLUS FR.

Stipe very short or wanting; pileus and lamellae yellow or yel-
lowish. S. 989; St. 2:69; M. B. 1²:32; A. 170; M. 179.

P. panuoides Fr.

Stipe present; pileus brown or reddish-brown.

Stipe with brown or blackish tomentum; lamellae adnate
or slightly decurrent. S. 988; Mc. 329; M. B. 1²:31;
St. 2:68; A. 169; H. 288.

P. atrotomentosus (Batsch) Fr.

Stipe not tomentose; lamellae decurrent.

Pileus somewhat viscid, margin at first with grayish
down, otherwise glabrous; lamellae close. S. 987;
St. 2:68; M. B. 1²:30, H. 287; A. 166; Mc. 328.

P. involutus (Batsch) Fr.

Pileus dry, minutely tomentose; lamellae subdistant. S. 1139; A. 167; H. 289; Mc. 394.

P. rhodoxanthus (Schw.) Atk.

NOTES.

P. porosus Berk. (S. 991; M. 179) is usually known as *Boletinus porosus* (Berk.) Peck. It is also known as *Boletinellus merulioides* (Schw.) Murrill. N. Am. Flora 9³: 158.

P. rhodoxanthus is difficult to place satisfactorily. It is sometimes known as *Gomphidius rhodoxanthus*, but *Gomphidius* has a glutinous universal veil, while this species is never glutinous. *Flammula*, *Phylloporus*, and *Boletinus* have each been proposed as the proper genus for it. *P. flavidus* Berk. (S. 987; M. 179) is probably the same plant.

BOLBITIUS FR.

A.¹ Pileus viscid when moist.

B.¹ Pileus striate or sulcate; lamellae not decurrent.

C.¹ Young pileus pure white, sordid with age. Myc. Notes 1:18*B. sordidus* Lloyd

C.² Pileus not white.

D.¹ Pileus sulcate, brown or brownish, 4-6 cm.; lamellae free. S. 14: 156; Jour. Cin. Soc. Nat. Hist. 18: 36.....*B. radians* Morg.

D.² Pileus striate only, yellow, usually less than 4 cm.; lamellae adnexed. S. 1074; H. 346; St. 362.....*B. fragilis* (L.) Fr.

B.² Pileus not striate or sulcate; lamellae decurrent. S. 1077.
B. macrorrhizus B. & Mont.

A.² Pileus not viscid.

B.¹ Pileus yellow, not striate; lamellae adnexed. S. 1075; M. 177; St. 362.....*B. titubans* (Bull.) Fr.

B.² Pileus cinereous, striate; lamellae free. S. 1113; M. 176; P. R. 29: 41.....*B. pulchrifolius* (Peck) Mass.

NOTE.

Lloyd thinks *Bolbitius radians* the same plant at *Pluteolus coprophilus*.

AGARICUS LINN.

(*Psalliota* Fr.)

- A.¹ Pileus distinctly brown or tawny.
 - B.¹ Whole surface of pileus tawny-brown, fibrillose-scaly. S. 1000; St. 307; Mc. 334; M. 112; P. R. 36:48.
A. silvaticus Schaeff.
 - B.² Pileus white or whitish with numerous minute brown scales, disk usually brown and smooth. S. 1003; P. R. 36:48; Mc. 345; H. 315; A. 23.
A. placomyces Peck
- A.² Pileus (except for scales if present) white or whitish or somewhat yellowish; rarely brownish, never tawny.
 - B.¹ Mature pileus usually more than 4 cm. broad.
 - C.¹ Stipe solid. S. 994; P. R. 36:45; H. 308; Mc. 336; A. 20.....*A. rodmani* Peck
 - C.² Stipe stuffed or hollow.
 - D.¹ Plants occurring in grassy or open fields, etc.
 - E.¹ Veil large, double; lamellae long whitish or pallid. S. 994; St. 305; P. R. 36:46; H. 310; Mc. 341; A. 21; M. 111.
A. arvensis Schaeff.
 - E.² Veil scant, usually lacerate; lamellae soon pink. S. 997; St. 306; P. R. 36:42; Mc. 332; H. 307; A. 18; M. 112.
A. campester Linn.
 - D.² Plants growing in woods or groves.
 - E.¹ Pileus with small brown scales, disk smooth, brown. S. 1003; Mc. 345; P. R. 36:48; H. 315; A. 23.....*A. placomyces* Peck
 - E.² Pileus glabrous or slightly silky, whitish, or yellowish in center.

- F.¹ Bulb of stipe oval. S. 998; Mc. 343;
St. 307; P. R. 36:47; H. 309; A. 22.
A. silvicola Vitt.
- F.² Bulb of stipe flattened. M. S. M. 163;
H. 311.....*A. abruptibulbus* Peck
- B.² Pileus usually less than 4 cm. broad, very thin, pale yellow. S. 1006; Mc. 334; St. 308; H. 313; A. 24; Myc. Notes 1:28.....*A. comtulus* Fr.

NOTES.

A. arvensis and *A. silvicola* are sometimes regarded as varieties of *A. campester*.

A brown variety of *A. campester* occurs but is not common. This species is reported as usually occurring from August to October while *A. rodmani* is said to occur in May and June.

A. xylogenus Mont. (S. 1010), described from Sullivan's material is not an *Agaricus* in the present limitation of the term. It is probably a yellow form of *Lepiota cepaestipes*. *A. foederatus* B. & M. (S. 1003), also described from Sullivan's material, is said to have the lamellae affixed and the spores brown. It is, therefore, either a *Pholiota* or a *Stropharia*. Morgan refers it to the latter genus.

A. fabaceus Berk. (S. 994; M. 111), described from Lea's material, is reported common by Morgan, while Lloyd says it has not been recognized in the last fifty years. The pileus was described as being viscid.

A. abruptibulbus is described as white, becoming yellowish in drying. Plants collected at Oxford and referred by the writer to this species (Ohio Nat. 10: 178) were tawny even when young but had the bulbous stipe of the above species. Plants collected at Columbus in September, 1910, are similar in every respect except that the stipe is not distinctly bulbous. These have been referred to *A. silvaticus* which European writers describe as brown or tawny. The Oxford plants are for the present regarded as a bulbous form of *A. silvaticus*.

STROPHARIA FR.

- A.¹ Pileus viscid or glutinous.
 - B.¹ Plants growing on dung or richly manured ground.
 - C.¹ Pileus at first conical then expanded and umbonate.
S. 1021; P. R. 30:41; J. M. 14:72.
S. umbonatescens Peck
 - C.² Pileus at first hemispherical, not umbonate; stipe viscid.
 - D.¹ Pileus soon expanded; stipe stuffed with a pith.
S. 1021; A. 32; H. 322; St. 314; Mc. 350;
J. M. 14:71; M. 113.....*S. stercorearia* Fr.
 - D.² Pileus never fully expanded; stipe fistulous. S.
1022; St. 314; Mc. 351; M. 113; A. 31; J. M.
14:71; H. 321.....*S. semiglobata* Batsch
 - B.² Plants growing on wood or on the ground, not on dung.
 - C.¹ Stipe hollow, viscid; pileus with bluish-green gluten,
at least when young. S. 1013; St. 309; Mc. 349;
M. 112; A. 32; J. M. 14:74; H. 322.
S. aeruginosa Curt.
 - C.² Stipe solid; pileus viscid, ochraceous. J. M. 14:73.
S. drymonia Morg.
- A.² Pileus neither viscid nor glutinous.
 - B.¹ Pileus glabrous, even, ochraceous. H. 321; J. M. 12:
194; J. M. 14:69.....*S. hardii* Atk.
 - B.¹ Pileus with minute white scales, fulvous; margin striate.
S. 1003; Mc. 339; J. M. 14:70.
S. foederata B. & Mont.

NOTES.

S. micropoda Morgan Jour. Myc. 14:73, does not seem distinct from *Flammula polychroa* which has a veil in young plants. Remnants of the veil usually mark its position on the stipe.

Morgan reports *S. submerdaria* Britz. from Preston, O. Britzelmayer's description is not available except the very short one in Saccardo (11:71). *S. aeruginosa* is given by Morgan as *S. viridula* Schaeff.

HYPHOLOMA FR.

- A.¹ Pileus glabrous except that sometimes cobwebby remnants of the veil occur on the margin.
- B.¹ Pileus hygrophanous.
- C.¹ Lamellae dark violaceous in very young plants, adnexed. S. 1038; St. 322; A. 28; Mc. 363; J. M. 14: 29; M. 114.....*H. candollecanum* Fr.
- C.² Lamellae long remaining white or whitish, adnate or mostly so.
- D.¹ Pileus brown or tawny when fresh. S. 1039; St. 323; Mc. 363; A. 27; J. M. 14: 27; H. 325; M. 114.....*H. appendiculatum* Bull.
- D.² Pileus whitish or yellowish. S. 1042; P. R. 29: 40; J. M. 14: 27; H. 323; Mc. 362.
H. incertum Peck
- B.² Pileus not hygrophanous.
- C.¹ Pileus yellow or tinged tawny; lamellae sulfur-yellow then green. S. 1029; St. 318; J. M. 14: 31; Mc. 357; M. 114.....*H. fasciculare* Huds.
- C.² Pileus red or brownish-red.
- D.¹ Taste bitter; mature lamellae sooty-olive. S. 1028; St. 323; Mc. 359; A. 26; J. M. 14: 31; H. 326; M. 114....*H. sublateritium* Schaeff.
- D.² Taste not bitter; mature lamellae purple-brown. S. 1028; H. 327; P. R. 49: 61.
H. perplexum Peck
- A.² Pileus innately fibrillose or scaly.
- B.¹ Pileus hygrophanous; at first velvety or tomentose, becoming glabrous; lamellae black-spotted. S. 1034; St. 321; J. M. 14: 66; Mc. 360; M. 114.
H. velutinum Pers.
- B.² Pileus not hygrophanous; lamellae not black-spotted.
- C.¹ Flesh and veil white; pileus whitish to brown. S. 1033; St. 320; Mc. 361; A. 28; H. 325; M. 114.
H. lacrymabundum Fr.

C.² Flesh and veil tawny; pileus tawny-red. S. 1034; St. 320; M. 114; J. M. 14: 66.

H. pyrotrichum Holmsk.

NOTES.

H. perplexum is regarded by a number of writers as not specifically distinct from *H. sublateritium*. *H. incertum* is sometimes regarded as a variety of *H. candolleianum*.

Morgan lists *H. candolleianum* as *H. mutabile* Fl. D. and *H. sublateritium* as *H. lateritium* Schaeff.

H. comaropsis Mont. (S. 1036), described from Sullivan's material has not since been recognized.

PILOSACE FR.

A single species, *P. eximia* Peck, is reported. The pileus is dark brown and smooth; lamellae free, dull red to brown. The spores are said to be reddish. S. 1012; P. R. 24: 70; M. B. 75: 25; H. 319; J. M. 13: 254.

PSILOCYBE FR.

A.¹ Plants growing in sand; stipe clavate. S. 1050; St. 327; J.

M. 13: 145; H. 330.....*P. ammophila* Dur. & Lev.

A.² Plants not growing in sand; stipe not clavate.

B.¹ Pileus campanulate or somewhat convex at maturity; plants growing in grassy places. S. 1055; St. 331;

H. 328; A. 48; J. M. 13: 248.....*P. foenisecii* Pers.

B.² Pileus convex to plane; plants on wood or on ground among leaves.

C.¹ Pileus brown when moist; lamellae adnexed, crowded. S. 1052; St. 329; H. 329; Mc. 365;

J. M. 13: 247.....*P. spadicea* Schaeff.

C.² Pileus livid; lamellae adnate. S. 1053; St. 330; J.

M. 13: 250.....*P. cernua* Vahl.

NOTES.

P. spadicea has not been definitely reported from Ohio although it doubtless occurs here.

P. rhodophaea Mont. (S. 1050; J. M. 13: 249), *P. pulicosa* Mont. (S. 1056; J. M. 13: 249), and *P. sullivanii* Mont. (S. 1047; J. M. 14: 69) have not been recognized since 1856.

PSATHYRA FR.

A.¹ Plant not violaceous.

B.¹ Pileus umbonate. S. 1069; J. M. 13: 152.

P. subnuda Karst.

B.² Pileus not umbonate.

C.¹ Pileus striate; stipe arising from mycelial bulb; growing in sand. J. M. 13: 152.

P. miamensis Morg.

C.² Pileus even; stipe nearly equal; not growing in sand. S. 16: 126; J. M. 13: 152; B. T. 26: 68.

P. microsperma Peck

A.² Whole plant violaceous. S. 1063; J. M. 13: 151.

P. pholidota Mont.

COPRINUS FR.

A.¹ Lamellae crowded; substance of pileus rather thick and fleshy; pileus often striate but not plicate.

B.¹ Pileus scaly or floccose-villous or nearly glabrous, not atomate or mealy.

C.¹ Scales of pileus small or medium, formed by breaking up of surface of pileus.

D.¹ Pileus at first cylindrical; white, shaggy; stipe annulate. S. 1079; St. 348; Mc. 370; H. 332;

A. 33-40; M. 173.....*C. comatus* Fr.

D.² Pileus at first ovoid.

E.¹ Pileus cinerous, scales reddish-brown; stipe with similar scales, annulate. S. 1081; M.

173; pl. 8.....*C. squamosus* Morg.

E.² Scales of pileus not reddish-brown; stipe not scaly.

F.¹ Plants growing on fallen trunks or stumps; pileus grayish-brown. S.

1083; M. 174; St. 350; Mc. 374.

C. fuscescens (Schaeff.) Fr.

F.² Plants not growing on trunks.

G.¹ Spores smooth; plants in rich soil and grassy places; pileus grayish-brown to lead-colored. S. 1081; St. 350; H. 333; A. 40; Mc. 373; M. 174.

C. atramentarius (Bull.) Fr.

G.² Spores rough; plants growing about stumps in woods; pileus grayish-brown. S. 1082; P. R. 26:60; M. 175*C. insignis* Peck

C.² Scales of pileus large, superficial; formed by breaking apart of the universal veil; or pileus densely villous or mealy-floccose.

D.¹ Stipe annulate, at least when young; plants on stumps, soil or old leaves.

E.¹ Scales of pileus ochraceous. S. 1082; P. R. 25:79; M. 174.....*C. variegatus* Peck

E.² Scales of pileus white. S. 14:158; H. 336; B. T. 22:491.....*C. ebubosus* Peck

D.² Stipe not annulate; plants usually on dung.

E.¹ Pileus cylindrical to conic. S. 1087; St. 352; H. 338; Mc. 376.....*C. fimctarius* Fr.

E.² Pileus ovate to campanulate.

F.¹ Pileus and stipe downy-villous, at least when young, white; lamellae adnexed. S. 1088; St. 353; Mc. 378; M. 175.

C. niveus (Pers.) Fr.

F.² Pileus buff to darker, with large scales; stipe nearly glabrous; lamellae free. S. 16:130; B. T. 26:68.

C. laceratus Peck

B.² Pileus with sparkling atoms or with mealy particles, at least when young.

C.¹ Lower part of stipe floccose-downy, plants on dung or ground. S. 1106; Mc. 382; P. R. 24:71; M. 175.....*C. semilanatus* Peck

- C.² Stipe not floccose-downy; plants not on dung.
 - D.¹ Pileus with sparkling atoms, yellowish-brown; usually on ground about stumps; common. S. 1090; St. 354; Mc. 378; H. 335; M. 175.
C. micaccus (Bull.) Fr.
 - D.² Pileus floccose-mealy; usually on trunks or stumps of trees.
 - E.¹ Lamellae broad. S. 1083; St. 350; Mc. 374; M. 174. *C. fuscescens* (Schaeff.) Fr.
 - E.² Lamellae narrow; plants usually growing from patch of brown mycelium (Ozonium). S. 1092; St. 355.
C. radians (Desm.) Fr.
- A.² Lamellae distant or subdistant; pileus very thin, plicate-sulcate; usually growing on dung or richly manured ground.
 - B.¹ Pileus less than 1 cm. broad.
 - C.¹ Lamellae free. S. 1101; St. 358; M. 176.
C. radiatus (Bolt.) Fr.
 - C.² Lamellae attached. S. 1106; St. 359; Mc. 382; H. 337. *C. ephemerus* Fr.
 - B.² Pileus usually more than 1 cm. broad.
 - C.¹ Lower part of stipe floccose-downy. S. 1106; P. R. 24:71; M. 175; Mc. 382. *C. semilanatus* Peck
 - C.² Stipe glabrous or nearly so.
 - D.¹ Lamellae free. S. 1100; St. 358; M. 176.
C. nycthemerus Fr.
 - D.² Lamellae attached.
 - E.¹ Spores angled or angular. S. 1113; P. R. 26:60. *C. angulatus* Peck
 - E.² Spores elliptical.
 - F.¹ Disk of pileus raised; lamellae attached to stipe. S. 1106; St. 359; Mc. 382; H. 337. *C. ephemerus* Fr.
 - F.² Disk at length depressed; pileus bluish-gray, disk brownish or rufescent; lamellae united to a collar at apex of stipe. S. 1108; St. 359; Mc. 383; M. 176. *C. plicatilis* (Curt.) Fr.

NOTES.

C. fimetarius and *C. ephemerus* have not been definitely reported from Ohio.

C. insignis is said to resemble *C. atramentarius* and to differ from it in the roughened spores (P. R. 26:60). It may be only a variety.

C. radians in Europe is said to occur on moist plaster walls. The only reference to it in Ohio gives it as occurring on trunks of trees (Myc. Notes 1:145). It is probably the same plant referred by Lea and Morgan to *C. fuscescens*.

A specimen labeled *C. angulatus* and collected by Lloyd at Cincinnati is in the state herbarium at Albany.

C. berkleyi and *C. stenophyllus*, described from Sullivant's material by Montagne, are omitted (S. 1094, S. 1095).

ANELLARIA KARST.

The species of this genus were separated from *Panaeolus* on account of the zone or annulus about the stipe. Only one species, *A. fimiputris* (Bull.) Karst., has been reported from Ohio. S. 1126; St. 339; J. M. 13:62; M. 116.

PANAEOLUS FR.

A.¹ Pileus viscid.

B.¹ Stipe annulate or zoned; pileus at first conical, lead-colored. S. 1126; St. 339; M. 116; J. M. 13:62.

P. fimiputris Bull.

B.² Stipe not annulate; pileus at first campanulate, pale tan. S. 1119; St. 339; J. M. 13:62. . . . *P. phalaenarium* Fr.

A.² Pileus not viscid.

B.¹ Pileus white, whitish or grayish when fresh, sometimes yellowish in age.

C.¹ Pileus usually 5-8 cm. broad; stipe solid. S. 1123; Mc. 385; H. 343; M. 116; J. M. 13:60; P. R. 23.

P. solidipes Peck

- C.² Pileus usually less than 3 cm. broad; stipe hollow.
S. 1122; St. 341; Mc. 386; H. 344; J. M. 13:59.
P. papilionaceus Fr.
- B.² Pileus tan to smoky-black, etc., not white.
- C.¹ Pileus with brown or blackish zone about the margin.
- D.¹ Pileus conical, acutely umbonate. S. 1124; St. 342; J. M. 13:59.....*P. acuminatus* Fr.
- D.² Pileus campanulate, not umbonate. S. 1124; St. 342; Mc. 385; J. M. 13:59; M. 116; H. 342.
P. fimicola Fr.
- C.² Pileus not zoned about the margin.
- D.¹ Pileus moist or hygrophanous.
- E.¹ Pileus sooty-black when moist, not reticulate.
S. 1121; St. 340; J. M. 13:60.
P. sphinctrinus Fr.
- E.² Pileus tan or brown, usually pink-tinged, reticulate-rugose. S. 1120; St. 340; A. 45; H. 339; Mc. 384; J. M. 13:61.
P. retirugis Fr.
- D.¹ Pileus dry, not hygrophanous.
- E.¹ Pileus hemispherical; lamellae very broad.
S. 1122; St. 341; Mc. 386; H. 344; J. M. 13:59.....*P. papilionaceus* Fr.
- E.² Pileus campanulate. S. 1121; St. 340; Mc. 386; J. M. 13:60; H. 342; M. 116.
P. campanulatus Linn.

NOTES.

- P. fimiputris* is often placed in the genus *Anellaria*.
P. phalaenarum has not been definitely reported from Ohio.

PSATHYRELLA FR.

- A.¹ Pileus sulcate or plicate-sulcate.
- B.¹ Pileus less than 15 mm. broad, whitish to cinereous; common. S. 1134; St. 346; Mc. 391; J. M. 13:54; H. 347; A. 48; M. 117.....*P. disseminata* Pers.

B.² Pileus usually more than 15 mm. broad, yellow or rufescent when fresh. S. 1134; St. 346; J. M. 13:57.

P. crenata Lasch

A.² Pileus striate or striatulate, not sulcate.

B.¹ Pileus with tufts of hair at least when young, brown or reddish-brown. S. 14:163; H. 348; J. M. 13:55;

P. R. 50:107.....*P. hirta* Peck

B.² Pileus not hairy-tufted.

C.¹ Lamellae close; plants odorous. S. 1136; P. R. 24:70; J. M. 13:54.....*P. odorata* Peck

C.² Lamellae rather distant.

D.¹ Pileus campanulate, sprinkled with shining particles. S. 1132; St. 346; Mc. 390; J. M. 13:57; M. 117.....*P. atomata* Fr.

D.² Pileus conical, not atomate, stipe naked. S. 1127; St. 343; Mc. 389; J. M. 13:56; M. 117.

P. gracilis Pers.

NOTE.

P. falcifolia and *P. rupicola*, described from Sullivant's material by Montagne, are omitted. (See S. 1129, 1134, and J. M. 13:55.)

GLOSSARY.

Acrid, bitter, peppery.

Adnate, attached squarely to stipe (of lamellae).

Adnexed, slightly attached to stipe, or by upper corner only (of lamellae).

Alliaceous, of onions or garlic.

Annulus, the ring on the stipe of some Agarics, formed by the separation of the partial veil from margin of pileus.

Appendiculate, hanging in small fragments from margin of pileus (of veil).

Appressed, applied closely to the surface.

Arachnoid, like a cobweb.

Areolate, divided into little areas.

Azonate, without zones.

Bay, dark reddish-chestnut color.

Buff, light, dull brownish-yellow.

Campanulate, bell-shaped.

Capillary, hair-like.

Cespitose, growing in tufts or clumps, stipes usually more or less united at base.

Cinereous, ash-gray or light bluish-gray.

Clavate, club-shaped.

Conchate, shell-shaped.

Concolorous, used of the stipe when it is of the same color as the pileus.

Conidium, a non-sexual spore cut off from the end of a hypha or hyphal branch.

Context, substance of pileus (or stipe); flesh.

Costate, ridged or ribbed.

Crenulate, with fine rounded notches along the edge.

Decurrent, extending down the stipe.

Deliquescent, becoming liquid.

Denticulate, with small teeth or projections along the edge.

Depressed, slightly sunken (of center of pileus).

Dichotomous, regularly forked into two.

Disk, central portion of pileus.

Eccentric, not attached at center of pileus (of stipe).

Echinulate, minutely roughened (of spores).

Emarginate, with a deep notch at point of attachment to stipe (of lamellae); sinuate.

Even, not wrinkled, sulcate, striate or pitted, etc.

Explanate, becoming expanded, flattened.

Farinaceous, mealy, somewhat powdery (of surfaces); resembling flour or meal (of odors).

Ferruginous, of the color of iron-rust, rust-red.

Fibrillose, with fibrils.

Filiform, thread-like.

Fistulous, tubular, hollow.

Flesh, inner substance of pileus or stipe; context.

Floccose, downy, woolly; with woolly locks.

Floccose Trama, see *Trama*.

Flocculose, minutely floccose.

Free, not attached to stipe (of lamellae).

Fuliginous, dark smoke-color, smoky-brown.

Fulvous, yellowish-brown, tawny, or yellow-gray-brown.

Furfuraceous, with small scurfy scales.

Fuscous, brown or grayish-black.

Fusiform, spindle-shaped.

Gills, see *Lamella*.

Glabrous, without scales, hairs or pubescence; smooth.

Glutinous, covered with a thick sticky or slimy coat.

Granular, *Granulose*, covered with granules.

Hirsute, covered with stiff hairs.

Hygrophanous, having a watery appearance when moist and becoming paler and opaque in drying.

Hymenium, spore-bearing surface, covering the lamellae in Agarics.

Hypha, one of the elongated cells or filaments of which a fungus is composed.

Infundibuliform, funnel-shaped.

Innate, originating with, or blending with the substance of a part.

Inserted, growing from the substratum without a basal disk and not woolly or tomentose at the base; mycelium within the substratum and invisible.

Insititious, inserted.

Involute, rolled inward.

Lamella, one of the leaf-like plates on the under side of the pileus of an Agaric; a gill.

Lateral, attached to one side of the pileus (of stipe).

Latex, the milky or colored juice of certain plants.

Linear, very narrow and straight (of lamellae).

Marginate, having a well-defined margin.

Micaceous, covered with glistening scales.

Micron, one one-thousandth of a millimeter.

Mushroom, any fleshy fungus of reasonable size.

Mycelium, the whole mass of hyphae or fungal threads forming the vegetative portion of a fungus; among the Agarics this gives rise to the sporophore or fruiting structure known as a mushroom or toadstool.

Ochraceous, brownish-yellow.

Ovate, *Ovoid*, egg-shaped.

Pallid, pale, of an undecided color.

Partial veil, see *Veil*.

Pileus, the cap-like portion of an Agaric, with or without a stipe and bearing the lamellae on the lower side.

Plicate, folded like a fan.

Pruinate, covered with a bloom or powder.

Pubescent, covered with soft, short hairs.

Pulverulent, powdery or covered with a powder or dust.

Punctate, dotted with points.

Putrescent, soon decaying.

Reniform, kidney-shaped.

Resupinate, attached to the substratum by the back or upper part of the pileus which in this case is not provided with a stipe.

Rimose, marked with small cracks.

Rufescent, tending to a dull red or reddish color.

Rugose, wrinkled.

Rugulose, minutely wrinkled.

Scabrous, with a rough surface.

Sclerotium, a hard, compact, tuber-like body containing stored food.

Scrobiculate, marked with small pits or depressions.

Serrate, margin with saw-like teeth.

Serrulate, minutely serrate.

Sessile, without a stipe; pileus attached directly to substratum.

Sinuate, with a deep notch at point of attachment to stipe; emarginate (of lamellae).

Solid, substance uniform and continuous within, not hollow or stuffed (of stipe).

Spathulate, shaped like a spathula or spoon.

Squamose, with scales.

Squamulose, with small scales.

Squarrose, with erect pointed scales.

Stipe, stem.

Striate, marked with parallel or radiating lines.

Strigose, with stiff erect hairs.

Stuffed (of stipe), interior filled with a material different from the outer part, usually softer.

Substratum, the substance upon or within which a fungus grows.

Sulcate, marked with grooves or furrows.

Toadstool, a fleshy fungus shaped like an umbrella.

Tomentose, more or less densely matted, hairy.

Trama, the inner portion of the lamellae or pileus; when made up of interwoven fibers of a uniform diameter, it is said to be *floccose*; when the hyphae are frequently enlarged so as to give, in section, the appearance of rounded cells, it is said to be *vesiculose*.

Tuberculate, with raised tubercles or nodules.

Umber, olive-brown or dark-brown.

Umbilicate, with a central depression or umbilicus, but not funnel-shaped.

Unibonate, with a central elevation or umbo.

Uncinate, extending down the stipes as a short tooth or hook, but not decurrent.

Universal Veil, see *Veil*.

Veil, a membrane enclosing the entire mushroom when young (*universal veil*), or extending from stipe to margin of pileus and enclosing the lamellae (*partial veil*).

Venose, with swollen lines or wrinkles.

Ventricose, swollen in the middle.

Vesiculose Trama, see *Trama*.

Viscid, covered with a sticky liquid or merely sticky.

Volva, the remnant of the universal veil at the base of the stipe as a cup or sheath, or broken into fragments.

Zonate, marked with zones or concentric bands.



Proceedings
of the
Ohio State
Academy of Science

An Ecological Study of
Buckeye Lake

BY
FREDERICA DETMERS

241519

VOLUME V, PART 10

Special Paper No. 19

An Ecological Study of Buckeye Lake

A Contribution to the Phyto
Geography of Ohio

By

FREDERICA DETMERS

Botanical Department, Ohio State University

PUBLICATION COMMITTEE

J. C. HAMBLETON

E. L. RICE

C. G. SHATZER

COLUMBUS, OHIO:
The F. J. Heer Printing Co.
1912

Published by a grant from the
Emerson McMillin Research Fund.
Date of publication
May, 1912.

Contribution from the
Botanical Laboratory of the Ohio
State University.

TABLE OF CONTENTS.

	PAGE.
Introduction	5- 9
Location of Buckeye Lake.....	9- 10
Physiographic features of the lake and immediate vicinity.....	10- 14
Floristic survey of the shores.....	14- 33
Classification of the islands.....	33- 34
Survey of Cranberry Island.....	34- 74
Survey of Orchard Island.....	74- 87
Survey of Lieb's Island.....	87- 90
Survey of a recently exposed peat-mass.....	90- 92
Survey of Typha tussocks.....	92- 94
Islands formed from fragments of other islands.....	94- 95
The flora of the lake bed.....	95- 97
Development of the flora.....	97-100
Annotated list of plants of Buckeye Lake.....	101-132
Bibliography	132-138



AN ECOLOGICAL STUDY OF BUCKEYE LAKE.

INTRODUCTION.

The problem of an ecological survey of Buckeye Lake was taken up on account of the many interesting and instructive features which the region offers. It is an artificial lake maintained under artificial conditions and used for the past eighteen years as a pleasure resort. Because the basin is very shallow, aquatic plants if left undisturbed, would soon gain possession of the entire area and render navigation impossible. To prevent this, the vegetation in the main channels and where landing places were desired, has been frequently and perhaps permanently destroyed.

This lake then offers a field for the study of a natural ecological succession in an uninterrupted development since the beginning of the present lake, eighty years ago, and also denuded areas with a more or less successful invasion and secondary succession. It is moreover, the habitat of a Cranberry-Sphagnum bog, which without doubt antedates the lake and the former swamp.

In the following paper I shall attempt to present a general view of the flora of the entire region, obtained by a detailed survey of areas typical of the different phases presented in the region and shall try to trace the development of the flora.

The beginning of a systematic study of ecological phytogeography is of very recent date, Humboldt (1805) is credited by Warming⁶³ as being "the first to lay stress upon the significance of plant-physiognomy in relation to the landscape," and consequently the subject is experiencing many developmental stages in the methods of study and in the terminology. In the latter especially there is diversity of opinion among the most eminent ecologists, not so much as to the relations existing be-

tween the concepts of formation, association, and society; but as to the value of the respective terms. Griesebach³⁵ was the first to employ the term formation in connection with phytogeography. To him a "phytogeographical formation" is a group of plants which has a fixed physiognomy, such as a meadow or forest. Warming⁶³ writes:—"A formation may then be defined as a community of species, all belonging to definite growth forms, which have become associated together by definite external (climatic or edaphic) characters of the habitat to which they are adapted. Consequently, so long as the external conditions remain the same, or nearly so, a formation appears with a certain determined uniformity and physiognomy, even in different parts of the world, and even when the constituent species are very different and possibly belong to different genera or families."

Hence Warming's concept agrees with that of Griesebach in making physiognomy the controlling factor in a formation and uses this as the basis of classification. Clements⁹ also sees the formation as an organic unit conditioned by the habitat and it must therefore be co-extensive with the latter. Consequently his classification of formations is based on habitat. Adams⁴ says:—"A formation or climax society is composed of a relatively limited number of species which are dominant in a given environment of geographic extent. Such dominance implies extensive range, relative abundance and ability to indefinitely succeed or perpetuate itself under given conditions." And Schimper⁵² recognizes two ecological groups of formations, climatic or district, composed of three chief types, woodland, grassland and desert; and edaphic or local formations, which are conditioned by the soil; as swamp, rock, sand dune, etc. Graebner³² advocates making the percentage and nature of inorganic salts dissolved in the soil water, the controlling factor in the character of vegetation. He therefore recognizes the groups of formations; 1, where the water contains a high per cent of mineral salts; 2, where the per cent of mineral salts (supposedly available to plants) is low; and 3, saline water.

Other authors extend the term formation to cover a much larger concept, whose limitation is based on the water available to plants and therefore recognize Xerophytic, Mesophytic and Hydrophytic formations.

The term association is also variously interpreted; but being employed in a more restricted sense than formation there is greater unanimity of opinion.

In this paper an association stands for a unit of vegetation exhibiting a definite growth form, which is characteristic of a certain habitat. For example:—the upland meadows in the vicinity of Buckeye Lake are occupied by grass associations, the bog-meadow of Cranberry Island is occupied by a Cranberry-Sphagnum association. The dominant species in each case giving character to the association.

The various associations include ecologically related communities of species having definite floristic composition. These are grouped in societies to which the principal ones give name and character. In certain areas in the bog-meadow *Dulichium arundinaceum* occurs with the *Oxycoccus* and *Sphagnum* in such abundance as to give a definite character to those areas and forming an *Oxycoccus-Sphagnum-Dulichium* society. Again altho *Sphagnum cymbifolium* is the most abundant and widely distributed species of *Sphagnum* in the bog, there are areas in which *Sphagnum acutifolium* var *versicolor* occurs to the almost complete exclusion of *S. cymbifolium*. As these two species differ greatly in appearance the contrast between the two *Sphagnum* societies is striking.

A marsh offers another illustration of well defined associations, distinguished by plants of most characteristic growth-form e. g.:—erect plants with slender culm-like stems and long relatively narrow leaves, with the roots, rhizomes and lower portion of the erect stem only, submerged in relatively quiet, shallow water along the margins of lakes, bays and gulfs and sluggish streams. The dominant plant may be a *Typha*, a grass or a sedge. The particular marsh is then a *Typha*, grass or a sedge association according to the plant which lends it character.

Associated with the dominant species are others of minor importance, which however may be abundant and conspicuous enough in various parts of the association to lend character to the vegetation of that part. Thus, in one part, *Scirpus fluviatilis* may be a dominating species of nearly equal rank with the *Typha*; we have then a *Typha-Scirpus* society in the *Typha* association. A society may also consist of a single species only, as an isolated tussock of *Scirpus lacustris* in a *Typha* association. The society should always be clearly defined; altho there is generally a transition from one to the other at the margins. The societies are designated by their principal species. With these are generally associated others of secondary importance, secondary species, which may belong to the same or to another succeeding or preceding association. In the latter case they show a relationship to the society in which they occur. As for example, in a *Typha-Sphagnum* society *Potamogeton lonchites* belonging to an association of fixed aquatics, is frequently present, persisting and growing well, even where the water has entirely receded leaving a moist but not wet mud flat. The shoots of the *Potamogeton* are shorter than those in the water but are green and thrifty. That the plant does not suffer from the diminution of water in the substratum seems to be due to the increased humidity of the atmosphere at the level of the shoots.⁶⁶ Thus the *Potamogeton* is benefited by the presence of the taller plants, for if these were absent the *Potamogeton* would soon succumb.

The societies and associations may develop a zonal or an alternate arrangement. The former term is used in this paper to designate a more or less well defined crescentric arrangement which results typically from a radial growth from a common center. Alternation is used to designate scattered masses, exhibiting no definite relationship in space to one another. The location of each such mass is determined either by local conditions or thru accidents of dissemination.

Transects have been charted in a few areas to develop the succession from one society or association to another. These



FIG. 2.—15



FIG. 1.—Topographic map of Buckeye Lake and vicinity; U. S. Geological Survey, 1907; contour interval 20 feet (6 m.); scale, 1 inch=1 mile (2.5 cm.=1.6 km.).

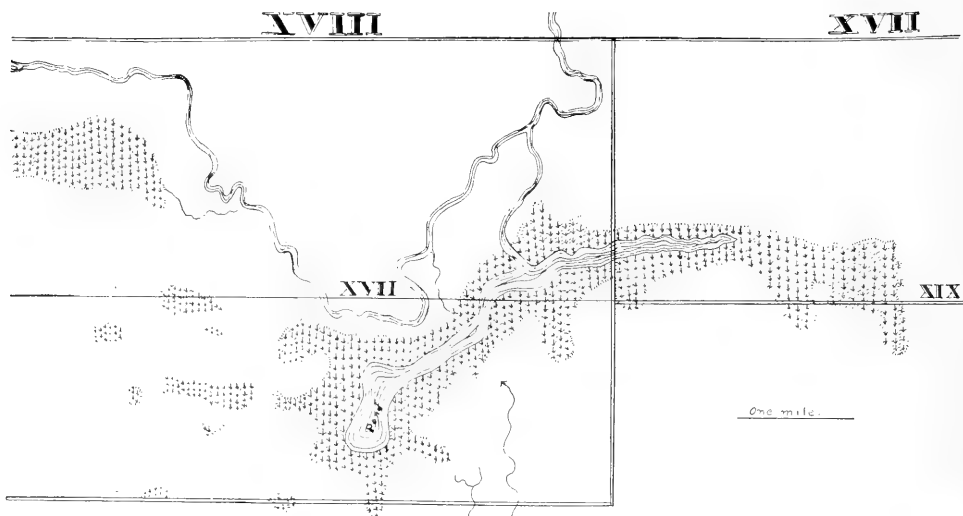


FIG. 2.—Map of the "Big Swamp" of the Survey of 1801. A number of smaller swamps of which the largest is the Bloody Run Swamp are shown at the left.

are included in the description of that region in which they were charted.

Before proceeding with the paper I wish to make acknowledgment to the following persons for the courtesies and assistance I have received. To Dr. Alfred Dachnowski under whose supervision the work was done; Dr. C. A. Davis of the U. S. Bureau of Mines, and Professor J. A. Schaffner for assistance in the identification of plants; Mr. H. H. Bartlett for the identification of the Musci and Hepaticae, Mr. Wilmer Stover for the identification of fungi; Professor C. E. Sherman and J. R. Chamberlain of the Ohio State University; Messrs. Bootin and Sawyer of the Canal Commission, and to Captain Chittenden for charts, maps and information concerning the reservoir and lake; Miss Clara Mark and Mr. Lionel King for photographs of local features.

LOCATION OF LAKE.

Buckeye Lake, (Fig. 1) is situated in Licking, Fairfield and Perry counties in Ranges 17 and 18, Townships 17, 18 and 19. It is a long irregular body of water with its longest diameter from east to west extending from $82^{\circ} 25' 27''$ to $82^{\circ} 31' 12''$ west longitude, approximately $7\frac{1}{3}$ miles long from east to west, and varying in width from one-fourth mile in the eastern portion to a mile and one-half at the extreme western end, and covering an original estimated area of 4,200 acres. Originally used as a reservoir for the Ohio canal,³³ on May 21st, 1894, the General Assembly of Ohio passed an act reserving this reservoir for a public park and summer resort to be known as Buckeye Lake.

The site of the lake was a more or less completely tree-covered impassable swamp known to the Indians and early settlers as the "Big Swamp," "Two Lakes" or "Big and Little Lake."³² It lay diagonally across the southeast corner of Twp. 17, and almost half across the southern border of Twp. 19. In the center of this area was a long narrow lake (Fig. 2) fed by several small streams, of which the largest were Buckeye and Honey creeks. The lake drained into the South Fork of the Licking River.

The region surrounding Buckeye Lake includes the southern townships of Etna, Union, Harrison in Licking County, and the northern townships of Violet, Liberty and Walnut in Fairfield County, and Thorn Township in Perry County, and is covered by both the Illinoian and Wisconsin drift sheets to a depth varying from a few feet to 453 feet, as shown by the records of gas wells in the area.

PHYSIOGRAPHIC FEATURES.

The region to the southwest and west of Buckeye Lake is a till plain devoid of large boulders and characterized by clay containing many small sharp irregular rock fragments; the surface is rolling, broken by low gently sloping hills and the shallow open valleys of young streams, many of the smaller of which are wet weather streams only. The drainage belongs to two systems, the Licking-Muskingum and the Scioto River systems. The water shed is a low table land, 3-5 miles wide, surmounted by low hills, obliquely crossing the boundary between Licking and Fairfield counties and sloping gradually to the plain on which lies Buckeye Lake.

The margin of the table land is dissected by numerous small streams. Those flowing towards the north, northeast and east are tributaries of the South Fork of the Licking River, while those flowing towards the southwest, south and southeast join Sycamore and Little Walnut creeks of the Scioto River system. The surface of the region is marked by many swamps, of which the largest are the Bloody Run or Pigeon Roost swamp, two miles southeast of Kirkersville where the South Fork of the Licking changes its course from almost due east to south, and the "Big Swamp" the present site of Buckeye Lake. All of these swamps except Buckeye Lake, have been drained, the smallest are now mere depressions in meadows or cultivated fields and the largest, Bloody Run swamp, is almost wholly under cultivation. It covers an area of 400 acres of which 250 is muck land. To the east of the road Mr. Brown raises celery and other vegetables, and to the west the Livingston Seed Company have

their onion farm. Thirteen years ago this was a bog forest of Soft Maple and Swamp Ash with an undergrowth of Willow and Poison Sumac. The drove well at Mr. Brown's barn shows seventeen feet of peat, three feet of yellow clay, then hard pan covering the gravel from which comes the supply of running water. *Impatiens* stems were found in the muck at a depth of three feet.

The till plain bordering Buckeye Lake on the west has an elevation of 890 feet close to the lake, while the lake surface is 892 feet above sea level.

The eastern portion of Buckeye Lake is surrounded by moraines in which large boulders are quite frequent. The land has a distinctly hill and valley topography, however, the highest elevation within 5 miles of the lake is 1,100 feet, no higher than the crest of the water shed to the west; but the surface is more deeply dissected and the drift cover is thinner, hence the greater prominence and ruggedness of the hills.

Just east of the southeastern extremity of the lake, the rim of hills is dissected by a valley a mile and one-half wide. Just east of Thornville Station a morainal loop crosses the valley and completely blocks it except for a narrow cut, which is now occupied by the parallel tracks of the Shawnee branch of the Zanesville and Western railroad from the south, and the Baltimore and Ohio from the north. The cut whose present surface is 900 feet above sea level, is partially filled with overflow clays and gravel.

Jonathan Creek has its source in the hills immediately south of the cut and here the present valley of Jonathan Creek is two miles wide. The cut above mentioned is very evidently an overflow channel for the lake. The latter from its shape, position with reference to the valley of Jonathan Creek and the morainal loop must be regarded as a finger lake, formed in the upper portion of the old valley of Jonathan Creek by the morainal loop at Thornville Station.²⁷ The waters of the lake cut thru the moraine at Thornville Station,⁶⁵ then later found a lower outlet to the north into the South Fork of the Licking River. The

water level of the old lake after the opening of the outlet to the north could not have been much higher than it is now.

The South Fork of the Licking River rises in Jersey Township near the western border of Licking County, follows a generally southeasterly course, passes into Fairfield County until a short distance northwest of Buckeye Lake where it describes a narrow loop and flows northeast to Newark. The old lake in the Big Swamp drained into the river at this loop.

Surrounding the old lake was a wooded swamp,³² bearing "White and Black Oak, Black Jack, Elm, Red Maple, Sugar Maple, Beech, White Ash, Hickory, Ironwood, Wild Cherry, Box Elder, Gum, Black Walnut and Dogwood, and many of them were large trees." Stumps four feet in diameter have been taken from the reservoir. Besides these larger forest trees, there was an abundance of "Wild Plum, Hawthorn, Alder and Sumac." It is also reported that cranberries grew plentifully in the swamp.

In the history of Perry County,³⁴ the statement is made that wild plums, wild cranberries and the red thorn berries were in early times, very plentiful in the northern part of the swamp. The Indians are said to have resorted to the lake in considerable numbers for the purpose of fishing and to the swamp for the various berries.

This swamp was chosen for the site of the reservoir for the Ohio Canal.³³ The "old reservoir" was begun in 1825 and completed in 1828. Then because the water level in the canal was not high enough to permit the carrying of even half a load during the drier summer months, an additional 500 acres, known as the new reservoir was added in 1832 to the west end of the old one.

The size and shape of the present reservoir conforms in general, to that of the "Big Swamp" as shown in the surveys of 1799 and 1801. There are striking disparities in the size and outline of the swamp areas in these two early surveys. That of 1799 conforms more closely to the size and outline of the present reservoir.

In Fig. 3, Plate II the map of the survey of 1799 has been

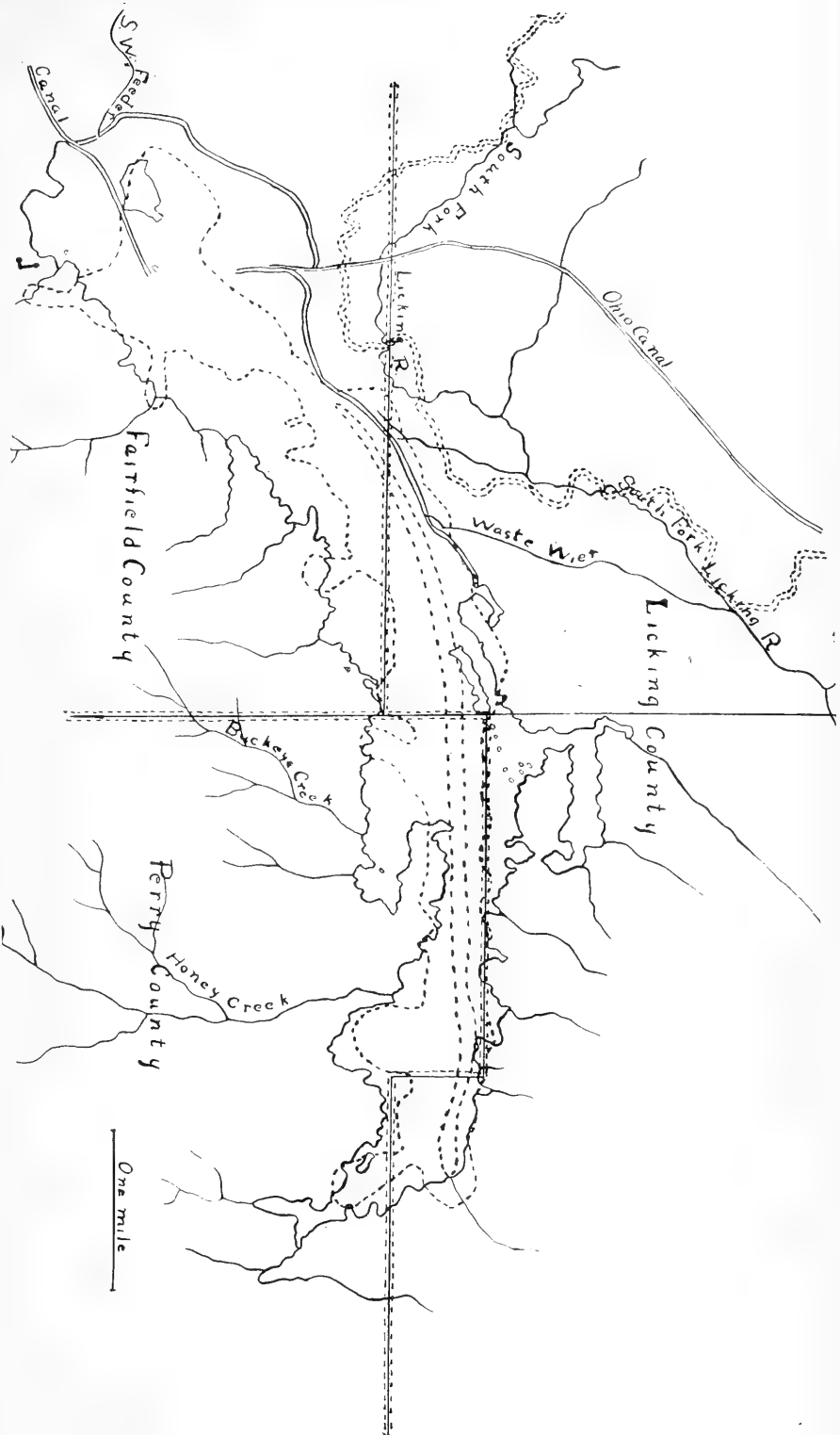
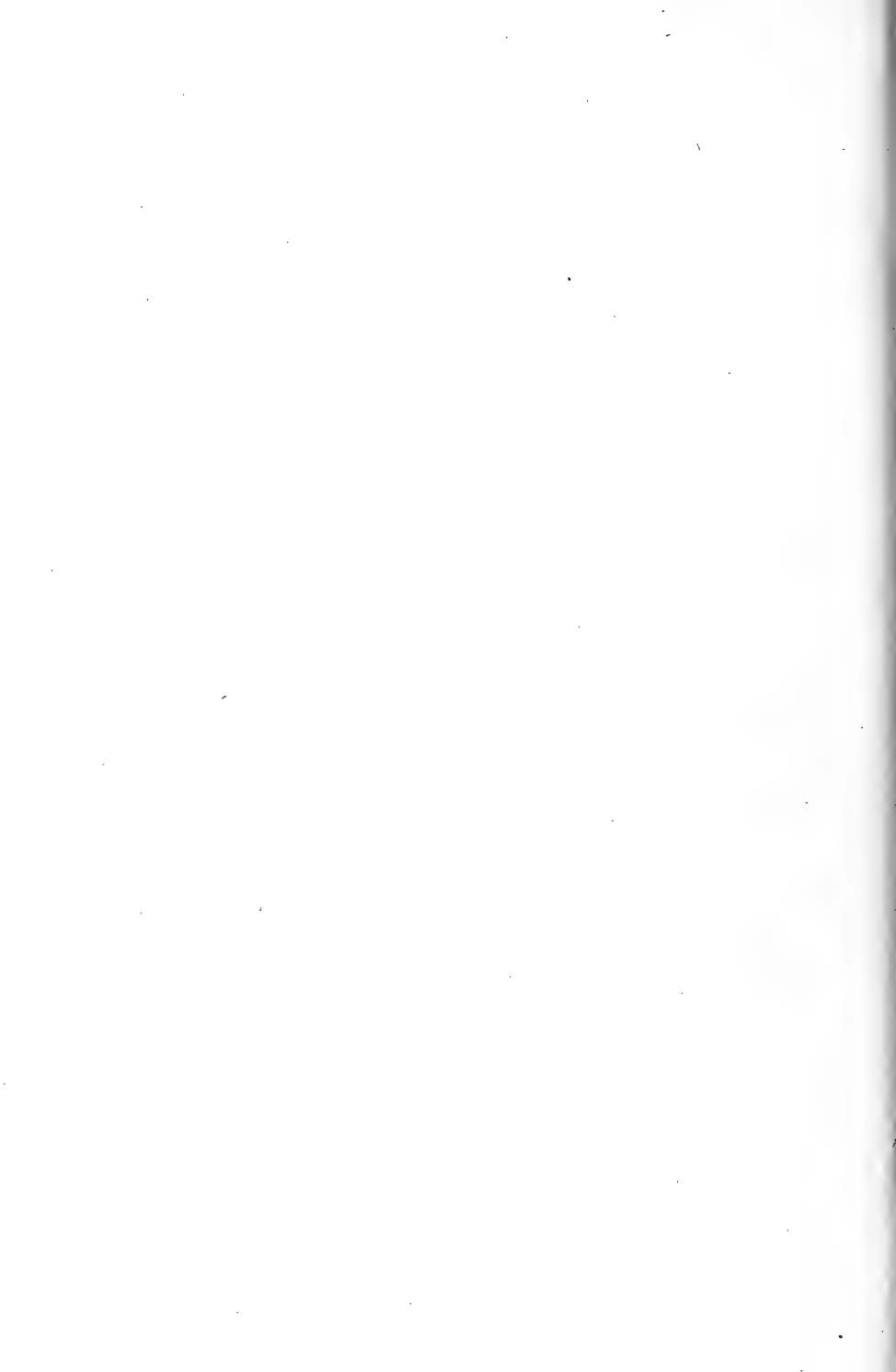


FIG. 3.—Map of the "Big Swamp" of the Survey of 1799 superposed on that of the Survey of 1909 by the Civil Engineering Department of the Ohio State University.



superposed on a composite of the survey made recently by the Canal Commission and one made during the summer of '09 by the Civil Engineering Department of the Ohio State University. The map of the recent surveys is drawn with unbroken and that of 1799 with broken lines. As the water at the standard level is about nine feet higher than that of the original swamp, the reservoir naturally extended farther than the old swamp in those directions where the spreading waters were not checked by a levee or by natural banks; as for example, toward the southwest, south and southeast, where low lands bordered the swamp; and toward the north a long irregular arm of the reservoir extends up a low valley. On the north side a part of the old swamp was cut off by the embankment. A comparison of the superposed areas will show this better than it can be stated in words.

The old lake is represented as a long, narrow ditch with very regular banks. This regular outline seems impossible when one considers the nature of the surrounding land. In the report of the surveys, the swamp is frequently written of as impassable, so the map of the lake is therefore very likely not from an actual survey. Moreover the Indians and early settlers called the waters "Two Lakes" or "Big and Little Lake" indicating the presence of two bodies of water in place of one.

Altho the present lake and its predecessor the "Big Swamp," are distinctly post-glacial and occupy a long shallow kettle in the surface of the upper drift sheet, the basin was a part of the pre-glacial Newark River valley. A probable branch of the Newark River flowed in the valley now occupied by Jonathan Creek,²⁷ was continuous with the Buckeye Lake basin, and joined the Newark River $\frac{1}{2}$ mile southwest of the present site of the waste weir. There is no evidence that Buckeye Lake was a part of a large post-glacial lake of long duration. The melting of so vast an area of ice caused of course a great sheet of water which, however, could not have endured for a great length of time as there is no evidence of lake sands, clays or beaches and as there seems to be conclusive evidence that there was one and probably two drainage channels, Licking River⁴⁷ and Jonathan Creek, open

to the east at that time. There were, however, numerous large and small shallow depressions formed by the unequal deposition of the drift in the till plain which were at first shallow lakes and later became swamps.

SURVEY OF THE SHORES.

With the exception of the portion occupied by the levee, the shores of the present lake are generally low and are bordered by a more or less extensive swamp vegetation.

The levee extends along the north shore from the park westward and completely around the western end of the lake. It is interrupted only at the waste weir. The face of the embankment is of rock with clay above and much of this has been recently cemented. The summit is from 4-6 feet wide and clay covered. The steep slope and the firmly packed clay offer xerophytic conditions to plants whose root systems are not deep, and distinctly mesophytic conditions to those whose roots strike deep enough to reach the water level of the lake. The center of the levee is used as the pathway to the cottages bordering the north shore. Along both edges is a more or less interrupted line of trees, consisting of *Salix nigra*, *S. alba*, *Ulmus americana*, *Acer rubrum*, *A. saccharinum*, *Prunus serotina*, *Quercus imbricaria*, *Q. rubra*, *Q. palustris*, *Q. bicolor*, *Populus deltoides*, *Platanus occidentalis*, *Celtis occidentalis*, besides the few apple and peach trees which have been planted near cottages. The trees were formerly much more dense than they now are; but many have been cut down to make way for cottages. There are scarcely any shrubs, an occasional *Sambucus canadensis* and *Vitis aestivalis* along the outer margin is all that is left of the shrub zone. The herbs are but few, only those which can endure strong light exposure and dry soil as *Lactuca scariola*, *Ambrosia trifida* and *A. artemisiifolia*, *Oxalis stricta*, *Erigeron annuus*, *Anthemis cotula*, *Achillea millefolium*, *Polygonum persicaria* and *P. pennsylvanica*.

The outer slope of the embankment is also generally steep. It is in some places grass covered and in others bears trees.



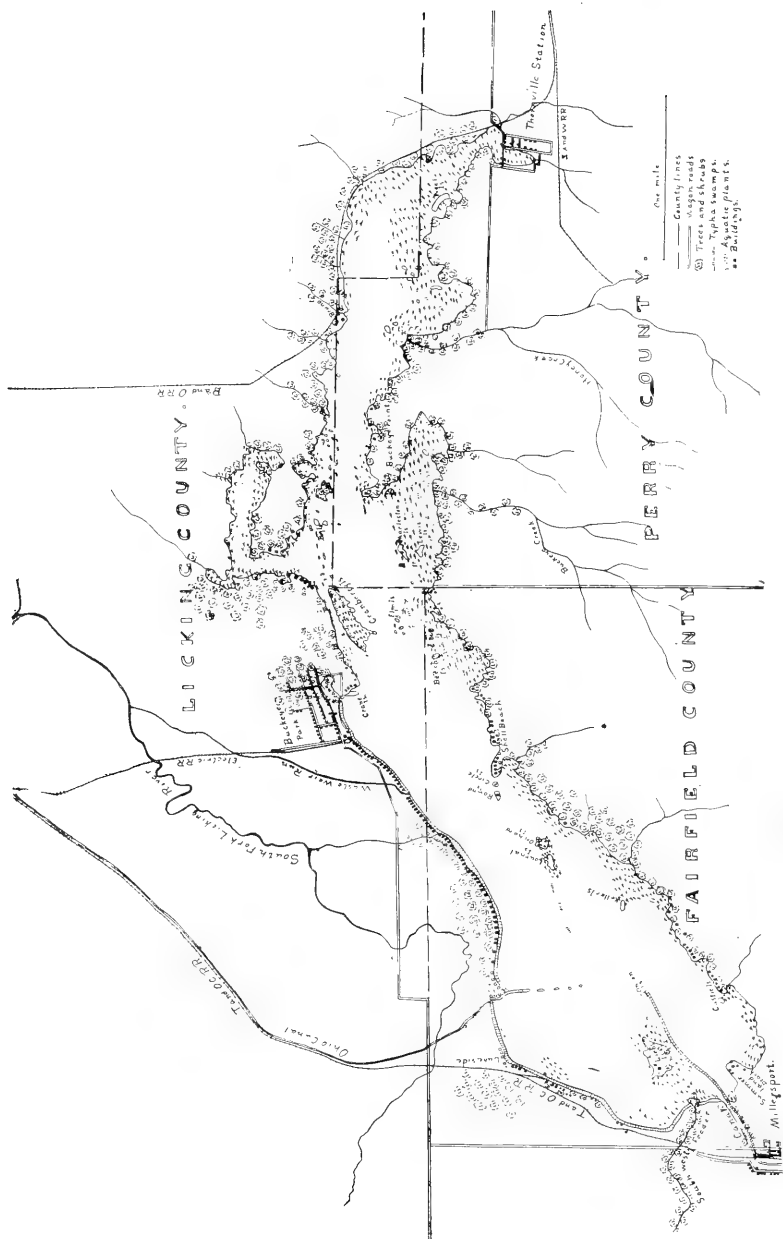


FIG 4.—Buckeye Lake at the present time, showing the areas in which a dense aquatic vegetation has developed and the trees along the shore.

Back of the levee is a low belt 40-50 feet wide. From the park to the waste weir this low land has been drained and small areas have been cultivated. Part of it is overgrown with grasses, *Carices*, *Erigeron annuus*, *Onagara biennis*, *Aster* sp. An occasional cottage occupies the low land, which is bordered on the north by meadows or cultivated fields.

From the waste weir to a quarter of a mile west, the land slopes from the top of the levee to the fields, there being no intervening ditch. Three-quarters of a mile west of this, the ditch appears again and is only partially drained. It is the bed of a small stream, a tributary to Licking River, which had its headwaters in the large swamp but which has been cut off from the lake by the levee. This creek valley was formerly a wooded swamp with water deep enough to admit of rowing, but is now much disturbed, paths cut thru and partially drained. The trees are the same as those on the embankment, *Ulmus americana*, *Salix nigra* and *Platanus occidentalis* being the most numerous. There are still small areas of *Nymphaea advena*, *Peltandra virginica*, an occasional *Sparganium eurycarpum* and *Typha latifolia*. The open pools are covered with *Lemna trisulca* and *L. minor* and *Spirodela polyrhiza*.

All the available space on the north slope of the levee has been leased by the State for building sites, most of which are now occupied. This has had a marked effect on the swamp north of the levee. Draining the ground and the building of paths has largely destroyed the former vegetation. The levee extends entirely around the west end of the lake to the canal at Millersport, near which it has been cut thru to admit of the southwest feeder to the lake. The vegetation is much the same as along the north bank except that the smaller number of cottages and less frequent traffic have served to preserve it. The summit of the embankment is generally grass and weed covered except a narrow path along the center; the west slope is quite steep and tree covered for the entire distance. At its foot from Lakeside to the spur track of the Toledo and Ohio Central railroad, is open water with a *Scirpus lacustris*, *Nymphaea advena*

society. South of the spur track a drainage ditch has converted the swamp into a mesophytic wooded zone with a dense field stratum of grasses and common weeds. At the curve of the levee towards the southwest there is a border of shrubs, *Sambucus canadensis* and *Salix nigra* along the ditch. Farther south where the railroad track diverges from the shore the depression between the two is occupied by *Typha latifolia* and *Nymphaea advena* in alternating masses, with *Homalocenchrus oryzoides*, *Juncus tenuis* and *Scirpus fluviatilis* and other sedges along the margin and a border of *Sambucus* and *Salix* at the foot of the embankment.

Along the water's edge the levee has not been kept in as good repair as that of the north shore. Originally banked with rock at the base, this has in one place broken down, the earth has been washed into the shallow water, building a mud flat about ten feet wide. On this and extending into the water are *Sagittaria latifolia*, *Scirpus fluviatilis* and *Homalocenchrus oryzoides*, *Scirpus lacustris*, *Potamogeton lonchites* and *Nymphaea advena* in the order named.

But few launches enter the western arm of the lake; this and the small number of small docks and the entire absence of large ones, have permitted an abundant growth of fixed aquatics.

Near Lakeside are two *Castalia tuberosa* beds. Just south of these and near the spur track is an extensive *Typha latifolia* tussock surrounded by alternating *Nymphaea advena*, *Potamogeton lonchites*, *Polygonum emersum* and *Nelumbo lutea* societies. About fifty yards farther south an extensive field of *Nelumbo lutea* begins, it spreads over 300 yards out into the lake and extends to Lieb's Island. The marginal zone of fixed aquatics extends from this point to the mouth of the canal.

The Southwest feeder taps the south branch of the Licking River at Kirkersville; it has a general southwesterly direction and enters Buckeye Lake one-eighth of a mile north of the canal at Millersport. Near its mouth it is a very sluggish stream not more than twenty feet wide, confined between steep banks which are densely wooded on the outer slopes. Immediately at the

mouth the banks are low, flat and wet and are covered with a dense growth of *Hibiscus moscheutos* and with a few *Sambucus canadensis* and *Salix nigra* shrubs; this is followed lakeward by a mixed *Hibiscus-Scirpus* zone which passes into a dense growth of *Typha latifolia*. In the more open water *Nelumbo lutea* becomes dominant. Altho the feeder has so little current, enough sediment has been deposited during the eighty years of its existence to form a broad low delta.



FIG. 5.—Zones of vegetation at mouth of S. W. feeder. Clump of willows at the center are on the delta.

The levee which was the eastern embankment of the canal and the western of the old reservoir, is intact only from the southern end to Onion Island. The remainder consists of detached portions with broad open water channels between them. These broken portions bear a few trees, willows and elms. Some places are so broken down that the trees are standing in water. From the margin of the lake to Lieb's Island the levee is clothed with large trees on the south side and a shrub zone, *Sambucus* and *Salix nigra* on the north. The shrub zone is interesting as it has had undisturbed possession only since the abandoning of the use of canal boats.

Summerland Beach on the southwest is a rather high, grass-grown point with a thin fringe of trees at the margin, and no marsh zone forming. The cove immediately to the southeast is low and flat and furnishes an interesting example of the succession of marsh and aquatics by ruderal herb societies. There is a marginal zone of *Polygonum emersum* then *Nelumbo lutea* and *Potamogeton lonchites*, followed by a *Polygonum-Scirpus fluviatilis* zone associated with *Roripa palustre*, *Galium asprellum* and *Hibiscus moscheutos*. In this zone the surface has so recently been under water that it is wet and bears many



FIG. 6.—Lakeward side of Cove southeast of Summerland Beach. At outer margin is a society of *Polygonum emersum*, this is followed by a *Nelumbo lutea* zone which is succeeded by sedges.

stranded *Potamogeton lonchites* whose leaves are broader than when in water, and the tips of whose shoots are erect. This zone is followed by a broad mixed belt; towards the outer margin of which *Hibiscus* and *Scirpus* are dominant. There are numerous scattered clumps of *Sambucus canadensis*, *Hibiscus* and two *Salix nigra*, while *Polygonum emersum* and *P. sagittatum* are abundant. A narrow line of elms crosses it diagonally as though marking a former shore line. This zone is largely invaded by ruderal herbs of which *Ambrosia trifida*, *Verbena hastata*, *Lactuca scariola*, *L. canadensis*, *Urtica gracilis*, *Dip-*

sacus sylvestris and Oxalis cymosa are the most abundant. Towards the inner margin of the cove the ruderal societies are dominant. To the south is a clover field so filled with Aster sp., Lactuca canadensis, Ambrosia trifida, Erigeron sp., Geum canadense, Stachys aspera, Achillea millefolium, Anthemis cotula and Dipsacus sylvestris that the clover is visible only on close scrutiny.

No levee was built along the south shore of the lake, which is low, marshy and bordered by a tree zone except in the ex-



FIG. 7.—Head of cove southeast of Summerland Beach. Ruderals have taken almost entire possession of the mud flat.

trreme southwest portion near Shell Beach and southeast where cultivated fields extend to the lake. From Summerland Beach to Shell Beach, within recent years, short stretches of embankment of planks stone or concrete have been built in front of cottages and hotels. These together with the docks and boat landings have greatly interfered with the vegetation. From Castle Island to Shell Beach the shallow waters within 50-100 yards from the shore have a more or less dense growth of fixed aquatics and swamp plants. In the quiet waters surrounding

Journal and Orchard Islands and extending to the shore, the swamp shows well defined zonation. The outer zone is an almost pure growth of *Nelumbo lutea* in water from 4-5 feet deep. Next is a mixed zone of *Nelumbo lutea* and *Polygonum emersum*. The latter becomes dominant nearer the shore. This is bordered by a dense growth of *Typha latifolia* with which *Sparganium eurycarpum*, *Polygonum emersum* and sedges are associated. The *Typha* zone begins in water two and one-half feet deep and extends up above the water level on the mud flat. This is followed by an *Hibiscus* zone, and this in turn by a thin fringe of shrubs, *Sambucus canadensis* and *Cornus stolonifera*. The trees, remnants of the older vegetation, are mostly *Salix nigra*. There is here and there an *Ulmus americana* and *Hicoria ovata*.

The outline of the south shore is very irregular. The hills to the south form a front of irregular lobes 900 feet above sea level extending to near the water's edge. Between these lobes are the valleys of brooks, many of which are now mere depressions in the cultivated fields, a few are still occupied by small streams. The lake has ascended these valleys forming troughs between the lobes of higher land. As the water in these coves is extremely shallow they are all filled with a dense growth of fixed aquatics and shore marsh plants. The mouth of the valley of Buckeye Creek is an almost impenetrable marsh, three-fourths of a mile wide from Custer's Point to its eastern margin back of Buckeye Point. This is the most extensive continuous association of fixed aquatics in the lake. The marsh extends out into the lake as far to the west as Custer's Point and Elm Island and nearly half way across the lake to the north. It completely surrounds Charleston and Lewis Islands, and an island just west of Buckeye Point and also forms a broad zone around the latter. The greatest depth of water is five and one-half feet. At this depth, at the lakeward margin of the association, occur pure societies of *Nelumbo lutea*, *Potamogeton lonchites*, mixed societies of several species of *Potamogeton lonchites*, *pectinatus* and *natans*, and often with *Castalia tube-*

rosa. *Nelumbo lutea* is also often associated with *Castalia tuberosa*. There are several large tussocks of *Typha angustifolia* at a depth of two and one-half to three and one-half feet. These are always pure societies except that at the margin of the tussocks are generally a few *Castalia*, *Nelumbo*, *Potamogeton* or even *Nymphaea advena* leaves. In the center of the tussock are no other plants. Not as numerous but alternating with the *Typha angustifolia* are tussocks of *Typha latifolia*. This latter species grows in somewhat shallower water, water at a depth of one and one-half to two and one-half feet. It never seems to occur as a pure society, but it always associated with *Sparganium eurycarpum*, *Polygonum emersum* and often with *Hibiscus moscheutos* and *Scirpus fluviatilis*. *Bidens* species are often growing on the uprooted masses or even on the sediment covered bases of the living stalks.

The two associations here represented, that of fixed aquatics with floating or submerged leaves and that of a reed marsh, do not exhibit a well defined zonal arrangement, except where they border an island, Buckeye Point or the shore of the cove. Then either a pure *Nelumbo* society or a *Nelumbo-Polygonum emersum* society forms the outer zone in water varying in depth from 5 to $2\frac{1}{2}$ feet. This is followed by a *Polygonum* zone or a *Polygonum-Potamogeton* or by a *Typha* zone. The *Typha* zone in some cases, extends to the exposed shore line; in others there is a *Typha-Scirpus*, or *Typha-Hibiscus* followed by a shrub zone. The shrub zone is generally but poorly represented. In the open water the associations exhibit an alternation. Depth of water and wind exposure have some influence on the position of the societies. *Typha angustifolia* grows in deeper water than *T. latifolia*; *Nelumbo lutea* and *Castalia tuberosa* grow in deeper water than *Nymphaea advena*. *Potamogeton lonchites* and *P. pectinatus* grow in deeper water and where wind exposure is greater than *P. zosterifolius* and *P. pusillus*. All the *Potamogeton* grow more luxuriantly to the lee of an island and of *Typha* masses than on the windward side. *Polygonum emersum* is gregarious. It grows in water $5\frac{1}{2}$ feet deep and also in the mud

above the water level. It covers large areas as a pure society but is often associated with *Potamogeton*, *Nelumbo*, *Castalia*, *Typha* and even *Hibiscus*. Thus in making one's way through the cove at the mouth of Buckeye Creek, one encounters *Typha* tussocks, a large patch of *Nelumbo*, *Castalia*, smaller dense masses of *Pontederia cordata*, *Scirpus lacustris* with *Utricularia vulgaris* or *Potamogeton* associated. In the center of the cove, sheltered by the point and with water $2\frac{1}{2}$ or less feet deep, is an extremely dense, almost impenetrable mass of *Potamogeton zosterifolius* with *Ceratophyllum demersum* under the surface.

According to the topographic map, Buckeye Creek flows through the center of this marsh. There is no evidence of flowing water or an open channel and the zone of *Typha latifolia* lining the shore is unbroken.

A mile and one-eighth farther east, Honey Creek enters the lake. Its channel has been kept open thru the marsh. The lower portion looks more like a canal than a creek, with its uniform shores and earth banks. The channel at the mouth is about fifteen feet; fifty yards up-stream it is not more than eight feet wide with a uniform depth of $31\frac{1}{2}$ inches. The fall in the creek is so little that the current is barely noticeable. (Fig. 9.) An extensive vegetation with well marked zonation spreads out into the lake on either side of the creek. (Fig. 8.) These zones are composed of:

I. An association of semi-aquatics comprising three societies which show alternation rather than zonation.

i. *Nelumbo*-*Potamogeton* society.

Principal species

Nelumbo lutea

Potamogeton lonchites

Secondary species

Potamogeton pectinatus

P. natans

This society covers an area 100 feet broad on the west and somewhat less on the east side of the creek. There are also



FIG. 8.—MAP OF THE MOUTH OF HONEY CREEK.

LEGEND OF THE PLANT SOCIETIES.

- | | |
|--|----------------------------|
| 1. Nelumbo-Potamogeton society. | 5. Ruderal herb society. |
| 2. Nymphaea advena society. | 6. Salix society. |
| 3. Typha-Sparganium society. | 7. Ulmus-Fraxinus society. |
| 4. Homalocenchrus-Scirpus fluvii-atilis society. | 8. Cultivated fields. |

Societies 1 and 2 belong to the association of semi aquatics, 3 to the Typha, 4 to the Sedge, 5 to the Ruderal herb, 6 and 7 to the Mesophytic forest association.

smaller areas occupied by this society farther in shore where it alternates with the Second society of the semi-aquatics and also with the sedge society of the shore plants.

2. *Nymphaea advena* society: *Nymphaea advena* is present in clumps between the Lotus bed and the shore, alternating with areas of the *Nelumbo* and *Scirpus* societies.

3. *Castalia tuberosa*-*Potamogeton lonchites* society: This society forms a fringe bordering the open water of the creek.



FIG. 9.—Plant associations bordering the mouth of Honey Creek, showing Society 1 of Association I, Societies 1 and 2 of Association II, and Societies 1 and 2 of Association V of the map of Honey Creek.

The seasonal aspect is marked in this association. In June the *Nymphaea* and *Scirpus* with their erect leaves from 1-3 feet above the water level, were the most conspicuous plants. In the latter part of July and during August, the *Lotus* is in full bloom, the flower stalks and large leaves standing 2-3 above the water almost conceal the *Nymphaea*.

Succeeding Association I is an association of shore plants extending from water 1-2 feet deep to well up on the mud flat wholly above the water.

This is II. *Typha* association, comprising 5 societies as follows:

1. *Scirpus fluviatilis* society: This society alternates with those of Association I and also forms quite a dense border at the margin of the

2. *Typha-Sparganium* society: The dominant species of which are *Typha latifolia* and *Sparganium eurycarpum*. These in deeper water are associated with *Scirpus fluviatilis*, *Potamogeton natans*, *P. lonchites*, *P. pectinatus* with *Lemna minor* on the surface of the water. The *Typha-Sparganium* zone extends 150 feet up-stream and to the west completely across the cove. Along the inner portion of the zone the *Potamogeton* and *Castalia* have disappeared and the society becomes a

3. *Typha-Homalocenchrus-Sparganium* society: *Homalocenchrus oryzoides* becoming one of the dominant members. The ground is distinctly wet but is not completely covered with water. The associated plants are *Hibiscus moscheutos*, *Sagittaria latifolia*, *Rumex brittanica*, *Scirpus fluviatilis* and *Boehmeria cylindrica*. This is bordered by a narrow (10-foot wide at the widest) crescentric zone of a

III Sedge Association consisting of:

1. *Homalocenchrus oryzoides* society, with the associated species of *Sparganium eurycarpum*, *Sagittaria latifolia*, *Carex sparganioides*, *C. frankii*, *Hibiscus moscheutos*, *Peltandra virginica*, *Rumex crispus*, *Solanum dulcamara*, *Sium cicutaefolium*, *Cicuta bulbifera*, *Boehmeria cylindrica*, *Scirpus atrovirens*, *Convolvulus sepium*, *Oxalis cymosa*, *Panicularia nervata*, *Eupatorium perfoliatum*, *Mentha spicata* abundant near the margin of the creek. This zone lies along the creek between the Willow and *Typha* zone. Near the head of the cove it merges into a mixed one of a

2. *Homalocenchrus-Scirpus fluviatilis* society which lies between the broad *Typha* covered belt and the ruderals.

Between the grass and sedge grass zones, 1 and 2, and the marginal border of trees is a zone which is occupied by a ruderal herb association composed of a variety of plants, several of which

are generally found in cultivated fields or in much drier situations as along railway tracks, but which here grow on a mud flat closely associated with river bank and marsh plants. These are *Equisetum arvense*, *Dipsacus sylvestris*, *Pastinaca sativa* and several species of *Labiatae*.

IV Ruderal Herb Association.

1. Ruderal herb society. *Viola papilionacea*, *Erigeron annuus*, *Dipsacus sylvestris*, *Oxalis stricta*, *O. cymosa*, *Solanum nigrum*, *S. dulcamara*, *Equisetum arvense*, *Homalocenchrus oryzoides* a straggler from the outer zone, *Eleocharis obtusa*, *Juncus tenuis*, *Eupatorium purpureum*, *E. perfoliatum*, *Verbena hastata*, *Phleum pratense*, *Poa pratensis*, *Achillea millefolium*, *Angelica atropurpurea*, *Mentha piperita*, *M. spicata*, *Geum canadensis*, *Verbesina squarrosa*, *Teucrium canadense* and *Lysimachia nummularia* at the margin of the tree zone.

This society shows greater seasonal changes than the others. Early in the spring, *Viola papilionacea* is one of the dominant species, in the latter part of June it is difficult to determine which are the dominant species, for the larger, coarser and therefore more conspicuous plants as the Teasel, *Verbena* and *Eupatorium* are about half grown and not dominantly prominent. A month later they overshadow all the others.

V. Mesophytic-forest association: This association includes two very distinct societies. A *Salix* society which occupies the filled ground bordering the creek and at the head of the marsh and an *Ulmus-Fraxinus* society bordering the lake and of the same type as the original swamp forest.

1. *Salix* society. A zone of willows borders the banks of the creek from the *Typha* zone to and into the cultivated fields south of the lake. At the edge of the *Typha* zone it is a narrow fringe of willows on the immediate banks of the stream, toward the head of the cove it broadens into a belt 50 feet wide on either side of the stream and finally merges into the tree border of the lake. Where it broadens it is open with scattered clumps of willows, shrubs and a luxuriant ground

cover of herbs. The ground is low and muddy but not distinctly wet.

Principal species

Salix nigra *S. alba*

Secondary species

Trees:

Young *Fraxinus americana* *Ulmus americana*
Juglans nigra

Shrubs:

Rosa carolina
Cornus stolonifera *Rubus nigrobaccus*

Herbs, 7-8 feet tall:

Angelica atropurpurea

Herbs, 2-3 feet tall:

<i>Teucrium canadense</i>	<i>Asclepias syriaca</i>
<i>Carex lurida</i>	<i>Juncus tenuis</i>
<i>C. lupulina</i>	<i>Homalocenchrus oryzoides</i>
<i>C. tribuloides</i>	<i>Scirpus atrovirens</i>
<i>Agrimonia parviflora</i>	<i>Lysimachia numularia</i>
<i>Geum canadense</i>	<i>Equisetum arvense</i>
<i>Apios apios</i>	<i>Achillea millefolium</i>
<i>Roripa palustre</i>	<i>Dipsacus sylvestris</i>
<i>Impatiens biflora</i>	<i>Verbena hastata</i>
<i>Rumex crispus</i>	<i>Festuca elatior</i>
<i>Iris versicolor</i>	<i>Phleum pratense</i>

These herbs lack the correlation of distinct societies but *Mentha spicata* and *M. piperita* show well defined social unity and may be regarded as herb societies ranking as subordinate members in the forest zone.

The original margin of the lake is outlined by a zone of forest trees, 20 to 30 feet wide and which terminates abruptly

at the margin of the cultivated field on the south. This zone is represented by an

2. *Ulmus-Fraxinus* society

Principal species

Ulmus americana *Fraxinus americana*

Secondary species

Trees:

<i>Fraxinus nigra</i>	<i>H. minima</i>
<i>Gleditsia triacanthos</i>	<i>Salix nigra</i>
<i>Cornus florida</i>	<i>S. alba</i>
<i>Hicoria ovata</i>	

Shrubs: *Cornus stolonifera* is quite abundant especially on the side towards the field but hardly forms a definite shrub zone; there are also *Sambucus canadensis*, *Rubus nigrobaccus* and *R. occidentalis* with *Rhus toxicodendron* on many of the trees. Herbs much the same as in the Willow zone. *Glechoma hederacea* and *Poa pratensis* form the ground cover at the western margin.

The east bank of the creek is a duplication of the west except that there is a pure society of *Scirpus lacustris* bordering the open channel.

This section is rather unique and only partially typical of the vegetation of the coves. Compared with the marsh farther west and the marsh borders of the larger islands, it lacks that unbroken zonation and graduated layering which is usual. Beginning with the outer margin and passing through the *Typha* zone the succession is normal, layering graded from the semi-aquatics with floating leaves not raised above the water surface, to *Nymphaea* standing from one to two and one-half feet above the surface, then the *Scirpus* and *Nelumbo lutea* with plants quite uniformly three feet tall, and finally the *Typha* zone which rises five to six feet above the water level. The

Hibiscus and Shrub zones of the southwestern border and islands are wanting but in their places are the Scirpus and grass zones of lesser height, these are followed by the weed belt in which because of the lack of definite organization among the plants, well defined layering is wanting. The weed zone is very likely due to the close proximity of the cultivated fields and to the fact that these mud flats are pastured.

Honey Creek is one of the principal feeders of the lake, but the water is generally so sluggish that but little current is perceptible and the channel is so narrow that the lake receives but little water from this source.

The other important tributary to the lake is the southwest feeder near Millersport, but this is in a condition similar to that of Honey Creek. The principal source of water supply seems to be that derived directly from rainfall. Engineer Bootin complains that it is difficult to keep the water level uniform. It falls very rapidly during the summer; as much as 4-5 inches in a week, altho but little water is permitted to run out.

The long narrow southeastern lobe of the lake from the mouth of Honey Creek to Thornville Station at the southeastern extremity is rapidly being filled with vegetation and presents the aspect of a marsh with but few clear areas. Thru its center from northwest to southeast is a boat channel but 3-5 feet wide and not more than 3 feet deep. The marsh includes several small low islands, a few of the larger with trees. Thornville Station is built on a little promontory between two lobes of the marsh. The western one extends to the Zanesville and Western tracks, where it ends in a wheat field. The eastern one is shorter, extending east to the Shawnee Branch of the Zanesville and Western railroad, and south to the southern limits of the town. The vegetation of the western lobe is mostly Potamogeton sp., Ceratophyllum demersum, Batrachium tricophyllum, Lemna trisulca and Spirodela polyrhiza with Typha latifolia along the shore. The eastern lobe bears a dense mass of Nymphaea advena, with Scirpus lacustris and Potamogeton sp. The lobe is fringed by willows.

The highway passing thru the northern edge of the town crosses the marsh on an embankment with a culvert to permit the passage of the boats.

On the east and northeast in the vicinity of Avondale the shore is bordered by rock hills deeply drift covered. These hills descend abruptly to the lake and are separated by large wooded ravines, the valleys of wet weather streams.

Many of these ravines are broad, open and low at the foot



FIG. 10.—Marsh at foot of ravine near Avondale, east side of lake. Typha and Sagittaria in the foreground. Hibiscus dominant in the center, with Phragmites and Zizania in the distance.

where they join the lake. The low, open stretches contain shallow water in which a dense marsh growth has formed, as shown in (Fig. 10) where *Hibiscus moscheutos*, *Phragmites phragmites*, *Zizania aquatica* (Wild Rice) and *Typha latifolia* are the most conspicuous plants. The shore between the ravines is bordered frequently by forest trees, willows at the water's edge, where, undisturbed by the presence of docks and boat landings there has developed a luxuriant growth of fixed aquatics. These are

chiefly pure societies of *Nelumbo lutea*. Fig. 11 is a view of the shore near Avondale. The sudden transition from a broad zone of *Nelumbo lutea* to the willows, which is due to deeper water along shore is strikingly shown.

The tracks of the Baltimore and Ohio railroad parallel the shore from Thornville Station to Avondale, the roadbed lying near the base of the hills. The wagon road runs for half a mile upon the summit of this ridge of hills, the deep drift cover



FIG. 11.—View near Avondale. The sudden transition from a *Nelumbo* zone to the Willows is due to the absence of very shallow water and a mud flat at the shore line.

of which contains many granite boulders. This ridge broadening greatly toward the northeast was the watershed between the old Newark River to the north and Jonathan Creek to the east. The shallow water along the shore bears a rather irregular belt of marsh vegetation which is broadest and most luxuriant at the mouths of the ravines. From Avondale northward, groups of small, generally wooded, islands skirt the shore.

The lake extends into a long irregular arm to the north, the broad, open valley of a former stream. This northern

area is very marshy especially along the low, flat west and north shores. The southeast shore is higher, and is part of a land area rising to 920 feet and almost encircled by the marsh. The western half is wooded, the eastern is a cultivated field.

The north shore of the lake from the northern lobe to Cranberry Island is low and marshy and bordered by fields. The bank along the field just north of Cranberry Island is from 6-8 feet high with a steep gradient; at the water's edge is a scanty growth of *Nelumbo lutea* with *Castalia tuberosa* and *Ceratophyllum demersum*. On the slope is a mixed association of *Polygonum emersum*, *Scirpus fluviatilis* and *Typha latifolia* at the base and *Hibiscus* higher up. Beyond the *Hibiscus* is a mixed growth of *Lactuca canadensis*, *Erechtites hieracifolia*, *Verbena hastata*, *Echinochloa walteri*, *Azelia macrophylla*, *Impatiens biflora*, *Mentha canadensis*, *Bidens cernua* and *Solidago canadensis*. A fragmentary shrub zone is in the process of formation. It is represented by a few *Sambucus canadensis*, *Cornus stolonifera*, *Cephalanthus occidentalis* and *Rosa carolina* shrubs. Beyond the shrubs is a well-trodden path at the edge of the field. A *Fraxinus americana* and *Ulmus americana* stand at the water's edge, a *Quercus rubra* stands on the bank.

West of this field is a wood, 10-12 acres in area, of large *Fagus americana*, *Ulmus americana*, *Prunus serotina*, *Acer saccharum*, *Hicoria ovata* and *Fraxinus americana*. The center of the woodlot is about 8 feet above the lake. The shore slopes very gradually under the water. In late summer a mud flat several feet wide is exposed which is sparsely clothed with a characteristic flora of *Heteranthera dubia*, *Eleocharis acicularis*, *Bidens cernua*, *B. comosa* and *B. discoidea*.

The channel between Cranberry Island and the north shore is narrow, shallow and contains stumps and logs and several small islands. The cove to the west is almost filled with a *Lotus* bed bordered along the shore by a narrow Sedge-*Hibiscus* zone.

To the west is a rather bold promontory called the "Point." It is grass-covered except a few elms, wild cherry and willows

at the water's edge. The shore of this point is exposed to west winds and to the washing of the waves. As a result a small beach began to form around the southwest corner. The drift bank was undercut by the waves, the clay was carried away and the gravel deposited at the foot of the bank. In the winter of 1910 and '11 a cement wall was built around the point to protect it from being washed away. This cement wall extends to the bridge which spans the entrance to Crane's pond, thus protecting Crane Island, a low, wooded tongue of land, from wave erosion. Crane Island is no longer surrounded by water. It is only partially separated from the Point by a narrow, swampy cove. Crane pond now deepened and used as a bathing pool and encircled to the north and south by boat houses, is merely an arm of the lake and was until recently, a swamp in which *Typha latifolia* and *Nymphaea* were the dominant plants. To the north of the pond is a low, wet wood. A small stream formerly made its sluggish way from the wood thru the meadow into the lake. The wood and meadow are being drained and rapidly occupied by cottages. All of the shore along the "Park" is occupied by public and private docks which precludes the presence of vegetation. The Park itself, formerly a low, wet wood, has been drained, many of the trees sacrificed, and the area now contains many buildings. It is the lake terminal of the Columbus, Newark and Zanesville electric road.

At several points along the eastern and northern shores, small beaches not more than a few feet wide and from 3 to 30 feet long, are in the process of forming. These beaches front exposed points of somewhat elevated areas, with a steep gradient to the water. Due to the action of waves, wind and rain, they are becoming denuded clay banks. Where the land is pastured the trampling of the cattle going to water greatly accelerates the aggrading. In every case the soil falls into the water, the clay is carried out and the sand and gravel are deposited at the foot of the bank. The absence of a marginal zone of aquatics is characteristic of these beaches.

THE ISLANDS IN BUCKEYE LAKE.

The islands of Buckeye Lake number fully fifty and vary in size from a mass of peat a few feet square to Cranberry Island with an area of approximately 45 acres. According to the manner of formation they may be placed in five classes.

I. Cranberry Island stands in a class by itself. It is a Sphagnum peat bog, which by the character of its flora and from the study of soundings shows that it antedates the lake and perhaps the Big Swamp.

II. There are about 20 islands, all tree covered ranging from Circle Island with an area of one-fifth of an acre; (there may be smaller ones) to Lieb's Island, 33.59 of an acre in area. Many of them are used as dwelling places. These were elevations in or were beyond the original swamp, and have never been submerged. They all bear large trees which are more than eighty years old, the age of the present reservoir.

III. Islands built on a foundation of exposed peat masses. During the latter part of every summer when the water has become thoroughly warmed and when the level is always low, masses of peat rise to the surface. The warming of the gases generated in the peat cause it to rise and at low water it soon becomes exposed. The surface is speedily covered with vegetation. Some of these peat masses remain permanently exposed; then shrubs and even trees gain a foothold in a few seasons and the peat mass becomes an island. Other peat masses are from time to time added to it and drifted logs lodged against it also help to build it up. Such islands are in their youth characterized by an aggregate of small masses with open pools between.

IV. Islands which have been built up in shallow water from the bottom of the lake.

V. Islands formed from the fragments of other islands. During storm winds of fall and spring, a part of an island may be torn loose, drift with the wind until it is caught against a stump or logs or becomes anchored in shallow water. In the

northeastern and southern parts of the lake are several islands evidently formed in this way.

There is evidence here and there of a sixth kind of island. Duck hunters build screens for their boats by driving willow stakes into the bed of the lake. These stakes sprout and if left undisturbed, will develop into a clump of willows around whose bases debris will collect and give rise to a composite vegetation. There is one such clump of sprouting willows just off the shore of the point. Evidently placed there to make a harbor for the boats.

I have made a detailed study of each one of these five classes of islands and shall give them here in order.

I. Cranberry Island.

The island locally known as the Cranberry Marsh, the Marsh, Cranberry Island or Cranberry Bog, lies in the eastern part of the lake close to and parallel with the north shore. Fig. (12). It is a long, irregularly shaped island, 3,250 feet long by 750 feet wide in its broadest part, and has an approximate area of 45 acres, according to the survey made in the winter of 1910 by Professor Chamberlin of the Civil Engineering Department of the Ohio State University. This is the only careful survey ever made of the island. The outline is very irregular due to many indentations and small fringing islands. This irregularity has been caused more by submergence and death of the trees, shrubs and other marginal plants, because of the frequent abrupt and extreme changes in water level, than to the growth and expansion of the island. Within recent years the island has been decreasing in size. The storms of winter every year detach fragments often of large size and sweep them away.

This island is a Sphagnum-Cranberry bog, and is of peculiar interest because, 1, its dominant vegetation composed of boreal species, is a relict of early post-glacial times left stranded in the swamp; 2, because Cranberry bogs are characteristic of regions of higher latitudes and this one is near the southeastern margin of the drift sheet; 3, because the bog, which must be



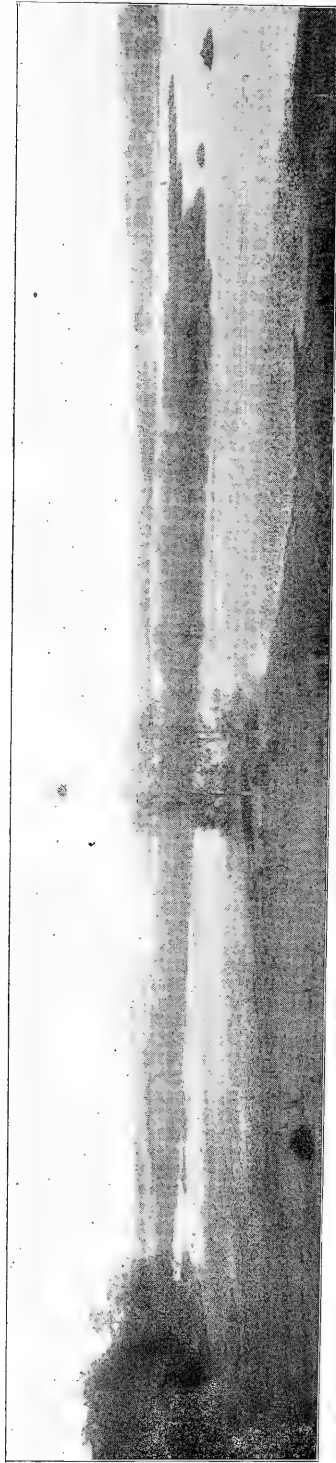


FIG. 12.—View of Cranberry Island from the west.

considered a relict of a former boreal vegetation is surrounded by a swamp of later formation and which belongs to the normal hydrophytic vegetation of the present climatic conditions;⁵⁹ and 4, because in the northern habitat, bog societies are usually related to conifer forests as a climax tree vegetation and the succession is unbroken thru the following zones: the pond or lake with 1, floating; 2, fixed aquatics; 3, the littoral marsh; 4, shore; 5, bog meadow; 6, low shrub or heath zone; 7, high shrub zone; 8, conifer forest which in some bogs is succeeded by 9, hardwood forest. In the cranberry bog the eighth or conifer zone is wanting and never seems to have been developed.

So far as I know, no conifer logs or other evidences of conifers have been found in the island, in the peat forming the bed of the lake or in the immediate vicinity of the lake, that is, within less than ten miles.

Altho the present Ohio forests are dominantly of the hardwood type, there are noteworthy remnants of former perhaps much more extensive conifer forests in the northwestern, northern and northeastern counties, especially those thru which the divide between the lake and Ohio River basins passes. Here were and still are, extensive Tamarack swamps. In the southern half of the State there are now no extensive conifer tracts, nor with one exception are the conifers dominant when associated with deciduous species but form always a scattering growth. *Pinus virginiana* occurs in the gorge of the Licking River in Licking County, on the sandstone hills in the valley of the Hocking in Fairfield and Hocking counties, and then follows the divide between the Scioto and Hocking rivers to the Ohio River; it also occurs in Scioto and Adams counties farther west. *Pinus rigida* is associated with *P. virginiana* on the sandstone hills of Fairfield and Hocking counties and occurs also in Jackson and Scioto counties. The Hemlock (*Tsuga canadensis*) has a scattering representation over the State, occurring quite as frequently in the southern as in the northern part. It is quite abundant on the hills of Fairfield and Hocking counties, where,

however, it is but a small tree. It is also found in Greene, Morgan and Scioto counties.

The Arbor vitæ (*Thuja occidentalis*) has been collected in the southern half of the State. In an interesting swamp near Springfield, Clark County, known locally as Cedar Swamp, this tree is the dominant one¹⁹. With it is associated *Betula pumila*. This is the southernmost range in the State of this northern shrub. In the gorge of the Little Miami near Yellow Springs, Greene County, the Arbor vitæ is a fine, large tree. The Red cedar (*Juniperus virginiana*) is also more abundant in the southern than in the northern half of the State. It is generally distributed thru the southwestern counties and along the Ohio River as far east as Gallia County. The Larch or Tamarack (*Larix laricina*) seems to be entirely absent from the central and southern parts of the State. While *Oxycoccus macrocarpus*, the only Ohio species of cranberry, finds in this cranberry bog its southernmost range. *Scheuchzeria palustris* is another typical bog plant which seems to be rare in Ohio. In the history of Licking County,³³ the statement is made that the large peat bogs of the county were formerly cedar swamps. "The great peat bog along the north fork feeder in the outlots of Newark, was a cedar swamp and the bogs lie beneath and upon its surface." From personal inspection of the region here mentioned, and from conversation with various residents of Newark, I have not been able to verify this statement. Cedar Hill cemetery in Newark lies on a morainal ridge on which are a large number of cedars, both *Thuja occidentalis* and *Juniperus virginiana*. The ridge was forested but the cedars were planted since the beginning of the cemetery sixty years ago. Each person buying a lot, planted cedars, the Arbor vitæ in a hedge around the lot. Later the hedges were abolished and the trees at the corners only preserved, which accounts for the present mathematical arrangement of these trees.

5. Because the bog in point of development is still in a state of fluctuation and has not reached a relative stability, a climax society. The bog forest towards which the island is



FIG. 13.—MAP
LEGEND OF PLANT

- I. Floating aquatics association.
- II. Semi and fixed aquatics association.
- III. Marsh association.
- IV. Bog-meadow.

- 1. Sphagnum-Oxycoccus society.
- 2. Sphagnum-Oxycoccus-Dulichium society.
- 3. Sphagnum-Oxycoccus-Rynchospora society.
- 4. Sphagnum-Oxycoccus-Carex filiformis society.
- 5. Sphagnum-Oxycoccus-Carex interior society.
- 6. Sphagnum-Carex limosa society.
- 7. Dryopteris thelypteris.



CRANBERRY ISLAND.

ASSOCIATIONS AND SOCIETIES.

- 8. *Sagittaria latifolia*.
- 9. *Menyanthes trifoliata*.

V. Gaylussacia-heath association.

VI. Bog-thicket association.

VII. Most mature areas of forest-shrub mixed association.

- 10. *Typha latifolia*.
- 11. Exposed peat with covering of *Bidens* sp. and other herbs.
- 12. Masses of dead timber.
- 13. Clumps of *Decodon verticillatus*.
- P. *Peltandra virginica* in bog-meadow.
- N. *Nymphaea advena* in bog-meadow.



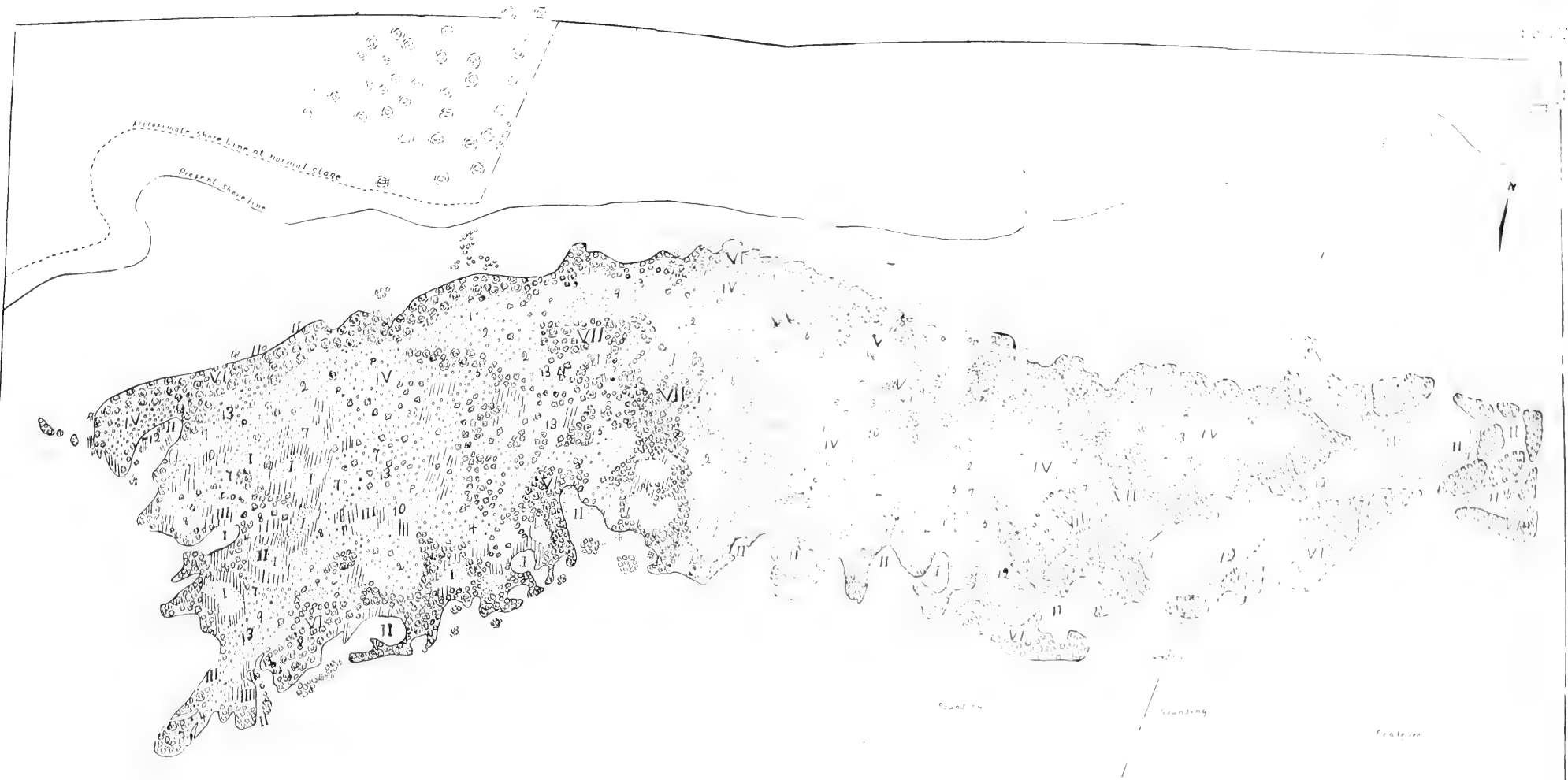


FIG. 13.—MAP OF CRANBERRY ISLAND.

LEGEND OF PLANT ASSOCIATIONS AND SOCIETIES.

- | | |
|--|--|
| I. Floating aquatics association. | 8. <i>Sagittaria latifolia</i> . |
| II. Semi and fixed aquatics association. | 9. <i>Menyanthes trifoliata</i> . |
| III. Marsh association. | V. <i>Gaylussacia</i> -heath association. |
| IV. Bog-meadow. | VI. Bog-thicket association. |
| 1. <i>Sphagnum</i> - <i>Oxycoccus</i> society. | VII. Most mature areas of forest-shrub mixed association. |
| 2. <i>Sphagnum</i> - <i>Oxycoccus</i> - <i>Dulichium</i> society. | 10. <i>Typha latifolia</i> . |
| 3. <i>Sphagnum</i> - <i>Oxycoccus</i> - <i>Rynchospora</i> society. | 11. Exposed peat with covering of <i>Bidens</i> sp. and other herbs. |
| 4. <i>Sphagnum</i> - <i>Oxycoccus</i> - <i>Carex filiformis</i> society. | 12. Masses of dead timber. |
| 5. <i>Sphagnum</i> - <i>Oxycoccus</i> - <i>Carex interior</i> society. | 13. Clumps of <i>Decodon verticillatus</i> . |
| 6. <i>Sphagnum</i> - <i>Carex limosa</i> society. | P. <i>Peltandra virginica</i> in bog-meadow. |
| 7. <i>Dryopteris thelypteris</i> . | X. <i>Nymphaea advena</i> in bog-meadow. |

tending is being invaded by oaks changing the bog to a meso-phytic forest.¹³

The general character of the vegetation of the island is that of a bog meadow surrounded by a border of trees, shrubs and taller herbs, and this by a more or less complete marginal marsh zone. (Fig. 13) The surface of the meadow is interrupted by the presence of thickets of trees and shrubs, by *Typha* clumps and by open pools. The shrub border is also much interrupted by enclosed pools, marginal lagoons and coves.

A critical study of the flora disclosed the presence of the following associations.

- I. Floating aquatics association.
 - II. Fixed aquatics with submerged leaves.
 - III. Semi-aquatic plants growing characteristically in shallow water from 5½ feet to emergence on mud flats at low water.
 - IV. Marsh association.
 - V. Bog-meadow association.
 - VI. Heath or low shrub association.
 - VII. Bog-thicket or high shrub association.
 - VIII. Bog-forest association.
- I. Free floating macroscopic plants.

Spermatophyta wholly on the surface as the Lemnaceae, floating forms as *Utricularia minor*, Pteridophyta as the Salviniaceae; Bryophyta as *Riccia* and *Ricciacarpus* together with Algae, the filamentous forms as *Cladophora* sp. and *Spirogyra* comprise the formation.

The association occupies the shallow water at the margin of the island and comprises the principal, often the entire vegetation of the pools both marginal and enclosed, whether these pools are in the shrub zone or in the bog-meadow.

These plants are associated in various societies whose differences expressed by the dominant species seem to be due to differences in the depth of the water and the light exposure.

The aquatic vegetation of rather small, more or less completely separated and isolated ponds do not form as clearly defined societies as aerial plants or aquatic plants in larger bodies of water where there are currents.⁴² They must largely depend on the accidents of dissemination. However, the intensity of the light exposure is a strongly contending factor and in some cases the depth of water and nature of substratum determines the society.

This is well shown by *Wolffiella floridana* which forms an almost pure society in one of the small pools in the margin of the open *Sphagnum* zone, and while it does not occur at all in other small pools with exactly the same factors of environment, it does grow in a large shaded marginal pool wholly separated from the small pool and quite a distance from it. The plant is an invader from the south. Up to its discovery in Buckeye Lake it was not reported farther north than southern Missouri and finding its most congenial habitat in the bayous, lakes and ponds of the Gulf states. Buckeye Lake is visited every spring by large numbers of ducks who stop here to rest and feed in their northward flight. The small fronds of *Wolffiella* must have been clinging to the feet of some of these ducks and were washed off in the small pools in which they were discovered. Later they were carried in the same way to the larger pond. However, after accidental dissemination has taken place, the plant will grow or not grow according to whether or not the habitat be a congenial one, and will form societies with others to which the same environment is congenial, that is, those to which the conditions are suited will survive and flourish and those to which conditions are unfavorable will remain of secondary importance or succumb entirely.

Association I is composed of the following societies:

1. *Lemna-Spirodela* society
2. *Utricularia minor* society
3. *Wolffiella floridana* society

4. Nostoc society
5. Riccia fluitans society
 1. Lemna-Spirodela society
 - Principal species
 - Lemna trisulca
 - L. minor
 - Spirodela polyrhiza
 - Secondary species
 - Cladophora sp.
 - Wollfia columbiana
 - W. punctata

This society covers the largest areas and occurs most frequently. The surface of the larger pools and marginal lagoons is characteristically covered wholly or in large part with a mat of Lemna trisulca, L. minor and Spirodela polyrhiza; below this surface mat is a thick substratum, an almost pure growth of Ceratophyllum demersum which is in these pools the dominant and often only species of the II association. It is almost impossible to wield the oars in the thick tangle of Ceratophyllum. Wollfia columbiana is not widely distributed but occurs in several marginal pools in the east side. The fronds are so minute that it is seen with difficulty.

2. Utricularia minor society
 - Principal species
 - Utricularia minor
 - Secondary species
 - Riccia fluitans
 - Lemna trisulca
 - L. minor
 - Spirodela polyrhiza.
 - Spirogyra sp.
 - Nostoc sp.

This society is not found in exposed situations, it occupies small, shallow pools in the open margin of the shrub zone. In several very shallow, open basins in a *Typha latifolia* tussock, excepting a scanty growth of Algae, the dominant and only clearly visible plant was *Utricularia minor*.

3. *Wolffiella floridana* society.

This plant is indigenous to sub-tropic regions and is found in swamps and pools of stagnant water often associated with *Ricciocarpus natans*. It was reported from Florida as early as 1877, later in 1896 it was found in a swamp in southeastern Missouri and up to the time (1906) of its discovery by Dr. W. A. Kellerman in the pool in Cranberry Island, the Missouri station was its farthest north. It forms an almost pure society in a small basin about 12-18 inches deep in the Bog meadow near the thicket border. Here it forms so copious a growth that the surface is filled with clusters of the small filamentous fronds. During the winter the plants sink to the bottom to rise again in the warm days of April.

4. *Nostoc* sp. society.

Several small, narrow pools, mere depressions in the *Sphagnum* cover, situated at the margin of the wooded belt and shaded by a border of *Typha latifolia* and lined with *Sphagnum* and *Oxycoccus macrocarpus* stems, contain a copious growth of *Nostoc glomeratum* and *N. pruniforme*. These pools were almost without standing water, September 23, 1910, and the *Nostoc* had collected thickly over the *Sphagnum* and the *Oxycoccus* leaves and stems on the sides and bottom of the pool. They had evidently been in this condition for several days as the exposed *Nostoc* nodules were soft and decaying; only those still submerged were firm to the touch and dark green.

5. *Riccia fluitans* society.

Many of the small, shallow depressions in the bog meadow at the edge of the thicket have during some years, as 1911, an almost pure growth of *Riccia fluitans*.

The vegetation of the pools shows a marked seasonal variation. The plants sink to the bottom during the cold season and rise to the surface and are most abundant during the warmer months of late summer and early fall. In July, 1910, a small depression, 1 by 2½ feet in diameter and 6 inches deep, on the north side of a clump of *Alnus* in the open zone contained an abundance of *Spirogyra* and scarcely anything else.

II. Fixed submerged aquatics.

This association is but poorly represented at the island's margin. Close to the shore and often among roots of trees and under dead trunks there is a sparse growth of *Ceratophyllum* with *Potamogeton pusillus* and *P. pectinatus*.

In the sheltered land-locked coves of the south and east side and in the larger pools within the bog, *Ceratophyllum demersum* forms a dense substratum. It is always underneath a cover of floating aquatics, *Lemma trisulca*, *L. minor*, *Spirodela polyrhiza*, and *Wolffia columbiana*. In some of the smaller pools in the bog meadow, *Batrachium trichophyllum* is associated with *Ceratophyllum*. In two other small, very shallow pools fully exposed to the light, *Utricularia vulgaris* is dominant.

III. Association of Semi-aquatics.

Semi-aquatics are plants rooted in the substratum and generally with leaves and flower stalks above the water. They may also have floating leaves as *Castalia* and *Nelumbo*. The latter, later in the season and especially in shallow water, lifts its leaves and blossoms several feet above the water surface. (Fig. 14) *Nymphaea*, *Peltandra* and *Pontederia* always bear their leaves well above the surface. This association grows in water 5½ feet deep in Buckeye Lake and from this depth to emergence on the shore.

There is but a scanty and fragmentary representation of this association as a marginal one in the immediate vicinity of Cranberry Island. Formerly *Castalia tuberosa* was quite abundant in the larger lagoons at the east side of the island, but for the past four or five years the water level in the lake has always been

low during the winter and the *Castalia* has almost been eradicated, possibly thru freezing, or it may be thru the tearing up of the rhizomes. Other portions of the lake, especially the southeastern lobe, still show extensive lily pads. In a protected indenta-



FIG. 14.—A habit picture of *Nelumbo lutea*.

tion of the shore of the main land northwest of the marsh, there is a large patch of an almost pure growth of *Nelumbo lutea* which extends eastward to the small group of islands fringing the north shore of the bog. At the outer margin of the *Nelumbo*

area are some *Castalia* plants. There are also some in sheltered coves on the east side of the island.

Associated with the *Castalia* and always present in appreciable numbers are several species of *Potamogeton*. In fact the semi-aquatic plants which have gained a foothold are mostly *Potamogeton lonchites*, *P. natans*, *P. pectinatus*, *P. pusillus* and *P. foliosus*, of these *P. lonchites* is the most abundant. The best development of the association is on the northwest and north sides where the water is shallow and where the irregularity of the shore line affords many sheltered coves. The association is spreading from the north shore of the lake toward the island and if not too much disturbed by the fluctuations in the water level, will no doubt soon fill this narrow and shallow water area. The south and southeast sides of the island extend abruptly into deeper water, and are also exposed to the full sweep of the wind. Here the fixed aquatic association is almost wanting along the margin. A few *Potamogeton* plants and Algae are in evidence close against the bank sheltered by the exposed Alder roots and Hibiscus stems.

There are small scattered *Peltandra virginica* societies in small, shallow depressions in the shore at the water's edge, all thru the thicket border and also in such depressions in the open bog. They are also a prominent part of the vegetation of the small islands skirting the shore of the bog. One such, north of the bog, is merely a rather dense growth of *Peltandra virginica* and *Pontederia cordata* growing on a slightly elevated mass of peat.

Nymphaea advena, another fixed aquatic tho quite abundant in other parts of the lake, is wanting near the margin of the bog; this makes the presence of the plant in a single small pool well towards the center of the bog-meadow all the more striking. (Fig. 25.)

The shallow coves on the northern, northeastern and eastern margins and all the larger lagoons on the east side have an abundance of dead timber chiefly *Rhus*, *Alnus* and *Acer* trunks.

(Fig. 15.) This indicates submergence due to settling of the peat. At low water the exposed peat bench quickly becomes covered with land plants. The extreme fluctuation in water level, 5-8 feet at times, 6.85 feet below the normal water level during the winter of 1909, has destroyed or at least greatly disturbed the fixed aquatics.



FIG. 15.—Masses of dead *Rhus*, *Acer* and *Alnus* at low water in a large lagoon on the east side of Cranberry Island.

III. Vegetation of the shore.

A typical reed association, frequently the bordering zone of bogs, marshes and swamps, and well developed in other portions of the lake, is here but imperfectly formed. *Typha latifolia* is present in considerable numbers. The relative position of these species in the association, especially with reference to the depth of water, is also subject to variation; so it seems to me, that here, rather than a zonation of swamp societies is an



FIG. 16.—Cove southeast side of Cranberry Island. *Typha latifolia* is dominant at the head of the cove with *Decodon verticillatus* at either side on the more exposed outer margins.

alternation or even mixture of several societies of the shore and semi-aquatic associations. Sometimes *Peltandra virginica* grows in the water at the outer border and again it occupies the center or even the inner margin of the zone. Thus it is with the other species present.

In the more sheltered waters along the north shore, and everywhere at the head of small coves, *Typha* holds a conspicuous place at the water's edge, while the more exposed apices of points of land extending into the water are covered by clumps of *Decodon verticillatus*, whose long, pendulous branches extend in all directions. (Fig. 16.) When they touch the water or mud, the nodes at the point of contact develop roots and anchor the shoot; the free tip elongates and the result is a *Decodon* shrub established sometimes 3-4 feet distant from the parent plant. *Decodon* is best adapted to reaching out and extending the margin of vegetation several feet in advance. The large, thick root stalks and fibrous roots of *Typha* serve well to gain a foothold and thus prevent the soil from washing away and by the accumulation of the large stalks and leaves build up the surface level.

Often the marsh zone is invaded and crossed by the thicket. Then *Rhus* and *Alnus* shrubs or even maple trees grow at the extreme edge of the island, their roots exposed or under water.

At other points the marsh extends thru the thicket; or if the latter be wanting, into the bog-meadow in tongues or isolated patches. The larger pools in the bog are bordered by a fringe of *Typha latifolia*, *Decodon verticillatus* and *Hibiscus moscheutos*. (Fig. 17.) Sometimes small depressions hold one or a few *Peltandra virginica* or *Nymphaea advena* plants. *Sagittaria latifolia* is becoming very abundant in the southwestern portion of the bog-meadow.

The characteristic species of the marsh zone are *Typha latifolia*, *Decodon verticillatus*, *Peltandra virginica*, *Hibiscus moscheutos*, *Dianthera americana* and *Rosa carolina*. In early summer the clumps of *Rosa* make a rose garden of the swamp;

later this is changed to a rose mallow garden by the large rose-colored bells of *Hibiscus moscheutos*.

Associated with these dominant species is a large number of plants, additions to which are made from year to year by the successful ecesis of invaders from nearby regions. The secondary species of the marsh zone are in large part also the associated species of at least the outer portion of the thicket association, due to the invasion of the marsh by the shrub zone. Altho in general the water level is not as high as in the marsh, the surface is broken by innumerable small pools and depressions between the clumps of ferns and roots of shrubs, and there the marsh plants find sufficient water.

The most marked difference between the two associations is in the light exposure. In the deeper shade of the thicket many of the marsh plants as *Impatiens biflora* and *Triadenum virginicum*, tho numerous, are small and weak and do not blossom.

The secondary species of the marsh association given in general in the order of their abundance are as follows:

Impatiens biflora is generally distributed thruout the formation. When growing in full light exposure at or very near the water's edge, it is tall and vigorous and generally covered with *Cuscuta gronovii* which also grows luxuriantly on *Decodon*. *Solanum dulcamara* grows in detached masses over shrubs and herbs or roots at the outer margin of the zone, the long branches hanging down to the water. It is a very conspicuous plant in the late summer and autumn with its numerous clusters of bright-red berries.

Three species of *Bidens*, *Bidens cernua*, *B. discoidea* and *B. frondosa* grow at low water on the shelf of exposed peat. *Bidens cernua* and *B. discoidea* grow even in shallow water. In a remarkably short time after masses of peat have risen above the surface, they are taken possession of by one or several of these species of *Bidens* and the unsightly peat mass shortly becomes a varitable carpet. *Echinochloa walteri* is frequently associated with the *Bidens*. They take possession of every rotting stump and log as soon as it comes above the surface.



FIG. 17.—Pool south side of Cranberry Island, with a dense border of *Typha latifolia*, *Decodon*, *Dryopteris*, *Peltandra virginica* and other marsh herbs. The surface of the water is covered with *Lemna trisulca* and *Spirodela* over a dense mat of *Ceratophyllum demersum*.

Bidens trichosperma shows its brilliant yellow flowers at the margin of several of the smaller islands and with *B. comosa* is quite abundant on the long south lobe of the island. *Roripa palustris* is another plant which grows on exposed points or old root masses in the shallow water. *Roripa americana* and *Cardamine bulbosa* are frequent in the wetter portions of the more shaded border. *Galium trifidum*, *G. asprellum*, *Scutellaria lateriflora* and *Campanula aparinoides* are closely associated, especially on the long southern lobe. The tall paniced inflorescence and large leaves of *Rumex brittanica* are conspicuous features of the border where the water level is high.

Another plant growing in the water or at the margin of the island among *Hibiscus* and *Typha* is *Polygonum emersum*, an extremely abundant amphibian in the lake. *Eleocharis acicularis* forms a thick mat over small areas of exposed peat, on old root masses and often on the mud at the entrance to paths.

The following species are present in small numbers in often but one locality or they may be found scattered sparingly thru the swamp zone, sometimes they are even fairly abundant but not strikingly so. *Sagittaria latifolia*, *Rumex verticillatus*, *Boehmeria cylindrica*, *Polygonum acre*, *P. cicutaeifolium*, *Gerardia paupercula*, *Comarum palustre*, *Viola blanda*, *Carex decomposita*, *C. pseudo-cyperus*, *C. comosa*, *C. stipata*, *C. alata*, *C. vulpinoidea*, *Scirpus fluviatilis*, *Cyperus erythrorhizos*, *C. strigosus*, *Echinochloa walteri*, *Homalocenchrus oryzoides*, *Muhlenbergia racemosa*, *Calamagrostis canadensis*, *Panicularia nervata*, *Eragrostis hypnoides*.

Typha angustifolia which normally grows in deeper water than at the very margin of the peat shelf, occurs in two situations at the margin of small islands forming the eastern portion of the bog.

Scirpus lacustris is wanting at the margin but there is a thin growth in small, shallow depressions in the bog-meadow.

Of the seventeen species of grasses and sedges which occur in the marsh zone, none are present in sufficient abundance to lend character to the zone. The majority are found as isolated

plants or caespitose in only one or two situations and then generally at the extreme margin of the island or bordering a pool. *Carex decomposita* is new to the state list. It occurs here in two places, both on the east side of the island. The one is at the extreme water's edge at the base of a dead alder on a small island bordering the larger one, and the second is at the edge of a lagoon surrounded by the bog-forest.

During the fall of 1909 the long southern lobe of the island was cleared of trees and shrubs. During the following spring and summer the area was covered with an exceedingly dense growth of *Alnus*, *Rhus*, *Salix* and *Acer* shoots from the old stumps together with a very large number of herbs, which with the stronger light exposure had a much better chance to grow. A large number of sedges and grasses grow in this cleared area, and since it is open to invasion, certain plants were found growing here that could not be discovered anywhere else on the island. *Dianthera americana* grows in such masses on the western border of the lobe as to dominate the zone over a small area. Last August two plants of *Onagra biennis* were found among the branches of a fallen maple. This lobe was formerly wooded to the water's edge at the south end with but a narrow swamp border on the west and east sides. The water is quite deep just to the south, and if the maps of the survey of 1801 and 1799 are correct, the bog was nearest the margin of the old lake at this point. Aquatic plants are almost wanting.

V. Bog-meadow association.

The greater portion of the island is a *Sphagnum Oxycoccus* bog, of which everywhere the dominant plants are several species of *Sphagnum* and *Oxycoccus macrocarpus*. (Fig. 18.) These two are nearly always associated with other plants in such numbers as to form characteristic societies with them.

The bog-meadow corresponds to the High moor or Heide-moore of Europe as described by Warming,⁶³ Schimper,⁵² Gräbner,³² and Früh and Schröter.²⁸ It is a formation according to these authors, characteristic of high temperate latitudes where the low temperature, abundant moisture with the exclusion

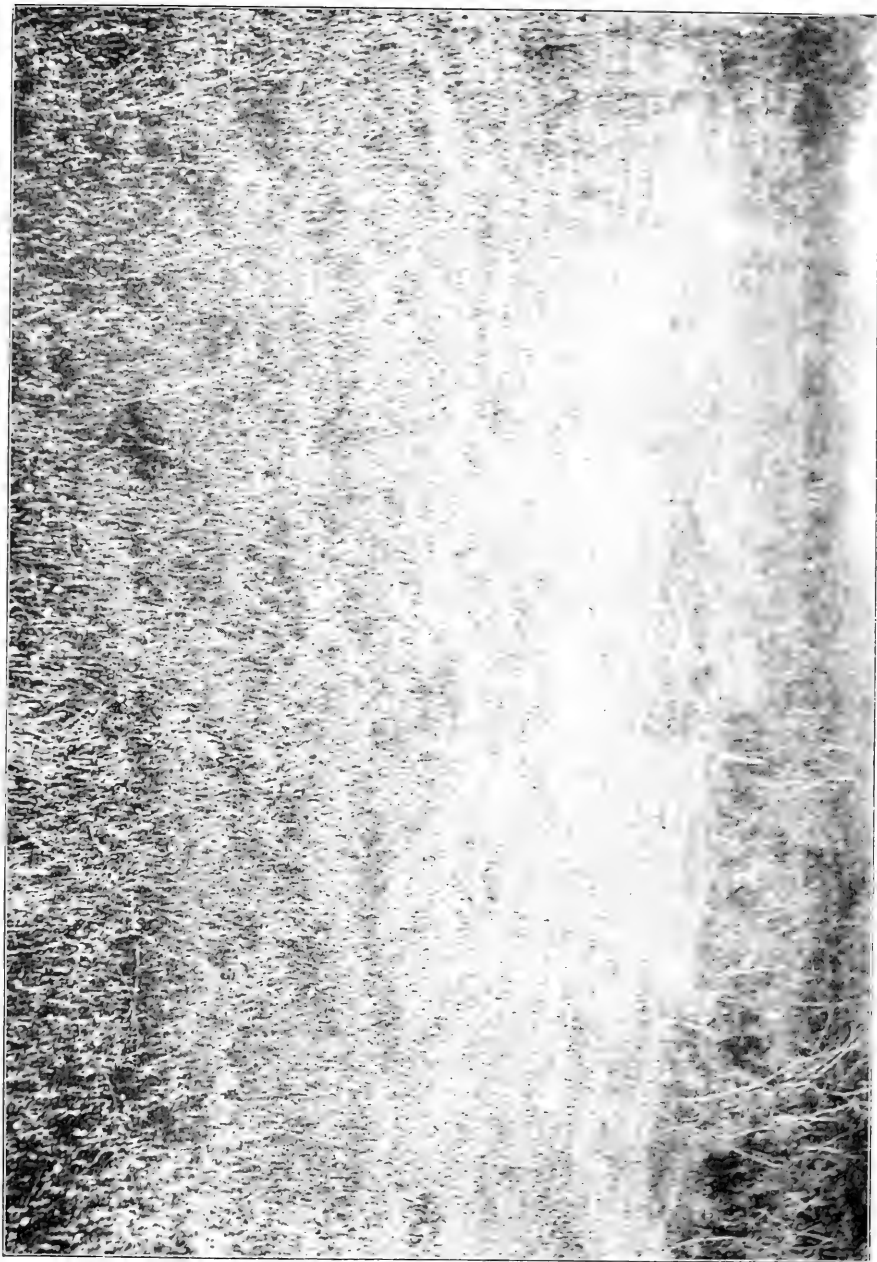


FIG. 18.—A characteristic view of the bog-meadow, Cranberry Island. The cranberries are fruiting freely. In the distance are shrub invaders chiefly *Rhus vernix* and finally the shrub border.

of oxygen, and the acidity of the bog substratum permit a large accumulation of peat. The water of the Heidemoore is characteristically poor in mineral salts especially lime, and rich in organic matter to which the dark color and the accumulation of gases as methane and hydrogen sulphide is due.

It is said to be a formation poor also in available nitrogen compounds, for the nitrogen tho present in abundance in the organic matter, is in the form of insoluble proteins "Humificirte Eiweisskoerper"; and unless decomposed by mycorhiza and bacteria cannot be used by the higher plants. Neither the low soil temperature of high latitudes, the acidity of the bog water, the low per cent nor the character of the inorganic salts present, play, however, as important a role in determining the character of a bog flora as has been until recently claimed.¹⁷

In the Cranberry bog the temperature of the peat substratum during the spring and summer is not lower than that of other soils, and is more uniform than that of the air. The living portions of stems and roots extend but a few inches below the surface of the soil which is saturated with or covered with water and consequently has a less variable temperature than that of the overlying air. And altho Sphagnum bogs find their optimum development in high temperate latitudes, being rare in arctic regions and rare as far south as 40° north latitude they are not unknown in lower temperate latitudes and even in the subtropics. Harper³⁶ reports Sphagnum bogs in Florida; and in discussing the formation of peat in Florida swamps and bogs, says: "High temperature alone would hardly prevent the formation of peat where the humidity and topography were favorable. The scarcity of peat in the humid tropics where vegetation is so luxuriant can probably be explained on topographic grounds."

The notion prevalent until two or three years ago that the formation of peat is inhibited in the humid tropics by the high temperature is due to the lack of discovering peat in the tropics and not to its absence. Potonie⁴⁸ reports the discovery of typical

peat in a bog forest in the island of Nusa Kambangan in the province of Banjumas, Java.

The statement is frequently and positively made that Sphagnum will not grow in the presence of lime (calcium carbonate) and that the presence of Sphagnum is an indication of a low per cent or the absence of lime. Sendtner states positively that when Sphagnum is brot in contact with water containing lime it dies. Gärbner³⁹ finds the contrary. He watered Sphagnum cultures with lime-water and when the experiment was continued under normal conditions, the plants did not die; but on the contrary grew well. They even after a winter's duration grew well in the following spring. Weber grew various species of Sphagnum in pure lime. These experiments demonstrate that altho Sphagnum normally grows in lime-free soil or with but a low per cent of lime, the presence of lime is not fatal. In the upper peninsula of Michigan about 6 miles west of St. Ignace is a Sphagnum bog in which Chara, an alga which frequents water containing lime, and Sphagnum grow side by side. Calluna vulgaris, an Ericad characteristic of High moor formations in Europe, grows in lime-free soil but also occurs in lime soil in great enough abundance not to be accidental.³⁹

That a bog is an ecological vegetation unit under conditions of physiological drouth to which is due the xerophilous character of the flora, is now generally accepted; but not until recently has it been discovered and demonstrated that the unavailability of the water is due to the decomposition products of microorganisms in the soil.¹⁷ These products are toxic to the plants, check root absorption and are instrumental in the development of structures characteristic of xerophilous plants.

Sphagnum is the dominant plant in the bog-meadow; and in this locality the recognized peat builder of the present upper stratum. Its habit of growth and structure adapt it well to the continued development of the shoots above the accumulation of dead Sphagnum. According to Reichart a Sphagnum frond continuing to grow at the apex while it is dying beneath may attain

to the age of our oldest trees. No roots nor internal conducting systems develop but the elongated hyaline cortical cells of the stem and branches, and the hyaline cells of the stem and branch leaves offer a system of capillaries thru which water is readily conducted. At every fourth stem-leaf a fascicle of branches from 2-3 inches long, tapering and very slender hang down, close appressed to the stem, around which they form an absorbing and water-conducting mantle. The leaves of both stem and branches are but one layer of cells in thickness. They are convex, imbricated and closely invest the axis, forming thus narrow spaces thru which water passes by capillarity. The hyaline cells of stem and leaves act as water reservoirs; they are large, elongated cells whose walls are strengthened by spiral thickenings. The close massing of the fronds contributes largely to the sponginess of the Sphagnum turf.

The capacity of Sphagnum for absorbing water is enormous. Lesquereux found that air-dry Sphagnum in contact with water absorbed seventeen times its own weight. Duegeli obtained results of 18.5 to 22.96 times the weight of Sphagnum. Because the external cells so readily absorb and conduct water, the plant is independent of a water supply from the soil and the shoots continue to live and grow. The result is a characteristic elevation of the surface of the bog from the margin to the center, giving rise to the term High moor of the German writers. Schimper⁵² states that the center may lie four meters higher than the border. Ganong^{29 30} made a similar observation on peat bogs in New Brunswick which were from 14-15 feet higher in the center than at the margin and still rising.

In Cranberry Island the meadow is so interrupted by masses of shrubs that this uniform elevation does not occur; but it is noticeable in smaller areas. The Sphagnum has built up hummocks or little mounds from 3 to 6 or 7 decimeters (12-24 or 32 inches) high around the base of isolated shrubs, clumps of ferns, the border of a thicket and the margin of small pools, and in some areas as in the northeastern portion of the meadow, these hummocks are very frequent where there are no shrubs.

The Societies of the Meadow.

Certain small areas contain an almost pure *Sphagnum-Oxycoccus* society (indicated on Fig. 13 by 1) and forming a banked up narrow border surrounding the large masses of thicket. All other areas are dominated by one or two other plants, in most cases a sedge, taller and more conspicuous than the cranberry or sphagnum. These societies altho quite clearly differentiated the one from the other, at their centers where the dominance prevails, blend at their margins so that the secondary species of all the Sedge-Oxycoccus-Sphagnum societies are the same and will be listed together. The societies are:

1. *Oxycoccus-Sphagnum*:—A pure society of the two dominant species, *Oxycoccus macrocarpus* and *Sphagnum cymbifolium* is rather rare, and covers but a small area of the entire bog-meadow. In the broad, open stretch of meadow towards the northern border there are areas from ten to fifteen feet square which have but a scanty intermixture of other plants. The water level is not high and the *Oxycoccus* is at its optimum. The plants are not unusually large but they flower and fruit freely. The borders of thickets have an almost pure growth of this society, showing the characteristic banking. In the shade of the shrubs the *Oxycoccus* quite hides the *Sphagnum* thru its luxuriant growth but it is uniformly sterile. Towards the western end of this open meadow, *Sphagnum cymbifolium* is being largely replaced by the small, closely set, reddish fronds of *Sphagnum acutifolium versicolor*. The plant is conspicuous in the late summer and fall when the fronds are most highly colored.

The *Oxycoccus-Sphagnum* society is most strikingly a seasonal one. During the spring months of April, May and early June, the sedges have not attained their full development and are consequently not as prominent as later. This is well illustrated by *Eriophorum virginicum*. The *Eriophorum* is very conspicuous in the late summer and fall.

2. *Oxycoccus-Sphagnum-Dulichium arundinaceum* society: (Fig. 19). *Dulichium arundinaceum* is an extremely widely disseminated sedge, it is not only very abundant in the meadow but also frequent in the thicket and bog-forest. It is clearly a dominant species over noticeable areas of the meadow. The pro-



FIG. 19.—*Oxycoccus-Sphagnum-Dulichium arundinaceum* society. In the distance to the right *Eryophorum virginicum*, in the center and to the left *Osmunda cinnamomea* with the strict habit typical of this plant in the open bog.

minently three-angled stem thickly set with divergent leaves are characters which clearly distinguish it from the other sedges.

3. *Oxycoccus-Sphagnum-Rynchospora alba* society:—*Rynchospora alba* favors parts of the meadow with high water level. It is frequent in the wet paths and other shallow depressions of the meadow.

4. *Oxycoccus-Sphagnum-Carex filiformis* society:—To-

wards the east side of the meadow adjacent to the thicket association in hummocky Sphagnum is quite an area of *Carex filiformis* associated with *Oxycoccus macrocarpus* and *Sphagnum cymbifolium*. Its characteristic tall slender culms and filiform involute leaves are in sharp contrast to the sedges of adjacent societies. There is a similar area on the southwest portion of the island.

5. *Oxycoccus-Sphagnum-Carex interior* society:—*Carex interior*, a slender narrow-leaved low plant with strongly marked caespitose habit, is the dominant sedge in areas near the shrub border.

6. *Sphagnum-Carex limosa* society:—In a small shallow pool not more than 40 square feet in area, on the north side of the meadow is an almost pure growth of *Carex limosa*. The bottom and sides of the pool are lined with *Sphagnum acutifolium*. *Carex limosa* has here the prostrate creeping rooting-at-the-nodes habit of *C. chordorrhiza*. *Carex limosa* occurs in abundance in also another portion of the meadow under quite different conditions. The Sphagnum is very hummocky, there are numerous shrubs, other sedges as *Dulichium*, *Rynchospora* and *Eryophorum*, also *Menyanthes trifoliata* and *Pogonia ophioglossoides*. The *Carex* flowers and early matures its seeds; the brown pendulous spikes are quite unlike those of any other sedges associated with it. Later, after the seeds have fallen, the spikes disappear and then the presence of *Carex limosa* can scarcely be detected among the other plants.

Eryophorum virginicum (cotton grass) tall and particularly striking in late summer when the inflorescence is a white plumose mass, is also very abundant especially in the *Dulichium* and *Rynchospora* societies.

In the southwestern portion of the island, where marginal coves are large, inland pools numerous, and the water level is generally high, *Dryopteris thelypteris* associated with *Oxycoccus* and *Sphagnum cymbifolium* and *S. acutifolium* covers quite a large area of the open bog.

In the same portion of the island, but closer to the pools, *Sagittaria latifolia* has become very abundant.

Secondary species occurring in the above six societies of the bog-meadow are:

<i>Aster paniculatus</i>	<i>Triadenum virginicum</i>
<i>Dryopteris thelypteris</i>	<i>Dulichium arundinaceum</i>
<i>crisata</i>	<i>Rynchospora alba</i>
<i>Osmunda cinnamomea</i>	<i>Eryophorum virginicum</i>
<i>regalis</i>	<i>Drosera rotundifolia</i>
<i>Sagittaria latifolia</i>	<i>Menyanthes trifoliata</i>
<i>Eleocharis obtusa</i>	<i>Scheuchzeria palustris</i>
<i>Scirpus cyperinus</i>	<i>Carex interior</i>
<i>Peltandra virginica</i>	<i>filiformis</i>
<i>Juncus brachycephalus</i>	<i>limosa</i>
<i>effusus</i>	<i>leptalea</i>
<i>canadensis</i>	<i>stricta</i>
<i>Cephalanthus occidentalis</i>	<i>Pogonia ophioglossoides</i>
<i>Viola blanda</i>	<i>Calopogon pulchellus</i>
<i>Habenaria leucophaea</i>	<i>Arethusa bulbosa</i>
Seedling <i>Rhus vernix</i>	<i>Decodon verticillatus</i>
Seedling <i>Acer rubrum</i>	<i>Scutellaria lateriflora</i>
Seedling <i>Alnus rugosa</i>	<i>Solidago uliginosa</i>

Many of these are of general distribution, others are more local, some are more characteristic of the thicket border and have strayed out into the meadow; they are found, therefore, near the edge of the thicket. *Drosera rotundifolia* is a typical bog plant and is quite generally distributed but it is most abundant towards the southern end of the meadow. *Menyanthes trifoliata* and *Scheuchzeria palustris* also are of general distribution and grow best where water covers the surface. They are most often found, therefore, in shallow depressions, in pools and where the trampled paths are under water. The three orchids, *Pogonia ophioglossoides*, *Limodorum pulchellus* and *Arethusa bulbosa* when in blossom, are the most attractive plants in the meadow. All three are more common near the shrubs in the margin of the meadow close to the thicket border. One specimen of *Habenaria leuco-*

phaea was found in the summer of 1910 in the extreme southwestern portion of the meadow close to the shrubs.

In the southwestern part of the meadow are numerous shrubs scattered singly or in groups; among these *Dryopteris thelypteris* is very abundant. It is an invader from the shrub zone. It occurs in other portions also where there has been a general invasion from the shrub zone. *Osmunda cinnamomea* and

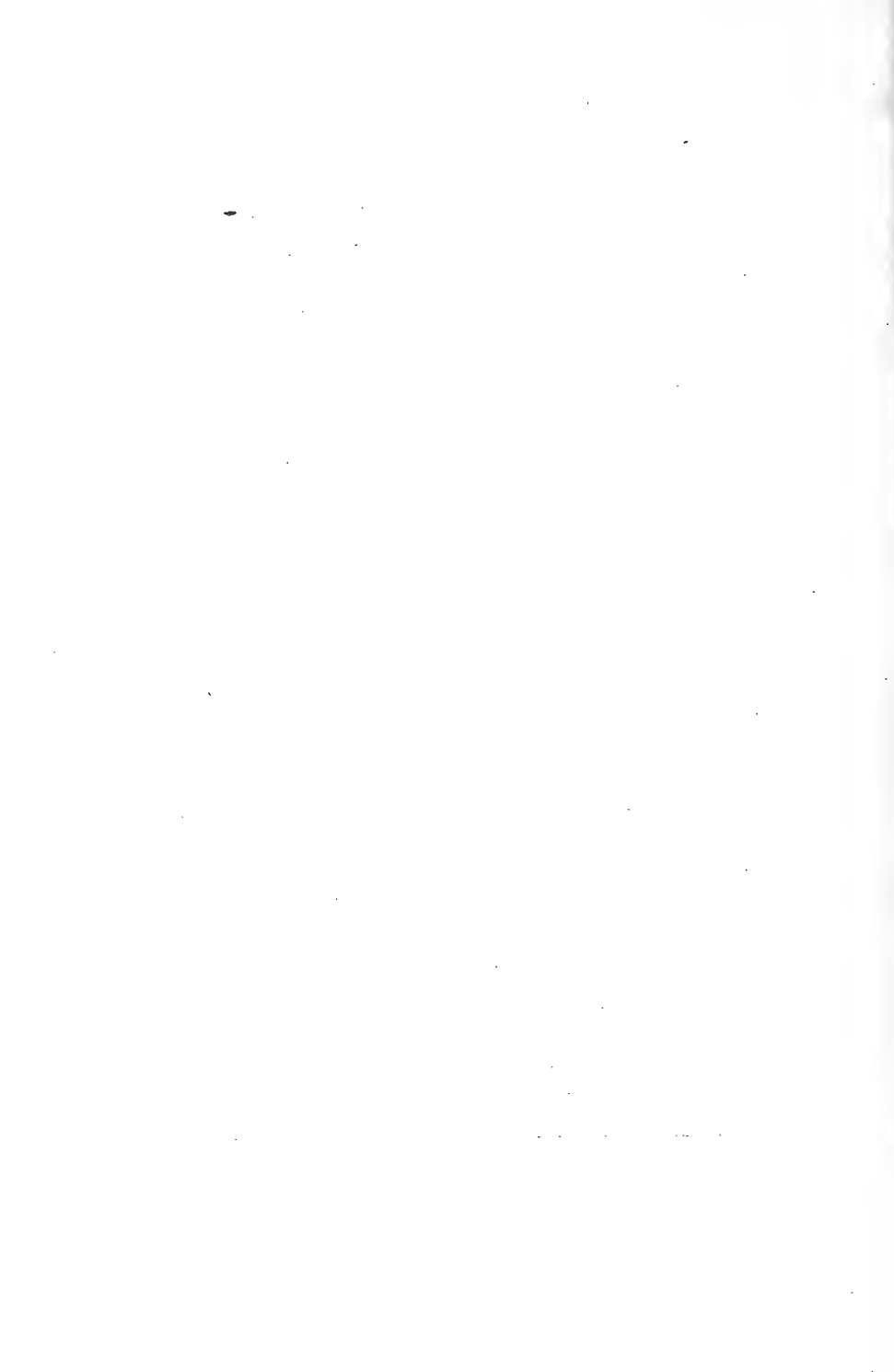


FIG. 20.—*Osmunda cinnamomea* in the open bog-meadow. The strict habit and stunted leaves are typical.

O. regalis are also invaders from the shrub zone. Of the two the former is the more abundant and more generally distributed. The greater number of the *Rhus* and *Alnus* shrubs in the meadow are surrounded at the base by this fern. The presence of these three ferns in the open bog is clearly a case of endurance and not of congenial habitat and is a striking illustration of the difference in the intensity of illumination and the greater satura-



FIG. 21.—*Osmunda cinnamomea* in the margin of the shrub zone. The large spreading fronds are in strong contrast to the strict habit shown in Fig. 20.



tion deficiency of the air of the open bog as compared with the thicket. Out in the open the fronds are small and stunted and held rigidly erect with pinnules folded and pinnae pressed against the rachis. (Fig. 20). In the margins of the shrub zone, the tall spreading fronds attain their maximum growth with pinnae and pinnules expanded to their fullest extent. (Fig. 21). All the plants of the bog-meadow show adaptation or adjustment to the more xerophytic habitat; but the ferns offer the most striking example. *Peltandra virginica*, a marsh plant, occupies small pools in the central bog. These pools at normal water level are nearly full of water, the walls are closely covered with *Sphagnum* which grows down to or even below the water. On such moist banks as these *Viola blanda* is enabled to invade the bog. In the fall when the water is low, the pools are almost free from standing water and contain the dead decaying *Peltandra* leaves and the large fruit clusters. In one such depression on the west side of the meadow are thrifty *Nymphaea advena* plants. (Fig. 25).

V. The *Gaylussacia* heath or low shrub association.

The heath association is of the low shrub character of vegetation. In a typical bog the characteristic plants of this association are low shrubs of the *Ericaceae* and *Vacciniaceae* families as *Gaylussacia resinosa*, *Andromeda polifolia*, *Chamaedaphne calyculata*, *Ledum groenlandicum* and *Potentilla fruticosa*, of the *Rosaceae* associated with *Sphagnum* sp. and often with *Rubus hispidus* as a ground cover. These form a dense, compact, almost impassable stratum. This association is almost wanting in Cranberry Island. There are a few small clumps of *Gaylussacia resinosa*, which are with two exceptions just at the inner margin of the shrub zone or entirely within this zone. (Fig. 22.) The two exceptions are two small groups of *Gaylussacia* in the open meadow (Fig. 13 V). The shrubs are stunted and did not blossom in 1910. They have blossomed freely during the spring of 1911. The heath is spreading quite rapidly but is still mostly confined to the shrub zone. The association is composed of but one society, the *Gaylussacia* society, in which are no other species of the heath association; but *Sphagnum cymbifolium*, *S. acuti-*

folium var. versicolor, and *Oxycoccus macrocarpus*, species of the bog-meadow and *Alnus rugosa* and *Aronia arbutifolia* of the bog-thicket occur.

VI. Bog-thicket association.

The bog-thicket zone is the most conspicuous feature of the island. The bog-meadow is surrounded on all sides by the thicket



FIG. 22.—*Gaylussacia resinosa* society at margin of and extending into the thicket. The belt transect Fig. 26 was taken through this society.

and trees. From all approaches the island presents the appearance of being densely wooded. It is the most gregarious and complex association, being composed of characteristic bog plants as *Rhus vernix*, *Aronia*, *Ilex*, bog ferns and mosses, together with a large addition of swamp species as *Rosa carolina*, *Peltandra virginica*, *Triadenum virginicum*, *Impatiens biflora* and others; besides these, *Alnus rugosa* is very abundant. There are

many invaders from without, some of these remain and so from year to year the association receives additions to its flora. This is partially due to the position being a marginal one. In this it resembles the marsh but the greater shade afforded seedlings by the shrubs seems to protect them from excessive transpiration. Winds carry seeds from surrounding areas, the marginal thicket serves as a wind break and many of the seeds do not reach the central zone. Other seeds are transported by water currents and become lodged on the peat shelf among the exposed roots at the margin or may be washed farther in. The trees and shrubs offer a resting place for the birds; and the fruits and seeds they carry are dropped among them. The seedlings of *Quercus palustris*, *Q. imbricaria* and *Fagus americana* can only be accounted for in this way.

The position of the thicket is unique in that it lies between the marsh and meadow. In many bogs the meadow is wanting; where it is present, it is generally a sedge-grass meadow and intervenes between the shore vegetation and shrub zone. The normal order of succession seems to be:

1. Floating aquatics.
2. Fixed aquatics, submerged or with floating leaves.
3. Marsh.
4. Meadow.
5. Low shrub or heath.
6. Thicket.
7. Forest.

This succession has not developed uniformly on Cranberry bog, for the thicket has invaded the marsh zone on the one side and the bog-meadow on the other; so that not only is the inner margin of the thicket quite irregular, but detached individuals and masses of shrubs have pushed into the meadow and are scattered all thru it. (Fig. 23.)

It is also difficult to draw a line of demarcation between the bog-thicket composed of shrubs and the bog-forest or even to distinguish a transition zone between them.

The dominant tree and the only one present in appreciable numbers and of mature age and size is *Acer rubrum*. Wherever the shrub zone is well developed this tree is also present. It has likewise invaded the meadow. All thru the latter, stunted straggling maples appear.

The bog-forest is just becoming established. In certain por-



FIG. 23.—View of bog-meadow, Cranberry Island, with shrubs scattered singly and in masses. *Decodon verticillatus* is here the most conspicuous but there are many half dead *Rhus* and *Alnus* and one *Acer* to the left.

tions of the wooded belt, *Acer rubrum* is present in such numbers and has attained such a size that it dominates the vegetation. Almost in the center of the island is one such area, another is in the wooded belt skirting the north shore, another and this is the most pronounced forest, is on the northeastern border of the island (Fig. 13 VII). Besides *Acer rubrum* a few other forest

trees are becoming established. In the wood on the northeast is a young *Quercus palustris* about 25 feet tall. There are also a number of *Q. palustris* seedlings, and two, two-year old *Q. imbricaria*. Close to the water's edge is a young *Prunus serotina*. *Quercus palustris* seedlings were also found in the other forest areas. Associated with *Acer rubrum* and equally characteristic are *Alnus rugosa* and *Rhus vernix*. Both of these are small trees rather than shrubs where the environment is most favorable.

From readings taken from stumps, it is estimated that the largest maples are about 35 years old, they are about 50 feet tall and from 15 to 18 inches in diameter.

As the entire wooded zone is a blending of the two associations, forest and thicket, I shall treat of them as one. The dominant species of the entire wooded belt are *Acer rubrum*, *Alnus rugosa* and *Rhus vernix*. Other tall shrubs and small trees form with them a dense growth. *Aronia arbutifolia* and *A. nigra* are everywhere present. *Ilex verticillatus* is frequent at the more open margins. On the north, east and south sides, *Cornus stolonifera* forms conspicuous clumps at the water's edge. Also near the water but sometimes in the open bog is an occasional *Cephalanthus occidentalis*; *Sambucus canadensis* is not infrequent in the more open or central portion of the bog-forest. Scattered all thru the thicket border are the strong thorny canes of *Rubus nigrobaccus*. *Rosa carolina* and *Decodon verticillatus*, members of the marsh zone, occur also in the western portion of the shrub thicket. *Salix discolor*, the most abundant willow in the bog, occurs at the margin associated quite frequently with *S. petiolaris*. A low shrub layer is wanting but at a height of from 2.5-3 feet, the tall broad fronds of *Osmunda cinnamomea* form a dense stratum. In the more open regions of the shrub and forest zone these ferns have found optimum conditions for growth. The large branching rhizomes and strong leaf bases form hummocks which with the exposed roots of trees and shrubs form in many places the only dry spots in the zone. Where *Osmunda* is abundant the shade of the fronds permits

no growth of vegetation underneath. The ferns form a green border just within the outer edge of nearly the entire wooded zone.

Other areas, generally where the taller trees are most numerous, bear a field or low herb stratum of sedges such as *Carex interior*, *C. retroflexa*, *Eleocharis palustris*, *Dulichium arundinaceum* and other low herbs such as *Triadenum virginicum*, which in the shade is low and sterile, *Boehmeria cylindrica*, *Adicia pumila*, *Impatiens biflora*, *Cardamine bulbosa*, *Roripa americana*, *Comarum palustre*, *Dryopteris thelypteris*, *D. cristata*, *Habenaria lacera* and *H. clavellata*.

Sphagnum sp. forms a ground layer which extends often to the marsh zone. In this are many *Rhus*, *Acer* and *Aronia* seedlings. Immediately beneath the larger shrubs and trees the ground often seems bare but scrutiny reveals a dense closely packed mat of a pure growth of *Cephalozia* and *Pallavicinia lyellii* or of *Pallavicinia* alone. These small Hepaticae lie so firmly pressed against the ground and are often so dark in color that they have not the appearance of living plants. Scattered singly, in twos or in threes everywhere thruout the central portion of the zone is a small slender herb with pale green thread-like, angled, erect and rigid stems, 3-5 inches tall, with small scale-like leaves and slender spikes of small flowers, a most insignificant little plant, one of the *Gentianaceae* family, *Bartonia virginica*, which next to the dominant shrubs and trees, is the most characteristic and abundant plant in the association.

There are several large pools in the wooded zone; these are surrounded by marsh plants and bear the same pond vegetation already discussed.

Between the exposed roots of trees and shrubs and between clumps of ferns are small depressions filled with water. Bryophyta as *Sphagnum* sp. *Polytrichum commune* or *P. ohioense*, the water moss *Brachythecium plumosum* and *Pallavicinia lyellii* line the sides and bottom of these pools. *Spirogyra* and other algae float on the water or cover submerged leaves and stems. *Viola blanda* and *Cardamine bulbosa* grow in the water or on the mar-

gin. Some times such a pool is almost filled with long rhizomes of *Rumex verticillatus* or with *Menyanthes trifoliata*.

The following is a complete list of the plants of the bog-thicket and forest:

Dominant species.

<i>Acer rubrum</i>	<i>Rhus vernix</i>
<i>Alnus rugosa</i>	

Secondary species:

Shrubs and small trees.

<i>Aronia arbutifolia</i>	<i>Cephalanthus occiden-</i>
<i>atropurpurea</i>	<i>talis</i>
<i>nigra</i>	<i>Sambucus canadensis</i>
<i>Ilex verticillatus</i>	<i>Rubus nigrobaccus</i>
<i>Cornus stolonifera</i>	<i>Decodon verticillatus</i>
<i>Salix discolor</i>	<i>Oxycoccus macro-</i>
<i>petiolaris</i>	<i>carpus</i>
<i>sericea</i>	

Herbs:

<i>Osmunda cinnamomea</i>	<i>Bidens trichosperma</i>
<i>regalis</i>	<i>comosa</i>
<i>Dryopteris thelypteris</i>	<i>Eryophorum virgin-</i>
<i>cristata</i>	<i>icum</i>
<i>spinnulosa</i>	<i>Triadenum virginicum</i>
<i>Carex filiformis</i>	<i>Impatiens biflora</i>
<i>interior</i>	<i>Menyanthes trifoliata</i>
<i>retroflexa</i>	<i>Roripa americana</i>
<i>leptalea</i>	<i>Cardamine bulbosa</i>
<i>Aster paniculatus</i>	<i>Habenaria lacera</i>
<i>puniceus</i>	<i>clavellata</i>
<i>puniceus lucidulus</i>	<i>Gyrostachys cernua</i>
<i>Solidago uliginosa</i>	<i>Boehmeria cylindrica</i>
<i>Comarum palustre</i>	<i>Adicea pumila</i>
<i>Apios apios</i>	<i>Polygonum punctatum</i>
	<i>arifolium</i>

Homalocenchrus ory-	Erechtites hieracifolia
zoides	Scutellaria lateriflora
Agrimonia parviflora	Lycopus virginicus
Geum canadense	Mentha arvensis cana-
virginicum	densis
Cicuta bulbifera	Gerardia paupercula
Sium cicutaefolium	Viola blanda
Erigeron canadensis	Echinochloa walteri

Ground cover.

Bartonia virginica	Pylaisia intricata on
Sphagnum cymbifolium	base of tree trunk.
parvifolium	Cephalozia connivena
acutifolium	lunulaefolia
Pallavicinia lyellii	These two small Hepa-
Eleocharis acicularis	ticae thickly cover small
Amblystegium varium	patches of ground in the
kochii	tree zone in the north-
riparium in	eastern part of the island.
small pools	They are generally asso-
Aulocomnium palustre	ciated with Pallavicinia
on ground and in	lyellii.
pools	Brachythecium plumosum,
Thuidium virginianum	Spirogyra sp.
on base of tree	Naucoria paludosella
trunks	
recognitum on	
ground	
delicatulum	
padulosum	

Badhamia papaveracea on leaf of *Osmunda regalis* and on a twig in a pool.

The entire island is in a condition of transition tending toward maturity as expressed in a mesophytic forest climax society of deciduous trees. This is shown in the forest zone by

the invasion and successful ecesis of its most mature area, where the surface is driest and trees largest in the extreme eastern portion, by oaks, *Quercus palustris* and *Q. imbricaria*. In another portion of the forest zone two beech seedlings were found in the summer of 1910 but they have not survived.

There are also well marked invasions of one zone by another. The most advanced is that of the shrub-forest association into that of the bog-meadow. A survey shows that the meadow is dotted with numerous single maples, alders and *Rhus*; with small groups of a single species or two or three associated. Shrub copses and extensive tongues of the tree-shrub-border have invaded the meadow.

In the spring of 1910 there was an unusually heavy crop of maple seeds on the bog as elsewhere. These were disseminated everywhere. A very large number which fell in the meadow, sprouted and grew; so that during the summer of 1910 there were thousands of maple seedlings. The seedlings were counted in an area of 176.7 square feet in two distinct places; which showed a fair average. The one was to the north of a lobe of the thicket which encircled the area on the west, south, and east, leaving a northern exposure. The seedlings were thus shaded from the direct rays of the sun. In this area were 55 thrifty seedlings. The second area was out in the open, exposed all day to the sun and had been trampled over by cranberry pickers. There were no shrubs except two nearly dead *Rhus*. In this space were 110 seedlings. These seedlings have a poorer chance of survival than those in the more sheltered situation. Each year there are also many *Rhus* seedlings in the open bog. That these pioneers are not wholly successful is evidenced by the half-dead condition of the majority of the maples and shrubs; however, if but 1-2 per cent. of the seedlings reach maturity the bog-meadow will soon be a forest.

Besides the maples and shrubs there are numerous areas varying in size occupied by *Typha* (Fig 24), *Peltandra*, *Sagittaria* and *Decodon* stragglers from the marsh zone. These are laggards of the inhabitants of former larger marsh or pond areas.

Many of the smaller pools show the characteristic manner of invasion by the meadow. The depression may have but a plant or two of *Peltandra* or *Nymphaea advena*. (Fig. 25). The margin is banked up by the *Sphagnum* which grows over the edge and



FIG. 24.—*Typha latifolia* in the bog-meadow. A lag-gard from the marsh.

into the pool, often under the water, thus filling the depression from the margin to the water, raising the surface level so that the marsh plant can no longer survive.

In the northwestern part of the meadow the *Sphagnum* is

dying in many places. The diseased portions vary in extent from a few inches to more than a foot in diameter and in degree from Sphagnum beginning to look wet, grayish and decayed to wholly dead and dried plants. I have not yet been able to satisfy myself as to the cause of the disease. It may be of fungoid origin or due to the mechanical breaking and crushing of the plants. This portion of the bog is frequented by hunters and cranberry pickers



FIG. 25.—*Nymphaea advena* a semi aquatic completely surrounded by the encroaching bog-meadow.

and is crossed by many paths. Much of the diseased Sphagnum lies in and along these paths. Many of the affected areas are on top of the hummocks at the bases of *Rhus* and *Alnus* shrubs.

The first evidence of a diseased condition is the wet, greenish-gray appearance of the Sphagnum. Microscopic examination revealed that the fronds are covered with Algae imbedded in gelatin. A *Gleocapsa* is very abundant both on the surface and in the large hyaline cells of the scales. *Nostoc* and several other

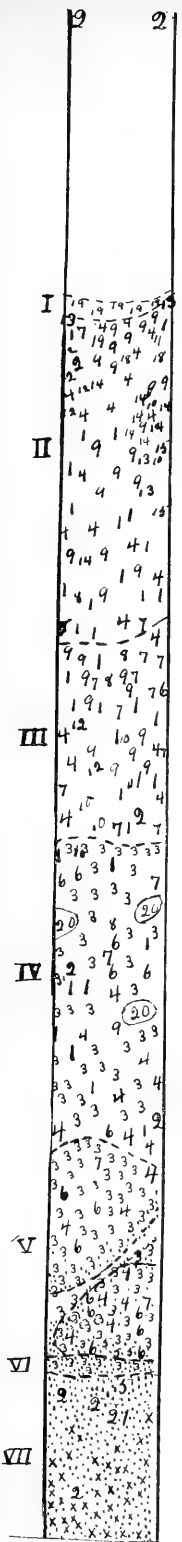
Cyanophyceae are present. Frequently fungal threads lie on the leaf and seem to be in the cells. In later stages the branches and finally the entire top of the frond becomes black. They are covered with small masses of Algae surrounded by fungal threads resembling the soredia of Lichens. The apothecia of two Discomycetes were found on the fronds. These have been identified by Professor Bruce Fink as the apothecia of the Lichens, *Gyalecta lutea* and *Lecidia uliginosa*. Examination of living fronds discovered fungal threads in the hyaline cells of the Sphagnum scales. Finally the Sphagnum dies and dries completely. The result of this dying of the Sphagnum is of ecological interest. Even before death occurs, *Pallavicinia lyellii* comes in frequently in the wetter areas. *Aulacomnium palustre* and *Polytrichum commune* or *ohioense* invade the drier areas of dead Sphagnum.

Study of a belt transect.

In order to present in detail the sequence of the associations of the island, the components of each and also the succession of one by another, a belt transect, 10 feet wide from a-a' and b-b' on the map, was studied and platted, (Fig. 13).

Beginning with the little cove at the shore the belt transect surveyed passes thru, I, a very narrow zone of aquatic plants; II, a mixed zone of marsh plants and bog shrubs; III, the high shrub; IV, the heath and V includes fifteen feet of the bog meadow. The transect was platted in a part of the island which would include the heath zone, for here the normal high latitude bog succession is developing except that the order of zones III, IV and V are reversed with reference to zone I, with a clearly outlined marsh wanting. Normally, the meadow when present, immediately follows the marsh, then the heath and the last in order is the high shrub and forest. The transect also revealed the rapid development of the heath zone, Fig. 26 is a diagram of this transect showing the relative breadth of zone and the position of the principal species.

The cove, thru the center of which the transect was taken, is almost closed, affording only a narrow passage from the



LEGEND OF PLANT ZONES AND ASSOCIATIONS.

- I. Zone of floating and fixed aquatics.
- II. Zones of marsh and bog-thicket association.
- III. Bog-thicket association.
- IV. Transition zone.
- V. Gaylussacia-heath association.
- VI. Transition zone.
- VII. Bog-meadow.

- 1. *Rhus vernix*
- 2. *Acer rubrum*
- 3. *Gaylussacia*
- 4. *Alnus rugosa*
- 5. *Pogonia ophioglossoides*
- 6. *Aronia arbutifolia*
- 7. *Osmunda cinnamomea*
- 8. *O. regalis*
- 9. *Typha latifolia*
- 10. *Dryopteris thelypteris*
- 11. *Carex interior*
- 12. *Cephalanthus occidentalis*
- 13. *Solanum dulcamara*
- 14. *Decodon verticillatus*
- 15. *Rosa carolina*
- 16. *Rumex brittanica*
- 17. *Peltandra virginica*
- 18. *Hibiscus moscheutos*
- 19. *Potomageton* sp.
- 20. Pools
- 21. *Menyanthes trifoliata*
- x Diseased *Sphagnum*
- Sphagnum* sp. and *Oxycoccus macrocarpus*.

FIG. 26.—Belt transect from a—a' to b—b' Fig. 13, map of Cranberry Island.

lake. At each margin stands a large dead maple. Water at the entrance is two feet deep and clear of vegetation, June, 1911.

The associations included in the transect are:

I. A zone with an association of floating and one of fixed aquatics: A narrow fringing border, two feet wide, of *Potamogeton lonchites* associated with *P. pectinatus*, *P. pusillus*, *P. zosterifolium* and the floating aquatics *Spirodela polyrhiza*, *Lemna trisulca* and *Spirogyra* sp. This zone is but poorly developed and lies close to the shore.

II. Mixed zone of high shrubs and marsh plants: This zone covers a belt 30 feet broad and is very typical of the margin of the island. An *Alnus-Rhus* society is the dominant one in the shrub and a *Typha latifolia* in the marsh association. The soil in the border, which is covered by the marsh and shrub association, is of an entirely different consistency from that of the *Sphagnum* mat. It is compact, has become compressed by the weight of shrubs and trees and no longer responds to the alterations in water level of the lake. Consequently when the water rises in the lake it rises over the border of the island, and the trees and shrubs at the margin stand in water; if this condition continues long enough they are killed, hence the prevalence of dead wood at the margin of many parts of the lake. On the other hand, when the water sinks in the lake, the island margin does not respond and a peat shelf is exposed. Depressions have arisen in the shrub border by the permanent sinking due to settling of the soil; these are filled with water when the general water level is high and become dry during periods of low water.

The water in the depressions of zone II is from 6 inches to 1 foot deep, and the surface is covered with a dense growth of *Lemna trisulca* and *Spirodela polyrhiza*. At the bases of several shrubs are small hummocks on which is a thin growth of *Sphagnum*. At the extreme margin of the lake is a more distinctly *Typha* border, interrupted, however, by a *Rosa carolina* at the eastern margin of the transect, several dead and one living *Alnus rugosa*, two *Rhus vernix* and a clump of *Peltandra* at the western margin, four small *Cephalanthus occidentalis*, the

tallest of which is 30 inches, and a clump of *Decodon verticillatus* at the water's edge. Back from the margin, the shrubs *Alnus* and *Rhus*, become more frequent, the *Typha* being confined to the more open water of the pools. There is a scattering growth of marsh herbs as *Comarum palustre*, *Triadenum virginicum*; *Bidens tricosperma* and *B. discoidea* at the base of the shrubs and on the stalks of the *Typha*, *Impatiens biflora*, *Viola blanda* often in the shallow water, *Cicuta bulbifera* and *Dryopteris thelypteris*. There is an entire absence of a sedge zone, the sedges being confined to one small clump of *Carex interior*.

A well defined stratification or layering is represented by the following species:

1. *Rhus vernix*-*Alnus rugosa* rising to a height of 12-15 feet. Many of these are in a half dead condition and there is also much dead timber.

2. *Typha latifolia*, thrifty plants in fruit and 6-7 feet tall.

3. *Rosa carolina*, a few shrubs at a height of 4-5 feet. *Rumex brittanica*, *Hibiscus moscheutos*, all at maturity as tall as the *Rosa*.

4. Low shrubs from 2-4 feet tall, *Cephalanthus occidentalis*, *Decodon verticillatus*, *Solanum dulcamara*.

5. Herbs. The height which these herbs attain varies of course with the season, at maturity they are from 1-2 feet tall. *Comarum palustre*, *Bidens tricosperma*, *B. discoidea*, *Impatiens biflora*, *Carex interior*, *Triadenum virginicum*, *Cicuta bulbifera*, *Peltandra virginica* and *Roripa americana*.

6. Ground cover. *Viola blanda*, *Aulocomnium palustre*, *Sphagnum acutifolium*, *S. cymbifolium* and seedling *Acer* and *Rhus* which are abundant near the outer portion of the zone.

III. Bog-thicket association: This covers a belt 18 feet wide on the western and 20 feet on the eastern border. The water level is high, the surface a succession of hummocks separated by a labyrinth of small irregular waterways with an average depth of 3 inches. The zone is characterized by a *Rhus*-*Alnus* society, with *Rhus vernix* and *Alnus rugosa* the dominant species.

The Rhus is taller and more abundant than the Alnus, and is fruiting freely.

Secondary Species.

Tree etage 15-20 feet	Acer rubrum
Shrub etage 10-12 feet	Aronia arbutifolia
Tall herb 2-5 feet	Osmunda cinnamomea, large spreading fronds
Low herb 8 in.-2 feet.	Impatiens biflora, abundant near inner border
	Triadenum virginicum
	Dryopteris thelypteris
Ground cover	Sphagnum acutifolium
	cymbifolium
	Aulocomnium palustre

A society of floating aquatics, Spirodela polyrhiza with Lemna trisulca underneath covers the surface of the waterways.

The shrub society is much interrupted by stools of Typha latifolia growing in the water. The plants are not quite as tall as in the marsh zone and not flowering as freely.

IV. Transition zone composed of a mixed vegetation of the Heath and High shrub associations: This is a zone 28 feet broad, characterized by tall thrifty Gaylussacia resinosa together with several Rhus, Alnus and Acer rubrum. The ground is dry, with surface entirely above the water, wanting in vegetation and covered with dry leaves and twigs.

There are three small pools, one at the western and two near the eastern margin of the transect, with Aulocomnium palustre and Naucoria on its borders. The pools themselves contain no macrophytes. The zone is a dense shrub growth with no herbs except a few Osmunda cinnamomea and Dryopteris thelypteris at the outer, northern margin, where the growth of Gaylussacia ends abruptly and the High-shrub zone begins. There are well defined etagen or layers, the tallest maple rises to 25 feet, the smaller one and the tallest Rhus about 15 feet; the Alnus and smaller Rhus 9-12 feet and then the dense growth of Gaylussacia

4-4½ feet tall, thrifty but sterile. In the outer margin of the zone is a thin ground cover of *Sphagnum*.

V. *Gaylussacia* association: The association covers a zone 18 feet wide and consists of a dense growth of *Gaylussacia resinosa* with but few associated species which are: small *Aronia arbutifolia*, *Alnus rugosa*, *Osmunda cinnamomea* and a thin ground cover of *Sphagnum cymbifolium*, *S. acutifolium* var. *versicolor*, *Aulocomnium palustre* and *Oxycoccus macrocarpus*. The zone consists of two small mounds separated by a narrow ditch and seems to have been formed by two clumps of *Gaylussacia* meeting at and finally overgrowing the ditch. At the base of the first mound the *Gaylussacia* are no taller than the *Oxycoccus* but increase in height to 30 inches in the center of the mound. The mound bordering the shrub zone shows a more luxuriant growth and the plants bordering zone IV attain 3 feet.

This is the first year I have found these plants blossoming and forming fruit. The few *Alnus* are weak, stunted plants, with the main branch dead. One *Alnus* at the eastern margin of the zone, is a tall shrub. The *Aronias* are but a few inches taller than the *Gaylussacia* and but one bears a few fruits. The *Osmunda* has the strict habit and short leaves characteristic of this fern in the open bog. The ground underneath is dry and the *Sphagnum* which grows well at the margin of the zone and the western edge of the ditch is almost wanting in the center. This ditch was evidently a path and is now filled with dry leaves. On the southern slope of the first mound are a few small *Pogonia ophioglossoides* and *Triadenum virginicum* not in blossom.

VI. A narrow, ½ foot wide, transitional zone, where the *Sphagnum* of the bog-meadow is beginning to form the mound of the Heath zone: The zone is occupied by a *Sphagnum-Oxycoccus* society. The *Oxycoccus* shows luxuriant growth and there is a scattering of two-year old *Gaylussacia resinosa*, 3-10 inches taller than the *Sphagnum* and which are not seedlings but shoots from underground stems that have spread out from the *Gaylussacia* plants.

VII. Bog-meadow association: The transect includes 15 feet of the bog-meadow with a Sphagnum-Oxycoccus society.

Dominant species:

Sphagnum cymbifolium Oxycoccus macrocarpus

Secondary species:

Drosera rotundifolia, *Scheuchzeria palustre*, *Dulichium arundinaceum*, and *Rynchospora alba* are uniformly distributed and here named in the order of their abundance. Five feet from zone VI and in the eastern half of the transect, are 49 *Menyanthes trifoliata*; three feet from zone VI are 13 *Pogonia ophioglossoides* not blooming. On the western margin of the transect are two almost dead *Rhus*. The larger is within two feet of zone VII, and has two shoots, of which the taller is 18 inches long and six years old. The smaller has 2, 3, and 4 year old shoots from 6-10 inches tall. Near the center is another *Rhus* with 2 two-year old shoots from 3-6 inches long. In each case the terminal bud of the main stem is dead. In the case of the largest *Rhus* the bud was killed at the end of the fourth year, and the present shoots have developed from lateral buds. This seems to be a prevalent condition of the *Rhus* in the open bog. There are also three seedling maples as shown on the diagram. In this zone the *Oxycoccus* is fruiting freely and has done so in past years; and the fruit has been gathered by the cranberry pickers. The outer portion of the zone shows a number of patches of diseased Sphagnum. By actual count thirty-four small areas were found varying from 4 to 120 square inches of diseased Sphagnum, from that which is just commencing to look wet and gray to completely blackened fronds.

The most striking feature of this transect is the prominence of the heath zone. It is here better developed than at any other place on the island and extends farther into the meadow. At other points the heath is confined to the shrub zone. During the past year (1911) the plants were much more thrifty than in former years and the society has made a striking advance into the meadow.

Where the heaths have once gained entrance they are better able than the taller shrubs as *Rhus* and *Alnus*, to supplant the vegetation of the meadow. The growth is dense, the lower strata become so dry and shaded that the *Sphagnum* and *Oxy-coccus* cannot long survive. Again the pioneer *Gaylussacias* do not come in as seedlings but as the advancing margin of shoots from the parent zone. This zone if left undisturbed, will supplant the meadow faster and more effectively than will the shrub-tree zone.

II. Forest-clad islands which were elevations on the swamp floor or were parts of the forest not included in the original swamp. Orchard Island is an example of the first and Lieb's Island of the second type of this class of islands.

ORCHARD ISLAND.

(Fig. 27.)

Orchard Island is one of a group of four wooded islands situated in the southwest portion of the old reservoir and close to the south shore. These islands were elevations in the Big Swamp of which Buckeye Lake is the successor, and were high enough to escape inundation when the swamp was converted into the reservoir in 1832, and later when the addition of the new reservoir in 1836 occasioned the raising of the water level an additional four feet. The highest portions of these islands remain above water at the standard or high water level, which is twenty-three inches above the normal. They bear large forest trees, some of which are twenty-eight inches in diameter.

Orchard Island is the largest of these. It has an area of 2.95 acres and is irregular in shape with the longest diameter from the southeast to the northwest. It lies about 200 feet from the south shore of the lake and is connected on the west by a marsh with State Journal Island. The entire surface has been apportioned into lots with an undivided area of common ground at the foot of the public dock, a narrow marginal area,



FIG. 27.—MAP OF ORCHARD ISLAND.

LEGEND OF PLANT SOCIETIES.

- | | |
|-------------------------------------|-------------------------------|
| 1. Nelumbo society, | 7. Forest society, |
| 2. Polygonum-Nelumbo society, | 8. Hibiscus society, |
| 3. Polygonum-Nelumbo-Typha society, | 9. Polygonum-Scirpus society, |
| 4. Polygonum-Typha-Bidens society, | 10. Sedge society, |
| 5. Hibiscus-Typha society, | 11. Beach without vegetation, |
| 6. Shrub society, | |



and one in the center of the island. There were, October, 1910, eight cottages and five docks.

Sixteen years ago, Mr. Wells leased the entire island, cleared the center and planted peach trees. His orchard must not have prospered as not one living peach tree remains today. This area is now covered with young forest trees; *Ulmus americana*, *Hicoria minima*, *H. ovata*, *Fraxinus nigra*, *F. americana*, *Tilia americana* and others.

There is a sparse growth of shrubs, *Rubus nigrobaccus*, *Rhus glabra*, *R. toxicodendron*, *Vitis vulpina*, etc. The herbage is also poorly developed; it consists of a thin growth of grass and common weeds which have been frequently mowed and in some places burned. A narrow border of larger trees, remnants of the original forest, surround this central area. On the south and west this forest border is twenty to thirty feet wide; but to the north and east there is sometimes but a single tree, the lawns extending to the water's edge.

An interrupted zonation of marsh plants occupies the shallow water and the now exposed mud plain surrounding the island. The marsh is well developed on the west, south and southeast, but has been more or less completely cleared away in the vicinity of the docks on the north, northeast and east sides.

The island exhibits a striking example of the invasion of plants into new areas, successful ecesis, the resultant succession, the consequent filling of the lake and the upbuilding of new land areas along the margin; and in the center a secondary succession in a partially denuded area. A detailed floristic study was made of a belt sixty feet broad and extending directly across the island from the southeast to the northwest, from a-a' to b-b' on the map. This belt covers a representative area of the island, including a section of the well developed marsh on the southeast, and on the northwest the marsh disturbed and reforming; a section of the oldest forest zone and of the rejuvenated central area.

There are four distinct groups of vegetation units or associations based on habitat and growth forms:

- I. The pond association
- II. The shore association
- III. The swamp-shrub association
- IV. The mesophytic-forest association

The first, second and fourth are well developed, the first exhibits a striking lateral and vertical zonation, the third is fragmentary, but it is of interest as an illustration of the intrusion and development of a zone between two previously existing ones.

I. The pond association on the southeast: This consists of an association of semi-aquatics with

1. *Nelumbo lutea* society

Principal species:

Nelumbo lutea

Secondary species:

Potamogeton pectinatus

Lonchites

natans

Ceratophyllum demersum

Cladophora sp.

Spirogyra sp.

The society forms a zone 20-40 feet broad. At the outer margin the water is 4-4.5 feet deep, at the inner about 8 inches. In the deeper water is a pure *Nelumbo lutea* family; in the shallower, the other plants, especially *Potamogeton pectinatus* and *Lonchites*, are quite abundant. There is some evidence of vertical zonation or layering; in the deeper water the *Nelumbo* leaves float on the surface; and in the shallower rise 12 inches above the surface.

2. *Nelumbo-Polygonum* society

Principal species:

Nelumbo lutea

Polygonum emersum

Secondary species:

Ceratophyllum demersum	Brachythecium plumosum
Spirogyra sp.	Riccia fluitans
Lemna trisulca	Ilysanthes gratioloides
Cladophora sp.	Sium cicutaefolium
Spirodela polyrrhyza	

This society forms a dense zone 60 feet broad, and extends from water 8 inches deep to wholly emersed surface. Thirty-five feet of the zone covers a mud flat which is submerged at the normal water level. The Polygonum has advanced into the Nelumbo. Towards the inner margin the Nelumbo is 2 feet tall and fruiting freely.

A short distance west of the belt studied, the Polygonum has entirely outdistanced the Nelumbo, replacing society 1 with a Polygonum zone external to a mixed Polygonum-Nelumbo zone.

Of the secondary species, Brachythecium plumosum is the most abundant, especially on the exposed mud surface, quite large patches of which are covered by a pure growth of the moss. The Riccia is also a conspicuous member of the ground cover. The herbs are very sparse.

Towards the west of the median line of the belt is,

3. A Polygonum-Nelumbo-Typha society. A zone composed of societies from the I and II associations.

Principal species:

Polygonum emersum
Nelumbo lutea
Typha latifolia

Secondary species:

Spirodela polyrrhyza
Lemna trisulca
Cladophora sp.
Ceratophyllum demersum

The secondary species, which are normally floating plants, are stranded on the mud and form but a thin covering. The

society covers a narrow lens-shaped area not more than 3 feet in its broadest portion. At the normal water level the surface is submerged, but now it is wholly exposed. The Polygonum is tall and vigorous with branches from 3-4 feet tall; the Nelumbo has large erect leaves and the plants are fruiting freely; the Typha is stunted in growth and sterile, the largest leaves are not more than 4 feet tall.

This zone is followed by the shore association which covers the low very gently sloping mud flat between the pond association and the forest. Typha latifolia is the dominant species on the outer and Hibiscus moscheutos on the inner margin. The following two societies are very evident.

4. Typha-Polygonum-Bidens society

Principal species:

Typha latifolia

Bidens cernua

Polygonum emersum

Secondary species:

Cyperus strigosus

Cicuta bulbifera

Eleocharis acicularis

Bidens frondosa

Riccia fluitans

Roripa palustre seedlings

Spirodela polyrhyza

Hibiscus moscheutos seedlings

Brachytecium plumosum

Polygonum emersum seedlings

Society 4 occupies a narrow zone less than 3 feet in width. The Typha is larger and more vigorous than in 3, but not fruiting; Polygonum emersum is still conspicuous but not nearly so much as in the preceding zone, while the Nelumbo lutea has entirely disappeared and Bidens cernua, represented by a few large plants, has come in. There are but a few of the taller herbs of the secondary species, but an abundant ground-cover of the Cyperus, Riccia and Eleocharis. This zone merges into:

5. Hibiscus-Typha society

Principal species:

Hibiscus moscheutos

Typha latifolia

Secondary species:

Taller herbs:

<i>Polygonum acre</i>	<i>Erechtites hieracifolia</i>
<i>Triadenum virginicum</i>	<i>Impatiens biflora</i>
<i>Scutellaria lateriflora</i>	<i>Galium trifidum</i>
<i>Cicuta bulbifera</i>	<i>Epilobium strictum</i>
<i>Solanum dulcamara</i>	<i>Boehmeria cylindrica</i>
<i>Echinochloa walteri</i>	<i>Agrimonia</i> sp.
<i>Homalocenchrus oryzoides</i>	<i>Acnida tamariscina</i>
<i>Aster paniculatus</i>	

Seedling trees:

<i>Acer rubrum</i>	<i>Quercus palustris</i>
<i>Gleditsia triacanthos</i>	

Ground-cover:

<i>Cyperus strigosus</i> , small mat plants	<i>Spirodela polyrhyza</i>
<i>Riccia fluitans</i>	<i>Brachythecium plumosum</i>
<i>Phialea scutula</i> on dead <i>Hibiscus</i> stems	<i>Cladophora</i> sp.

This zone is 40 feet wide and the ground surface is entirely above water, but so recently exposed that the stranded *Spirodela* and Algae are still green. The *Hibiscus* roots form small hillocks on which the *Spirodela* and Algae become stranded and on which the *Riccia* is very abundant. The taller herbs form a sparse weak growth due to the density of the *Hibiscus* which forms a 7-foot wall difficult to penetrate. The *Typha* is confined to the outer portion of the zone and has here obtained optimum conditions of growth, the plants are not copious, but are tall, vigorous and fruiting freely.

II. Swamp-shrub association

6. *Cornus* society

Principal species:

Cornus stolonifera

Secondary species:

Rosa carolina	Hibiscus moscheutos
Sambucus canadensis	Solanum dulcamara
Micrampeles lobata	Homalocenchrus oryzoides
Polygonum acre	Galium trifidum
Erechtites hieracifolia	Carex lupulina
Scutellaria lateriflora	Convolvulus sepium
Mentha canadensis	Ulmus americana

This society consists of nine *Cornus stolonifera* in the section studied, and occupies an area 20 feet broad. About 10 feet to the west is another *Cornus stolonifera* far down into the Hibiscus-Typha zone; and about 40 feet still farther west, is a group of 15-18 feet tall *Cephalanthus occidentalis* which extends through the Hibiscus zone to the water's edge. Just east of the eastern margin of the transect is another group of *Cornus* with *Sambucus canadensis*.

The swamp-shrub association does not exhibit lateral zonation, but alternations as it consists of isolated shrub societies of which *Cornus stolonifera* is the principal species in one and *Cephalanthus occidentalis* in another. The associated species are grouped closely around the *Cornus*, most of the herbs form a sparse growth in the shade of the shrubs and *Micrampeles* and *Solanum* climb over them.

The two bordering associations the marsh-herb on the one side and the forest on the other, merge in the areas between the shrub societies. The presence of seedling *Ulmus*, *Quercus* and *Gleditsia* in the Hibiscus-Typha society shows clearly that the forest is invading the marsh, and if the higher portion of the mud flat is not again submerged, the shrub zone may never become more complete than it is now; it may be formed farther down on the shore or it may be entirely replaced by the forest. The incompleteness of the shrub zone is due to the existence of the forest prior to the development of the marsh.

III. Mesophytic-forest association

7. Ulmus-Fraxinus society

Principal species :

Ulmus americana *Fraxinus americana*

Secondary species :

Trees :

<i>Fraxinus nigra</i>	<i>Celtis occidentalis</i>
<i>Hicoria ovata</i>	<i>Tilia americana</i>
<i>minima</i>	<i>Gelditsia triacanthos</i>
<i>Ulmus fulva</i>	<i>Morus rubra</i>
<i>Quercus palustris</i>	<i>Salix nigra</i>

Lianas :

<i>Rhus toxicodendron</i>	<i>Smilax hispida</i>
<i>Vitis vulpina</i>	<i>Solanum dulcamara</i>
<i>Parthenocissus quinquefolia</i>	<i>Dioscorea villosa</i>

Shrubs :

<i>Cornus stolonifera</i>	<i>Rosa carolina</i>
<i>Rubus nigrobaccus</i>	<i>Cephalanthus occidentalis</i>
<i>occidentalis</i>	

Herbs :

<i>Muhlenbergia diffusa</i>	<i>Nepeta cataria</i>
<i>Agrostis perennans</i>	<i>Teucrium canadense</i>
<i>Syntherisma sanguinalis</i>	<i>Carduus lanceolatus</i>
<i>linearis</i>	<i>Arctium minus</i>
<i>Chaetochloa glauca</i>	<i>Helianthus decapetalus</i>
<i>Carex tribuloides</i>	<i>Urtica gracilis</i>
<i>vulpinoidea</i>	<i>Erigeron canadensis</i>
<i>frankii</i>	<i>Hedeoma pulgioides</i>
<i>Rynchospora alba</i>	<i>Mentha canadensis</i>
<i>Solidago canadensis</i>	<i>Lycopus americanus</i>
<i>Aster paniculatus</i>	<i>Oxalis stricta</i>
<i>sagittatum</i>	<i>Onagra biennis</i>

<i>Solanum nigrum</i>	<i>Meibomia viridiflora</i>
<i>Epilobium strictum</i>	<i>Eupatorium ageratoides</i>
<i>Verbena urticifolia</i>	<i>purpureum</i>
<i>Rumex obtusifolius</i>	<i>Bidens bipinnata</i>
<i>Geum canadense</i>	

Fungi:

<i>Agaricus campestris</i>	<i>Lycoperdon wrightii</i>
----------------------------	----------------------------

The forest association extends across the island from margin to margin, and presents two distinct zones: 1. A border zone 20-30 feet wide, consisting in part of large trees, the remnant of the original forest. It is a very open border, not more than three trees deep, the tallest of these trees having attained a height of 60-65 feet. The shrub stratum is very poorly developed. It is represented on the south side by a few *Cornus*, *Rosa* and *Cephalanthus*, at the outer margin of the zone; these are wanting on the north side. The field stratum is composed almost wholly of grasses of which *Muhlenbergia diffusa*, *Agrostis perennans* and *Syntherisma sanguinalis* and *linearis* are the principal species. Associated with these is a scanty growth of herbs; and on the south side an abundant growth of *Rhus toxicodendron*, *Parthenocissus quinquefolia* and *Vitis vulpina* trailing over the ground. The *Rhus* has also climbed two *Ulmus americana*. The grass and weeds have been mowed, so that the shrubs too are kept in a stunted condition.

Surrounded by the older forest zone lies a rejuvenated area clothed with young forest trees, among which *Ulmus americana* predominates; fully nine-tenths of the trees are of this species. This is a part of the area which was cleared sixteen years ago; but the forest has again invaded it and become established. The ground slopes gently downward toward the southeast and more abruptly toward the northwest. The elevation of the highest portion is not more than 4 or 5 feet above the standard water level. The gentle slope and the thin shade of the young trees, together with the loose, light soil, provide a dry, sunny habitat on which *Carduus*, *Aster*, *Arctium*, *Hedeoma*, *Nepeta*, *Erigeron*

and other sun-loving plants find a congenial environment. The remains of large Burdocks and large *Rubus nigrobaccus* canes are frequent. There are scarcely any grasses in this central area, and as it has been mowed and burned, all the herbage is scanty.

On the northwest margin of the transect, the forest association is followed immediately by the marsh or shore association. The swamp shrub association is wanting. The marsh association is represented by three societies:

8. *Hibiscus moscheutos* society
9. *Polygonum-Scirpus* society and
10. *Scirpus lacustris* society. None of which show the development of the marsh zones on the south side.

8. *Hibiscus* society

Principal species:

Hibiscus moscheutos

Secondary species:

Hypericum mutilum

Impatiens biflora

Hedeoma pulegioides

Echinochloa walteri

Bidens cernua

Xanthium canadense

Rosa carolina

The society forms a narrow, interrupted border not more than four feet wide, of mature fruiting but not tall *Hibiscus moscheutos*. Of the secondary species the *Hypericum* is quite abundant at the outer margin of the eastern portion of the zone. The other species are very sparse, of the *Xanthium* and *Rosa* there is but a single plant.

9. *Polygonum-Scirpus* society

Principal species:

Polygonum emersum

Scirpus fluviatilis

Secondary species:

Cyperus strigosus	Typha latifolia
Ilysanthes gratioloides	Alisma plantago
Hypericum pennsylvanicum	Amaranthus hybridus
Polygonum acre	Arctium minus
Agrostis perennans	Acer rubrum seedling
Gratiola virginiana	Ulmus americana seedling
Erechtites hieracifolia	Hibiscus moscheutos seedlings
Echinochloa walteri	Scirpus lacustris
Eupatorium purpureum	Cladophora sp.
Roripa palustris americana	

This society is 40 feet wide with the entire surface exposed at the present low water level. Hence the extremely heterogenous collection of plants among the secondary species. Dead *Typha latifolia* stalks are so abundant in the western portion of the zone as to warrant considering it a dominant plant; but the *Typha* is not at all abundant in the eastern portion of the zone. *Arctium minus* and *Alisma plantago* growing close together illustrate strikingly the submerged and emerged stages of the society and the rapidity with which a new habitat is adopted by plants. That the ground has been recently exposed is evidenced by the fresh masses of *Cladophora*.

10. *Scirpus lacustris* society. This is a fringing zone 40 feet wide and extending only about half way across the belt, the surface is partly emerged. There is a 20-foot wide sandy beach scantily clothed with the *Scirpus*.

Secondary species:

Potamogeton natans
pectinatus
lonchites
Nelumbo lutea

The pond association along the north shore is represented only by a *Nelumbo lutea* society. A small bed of *Nelumbo lutea* borders the *Scirpus lacustris* society to the north-north-east. The leaves are but few and widely scattered.

Fifteen feet east of the belt is a public dock, four feet wide and extending 78 feet out into the water, and 54 feet up onto the shore. The marsh zones are not formed immediately on either side of the dock. On the upper portion of the beach close to the dock, the Hibiscus zone is coming in. Twenty feet east of the western margin of the belt, the marsh zones are interrupted

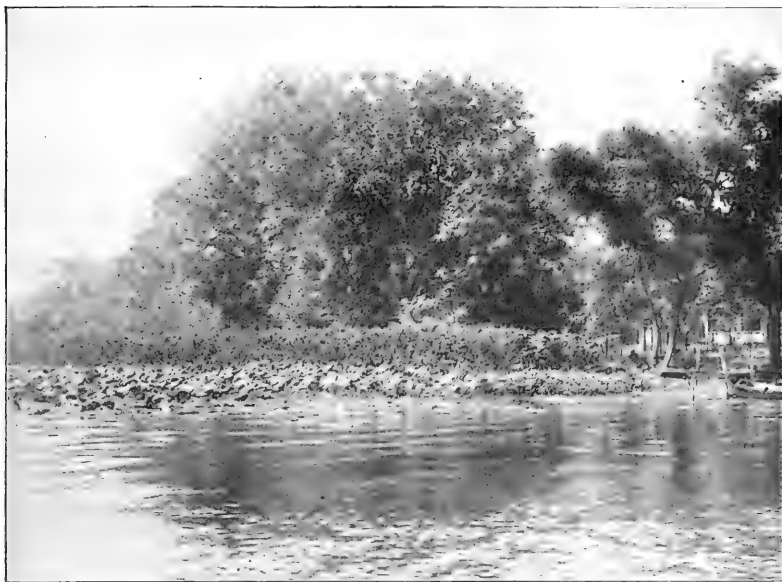


FIG. 28.—View of the vegetation from the S. E. side of the island in belt transect a-a', showing associations I, II and III; and societies 1, 2, 3, 4, 5, 6 and 7 of map.

by a boathouse on the beach with a runway for boats extending into deeper water. The development of the marsh association on the north side has thus been interfered with and the margin is also more exposed to storm winds and waves. A sandy beach 60 feet wide is building; it is occupied in part by the *Polygonum-Scirpus* and in part by the *Scirpus lacustris* zone.

At the south end of the section studied, both lateral zona-

tion and layering (etagen) are strikingly shown. There is a marked increase in elevation from one lateral zone to another, from the floating *Nelumbo* leaves to the tall *Ulmus americana* and *Quercus palustris*. This is well shown in the photograph. (Fig. 28.) There is a poor development of etagen in the indi-



FIG. 29.—View farther west than Fig. 28. *Polygonum emersum* forms the outermost zone, then follow zones or societies 2, 3, 4, 5, 6 and 7 of map.

vidual associations. In some there are the dominant plants and then the ground cover, in others a weak, irregular growth of taller herbs, while in the forest, the shrubs have either been cut or are young plants, and the vines generally trail over the ground.

LIEB'S ISLAND.

With the exception of the Cranberry Bog, this island is the largest in the lake, having an area of 33.59 acres. It lies in the southwestern portion of the new reservoir and is now connected with the old levee by a wagon bridge over the canal. The bridge permits of communication by land with Millersport.

Probably one-half of the island is under cultivation. There is a house surrounded by a lawn and orchard near the western border, and a cornfield occupies the rest of the cultivated area. The soil is a sandy loam with gravel subsoil, the general slope is from west to east.

Approaching the island from the north, the water 200 yards from the shore is very shallow, from 4-5 feet deep and is occupied by a pure *Nelumbo lutea* society. Between this and the shore is a narrow *Potamogeton lonchites-natans*-*Polygonum emersum* zone. This is followed by a more or less interrupted zone of *Typha latifolia* and *Sparganium eurycarpum*. This zone is interrupted by belts of *Scirpus fluviatilis* which extend to appreciable distances inland. On the margin of the island above water is a narrow zone of large forest trees of *Salix nigra*, *Acer rubrum*, *Ulmus americana*, *Fraxinus nigra* and *F. americana*. Beyond the trees is a rather fragmentary shrub zone with *Cornus stolonifera*, *Rosa carolina*, *Sambucus canadensis*, *Rubus nigrobaccus* and *R. occidentalis* as the principal species. Following the shrub zone and blending with it, is a narrow border which had not been cultivated; the ground is quite wet, and bears a mesophytic herb society. *Impatiens biflora*, *Rynchospora alba*, *Carex vulpinoidea*, *Triadenum virginicum*, *Echinochloa walteri*, *Viola papilionacea*, *Rumex brittanica* and *Ambrosia trifida* are the principal species. From this zone to the cultivated field is an irregular border from a few to about twenty feet wide which had been cultivated and sown to corn the previous year but this had been abandoned to a society of ruderales among which were also the mesophytic herbs of the preceding zone.

The following species were noticed: *Arctium minus*, *Soli-*

dagó canadensis, *Oxalis stricta*, *Geum canadense*, *G. vernum*, *Sambucus canadensis*, *Onagra biennis*, *Lycopus americanus*, *Ambrosia artemisiifolia*, *A. trifida*, *Polygonum hartwrightii*, *P. persicaria*, *Convolvulus sepium*, *Plantago rugelii*, *Veronica perigrina*, *Triadenum virginicum*, *Asclepias incarnata*, *A. seriacá*, *Apocynum cannabinum*, *Echinochloa walteri*, *Valerianella chenopodifolia*, *Nepeta cataria*, *Viola papilionacea*, *Galium aparine*, *Carex davisii*, *Verbascum blattaria*, *Rubus occidentalis* and *Taraxacum taraxacum*. This area extends for about fifty yards from a dense growth of *Scirpus fluviatilis*, a remnant of the swamp, on the east to a roadway and barnyard on the west.

The *Scirpus fluviatilis* society on low, wet land extends from the marginal marsh zone, thru the tree and shrub border well up into the cultivated field. It is a dense growth of the *Scirpus* overrun with *Convolvulus sepium* and with numerous *Solidago canadensis* which toward the higher and drier portion of the area becomes dominant.

Farther east the island is now connected with the embankment of the canal by a dense *Typha latifolia* society, with a zone of fixed aquatics, *Nelumbo lutea* and *Potamogeton* sp. towards the open water and a sedge zone, with *Scirpus fluviatilis* dominant, toward the land.

South of this the island touches the canal embankment, the former open water between them is a low, wet hollow overgrown with vegetation. The canal embankment bears a mesophytic tree and shrub society with *Ulmus americana*, *Fraxinus nigra*, *F. americana* and *Salix nigra* the dominant trees, and *Rhus glabra* the dominant shrub. At the foot of the embankment the ground is low and wet and covered with a jungle of *Salix nigra*, *Ulmus americana*, *Fraxinus nigra* and *americana*, *Gladitsia triacanthos* and *Platanus occidentalis*, with *Cornus stolonifera*, *Rhus glabra* the dominant shrubs and *Rhus toxicodendron*, *Celastrus scandens*, *Vitis aestivalis* climbing over trees and shrubs. The paths are under water in places. The drier portions are covered with sedges, *Rynchospora alba*, *Carex*

vulpinoidea and sparganoides associated with *Impatiens biflora*, *Geum canadense*, *Viola* sp.

The lowest portion of the depression between the island and the canal bears a *Typha latifolia* society. The land surface is a few inches under water. Surrounding this are the following zones in the order given:

1. *Polygonum emersum*, ground still under water.
2. *Eleocharis obtusa*, *Polygonum emersum* and *Hibiscus moscheutos* zone.
3. *Hibiscus moscheutos*
4. Shrubs.
5. Trees.

On the west side of this low area, that is, on the side toward the field, the tree belt is thin and chiefly of *Ulmus americana*. This is bordered on the west by a wet sedge zone, chiefly *Carex tribuloides*, *shortiana*, *lurida*, *lupulina*, *vulpinoidea* and *sparganoides* and *Rynchospora alba*. The outer or western margin has become a belt of brambles, *Rubus nigrobaccus*. Numerous *Solidago canadensis* border the cornfield.

On the western end of the island is the farm house and barn. A grass lawn surrounds the house and close to it are planted several apple, peach and cherry trees, one large *Tsuga canadensis*, a *Pinus strobus*, *Acer saccharum*, *Thuja occidentalis*, a large spruce and near the gate at the southeast a large *Castanea dentata*. The lane leading from the gate to the bridge over the canal is bordered on either side by alternating apple and chestnut trees to the belt of low ground. From this to the bridge are willows, principally *Salix nigra* and *alba*. This is the only region on the island or on the shore of the lake where I have found chestnuts and conifers. The healthy condition of the trees indicates that the soil of Lieb's Island is suited to them. Southwest of the lane of chestnuts is another small cornfield which is bordered by a fringe of willows at the margin of the island beyond which is a *Typha* zone in shallow water. A repetition of the marsh and fixed aquatic zones borders the island on the

southwest and west, the latter zone extends across the lake and unites with that of the west shore at the mouth of the southwest feeder.

Another interesting feature of this region is the rapidity with which the lake between the island and canal is being filled in. Part of it is already above the water level and supporting a meso-phytic vegetation.

III. Islands built on a foundation of exposed peat.

Near the north shore of the lake, between Cranberry Island and the woodlot, a small mass of exposed peat was studied as an example of the third class of islands. The islet, Sept. 23, 1910, was a small mass of peat 12 feet long and 8 feet wide at the broadest portion, with a very irregular shore line, and had been so recently exposed during the season that the surface was wet and stranded *Spirodela*, *Ceratophyllum* and *Cladophora* were still fresh and green.

The surface slopes very gently from the water level at the margin to the highest point just north of the center which is 8 inches above the water. On this highest portion are 4 *Bidens cernua*, 3 *Bidens frondosa*, 5 *Salix nigra* from 2-3 years old and 6 *Polygonum acrè*. These are the tallest plants, 1.5-2 feet tall. In their shade are 2 seedling maples, 4 seedling *Hibiscus* and numerous *Eleocharis acicularis*. In the center is a *Lotus* leaf.

The dominant species on the lower portion are *Eragrostis hypnoides*, *Cyperus strigosus* and *C. erythrorhizos*. The *Eragrostis* lies prostrate with roots at each node. *Cyperus strigosus* is erect and varies in height from 1-6 inches, while *C. erythrorhizos* is about 2 inches tall. Associated with these are 20 *Bidens cernua* seedlings, 7 *Hibiscus moscheutos* seedlings, 2 *Amaranthus hybridus* in bloom, 3 small *Typha latifolia* near the margin, 14 *Impatiens biflora* seedlings, 1 *Decodon verticillata* on the east side near the edge, 4 small *Peltandra virginica* on the west, with a number of stranded *Potamogeton lonchites*. Two areas of about one square foot each covered with the closely set capillary culms of *Eleocharis acicularis*, 1 *Ilysanthes gratioides*, 3 seedling *Erigeron* sp., 1 seedling *Solidago* sp., 1 *Homalo-*

cenchrus oryzoides. In small depressions where the peat is still distinctly wet it is covered with *Heteranthera dubia*, *Spirodela polyrhiza*, *Ceratophyllum demersum*, *Potamogeton foliosus* and *Cladophora* sp. One large decayed *Lotus* leaf covers an area of 1½ feet. In the margin of the islet are 2 small pools, 4 inches and 1 foot in diameter and the surface of each bears a *Spirodela* mat.

The peat shelf slopes gradually to water a foot deep within



FIG. 30.—Small peat mass which has been alternately exposed and submerged during several years. In a very short time after emergence it bears a varied and abundant vegetation.

five feet of the islet, which lies in the eastern margin of an extensive *Nelumbo lutea* society. The condition of the surface of the peat indicated recent exposure, the presence of 3 year old willows, that it had been in existence at least 3 years, and the two together that it had undergone alternate emergence and submergence.

This islet was again examined Aug. 1911. The vegetation had changed somewhat and the area was larger, the greatest length was 15 and greatest width 12 feet. On the northern end were 15.

Typha latifolia, 7 *Peltandra virginica* were scattered over the southern half. The willows in the center were not more than 2 feet tall, stunted and much branched. The sediment clinging to the tips of the branches showed that they had been entirely submerged. The ground cover was almost wholly composed of *Elocharis acicularis*, no other sedges or grasses could be found and but a few *Bidens*, *Hibiscus* and *Impatiens* seedlings. The peat shelf surrounding the island and with its surface just under water bore everywhere a copious growth of *Heteranthera dubia*, which had also invaded the mud flat. Fig. 30 is a photograph of the islet taken Aug. 4, 1911.

IV. Islands originating in shallow water thru the gradual upbuilding of the surface by the accumulation of vegetal remains, as illustrated in a Typha tussock.

In the eastern part of the lake from Custer's Point to the southeastern extremity are many *Typha tussocks* of both *Typha angustifolia* and *T. latifolia*, which differ strikingly in the structure of the flora, but which gradually pass from the one type to the other.

One of each type of tussock was studied. The *Typha angustifolia* tussock formed a pure society about 24 feet in diameter and grew in water 3 feet deep at the margin and 2½ feet in the center. The culms were fully ten feet tall and blooming freely. Only at the margin on the leeward side were there any other plants. Here, June 24, 1911, were a few *Potamogeton lonchites* and small *Castalia tuberosa* leaves with *Lemna trisulca* on the surface of the water.

The *Typha latifolia* tussock was 50 feet south of the *T. angustifolia*. Surrounding it in water from 3.5-3 feet deep was a zone of *Nelumbo lutea*, *Potamogeton pectinatus*, *P. lonchites*, *P. natans* and *Polygonum emersum*, the last nearest the *Typha*, which occupied a zone about 18 feet broad. In the outer margin of this zone were *Nelumbo* leaves. Associated with the *Typha* throughout the zone was *Sparganium eurycarpum*, *Polygonum emersum* and *Roripa americana*. The water decreased in depth towards the center where it was 9 inches. Here was a clump of *Hibiscus moscheutos* with *Lemna trisulca* floating on the water.

One of the causes of the difference in structure of a *Typha angustifolia* society and that of *T. latifolia* is the difference in depth of water at which they generally grow. The former grows in deeper water than the latter, however, the *angustifolia* sometimes grows at the very margin of a shore in water but a few inches in depth.

Another cause seems to be the habit of growth. The culms of *T. angustifolia* are massed forming a dense growth, while those of *T. latifolia* are farther apart permitting better light exposure and freer circulation of air at lower levels. A *T. latifolia* society always shows stratification, as in the one just described, the *Typha* forms the upper stratum at a height 5-6 feet above the water, the *Sparganium* the second at 4-5 feet, the *Polygonum* the third at 2.5-3 feet and the *Roripa americana* the fourth at one foot to 15 inches. This species occurs near the margin of the zone. At the extreme outer edge are the *Nelumbo* and *Potamogeton* leaves floating on the surface. The two species of *Typha* form characteristically distinct tussocks separated by open water. However, on the east shore of Buckeye Point a *Typha angustifolia* and *T. latifolia* society are adjacent and in the more open swamp there is a *T. angustifolia* society surrounded by a *T. latifolia* zone.

The thick root stalks and tough roots of *Typha* are firmly imbedded in the muck and are not easily uprooted, the thick tough culms and large leaves add materially each year to the surface level, so that it soon becomes high enough to support an amphibious and later a dry land flora. In general the bed of the lake is being built up in this way. Similar but less striking examples can be found in the beds of *Polygonum emersum*, some of which are quite extensive, as near Castle Island and another in water at a depth of 2 feet, 4 inches just west of Beech Island. *Polygonum emersum* does not form as dense a growth as the *Typhas* but the long creeping stems rooting freely at the nodes, and the numerous branches are the cause of the rapid extension of the mat, the tangle of branches catch and hold debris so that the surface soon becomes high enough to permit other plants as

Nymphaea, Peltandra and Pontederia to join the society. Polygonum emersum grows at a depth of $5\frac{1}{2}$ feet, not much of the lake basin is therefore forbidden ground to this pioneer upbuilder of the land surface.

V. *Islands formed from fragments of other islands.*

This is rather a means of dissemination and multiplication of islands than the forming of new ones.

Swamp and bog plants have but shallow root systems, the roots extend to a much greater distance laterally than vertically. The roots of even the largest trees on the Cranberry marsh reach a depth of not more than 10-12 inches below the surface. Such plants are but insecurely anchored and when in exposed situations as the margin of the island, are readily torn away in masses by the storm winds, swept before the wind to finally find lodgment in shallower water or against logs and stumps. There are a number of such fragments near the northeastern shore. They are characteristically small areas with relatively large trees and shrubs and with an entire absence of a marginal society of fixed aquatics. One such small island about 50 feet square, near the east shore of the lake so closely resembles the shrub-forest association of Cranberry Island that it seems a fragment of it bodily transported to its present position. I have designated this island Sphagnum bog Island No. 2. With the exception of the absence of Oxycoccus and the presence of another northern bog plant, Rubus hispidus, the flora is identical. The dominant species are Acer rubrum, Rhus vernix and Alnus rugosa. The living maples of which there are 12 fair-sized trees, are none of them more than 6 inches in diameter, one dead maple measures 8 inches in diameter 12 inches from the ground, and one maple stump is 14 inches in diameter. There are also two seedling Quercus palustris. The surface is high enough to be scarcely wet to the foot. Near the eastern end is quite an abundant growth of Rubus hispidus, a characteristic plant of the Tamarack bogs in the northern counties. In the Pymatuning bog on the border between the northeastern part of Ohio and

western Pennsylvania, it is a conspicuous member of the ground cover in the Heath zone.

Immediately north west of Sphagnum bog Island No. 2 is a somewhat smaller island which is a replica of the bog-meadow of Cranberry Island No. 1. In the center is a sphagnum-cranberry meadow and this is surrounded by a fringe of bog shrubs and trees. To this I have given the name Cranberry Island No. 2. This island and Sphagnum bog No. 2 are shown as Bog Islands on map Plate III, Fig. 4.

During the winter of 1911-12 a portion of the long southern lobe of Cranberry Island was dislodged and carried to the south side of the lake, where it now lies in several fragments near Custer's Point. This is the portion which was cleared of trees and shrubs two winters ago.

Of the many islands in the lake, but few besides the Cranberry bog Islands 1 and 2 bear Sphagnum. Until recently there was a small island mass with sphagnum in the shallow water just north of the Cranberry-bog. This has been dismembered. A fragment which is merely a mass of peat covered with *Peltandra* and *Pontederia* still occupies the original location, another fragment containing *Decodon*, *Hibiscus*, *Polygonum* and one *Salix* lies farther east near the shore, the remainder has entirely disappeared.

THE FLORA OF THE LAKE BED.

Attention has been called in the preceding pages to the shallowness of the lake basin. By this, of course, is understood the present lake and not its predecessor. The bed of the old swamp at the time of the beginning of the deposition of plant remains, must have been at the bottom of the deposit of peaty soil. This the cores, taken in the soundings at various stations of the lake, have shown. No well defined beach or shore lines remain; so that it is impossible to determine the original depth and extent of the lake; but after it reached its final outlet into the Licking River, the water cannot have stood at a much higher level than it does now. When the ancient lake stood at or above

the 900 foot level it must have spread over the plain which extends from the present lake to Newark. This broad sheet of water must, however, have been a temporary one, more in the nature of a broad river than a lake as there are no beaches or other evidences of a lake. The water must soon have fallen to a lower level than the plain and was confined to the long narrow basin occupied by the "Big Swamp." The lowest place in the rim was about $\frac{1}{2}$ mile south west of the Waste weir, and served as the outlet into the Licking River. This was considerably lower than the present lake. The field just north of the levee at this point is about 880 feet above sea level, whereas the surface of Buckeye Lake at the normal water level is 892 feet.

Were the vegetation permitted to grow without interference almost the entire lake would in a few years become a continuous growth of fixed aquatics and littoral marsh plants. As it is, large areas are now so covered, notably the western end of the lake which is scarcely more than 4.5 feet deep, the coves of the south shore, the extension of the lake to the north and the whole southeastern lobe. The various societies except in the coves where the growth is dense and competition more active exhibit alternation and not zonation. Accidents of dissemination have been the chief factors in the distribution of the societies. Depth of water and wind exposure have influence on the development, structure and succession of the societies. Soundings were taken to determine the greatest depth in which many of the fixed aquatics will grow. *Nelumbo lutea* frequently forms pure societies at a depth of 5-5.5 feet. In many places it is associated with *Castalia tuberosa* at a depth of 5 feet. *Potamogeton lonchites* was found at a depth of 5 feet; *Polygonum emersum* is gregarious. It was found at a depth of 5.5 feet and from that in all depths to the exposed mud flats. It has prostrate stems and floating leaves, the apex of the shoot ascending when growing in water, with an erect habit in very shallow water or in the mud. It forms pure societies and is also found associated with fixed aquatics as *Nelumbo*, *Potamogeton* sp. and swamp plants *Typha* and *Hibiscus*. *Typha angustifolia* grows at a

depth of 3.5 feet, *T. latifolia* 2.5 feet. *Nymphaea advena* was found at a depth of 2 feet and 10 inches.

Potamogeton zosterifolius was never found in as deep water as the other species of *Potamogeton*, and generally in sheltered situations as a well surrounded cove. In such situations it forms a dense mat, the stems and leaves floating on a substratum of *Ceratophyllum*. All the fixed aquatics form denser growths on the leeward side of shores, islands and tussocks. The disseminules drift and collect in sheltered places and the anchored plants are not torn loose by wind and waves.

DEVELOPMENT OF THE FLORA.

It is now well established that there is a broad pre-glacial river valley from Dresden westward past Newark to the Licking Reservoir (Buckeye Lake) and thence continues southwest to the Scioto River. There is also good evidence that a large valley from the southeast, now occupied in part by Jonathan Creek, joined Newark River Valley near the western end of Buckeye Lake. These two streams were diverted from their westerly course at a very early period, possibly by the first ice invasion.

Buckeye Lake lies in and was a part of this south east branch of the old Newark valley. Towards the eastern end the old valley was not much wider than the present one; but at the western extremity the lake basin is not over one-fourth the width and lies on the southern slope and not in the deepest portion of the old valley. The present basin is entirely post-glacial, as shown by the thickness of the drift, 100-390 feet, in wells immediately adjacent to the lake. Its longer axis is transverse to the direction of advance of the Wisconsin ice sheet and it extends from the till plain of the ground moraine in which the western part lies, to the terminal moraine which surrounds the eastern end.

Ecologically the present flora of Buckeye Lake is an example on a large scale of secondary invasion. Until recently a swamp forest, then denuded by submergence, there was provided a rich peat substratum for the present lake vegetation. With the

exception of Cranberry and two smaller islands near the east shore, the flora belongs to the present climatic conditions of the region. That invasion and migration are rapid and where not disturbed by man, successful, is shown almost everywhere in the lake. After ecesis the normal succession of fixed aquatics by marsh societies and these by shrub or, if adjacent to cultivated field or pastures, by ruderal societies follows rapidly and surely. The climax stage, the mesophytic forest, a remnant of the "Big



FIG. 31. Exposed mat of peat at margin of Cranberry Island.

Swamp" forest, forms almost everywhere a marginal fringe; and readily extends into the new territory as soon as a suitable habitat is provided. More than half, possibly three-fourths of the lake is not too deep for the pioneers, *Nelumbo lutea*, *Polygonum emersum*, *Castalia tuberosa* and *Potamogeton lonchites*, *pectinatus* and *natans* to become established. Floating macroscopic plants seem to have but little part in building up the flora. They are present only in limited and local areas in sheltered situations and shallow water where they have been preceded by fixed aquatics.

The plankton or floating microscopic organisms have not yet been studied.

During periods of low water large areas of peat are exposed. Such a mat is shown in Fig. 31, close to the margin of Cranberry Island. The tree stumps indicate that it once was a part of the forest zone of the island. The weight of living trees destroyed the buoyancy of the mat and caused it to sink. The death and removal of the timber released the load holding it down, then the lowering of the water and the warming of the mat caused the gases contained in the peat to expand and the peat to rise above the water surface. Every summer during the past five years the water has been lowered from a few to 6.85 feet. As it is late summer when this has been done the peat in the shallower portions of the lake, becomes warmed and rises to the surface. Very soon after exposure the surface is covered with *Bidens cernua*, *B. discoidea* and *B. frondosa*, with these are often associated *Cyperus strigosus* and *Echinochloa walteri*. Such peat mats bordering Cranberry Island are often veritable carpets of gold. When the water level is restored the peat is submerged and the vegetation disappears.

Cranberry Island has a longer record. The bog-meadow is a relic of the flora of the climatic conditions which prevailed at the close of each ice invasion, or perhaps more correctly at the beginning of each interglacial period. The vegetation may be very old or it may be post-Wisconsin; the position of the lake basin on the Wisconsin drift sheet would indicate the latter.

The meadow was undoubtedly much larger than it now is; but the former extent of the *Sphagnum-Oxycoccus* mat cannot now be determined. Soundings in the bog show that *Sphagnum* peat extends to a depth of 14 feet, forming a coarse fibered, loosely aggregated peat, with many water pockets. At 14 feet the core contained fragments of *Potamogeton* and *Scirpus lacustris* imbedded in a dark brown plastic peat. The stratum of dark brown peat with sedge remains is approximately 8 feet thick and is underlain by a more or less sandy marl containing small shells; beneath this varying from the 28-foot depth to the

40-foot level is a fine-grained blue clay. The peat deposit is thicker towards the south than towards the north side of the island²². The vertical section indicates by the marly deposits at the bottom of the series the presence of Characeae and Cyanophyceae; ²³ ²⁴ above this a long interval of a sedge bog and finally a Sphagnum-Cranberry bog. The bog developed as a marginal formation in the old lake and at the time of the beginning of the reservoir was more or less surrounded by the forest. Whether there was but the one or several Cranberry fields in the swamp I cannot determine. The report of cranberries growing in the northern part of Thorn Township, if correct, would mean either the extension of the present bog over a larger area to the south and east, or several small bogs. When in 1828 the old reservoir was completed and the waters rose and covered the swamp, the bog too was submerged. Near the shore, however, the lake as now must have been shallow and the light spongy sphagnum mat was soon enabled to rise to the surface. The current belief that it was at first a floating island appearing now here now there in the lake, seems unfounded. Mr. Gabriel Gritten, a man now 85 years old and hence five years older than the reservoir, lived in Millersport at the time and remembers having been on the island when he was a boy of eight. He says it was always where it now is and was like the present island except that there were no trees.

At the present time, in this restricted area, plants from a southeastern center of dispersal and which have been in the Ohio valley so long as to be recognized as endemic, have overtaken a small company of stragglers of the last great northward retreat, and the inevitable struggle for existence and supremacy results. Surrounded by a mesophytic forest, with meadows and fields close at hand the disseminules of many species find their way into the bog. That many invaders have entered the field before the soil was prepared for them is attested by dead or partially dead maples, alders and Rhus scattered thru the meadow; but that in the main the invasion is successful is demonstrated by the numerous copses of the same and allied trees and shrubs, which finally become confluent and in time will usurp the whole area.

ANNOTATED LIST OF PLANTS FROM BUCKEYE LAKE.

The following list is based on the plants collected at Buckeye Lake by myself and others. It is as yet incomplete as but few of the Thallophyta have been listed. This is due to the lesser prominence phytogeographically of this group and also to the want of adequate means of identifying them. It is hoped in the near future to greatly extend the list especially among the Thallophyta. Gill fungi are quite abundant in the forest zone of the shore and larger islands but few have as yet been identified. The plants are given in order beginning with the most primitive, the name of the series, class and family as well as the technical name of each plant is given.

THALLOPHTA

Myxomycetae

Physareae.

Badhamia papaveracea Beck and Rav. On leaf of *Osmunda regalis* and on a twig. Both leaf and twig were lying at the edge of a small pool in the forest zone of Cranberry Island.

ALGAE

Cyanophyceae

Nostocaceae

Nostoc cuticulare (Brebisson) Bornet and Flahault. Generally distributed on the leaves of *Potamogeton* and other aquatics.
N. pruniforme (Linn.) Agardh. Occurs in abundance in small shallow pools in the bog meadow of Cranberry Island.
N. coeruleum Lyngb. Small pools in the bog meadow of Cranberry Island.

N. sp. In shallow pools, clinging in clusters to the sphagnum and cranberry stems lining the basin. Bog meadow, Cranberry Island.

N. sp. Frequently found in the large hyaline cells of sphagnum.
Anabaena sp. Forms a fine green powdery layer over the surface of the ponds and lagoons at the margin of Cranberry Island.

Conjugatae

Mougeotiaceae.

Mougeotia sp. In the ponds of the bog meadow, Cranberry Island.

Spirogyraceae.

Spirogyra sp. Various species of Spirogyra are quite abundant and of general distribution in shallow water.

Protococcae

Protococcaceae.

Chlorochytrium lemnae Cohn. Endophytic in the leaves of Lemna trisulca.

Siphoneae.

Cladophoraceae.

Cladophora sp. Of general distribution in shallow water.

FUNGI.

Pyrenomycetae.

Erisibaceae.

Erisiphe cichoracearum DC. On leaves of Aster puniceus, shrub zone, Cranberry Island.

Discomycetae.

Helotiaceae.

Phialea scutula (Pers.) Gill. (*Helotium scutula* (Pers.) Karst.)
On dead Hibiscus stems Orchard Island.

Basidiomycetae.

Agaricaceae.

Agaricus campestris L. On ground, forest zone Orchard Is. and often very abundant on the grassy slopes of the levee on the north shore and in the fields bordering the south shore of the lake.

Hygrophorus miniatus sphagnophilus Pk. Abundantly associated with *Sphagnum* on Cranberry and other bog Islands.

Naucoria paludosella Atkinson. Abundant on the ground in the shrub and tree zones, Cranberry Island.

Polyporaceae.

Stereum sericeum Schw. On *Alnus* branches, shrub zone, Cranberry Is.

Irpex tulipifera Fr. On dead *Rhus* twigs, shrub zone, Cranberry Island.

Coriolus versicolor (L.) Murrill. On fallen tree trunk, shrub zone, Cranberry Island.

Polyporus ferruginosus Schrad. On fallen twigs, shrub zone, Cranberry Island.

Clavaria vermicularis Scop. Growing among diseased sphagnum in the southern extremity of the bog-meadow, Cranberry Island.

Gastromycetae.

Lycoperdaceae.

Lycoperdon wrightii Bk. and Curt. On ground in forest zone, Orchard Island.

Sphaerioideae.

Sphaeriopsidaceae.

Phyllosticta acericola C. and E. On the leaves of *Acer rubrum*. Especially abundant on seeding maples. The small leaves are almost covered with the discolored spots caused by the fungus.

Hyphomycetae.

Derматиaceae.

Cercospora sp. On the leaves of *Decodon verticillatus*. Bog plants are rather conspicuously free from parasitic fungi infesting their stems and leaves; but *Acer rubrum* and *Decodon* on Cranberry Is. are both badly infested and injured by fungi.

Lichenes.

Gyalectaceae.

Gyalecta lutea (Dick) Tuck. On diseased sphagnum. Bog meadow, Cranberry Island.

Lecideaceae.

Lecidia uliginosa. On diseased sphagnum, bog-meadow, Cranberry Island.

Parmeliaceae.

Parmelia cylisphora (Ach.) (*P. caperata* (L.) Ach.) On dead Alnus, forest zone, Cranberry Island.

P. tiliacea (Hoffm.) Ach. On branch of Alnus, forest zone, Cranberry Island.

BRYOPHYTA.

Hepaticae

Ricciaceae.

Riccia fluitans (L.) Occurs in abundance in small pools near the southern end of the bog-meadow on Cranberry Island; and also in the shallow waters or stranded on the mud at the margin of many of the other islands and the lake shore.

Metzgeriaceae.

Pallavicinia lyellii (Hook.) S. F. Gray. Thickly covering the ground over small areas of the drier portions of the forest association, also at the margins of small pools in the thicket and forest zones; and in areas of diseased sphagnum in the bog-meadow of Cranberry Island. It occurs also on the two smaller bog islands.

Jungermanniaceae.

- Cephalozia connivena* (Dicks.) Lindb. Occurs on the ground over small areas in the drier parts of the forest association, Cranberry Island.
- C. lunulaefolia* Dumort. This species grows in dense masses over small areas in the drier portions of the forest association, Cranberry Island.

Sphagneae

Sphagnaceae.

- Sphagnum Cymbifolium* Ehrh. The most abundant species of *Sphagnum* of the bog-meadow, thicket and forest on Cranberry Island. Also the two smaller islands towards the northeast on which sphagnum occurs.
- S. parvifolium* (Sendt.) Warnst. Thicket where water level is high, east side of Cranberry Island.
- S. acutifolium* var. *versicolor*. Covers quite large areas in the western portion of the bog-meadow and is invading the heath zone, Cranberry Island.
- S. recurvum* Beauv. Bog-meadow, northern portion, Cranberry Island.
- S. recurvum* var. *amblyphyllum*. Thicket southeast side of Cranberry Island.

Musci

Dicranaceae.

- Dicranum flagellare* Hedw. Bog-meadow in patches of diseased sphagnum, Cranberry Island.

Pottiaceae.

- Pottia truncatulata* (L.) Lindb. On the ground in ruderal zone north side of Lieb's Island; on base of tree, Rabbit Island.

Aulocomniaceae.

Aulocomnium palustre (L.) Schwaeger. Very common in the thicket and forest zones and also occurring in the bog-meadow in patches denuded by the death of the sphagnum. Cranberry Island and the two smaller bog islands.

Polytrichaceae.

Polytrichum commune L. Quite widely distributed in the woods. In the bog-meadow it forms dense masses at the summits of hummocks surrounded by shrubs and is also replacing the dead sphagnum in the bog-meadow of Cranberry Island.

Climaciaceae.

Climacium americanum Brid. Forest association, Cranberry Island.

C. americanum var. *kinderbergii* R. and C. Forest zone, Sphagnum bog Island No. 2.

Entodotaceae.

Pylaisia intricata (Hedw.) Cardot. On tree trunk, wooded belt, northeast border of Cranberry Island.

Leskeaceae.

Thuidium virginianum (Brid.) Lindb. On tree trunks, wooded border, Cranberry Island.

T. delicatulum (L.) Mist. On the ground, forest zone east side of Cranberry Island; forest zone, Sphagnum bog Island No. 2.

T. recognitum or *delicatulum*. On the ground underneath the trees and in small pools, wooded zone, Cranberry Island.

T. paludosum Sulliv. Rau and Hervey. On ground, wooded border of Cranberry Island.

Hypnaceae.

- Amblystegium varium* (L.) Hedw. On ground, wooded zone, Cranberry Island.
- A. riparium* (Hedw.) B. S. Margin of small pools in wooded border of Cranberry Island.
- A. kochii* B. S. On ground, forest zone, northeast side of Cranberry Island.

Brachytheciaceae.

- Brachythecium plumosum* (Sw.) On the ground, wooded zone Cranberry Island; and *Nelumbo-Polygonum* society, Orchard Island.

PTERIDOPHYTA

Filices

Osmundaceae.

- Osmunda regalis* L. Generally distributed throughout the thicket and forest zones, also quite frequent in the bog-meadow, Cranberry Island. Occurs also on two smaller islands towards the northeast.
- O. cinnamomea* L. Generally distributed throughout Cranberry and the two small similar islands. The largest and most abundant fern.

Polypodiaceae.

- Adiantum pedatum* L. Forest, Rabbit Island. Not abundant.
- Dryopteris thelypteris* (L.) A. Gr. Generally distributed throughout the thicket and forest zones and frequent in the bog-meadow, covering appreciable areas in the southwestern portion. Cranberry Island and also other islands.
- D. cristata* (L.) A. Gr. Quite generally distributed throughout the thicket and forest zones, Cranberry and other islands.
- D. spinulosa* (Retz.) Kuntze. In well shaded situations of the forest zone, Cranberry Island.

Equiseteteae

Equisitaceae.

Equisetum arvense L. Edge of marsh at foot of Baltimore and Ohio rail road embankment, east shore of Lake; ruderal society, Honey Creek.

ANGIOSPERMAE

Monocotylae

Typhaceae.

Typha latifolia L. Of general distribution in the shallow waters of the lake, at land margins and in the interior of many islands.

T. angustifolia L. Of general distribution in the lake, but less frequent than the former on shores and does not occur on the islands. Generally requires deeper water than the former species.

Sparganiaceae.

Sparganium eurycarpum Englm. Associated with *Typha latifolia* whenever the latter occurs abundantly.

Najadaceae.

Potamogeton natans L. Of general distribution in water $5\frac{1}{2}$ and less feet deep.

P. lonchites Tuckerm. Most abundant species and most widely distributed from water $5\frac{1}{2}$ feet deep to stranded on the shore.

P. lucens L. Two plants east of and near Beech Island.

P. zosterifolius Schumacher. Generally distributed forming dense mats in shallow water in sheltered situations.

P. pusillus L. Not very abundant but generally distributed.

P. foliosus Raf. Marsh east of Custer's Point and near small islands north of Cranberry Island.

P. pectinatus L. Abundant and widely distributed in water from $5\frac{1}{2}$ feet deep to stranded on low shores.

Juncaginaceae.

Scheuchzeria palustris L. Frequent and quite widely distributed in the bog-meadow, Cranberry Island.

Alismaceae.

Sagittaria latifolia Willd. Generally distributed in the marshes, and in southern portion of the bog-meadow.

Alisma plantago-aquatica L. Lewis Island; *Polygonum-Scirpus* society, Orchard Island.

Hydrocharitaceae.

Philotria canadensis (Mx.) Britt. In the shallow waters of the lake and ditches back of the levee.

Gramineae.

Panicum capillare L. Cranberry Island, eastern margin of bog-meadow, rare.

Echinochloa walteri (Pursh.) Nash. Abundant and widely distributed on low muddy shores.

Chaetochloa glauca L. *Ulmus-Fraxinus* society, Orchard Island; Cultivated ground, Lieb's Island; and along the lake shore.

Zizania palustris L. Marsh bordering east shore of lake.

Homalocenchrus oryzoides (L.) Poll. On the margin of Cranberry Island, very abundant on the mud flat at the mouth of Honey Creek and in the cove east of Summerland beach.

Syntherisma linearis (Krock.) Forest association of the majority of the islands.

S. sanguinalis (L.) Same distribution as the preceding.

Muhlenbergia diffusa Schreb. Of general distribution in open situations and also in the *Hibiscus moscheutos* societies, Orchard Island.

M. racemosa (Mx.) B. S. P. In the mud at the margin of the east side of Cranberry Island, and on the small island immediately north of Cranberry Island.

Phleum pratense L. Margin of wood bordering the lake.

- Cinna arundinacea* L. Swampy wooded margin of Lieb's Island.
- Agrostis alba* L. Quite common in fields and open borders.
- A. perennans* (Walt.) Tuckerm. Ulmus-Fraxinus society, Orchard Island.
- Calamagrostis canadensis* (Mx.) Beauv. Northwest portion of wooded border and at the extreme margin of the southeast lobe of Cranberry Island.
- Phragmites phragmites* (L.) Karst. In the marsh at the foot of the Baltimore and Ohio railroad embankment on the east shore of the lake and south of Avondale. This is up to the present the southernmost station for this grass in Ohio.
- Eragrostis hypnoides* (Lam.) B. S. P. In the mud in the open spaces of a small island immediately to the north of Cranberry Island. Occurs also on recently exposed peat masses.
- Poa pratensis* L. Common on grassy shores and islands, as Lieb's and Lewis Islands.
- Panicularia nervata* (Willd.) Kuntze. At the water's edge of the extreme south lobe of Cranberry Island, and on the mud flat at the mouth of Honey Creek.
- P. fluitans* (L.) Kuntze. Abundant in the marsh bordering the north shore of the eastern portion of the lake and east of Custer's Point south shore.
- Festuca elatior* L. Mud flat at mouth of Honey Creek.

Cyperaceae.

- Cyperus erythrorhizos* Muhl. At water's edge of wooded zone in northeast part of Cranberry Island. On masses of peat in lake.
- C. strigosus* L. Widely distributed on low shores, masses of peat and Cranberry Island, often occurring as mat plants on mud flats.
- Dulichium arundinaceum* (L.) Britt. Abundant and generally distributed in the bog-meadow; less abundant in the thicket and forest zones of Cranberry Island.

- Eleocharis obtusa* (Willd.) Schultes. Generally distributed in low wet ground.
- E. palustris* (L.) R. & S. Occurs sparingly in forest zone, Cranberry Island.
- E. palustris* var. *glaucescens* (Willd.) Gray. Close to a small pool in southwest portion of bog-meadow, Cranberry Island.
- E. acicularis* (L.) R. & S. Copious and widely distributed on low muddy shores.
- E. tenuis* (Willd.) Schultes. In the southeast portion of the bog-meadow, Cranberry Island.
- Scirpus lacustris* L. Quite generally distributed in shallow water and occurs on Cranberry Island at the margin of several pools.
- S. fluviatilis* (Torr.) Gray. Widely distributed and abundant in the marshes and bog.
- S. atrovirens* Muhl. Sedge zone, shore of Honey Creek.
- S. cyperinus* (L.) Bog-meadow, Cranberry Island.
- Eriophorum polystachyon* L. Cranberry Island, bog-meadow.
- E. virginicum* L. Generally but scatteringly distributed through the bog-meadow, Cranberry Island.
- Rhynchospora alba* (L.) Vahl. Abundant and generally distributed where the water level is high in the bog-meadow, Cranberry Island. At the margin of the forest, Orchard Island, and other wooded islands.
- Carex asa-grayi* Bailey. Swampy woods along the south shore of the lake.
- C. lupulina* Muhl. Generally distributed in the marshy borders of the lake.
- C. tuckermanni* Dewey. Swamp woods along the south shore of the lake.
- C. lurida* Vahl. Very common in the ditches and swampy wooded borders of the lake.
- C. pseudo-cyperus* L. In the swampy wooded borders of the lake, wooded islands and also at the margin of Cranberry Island.

- C. *comosa* Boott. In the swampy borders of the lake, islands and Cranberry bog.
- C. *frankii* Kunth. A very common sedge of the ditches and swampy borders of the lake.
- C. *squarrosa* L. Low swampy woods at margin of lake.
- C. *typhinoides* Schw. Low swampy woods at margin of lake.
- C. *filiformis* L. Bog-meadow, Cranberry Island where water level is high, but not near margin of island.
- C. *stricta* Lam. Bog-meadow, at margin of thicket in southeastern portion of Cranberry Island.
- C. *aquatilis* Wahl. Bog-meadow near pools in southern portion of Cranberry Island.
- C. *limosa* L. Abundant in small pool in northern portion of bog-meadow and among the Sphagnum and Oxycoccus in the northeastern portion of the bog-meadow, Cranberry Island.
- C. *laxiflora blanda* (Dewey) Boott. Charleston Island, drier portion.
- C. *leptalea* Wahl. Bog-meadow near margin of a pool, eastern portion of Cranberry Island.
- C. *conjuncta* Boott. Lewis and other wooded islands in eastern portion of lake.
- C. *stipata* Muhl. A few plants at the western edge of the southern lobe of Cranberry Island.
- C. *decomposita* Muhl. In two situations, at the base of a dead Alder at the water's edge of a small island bordering Cranberry Island on the east; and in the forest at the edge of a marginal pond on the east side of Cranberry Island. Reported for the state but no specimens in the State Herbarium up to the finding of the plant on Cranberry bog.
- C. *diandra* Schranck. Near a small pool, eastern portion of bog-meadow, Cranberry Island.
- C. *diandra* var. *ramosa* (Boott.) Same situation as the preceding.
- C. *vulpinoides* Michx. At the water's edge of the long southern lobe of Cranberry Island and in wet woods at margin of lake and on wooded islands.

- C. retroflexa Muhl. Thicket, Cranberry Island; and woods at margin of lake.
- C. sparganioides Muhl. Woods at margin of lake.
- C. interior Bailey. Abundant and widely distributed in the shrub and forest zones and at margin of bog-meadow, Cranberry Island, and other wooded islands.
- C. tribuloides Wahl. A very common species in wet situations on the borders of the lake and islands.
- C. alata Torr. Two situations on Cranberry Island, at the water's edge on the extreme southern lobe and at the edge of a pool in the thicket on the east side.

Araceae.

- Peltandra virginica* (L.) Kunth. In the marsh zone associated with *Typha* and *Decodon* of the shore and various islands and also alone or associated with *Pontederia cordata* or *Bidens* sp. in shallow water and on masses of peat.

Lemnaceae.

- Spirodela polyrhiza* (L.) Schleid. Widely distributed in the shallow waters of the lake and in ponds in the islands.
- Lemna trisulca* L. The most abundant and widely distributed floating macrophyte, often completely filling shallow depressions in Cranberry Island.
- L. minor* L. Associated with *Lemna trisulca* in the ponds of Cranberry Island and other shallow water.
- Wolffia columbiana* Karst. In several ponds in the thicket, Cranberry Island.
- W. punctata* Griseb. Associated with *W. columbiana*, Cranberry Island.
- Wolffiella floridana* (J. D. Sm.) Thomp. First discovered in 1906 in a small pool southeast side of bog-meadow at inner margin of thicket. Later in a larger marginal pool.

Pontederiaceae.

Pontederia cordata L. In shallow water north of Cranberry Island and in southern portion of lake.

Heteranthera dubia (Jacq.) MacM. In shallow water and on mud flats at margin of Orchard and State Journal Islands and north of Cranberry Island.

Juncaceae.

Juncus effusus L. Bog-meadow, occupying areas of high water level as in paths, Cranberry Island. Central portion of Lewis Island.

J. tenuis Willd. Common in grassy places on islands and the shore.

J. brachycephalus (Engelm.) Buch. In a wet depression in the southwestern portion of the Bog-meadow, Cranberry Island.

J. canadensis J. Gay. Associated with *Carex limosa* in a small pool of the bog-meadow, Cranberry Island.

Liliaceae.

Allium tricoccum Ait. Woods, Lewis and Rabbit Islands.

A. canadense L. Abundant at the edge of the wooded zone on north side of Lieb's Island along south shore of lake.

Erythronium americanum Ker. Very abundant in the rich woods north shore of Crane's pond.

E. albidum Nutt. Associated with but less abundant than *E. americanum*

Vagnera racemosa (L.) Morong. Common in woods at margin of lake, and on islands.

Salomonium biflora (Walt.) Britt. Wooded margins of the lake.

S. commutata (R. & S.) Britt. Shrub zone along eastern margin of lake.

Smilax rotundifolia L. Woods, Rabbit Island.

S. hispida Muhl. Woods, Rabbit Island and east shore of lake.

Dioscoraceae.

Dioscorea villosa L. In woods eastern margin of lake at Avondale.

Iridaceae

Iris versicolor L. Margin of forest zone at mouth of Honey creek and in swampy wood north of Lakeside.

Orchidaceae.

Habenaria clavellata (Mx.) Spreng. Common in forest of Cranberry Island and in the Sphagnum bog Island No. 2.

H. lacera (Michx.) R. Br. Frequent in wooded border Cranberry Island. In the center of Lewis Island the orchid was growing among *Solidago*.

H. leucophaea (Nutt.) Gray. Two plants found in thicket southeast side Cranberry Island.

Pogonia ophioglossoides (L.) Ker. Quite generally distributed in the thicket and in the Bog-meadow near margin of thicket, Cranberry Island.

Calopogon pulchellus (Sw.) R. Br. Abundant near the margin of the Bog-meadow, Cranberry Island.

Arethusa bulbosa L. Near the margin of the Bog-meadow, Cranberry Island.

Gyrostachys cernua (L.) Kuntze. Thicket southeast portion of Cranberry Island.

Dicotylae.

Salicaceae.

Populus deltoides Marsh. Buckeye Park, margin of Crane's pond and levee north and west shores of lake.

Salix nigra Marsh. The most widely distributed species at the margins of the islands and lake, along the canal and on the levee.

S. alba L. Next to *S. nigra* the most common and widely distributed *Salix*.

S. sericea Marsh. Margin of thicket, Cranberry Island.

S. petiolaris J. E. Smith. Margin of thicket, Cranberry Island, and other smaller islands more abundant than the preceding.

S. discolor Muhl. Most abundant and widely distributed shrub
Salix. Shores and margins of islands.

Juglandaceae.

Juglans nigra L. An occasional tree on the levee, north shore
of lake.

Hicoria minima (Marsh.) Britt. Forest zone, Orchard Island.

H. ovata (Mill.) Britt. Quite generally distributed along the
borders of the lake and on the forested islands.

Betulaceae.

Carpinus carolinianus Walt. One tree on Rabbit Island.

Alnus rugosa (DuRoi) Spreng. One of the dominant shrubs of
the forest and thicket of Cranberry and other swampy islands
in the eastern portion of the lake. Occurring also as isolated,
often half dead shrubs in the bog-meadow of Cranberry
Island.

Fagaceae.

Fagus americana Sweet. A dominant tree of the forest north of
Cranberry Island and of Rabbit Island and Buckeye Point.

Castanea dentata (Marsh.) Borkh. A lane of trees (planted) on
Lieb's Island.

Quercus bicolor Willd. Sparingly on the levee, north side of
lake.

Q. rubra L. Sparingly on the levee, north side of lake, and wood
north of Cranberry Island.

Q. palustris Moench. The most abundant and widely distributed
oak. Besides occurring everywhere along the shore and
wooded islands it has also invaded the bog. One young tree
and many seedlings are growing on Cranberry Island and also
seedlings on the Sphagnum bog Island No. 2.

Q. imbricaria Mx. Not as abundant but quite as generally dis-
tributed as *Q. palustris*.

Ulmaceae.

- Ulmus americana* L. Abundant and widely distributed, the dominant tree in the forest zone of the lake shores and islands. Has not yet invaded the bog.
- U. fulva* Mx. Sparingly on the levee, Orchard and other wooded islands.
- Celtis occidentalis* L. A few trees on the levee along north shore of lake, in woods near Avondale, and one tree on Rabbit Island.

Moraceae.

- Morus rubra* L. Orchard Island.
- Humulus lupulus* L. One vine east shore of lake south of Avondale.

Urticaceae.

- Urtica dioica* L. A very common herb in the forest zone of the shore, Lewis and Charleston Islands.
- Urtica gracilis* Ait. Forest zone, islands and shore.
- Adicea pumila* (L.) Raf. Common in thicket at margins of pools Cranberry Island, swampy woods along the shore and on other islands.
- Boehmeria cylindrica* (L.) Willd. Common and very generally distributed in swampy woods and in the bog thicket of Cranberry Island.

Polygonaceae.

- Rumex brittanica* L. Common in marsh zone Cranberry Island.
- R. crispus* L. Rather common along the margin of the lake.
- R. verticillatus* L. At water's edge, Cranberry Island.
- R. obtusifolius* L. Orchard Island, forest zone. Lieb's Island, ruderal zone.
- Polygonum hartwrightii* A. Gray. Zone of ruderals north side of Lieb's Island.
- P. emersum* (Mx.) Britt. Abundant and widely distributed, grows in the lake at a depth of 5½ feet, forms large mats in shallower water, forms well defined zones along shores and grows also on exposed mud flats.

P. persicaria L. Zone of ruderals, Lieb's Island.

P. punctatum Ell. (*P. acre* H. B. K.) In shrub zone and at margins of pools Cranberry Island; on mud flats of other islands and the shore of lake.

P. hydropiperoides Michx. Thicket, Cranberry Island.

P. sagittatum L. Mud flat of cove east of Summerland beach.

P. arifolium L. In mud at water's edge of shrub zone and margin of pools in the south side of Cranberry Island.

Amaranthaceae.

Amaranthus hybridus L. Small island north of Cranberry Island, Polygonum-Scirpus society, Orchard Island.

Acnida tamariscina (Nutt.) Wood. On mud of small island north of Cranberry Island.

Portulacaceae.

Claytonia virginica L. Abundant in woods north of lake.

Portulaca oleracea L. Cultivated fields bordering the lake.

Nymphaeaceae.

Nymphaea advena Soland. Quite generally distributed in shallow sequestered portions of the lake, most abundant in the extreme northern and southern lobes; two small clumps stranded in Cranberry bog.

Castalia tuberosa (Paine) Greene. Abundant and widely distributed, often associated with *Nelumbo lutea* growing at a depth of 5 feet.

Nelumbo lutea (Willd.) Pers. The most conspicuous in point of numbers, size and attractiveness of plant, fixed aquatic in the lake. Covering large areas in water down to 5½ feet deep in all portions of the lake except the extreme northern lobe.

Ceratophyllaceae.

Ceratophyllum demersum L. Forms dense and extensive submerged mats in ponds in the bog, in more or less protected coves of the lake, and less copious along the shores of lake and islands.

Anonaceae.

Asimina triloba (L.) Dunal. Woods, Rabbit Island.

Ranunculaceae.

Caltha palustris L. Swamp woods south shore of lake.

Syndesmon thalictroides. (L.) Hoffing. Woods, north border of lake.

Batrachium trichophyllum (Chaix.) Bossch. In a small pool southeast side of Cranberry Island, quite abundant south of the bridge in the extreme southeast lobe of lake west of Thornville station.

B. divaricatum (Schrank.) Wimm. (*Ranunculus circinatus*.) In shallow water in southern lobe of lake.

Berberidaceae.

Caulophyllum thalictroides (L.) Michx. Quite abundant in the woods on Rabbit Island and Buckeye Point.

Lauraceae.

Benzoin benzoin (L.) Coult. Rabbit Island.

Papaveraceae.

Bicuculla cucullaria (L.) Millsp. Woods bordering north shore of lake.

Cruciferae.

Lepidium campestre (L.) R. Br. Common in fields along shore of lake.

Roripa palustris (L.) Bess. Quite common near the water's edge of the shrub zone, Cranberry Island.

R. americana (A. Gr.) Britt. Shrub zone Cranberry Island.

Cardamine pennsylvanica Muhl. Marsh back of levee, Seller's Point.

C. bulbosa (Schreb.) B. S. P. Abundant in wet situations in the shrub zone, Cranberry Island.

Dentaria laciniata Muhl. Rich wet woods north of Crane pond.

Droseraceae.

Drosera rotundifolia L. Common and widely distributed in the bog-meadow, associated with *Sphagnum*, Cranberry Island and Cranberry Island No. 2.

Penthoraceae.

Penthorum sedoides L. Hibiscus zone, cove east of Summerland beach and also wooded islands and low shores.

Platanaceae.

Platanus occidentalis L. Occurs on the levee and on low shores. A frequent tree.

Rosaceae.

Rubus occidentalis L. Shrub zone Lieb's Island.

R. nigrobaccus Bailey. Common and very generally distributed along the lake shore and islands.

R. hispidus L. East end of small *Sphagnum*-bog island.

Comarum palustre L. Common in the shrub and forest zones of Cranberry Island.

Potentilla monspeliensis L. Ruderal zone, cove east of Summerland beach.

Geum canadense Jacq. Widely distributed on low ground of margin of lake and islands.

Rosa carolina L. Very abundant in the marsh zone of the cranberry bog, Orchard and other islands.

Malus malus (L.) An occasional tree planted on the levee and forming a lane of alternating Apple and Chestnut trees on Lieb's Island.

Aronia arbutifolia (L.) Medic. Generally distributed thru the thicket and forest zones of Cranberry Islands 1 and 2.

A. atropurpurea Britt. In thicket Cranberry Island, but less common than *A. arbutifolia*.

A. nigra (Willd.) Britt. Quite generally distributed in the shrub and forest zones of Cranberry Island.

Crataegus sp. One tree in wood north of Cranberry Island.

Prunus americana Marsh. East embankment of Southwest Feeder where it is abundant over a small area.

P. serotina Ehrh. Formerly one of the large and quite abundant forest trees in the vicinity of the lake. A fair number still remains. It has also invaded the Cranberry bog, on which in the forest of the east side is one young tree.

Amygdalus persica L. An occasional tree planted near cottages.

Leguminosae.

Gleditsia triacanthos L. Common along the levee and shores of the lake and the larger islands.

Meibomia viridiflora (L.) Kuntze. Forest, Orchard Island.

Lathyrus palustris var. *linearifolius* Ser. Sparingly at margins of pools in eastern and southeastern portions of Cranberry Islands.

Apios apios (L.) MacM. Quite abundant in the thicket, Cranberry Island.

Oxalidaceae.

Oxalis cymosa Small. Common in woods of shores and islands.

O. stricta L. Quite as common and generally distributed as *O. cymosa*, more common in drier situations.

Euphorbiaceae.

Euphorbia corollata L. Dry ground at edge of marsh west of the Baltimore and Ohio rail road tracks, south of Avondale.

Anacardiaceae.

Rhus glabra L. On Orchard, State Journal, Lewis and Lieb's islands and along the embankment of southwest feeder of the canal.

R. vernix L. The most abundant and widely distributed shrub on Cranberry and several smaller islands to the east. It finds optimum conditions in the wooded zone but numerous stunted, half dead shrubs are scattered thru the bog-meadow of Cranberry Island.

R. radicans L. The most common liane on the forested shores and islands.

Ilicaceae.

Ilex verticillata Ait. Quite abundant near the water's edge of the forest zone of Cranberry Island.

Celastraceae.

Celastrus scandens L. Copse east side of Lieb's Island and woods south shore of lake.

Aceraceae.

Acer saccharinum L. An occasional tree along the levee and in the park.

A. rubrum L. Of general distribution along the shores and on the islands, the only tree occurring abundantly on the bog island.

A. saccharum Marsh. Wood, shore of lake north of Cranberry Island.

A. negundo L. Woods north of Crane pond.

Balsaminaceae.

Impatiens biflora Walt. Very common and abundant in the marsh along shores of lake and islands.

Rhamnaceae.

Rhamnus lanceolata Pursh. East embankment of Southwest Feder.

Vitaceae.

Vitis labrusca L. Quite common in forest along shores and on islands.

V. aestivalis Mx. Same situations as *V. labrusca*.

Parthenocissus quinquefolia (L.) Planch. Forest, Orchard Island.

Malvaceae.

- Malva rotundifolia* L. Along the levee, door yards of cottages and in fields.
- Hibiscus moscheutos* L. A common and conspicuous plant in the marsh.

Hypericaceae.

- Hypericum perforatum* L. Transition zone between marsh and ruderales cove east of Summerland beach.
- H. multilum* L. North shore of Orchard Island in the Polygonum-Scirpus society.
- Triadenum virginicum* (L.) Raf. An abundant plant in the marsh and thicket of Cranberry Island and the Sphagnum-bog Island No. 2.

Violaceae.

- Viola papilionacea* Pursh. Woods along the shore.
- V. blanda* Willd. In the thicket generally at margins of pools, sparingly at margins of pools in open zone, Cranberry Island and Sphagnum-bog Island No. 2.

Lythraceae.

- Decodon verticillatus* (L.) Ell. A common and widespread marsh shrub.

Onagraceae.

- Epilobium strictum* Muhl. Scatteringly at margins of the island and of pools, south and east sides of Cranberry Island. In *Hibiscus-Typha* society on south side of Orchard Island.
- Onagra biennis* (L.) Scop. A common ruderal of lake shores and the drier open portions of some islands as Crawford's. In 1910 two plants were found in the bog beside a fallen maple on the cleared southern lobe of Cranberry Island.

Haloragidaceae.

- Proserpinaca palustris* L. Two plants were found in 1910 in the shallow water at western margin of southern lobe of Cranberry Island.

Myriophyllum spicatum L. In shallow water near the north, west and extreme southern portions of the lake.

Umbelliferae.

Sanicula canadensis L. Lewis Island.

Cicuta bulbifera L. Marsh of Cranberry and Orchard Islands.

Sium cicutaefolium Gmel. Thicket, southern lobe of Cranberry Island, and small swampy islands to the southeast.

Angelica atropurpurea L. Abundant in willow zone, mouth of Honey creek.

Cornaceae.

Cornus florida L. Rattlesnake Island and wooded hills, east shore of lake.

C. stolonifera Michx. A common shrub at the water's edge of Cranberry Island; forming the beginning of a shrub zone on other islands and along the shores of lake and bank of canal.

Nyssa sylvatica Marsh. One tree found on wooded hill, east shore of lake.

Vacciniaceae.

Gaylussacia resinosa (Ait.) T. & G. A few small areas on north side of Cranberry Island forming a low shrub or heath zone.

Oxycoccus macrocarpus (Ait.) Pers. A dominant plant of the bog-meadow; Cranberry Islands I and II.

Primulaceae.

Samolus floribundus H. B. K. Marsh, Lewis Island.

Lysimachia nummularia L. Margin of wood, east shore of lake, south of Avondale.

Naumbergia thyrsoiflora (L.) Duby. Quite abundant in the forest zone of Cranberry Island.

Oleaceae.

Fraxinus americana L. Of general distribution on wooded shores and larger islands.

F. nigra Marsh. In situations similar to that in which *F. Americana* occurs but not so abundant.

Gentianaceae.

Bartonia virginica (L.) B. S. P. Very abundant in and characteristic of the bog thicket and forest of Cranberry and Sphagnum-bog Islands.

Menyanthaceae.

Menyanthes trifoliata L. Abundantly distributed thru the thicket and places of high water level in bog-meadow of Cranberry and Sphagnum-bog Islands.

Apocynaceae.

Apocynum cannabinum L. Marsh border of forest zone, Lewis Island.

Asclepiadaceae.

Asclepias incarnata L. General in swamp woods of the shores, forested and bog islands.

A. syriaca L. Ruderal zone Lieb's Island.

Convolvulaceae.

Convolvulus sepium L. Common and generally distributed, abundant in open margin of Cranberry Island.

Cuscutaceae.

Cuscuta gronovii Willd. Abundant and widely distributed on *Impatiens biflora*, *Decodon verticillatus* and other hosts at the margin of many of the swamp islands.

Polemoniaceae.

Phlox paniculata L. Roadside, Shell beach.

P. divaricata L. General in woods of shores and several of the islands.

Verbenaceae.

- Verbena urticifolia* L. Forest, Orchard Island; ruderal society cove east of Summerland beach.
V. hastata L. Ruderal society; Charleston Island.
Lippia lanceolata Michx. Common on dry shores and drier portions of islands.

Labiatae.

- Teucrium canadense* L. Generally distributed in copses and thickets of the shore and islands.
Scutellaria lateriflora L. Very common in open margins of thickets adjacent to pools, Cranberry Island; and at edge of marsh, east shore of lake south of Avondale.
S. incana Muhl. Roadside, Shell Beach.
Nepeta cataria L. Edges of fields and roadsides.
Glechoma hederacea L. Abundant as ground cover in the forest zone, south shore of lake.
Stachys aspera Michx. Low ground south shore of lake.
Hedeoma pulegioides (L.) Pers. Forest zone, Orchard Island and other open woods.
Lycopus virginicus L. In thicket at edge of pools southeast side of Cranberry Island.
Lycopus americanus Muhl. Common on low shores and islands.
Mentha spicata L. Abundant in the willow zone, shore of Honey creek.
M. piperita L. Associated with *M. spicata*, shore of Honey creek.
M. canadensis L. (*M. arvensis* var *canadensis*) Quite abundant in the thicket of the southern part of Cranberry Island.

Solanaceae.

- Solanum nigrum* L. Lewis Island and in the fields along the shore of the lake.
S. dulcamara L. Very abundant climbing on the shrubs at the outer margin of most of the islands and also quite common along shore.

Datura stramonium L. Among the weeds, center of Charleston Island.

Scrophulariaceae.

Verbascum blattaria L. Ruderal zone, edge of cultivated field, Lieb's Island.

Chelone glabra L. Two plants were found (1910) at the margin of the Cranberry bog. Shore north of Cranberry Island.

Gratiola virginiana L. Marsh north of Seller's Point.

Ilysanthes gratioloides Benth. (*I. dubia* (L.) Barnhart) Nelyumbo-Polygonum society south shore Orchard Island.

Veronica peregrina L. Ruderal-zone north side of Lieb's Island.

Afzelia macrophylla (Nutt.) Kuntze. Quite common along the embankments of the east and northeast shores of the lake.

Gerardia paupercula (A. Gr.) Britt. Quite frequent in margins of thickets bordering pools on the south and southeast sides of Cranberry Island.

Lentibulariaceae.

Utricularia vulgaris L. Forms dense mats in small, shallow pools of the bog-meadow. Occurs also in the marsh of the southern lobe of the lake at Thornville Station.

U. minor L. Occurs frequently associated with *Spirodela* and *Lemna* in several small, shallow pools in the southern portion of the bog-meadow, Cranberry Island.

Orobanchaceae.

Leptamnium virginianum (L.) Raf. On Beech roots, Rabbit Island.

Acanthaceae.

Dianthera americana L. Forms a rather dense growth over a small area at the western margin of the southern lobe of Cranberry Island, also quite abundant on Elm and smaller islands to the southeast of Cranberry Island.

Plantaginaceae.

Plantago rugelii Dec. Ruderal-zone north side of Lieb's Island. Common on the lawns of Summerland Beach, the Park, and other places.

Rubiaceae.

Cephalanthus occidentalis L. A common swamp shrub, very generally distributed.

Galium circaezans Michx. Center of Lewis Island.

G. trifidum L. Generally distributed on low, wet shores and in the Cranberry bog in the southern part where there are many pools.

G. concinnum T. & G. Lewis Island.

G. asprellum Michx. Thicket among the pools southern portion of Cranberry Island.

Caprifoliaceae.

Sambucus canadensis L. In the forest and shrub zones of Cranberry Island and other islands and lake shore, common and widely distributed.

Valerianaceae.

Valerianella chenopodifolia (Pursh.) DC. Ruderal-zone north side of Lieb's Island.

Dipsacaceae.

Dipsacus sylvestris Huds. A common and conspicuous member of the ruderal societies on Lieb's Island, cove east of Summerland beach, shore of Honey creek and also where the woods of the shores border on the fields.

Cucurbitaceae.

Micrampeles lobata (Michx.) Greene. Shrub zone, Orchard Island.

Campanulaceae.

- Campanula aparinoides* Pursh. Associated with *Galium trifidum* in the more open thickets at the edges of pools in the southern part of Cranberry Island.
- Specularia perfoliata* (L.) A. DC. Edge of forest border south of Avondale on margin of lake.

Cichoriaceae.

- Taraxacum taraxacum* (L.) Karst. Door yards of cottages and in meadows.
- Lactuca scariola* L. Margin in levee north and west shores of lake.
- Canadensis* L. Baltimore and Ohio railroad embankment at edge of marsh east side of lake.

Ambrosiaceae.

- Ambrosia trifida* L. Very abundant at inner margin of forest zone where it abuts on the cultivated field, Lieb's Island. A common weed in other ruderal societies.
- A. artemisiaefolia* L. Very common and generally distributed in drier situations as railroad embankments, the levee, and door yards.
- Xanthium spinosum* L. Western portion of Charleston Island.

Compositae.

- Vernonia noveboracensis* (L.) Willd. Ruderal-zone western portion of Charleston Island.
- Eupatorium perfoliatum* L. Common on low, wet, open ground. Not a bog plant but was found in 1910 on the extreme southern lobe of the bog.
- E. ageratoides* Lf. Quite common in the forest zone of the shores and islands and has also invaded the southeastern portion of Cranberry-bog.

Solidago uliginosa Nutt. Of frequent occurrence in the shrub and forest zones of Cranberry Island and the other bog islands.

S. patula Muhl. Sphagnum bog Island No. 2.

S. canadensis L. In the *Scirpus* zone of Lieb's Island; abundant on Lewis and other islands and also on low, wet ground along shore.

Aster puniceus L. Of frequent occurrence in the inner margin of the wooded belt of Cranberry Island; also on the Sphagnum bog Island No. 2.

A. puniceus var. *lucidulus* Gray. One specimen collected by Walter Fischer on Cranberry Island.

A. paniculatus Lam. Quite generally distributed in the thicket and in the open bog on the south and southeast sides of Cranberry Island.

A. ericoides L. Ruderal zone west side of Charleston Island.

Erigeron canadensis L. Common at edges of fields and drier situations in forest zones. It has also invaded the eastern border of the southern portion of the bog.

Polymnia canadensis L. Quite abundant in forest of Rabbit Island.

Eclipta alba (L.) Hassk. Growing in the mud of a small marginal island north of the Cranberry bog.

Helianthus tuberosa L. Edge of marsh, east shore of lake south of Avondale.

Verbesina alternifolia (L.) Britt. Ruderal zone west side of Charleston Island.

Bidens cernua L. Abundant and widely distributed in the marsh areas, wherever masses of exposed peat are carpeted with vegetation. Occurs also on floating rotten logs and exposed root masses.

B. comosa (A. Gr.) Wiegand. Western margin of southern lobe of Cranberry Island.

B. discoidea (T. & G.) Britt. Very abundant on exposed peat shelves at the margin of Cranberry Island; on floating logs and also on the stalks and exposed masses of *Typha* and

Hibiscus; also on masses of exposed peat in the lake. This species with *B. cernua* and *B. frondosa* forms a veritable golden carpet over masses of peat which come to the surface in the lake. The *Bidens* is successful even before the surface of the peat is wholly exposed. They are generally associated with *Echinochloa walteri*.

B. frondosa L. Near outer margin of marsh of the southern lobe of Cranberry Island and on exposed masses of peat in the lake.

B. trichosperma (Mx.) Britt. Common in the shrub zone of the southeastern border of Cranberry Island.

B. trichosperma tenuiloba (A. Gr.) Britt. Local. At the margin of a pool in the southeastern side of Cranberry Island.

Achillea millefolium L. Generally distributed in edge of forest zones and fields and on the levee.

Erechtites hieracifolia (L.) Raf. Two plants found in the thicket north side of Cranberry Island. Quite common along the shore north of the island; also on Orchard Island.

Arctium minus Schk. A common and widely distributed ruderal.

Carduus lanceolatus L. Occurs sparingly in the forest zone Orchard Island.

The following is a list of plants which I have not found, nor are there specimens of them in the State herbarium, but they have been reported for Buckeye Lake by Herbert L. Jones in his catalogue of Phanerogams and Ferns of Licking County.

Aquilegia canadensis L. Rare. Reservoir and on the islands.

Rosa setigera Michx. Borders of swamp. Reservoir.

Cornus amomum Mill. (*C. sericea*.) Along the banks of the Reservoir.

Viburnum lentago L. Common in the swamps.

Helenium autumnale. Not common.

Gerardia tenuifolia Vahl. Cranberry Marsh.

Alnus incana (L.) Willd. Cranberry Marsh.

Valisneria spiralis L. Abundant in Licking Reservoir.

Juncus nodosus var. *megacephalus* M. A. Curtis. Licking Reservoir.

Cyperus inflexus Muhl. (*C. aristatus* Boeckl.) Licking Reservoir.

Rhynchospora glomerata (L.) Vahl. Licking Reservoir.

Poa flava L. (*P. serotina* Ehrh.) Abundant at Licking Reservoir.

BIBLIOGRAPHY.

1. ADAMS, C. C.
Southeastern U. S. as a center of geographical distribution of flora and fauna. *Biol. Bull.* 3: 123, 1903.
2. —————
The post-glacial dispersal of the North American Biota. *Biol. Bull.* 9: 53-71, 1905.
3. —————
Isle Royal as a biotic environment. *Biol. Survey Mich. Isle Royal*, pt. 1: 1-50, 1908.
4. —————
The ecological succession of birds. *Biol. Survey Mich. Isle Royal*, pt. 1: 121-136, 1908.
5. BARTLETT, H. H.
The submarine *Chamaecyparis* Bog at Woods Hole, Mass. *Rhodora* 2: 123. Dec., 1909.
5. BONSER, THOMAS A.
Ecological study of Big Spring Prairie. Wyandot Co., Ohio. *Ohio State Acad. Sci., Special paper* 7: 1903.
7. CHAMBERLAIN, T. C.
Classification of American glacial Deposits. *Jour. Geol.* 8: 270.
8. ————— and SALISBURY, R. D.
Geology 2:3: Earth History 1906.
9. CLEMENTS, F. E.
Research methods in ecology. 1905.
10. ————— and POUND, R.
The vegetation regions in the prairie province. *Bot. Gaz.* 25: 381-384, 1898.
11. COWLES, H. C.
The ecological relations of the vegetation of the sand dunes of Lake Michigan. *Bot. Gaz.* 27: 95-117, 167-202, 281-303, 360-391, Feb., Mar., Apr., and May, 1899.

134 *Proceedings of the Ohio State Academy of Science.*

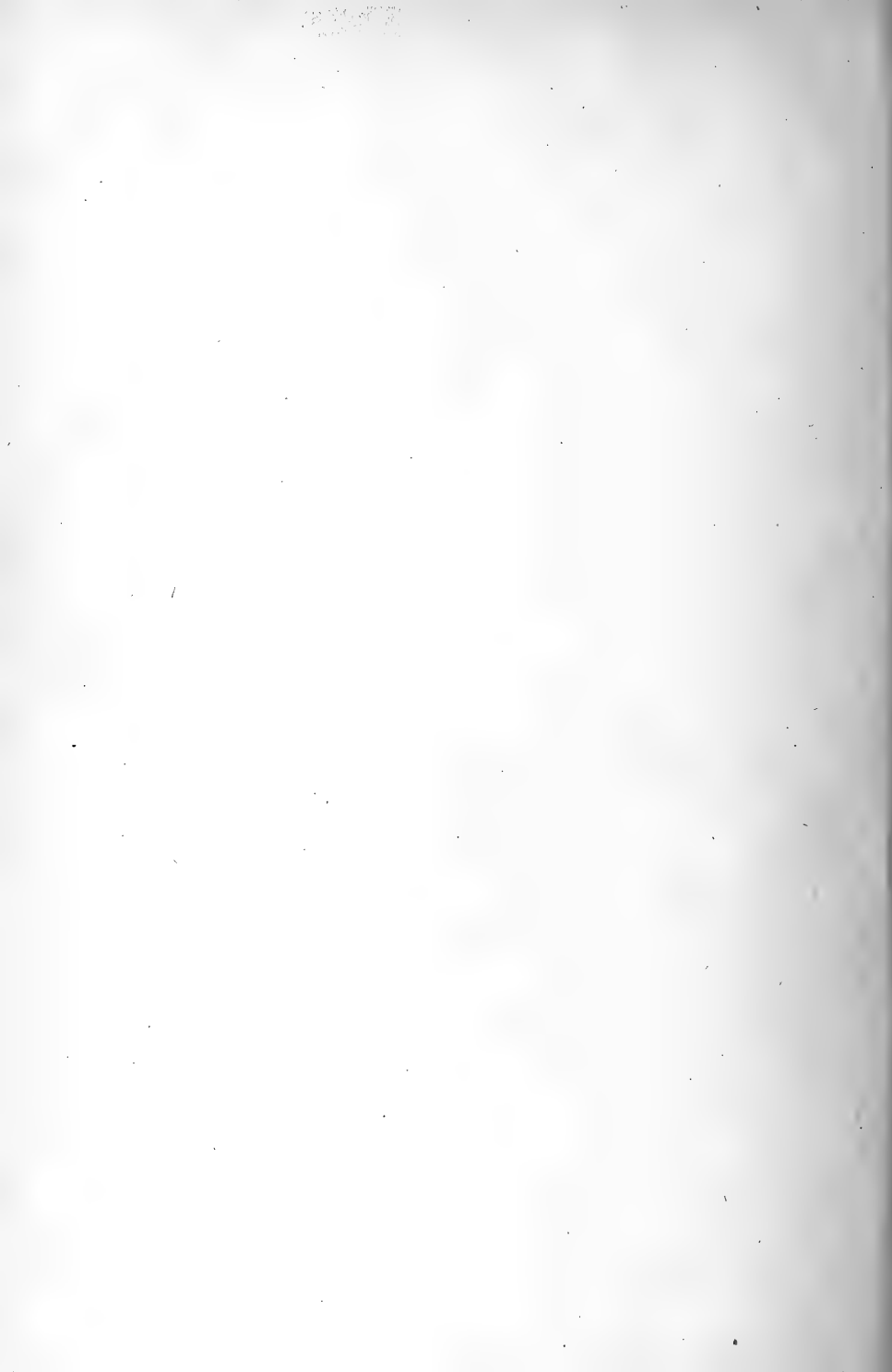
12. _____
The physiographic ecology of Chicago and vicinity. *Bot. Gaz.* **31**: 73-108, 145-182, Feb., Mar., 1901.
13. _____
The causes of vegetation cycles. *Bot. Gaz.* **51**: 161-183, Mar., 1911.
14. _____
The fundamental causes of succession among plant associations. Review in *Bot. Centr. Blatt.* **116**: 8, 1911.
15. DACHNOWSKI, ALFRED.
Contribution to the botanical survey of the Huron river valley. *Mich. Acad. Sci. Rep.* **9**: 116, 1905.
16. _____
Type and variability in the annual wood increment of *Acer rubrum*. *Ohio Nat.* **8**: 343, 1908.
17. _____
The toxic property of bog water and bog soil. *Bot. Gaz.* **46**: 130-143, f. 6, Aug., 1908.
18. _____
Physiologically arid habitats and drought resistance in plants. *Bot. Gaz.* **49**: 325-339, 1910.
19. _____
A Cedar bog in Central Ohio. *Ohio Nat.* **11**: 193-199, 1910.
20. _____
The problem of xeromorphy in the vegetation of the Carboniferous period. *Am. Jour. Sc.*, **32**: 33-39, July, 1911.
21. _____
The Vegetation of Cranberry Island. (Ohio). *Bot. Gaz.* **52**: 1-33, July, Aug., 1911.
22. _____
The Succession of Vegetation in Ohio lakes and Peat deposits. *Plant World*, **15**: 87-103, 1912.

23. DAVIS, C. A.
A contribution to the natural history of marl. Jour.
Geol. 8: 485, 1911.
24. _____
A second contribution to the natural history of marl.
Jour. Geol. 9: 491, 1911.
25. _____
Peat, essay on its origin, uses and distribution in Michi-
gan. Ann. Report. Mich. Geol. Survey, 97-363, 1906.
26. DAVIS, H. J.
Modification in the Jonathan Creek drainage basin. Bull.
Den. Univ. 11: 165-173, Mar., 1899.
27. DETMERS, FRED A.
A preliminary report on a physiographic study of Buck-
eye Lake. The Ohio Nat. 12:7 May, 1912.
28. FRÜH, J. und SCHRÖTER, C.
Die Moore der Schweiz. Bern, 1904.
29. GANONG, W. F.
Raised peat-bogs in New Brunswick. Bot. Gaz. 16: 123,
1891.
30. _____
Raised peat-bogs in the Province of New Brunswick.
Proc. Roy. Soc. Canada, II, 34: 131, 1897.
31. GLEASON, H. A.
The vegetation of the inland sand deposits of Illinois.
Bull. Ill. State Lab. Nat. Sci., 9:3, Oct., 1910.
32. Gräbner, P.
Die Heide Norddeutschlands. Die Vegetation der
Erde, 5: 1901.
33. GRAHAM, A. A.
History of Licking Co. (Ohio), 1881.
34. _____
History of Fairfield and Perry counties (Ohio), 1883.
35. GRIESEBACH, A. R. H.
Linnaea 12: 1838.

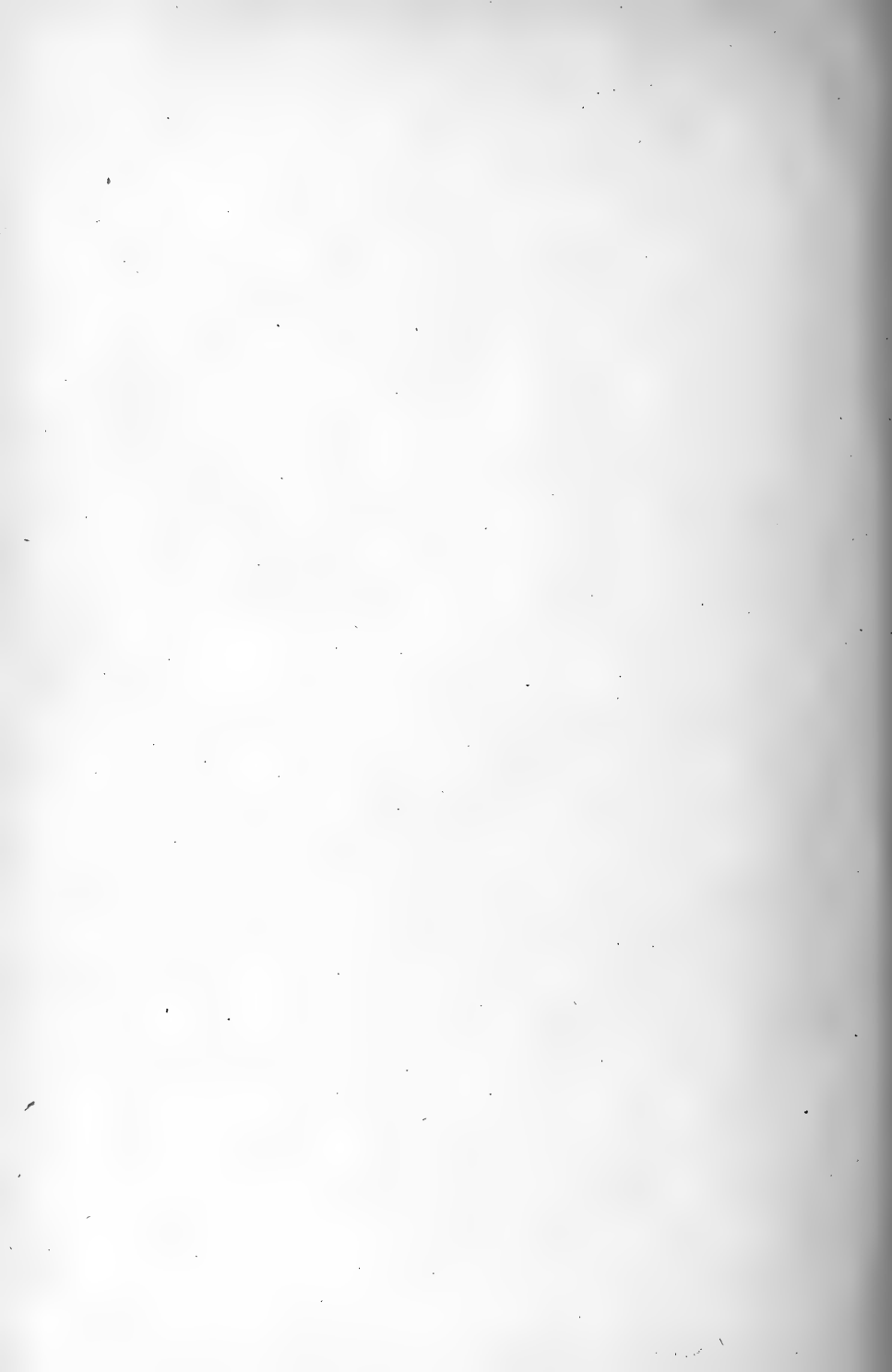
36. HARPER, ROLAND M.
Preliminary report on the peat deposits of Florida, 3rd
Ann. Rept. Florida Geol. Survey, 199-373, 1910.
37. HENSLOW, G.
The origin of plant structures by self-adaptation to the
environment exemplified by desert or xerophilous plants.
Jour. Linn. Soc. Botany, 30: 1894.
38. JACCARD, P.
Gesetze der Pflanzenvertheilung in der Alpenen Reg-
ionen. Flora 90: 349-377.
39. JENNINGS, O. E.
An ecological classification of the vegetation of Cedar
Point. Ohio Nat. 8: 291-340, Apr., 1908.
40. _____
A botanical survey of Presque Isle, Erie Co., Pa. Ann.
Carnegie Mus. 5: 289-421, May, 1909.
41. KARSTEN, G. and SCHENCK, H.
Vegetationsbilder. Series 17, pt. 8, Jena, 1910.
42. KEARNEY, T. H.
A report on a botanical survey of the Dismal Swamp
region. Contr. Nat. Herb. 5: 367-395, 1901.
43. LEVERETT, F.
Glacial formations and drainage features of the Erie and
Ohio basins. U. S. Geol. Survey, Mon. 41, 1902.
44. LIVINGSTON, B. E.
Physiological properties of bog water. Bot. Gaz. 39:
348-355, May, 1905.
45. _____
The relation of desert plants to soil moisture and to
evaporation. Carnegie Inst. Washington Pub., 50:20,
1906.
46. MACMILLAN, CONWAY
Observations on the distribution of plants along the
shore of the Lake of the Woods. Minn. Bot. studies.
Bull. Minn. Geol. and Nat. Hist. Survey, 9: 949-1023,
1897.

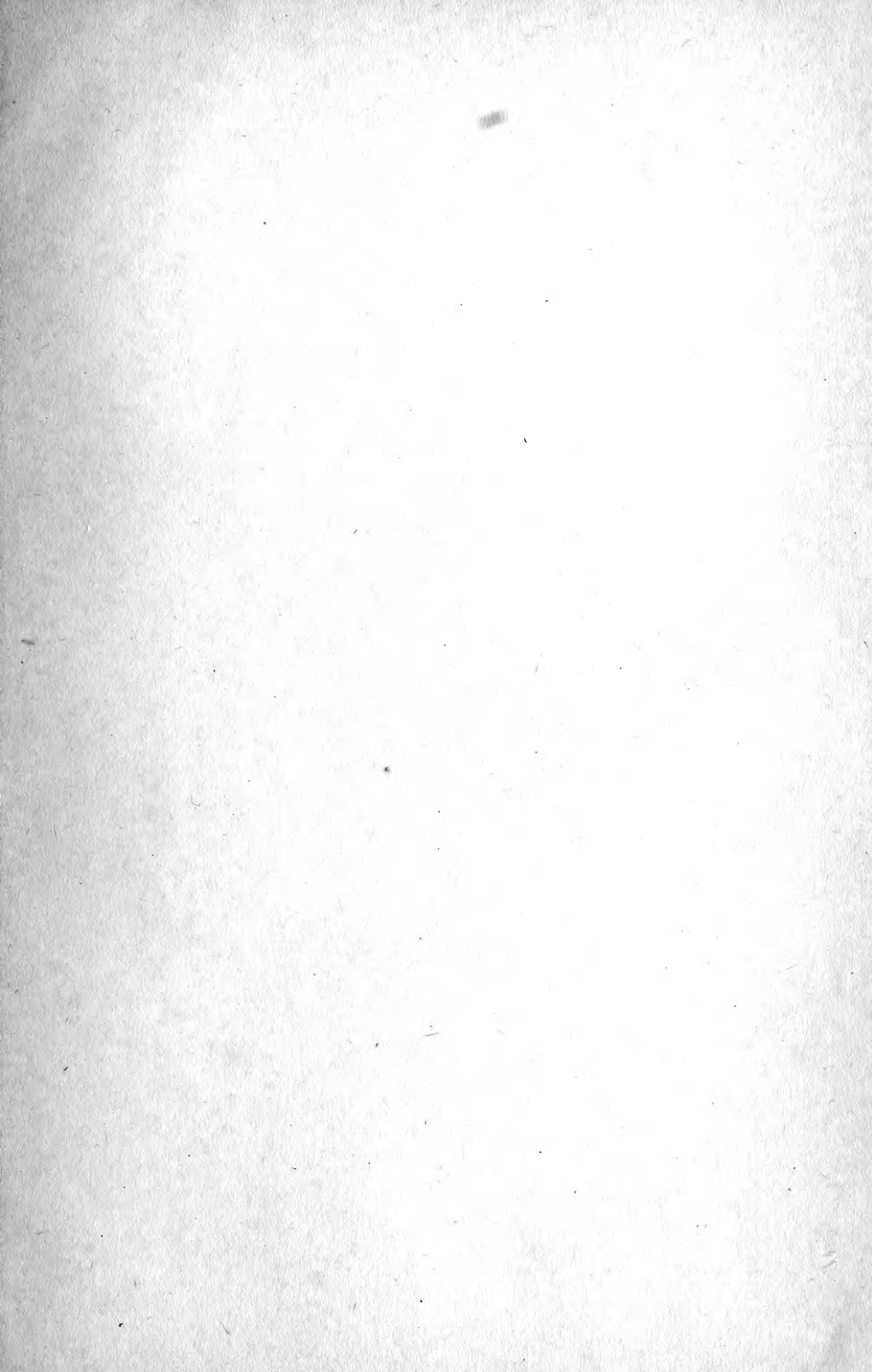
47. MATHER, K. F.
Age of Licking Narrows. Bull. Denison Univ. 14:
174-187, 1908-'09.
48. POTONIE, H.
Die Entstehung der Steinkohle. Berlin, 1910.
49. READ, M. C.
Geology of Licking Co., (Ohio). Geol. Survey of Ohio,
3: 348-361, 1878.
50. REED, HOWARD N.
A survey of the Huron river valley. I. The ecology
of a glacial lake. Bot. Gaz. 34:125-139. Aug, 1902.
51. SCHAFFNER, JOHN H., JENNINGS, O. E., and TYLER, F. J.
Ecological study of Brush Lake. Proc. Ohio State
Acad. Sci., 4: 4, Special paper 10, 1904.
52. SCHIMPER, A. F. W.
Pflanzengeographie. Jena, 1898.
53. SHREVE, FOREST; CHRYSLER, M. A.; BLODGET, FREDERICK
and BESLEY, F. W.
The plant life of Maryland. Md. Weather Bureau,
Spec. pub. 3: 1910.
54. SMITH, W. G.
The origin and development of heather moorland, Scott.
Geog. Mag. 18: 587-597, 1902.
55. SPALDING, V. M.
Problems of local distribution in arid regions. (Present
problems in plant ecology.) Am. Nat. 43: 472-486,
1909.
56. TIGHT, W. G.
Drainage modifications in southeastern Ohio and adja-
cent parts of West Virginia and Kentucky, U. C. Geol.
Survey, Prof. paper 13.
57. _____
A contribution to the knowledge of the pre-glacial
drainage of Ohio. Bull. Sci. Lab. Denison Univ., 8:
2, 47-50, 1894.

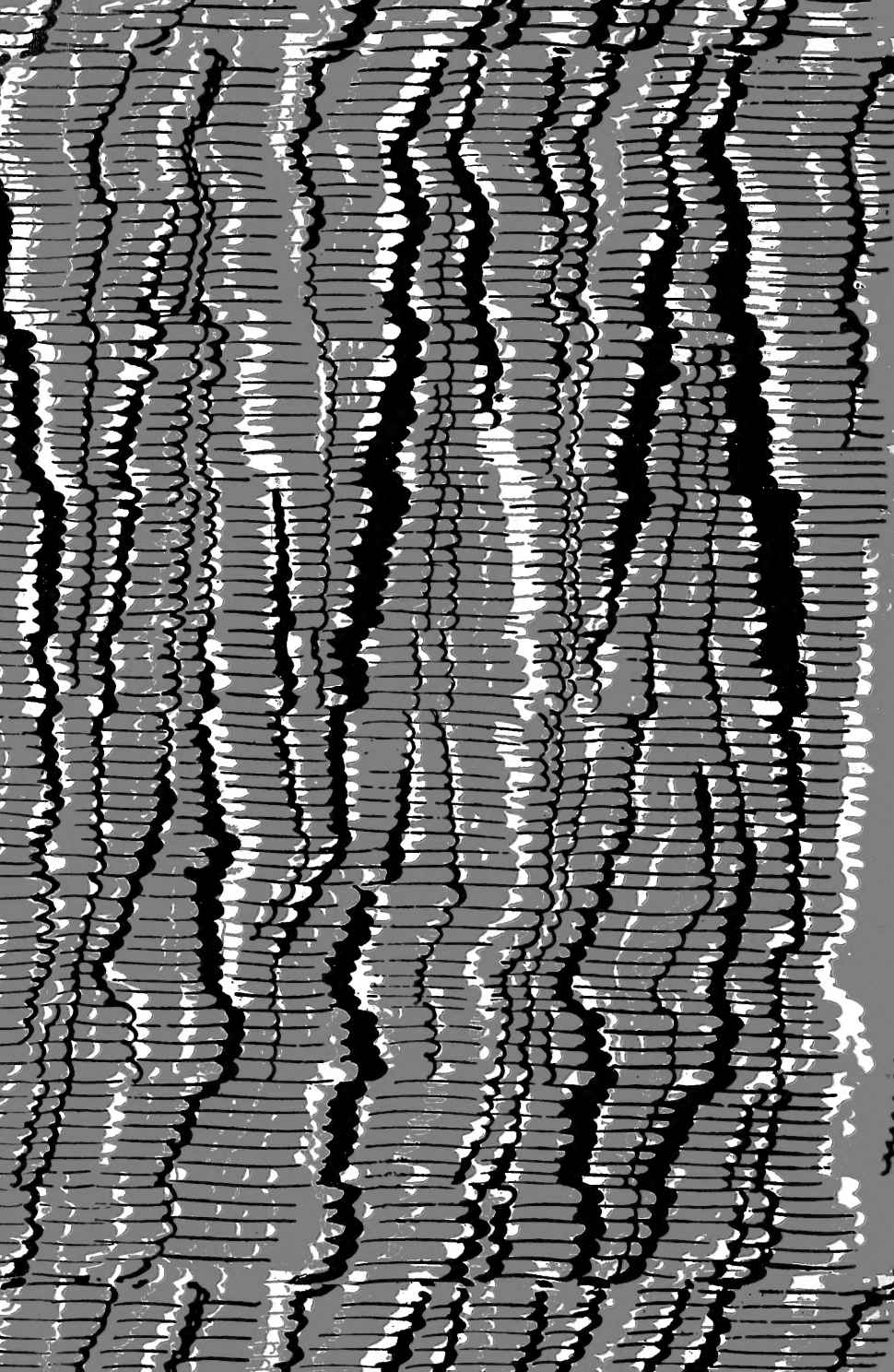
58. _____
Some pre-glacial drainage features of southern Ohio.
Bull. Sci. Lab. Denison Univ., 9: 22-37, 1895.
59. TRANSEAU, E. N.
On the geographical distribution and ecological relations
of the bog-plant societies of northern North America.
Bot. Gaz. 36:401-420, Dec. 1903.
60. _____
The development of palisade tissue and resinous de-
posits in leaves. Science, N. S. 19: 866, 1904.
61. _____
Forest centers of North America. Am. Nat. 39: 879-
889, 1905.
62. _____
The bogs and bog-flora of the Huron river valley. Bot.
Gaz. 40: 351-375, 418-448, 1905. 41: 17-42 f. 1-16,
1906.
63. WARMING, E.
Ecology of plants. 1909.
64. WELD, LEWIS H.
A peat-bog and morainal lake. Botanical survey of
the Huron river valley. Bot. Gaz. 37: 36-52, 1904.
65. WRIGHT, F. G.
The glacial boundary in Ohio, Indiana and Kentucky.
1884.
66. YAPP, R. H.
On stratification in the vegetation of a marsh and its
relation to evaporation and temperature. Am. Bot, 23:
275,320, 1909.

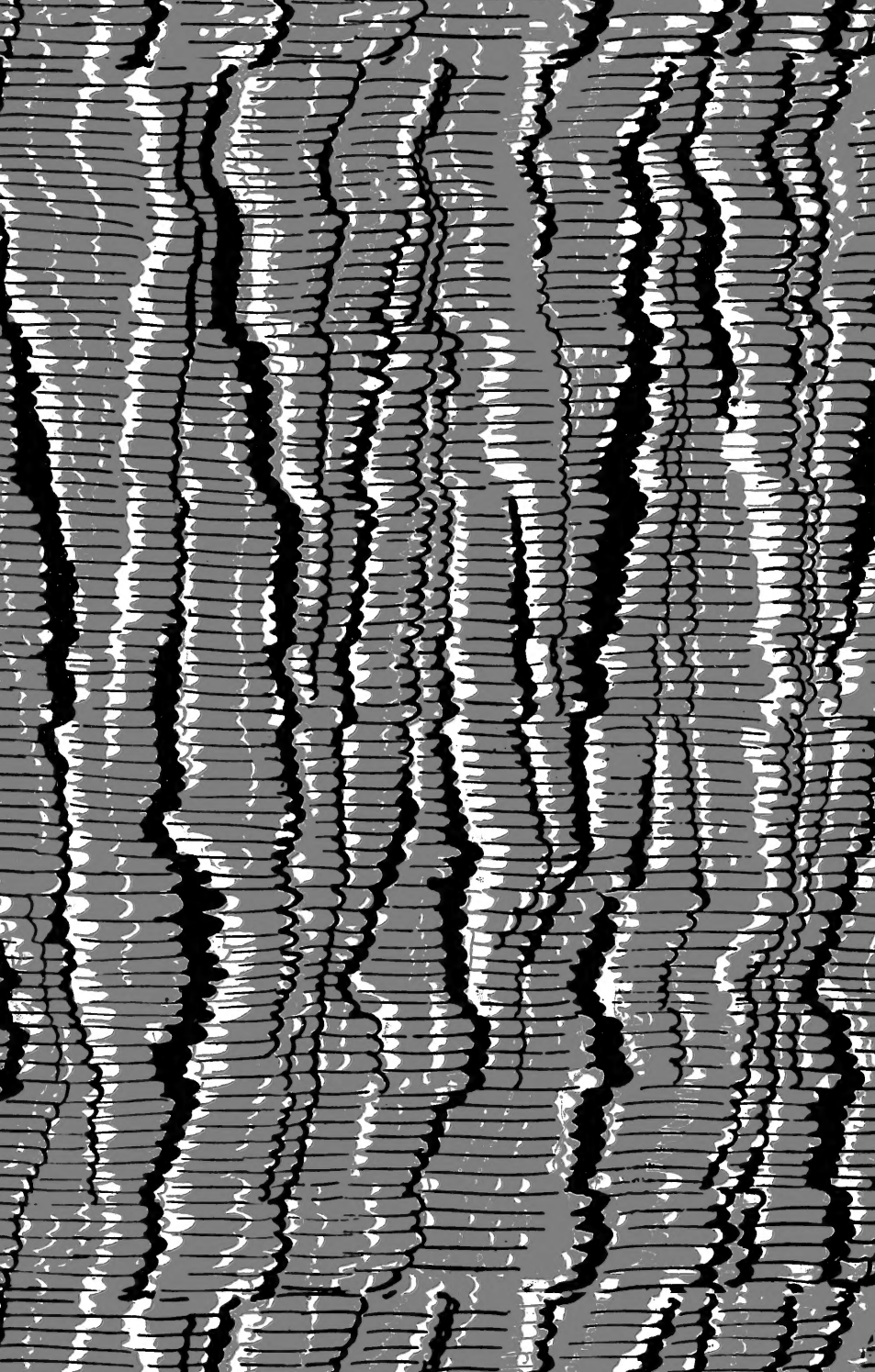












SMITHSONIAN INSTITUTION LIBRARIES



3 9088 00919 2105