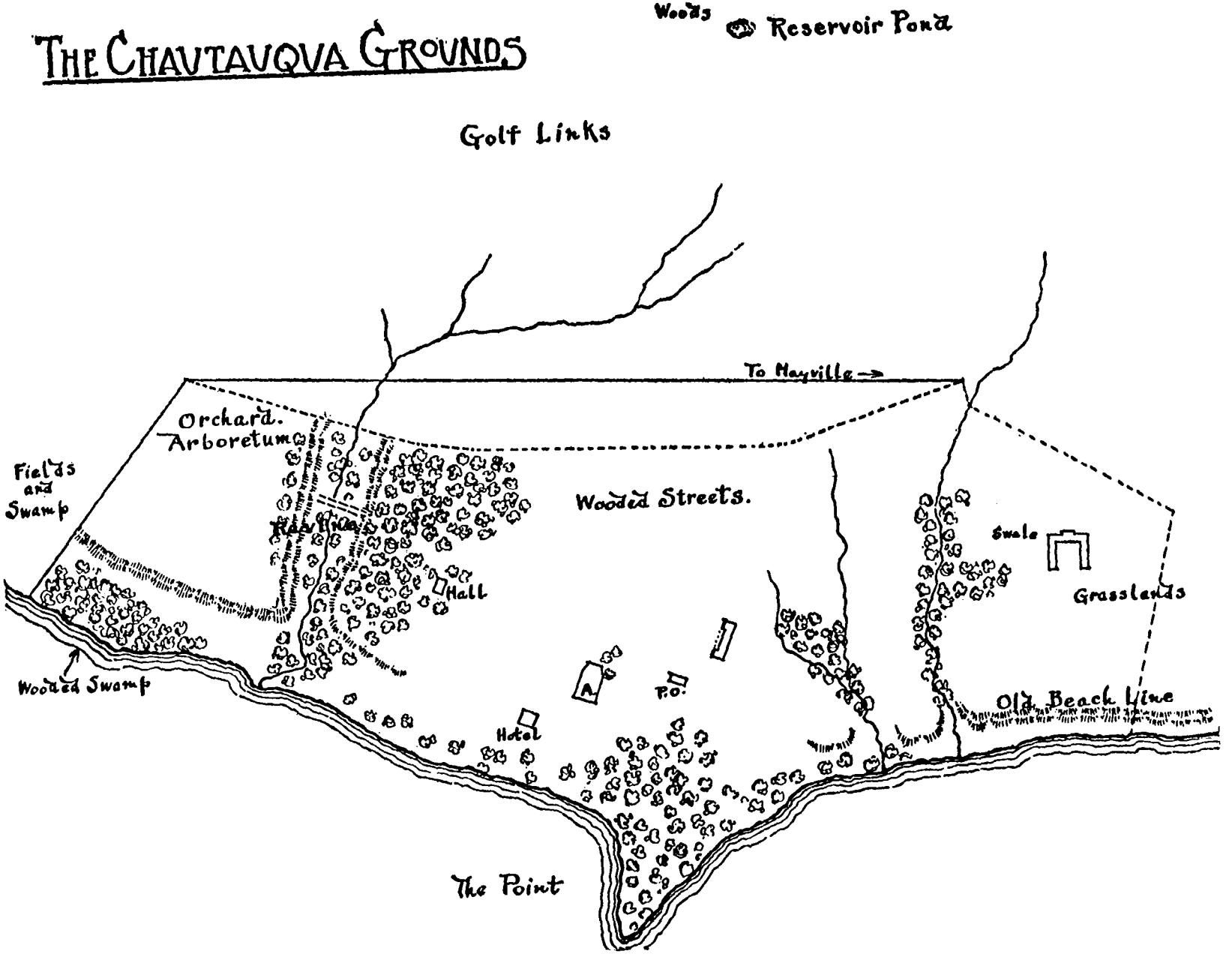
THE NATURAL HISTORY OF CHAUTAUQUA

The Chautauqua Grounds



THE NATURAL HISTORY OF CHAUTAUQUA

BY

VAUGHAN MacCAUGHEY

Teacher of Natural History in the
Chautauqua Summer Schools.

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TO MY MOTHER

PREFACE

The material in this little book is the outgrowth of ten years' natural history study and teaching in the Chautauqua region. The material is assembled in this form with the hope that it may be useful to the increasing number of nature-students who are actively interested in the rich and beautiful natural background of Chautauqua.

The subject-matter is not designed to take the place of that found in the standard reference books; it is suggestive rather than scientifically exhaustive. In the various lists, for example, only the common and fairly common forms are usually included; rare and adventitious species, although often of extreme scientific interest, are not of particular significance to the beginner in natural history.

It is significant that natural history has always been an integral part of the Chautauqua ideal. Wherever people may live,— amidst or far remote from the centers of culture,— Nature is omnipresent as the universal background of their lives. Natural history is the most cosmopolitan of the cultural elements; it is not nationalized, like literature, nor racial, like the languages, nor sectarianized, as is theology, nor provincialized, as is history. The natural history of any locality, no matter how apparently mediocre and humble, is a clean-cut epitome of the outstanding laws of the universe.

This book is based upon the fundamental proposition of the nature-study idea, namely, that happiness may be derived from an intimate and sympathetic knowledge of the common things of our out-of-doors.

VAUGHAN MACCAUGHEY.

CONTENTS

I Chautauqua's Natural History Background, 11

II The Summer Birds of Chautauqua, 13

III A Key to the more common Summer Birds of Chautauqua, 26

IV The Chautauqua Woodland, 29

V The Chautauqua Woodland Floor, 31

VI The Life of the Tree, 33

VII The Names of Trees, 35

VIII A Key to the Chautauqua Trees, 36

IX The Trees of the Chautauqua Grounds, 40

X The Shrubs of the Chautauqua Grounds, 43

XI The Sugar Maple, 44

XII The Beech Tree, 46

XIII Practical Suggestions for Chautauqua's Trees, 48

XIV The Wayside Plants of Chautauqua, 50

XV The Flowering Plants of Chautauqua, 52

XVI Pollination Methods of some Chautauqua Wild Flowers, 66

XVII Concerning Poison Ivy, 68

XVIII The Chautauqua Insects and their Allies, 69

XIX Insects which live on the Grape, 74

XX The Orders of Mammals and their Chautauqua Representatives, 75

XXI Some common Fishes of the Chautauqua Brooks, 77

XXII The Fishes of Chautauqua Lake, 79

XXIII The Chautauqua Mascalonge or Muskalunge, 80

XXIV The Swampy Places of Chautauqua, 83

XXV The Batrachians of Chautauqua, 85

XXVI The Reservoir Pond, 86

XXVII The Snakes of the Chautauqua Region, 88

XXVIII The Turtles of the Chautauqua Region, 89

XXIX Ferns and Mosses, 90

XXX A Synopsis of the Chautauqua Ferns, 92

XXXI Mushrooms and other Spore Plants, 94

XXXII The Mushrooms of Chautauqua, 96

XXXIII The Story of the Chautauqua Region, 100

XXXIV Résumé of the Geological History of the Chautauqua Region, 107

XXXV Topography and Geology of the Chautauqua Region, 109

XXXVI The Chautauqua Soil, 111

XXXVII The Chautauqua Region with reference to the physiographic regions of New York State, 113

XXXVIII The history of the Early Settlement and Agricultural development of the Chautauqua Region, 115

XXXIX The Cloud World, 117

XL The Kinds of Clouds, 118

XLI The Summer Meteoric Showers, 120

XLII Stars of the Chautauqua Summer Sky, 121

XLIII A Synopsis of Common Rocks, 123

XLIV Some suggestions for Natural History Field Work with Children, 126

XLV The Place of Natural History in the Educational Program, 128

Index, 135

THE NATURAL HISTORY OF CHAUTAUQUA

I. Chautauqua's Natural History Background

The Chautauqua Assembly Grounds are very favorably located for the study of Natural History. Western New York has been famous, from the earliest days, for the beauty and diversity of its rolling hills, its lovely woodlands, its verdant, stream-cut valleys, and its picturesque lakes. Lake Chautauqua is richly stocked with the varied forms of aquatic and semi-aquatic plant and animal life which are characteristic of the northeastern United States.

Within the Assembly Grounds itself are the pleasant wooded streets; groves, open and with undergrowth; thickets and ravines; brooks; grasslands, mown and unmown; orchard-land; the strand and the shallow water of the lake.

Within easy walking distance are many interesting and representative types of natural regions, including the extensive woodlands to the west, drumlins and glaciated hills, swamp-lands, deltas and spits along the lake, forested ravines and other less marked forms. All-day excursions to places of the most varied fauna and flora are easily feasible.

Geology: The Chautauqua region is the most westerly New York portion of the great New York-Pennsylvania Plateau, which occupies fully one-third of New York State. It is made up entirely of Devonian rocks, mostly upper Devonian shales and sandstones, some of which are richly fossiliferous. The well-known escarpment or " hill " between Mayville and Westfield forms the northern margin of this remarkable plateau.

Plant Life: On the Chautauqua Grounds are sixty species of native trees, representing thirty-five genera and eighteen

families. A number of other species occur in the region. The woodlands, both hardwood and coniferous, are extensive and varied. There are several hundred species of flowering plants, many ferns, mosses, mushrooms and lichens, and an unusual variety of swampland and aquatic plants.

Bird Life: There are over one hundred kinds of birds recorded during the summer season on and near the Chautauqua Grounds. Many birds nest in boxes and bird-houses provided by the Bird and Tree Club. This club affords many delightful opportunities for furthering and discussing bird study and bird protection.

Animal Life: The various common animals and insects of the eastern states abound in the Chautauqua region, and are available both for field studies, and as caged in terraria, aquaria, insect cages, school menageries, etc.

We have almost lost sight of the old "Natural History" in the intense specialization of modern science. It is time for the teacher, and the lover of nature generally, to strive once more towards the breadth of view that characterizes the naturalist. Few Chautauquans want highly specialized sciences: almost all desire a close touch with nature. They desire the new understanding of nature furnished by the technical studies of the last twenty-five years.

The steady growth of interest in Natural History subjects is one of the significant features of the American mind of today. This interest has manifested itself in many ways: in nature study in the elementary schools; in biology and the earth sciences in the high schools; in highly specialized courses in the laboratories of our universities; in bird and flower clubs; in state and federal commissions, in biological surveys; in a strikingly long and diversified list of other activities and organizations. Chautauqua has for many years recognized and provided for the various types of Natural History which integrate with her educational program.

II. The Summer Birds of Chautauqua

An Annotated Reference List

1. LOON FAMILY

1. **Common Loon.** Strictly aquatic; in secluded places along the lake-shore; frequently seen during the steamer trip to Jamestown; does not come near Assembly Grounds, but is seen occasionally flying over lake. Solitary; expert diver and fisher; powerful flier. Moves south in winter as open waters freeze.

2. HERON FAMILY

2. **American Bittern.** Fairly common transient visitor; uncommon summer resident; departs for the south about Nov. 10th. Breeding season, May 10–June 10. Not on Assembly Grounds, but in vicinity; Prendergast, Mayville Inlet, etc. Solitary, in swampy places, along lake-shore.
3. **Least Bittern.** Uncommon transient visitor; occasional summer resident. Fall migration about Sept. 25th. Breeding season June 10–25. Habitats similar to those of bittern.
4. **Green Heron.** Common summer resident; arrives from south about April 25th, departs Sept. 28th. Breeding season May 15–June 20. The most common of our herons. Often seen flying over lake adjacent to Assembly Grounds.
5. **Great Blue Heron.** Common transient visitor; fairly common summer resident; arrives in April, leaves in November. Nests at Prendergast, and other secluded swampy places. Occasionally seen flying high overhead; erroneously called "crane."

3. RAIL FAMILY

6. **Virginia Rail.** Uncommon summer resident; arrives from south about April 20th, leaves about Oct. 10th. Breeding season, May 10–June 20. Very shy and silent; never seen on Assembly Grounds; restricted to cattail marshes and swampy shores in the region.
7. **Sora Rail.** Rare. Arrives April 25th, departs Oct. 18th. Breeding season, May 25–June 15. Like the Virginia Rail in appearance and habits, but a trifle smaller. Found only in sequestered

swamplands and shores. Grass nest, in or near marshes; 8–15 eggs.

8. **Coot or Mudhen.** Fairly common transient visitor; occasional summer resident. Habitat, swampy places, like the rails and herons. Sometimes seen in open water, or in flight. The beak is beautiful ivory white.

4. SANDPIPER FAMILY

9. **Woodcock.** Rare summer resident, arriving in March and leaving in November. Breeding season, April 1–20. This beautiful gentle bird has been hunted to the verge of extinction, and will only be saved by rigorous protection. It occurs in remote, unfrequented woodlands and coverts in the Chautauqua region, and was at one time plentiful.

10. **Wilson's Snipe.** Fairly common transient visitor; uncommon summer resident; status as a game bird similar to that of the woodcock. Protection is imperative. Grass nest, in marshy places; 3–4 eggs.

11. **Solitary Sandpiper.** Fairly common transient visitor; casual summer resident. Is here during northward migration, May 1–20; during southward migration, July 15–Sept. 20. Peculiar nesting habits, as it uses the abandoned nests of such tree-building birds as robin, grackle, or wax-wing; eggs 4.

12. **Spotted Sandpiper.** Abundant summer resident; arrives April 18th, departs Sept. 10th. Breeding season, May 15–June 10. Also called Tip-up or Teeter, because of motion while walking. Common along lake-shore in immediate vicinity of Assembly Grounds, and also around pond in Golf Links.

5. PLOVER FAMILY

13. **Killdeer Plover.** Fairly common summer resident; arrives March 10th, leaves Nov. 15th. Breeding season April 15–May 20. Plentiful along lake-shore, on Golf Links, and in open country. Showy black and white rings around neck and breast. Begins to flock by August first.

6. QUAIL FAMILY

14. **Bob White or Quail.** Rare summer resident; formerly more plentiful, but hunted to the verge of extinction. A beautiful, gentle bird, that should be domesticated. Occasionally seen in woodlands and clearings in the Chautauqua region.

15. **Ruffed Grouse, or Partridge.** Uncommon resident; scarcity due to overhunting. Also the ground nesting birds have many natural enemies and a high death rate. A splendid bird, that should be adequately protected. Habitat, deep unfrequented woodlands; in early days there were partridges on the Assembly Grounds.

7. TURKEY FAMILY

(Wild Turkey). Formerly abundant in the Chautauqua region; hunted to extinction and now known only in the domesticated form.

8. PIGEON FAMILY

(Passenger Pigeon). A beautiful and wholly harmless bird; formerly abundant in the Chautauqua region; now entirely extinct through human butchery and "constant and unremitting persecution on their breeding grounds." Last records of live birds, 1898.

16. **Mourning Dove.** Sometimes erroneously called Wild Pigeon. Common summer resident; arrives March 20th, departs Nov. 15th. Breeding season, April 20–June 10. Occurs in old orchards and open woodlands in the vicinity; rare on Assembly Grounds. Nest a flimsy saucer of twigs; 2 white eggs.

9. HAWK FAMILY

17. **Marsh Hawk.** Fairly common summer resident; arrives about April 1st, departs Oct. 20th. Breeding season May 5–20. Frequently seen in open fields and marshy places in the vicinity, not on Assembly Grounds. A very useful hawk, feeding largely upon mice and other destructive rodents.

18. **Cooper's Hawk.** Fairly common summer resident; not on Assembly Grounds, but sometimes flying over lake; occurs in open country. This hawk is sometimes a chicken thief, but also feeds upon birds, mice, squirrels, frogs, and insects.

19. **Red-tailed Hawk.** Fairly common summer resident; habitat similar to Cooper's hawk; often seen circling high in the air; sometimes kills poultry, but on the whole is very useful, feeding chiefly upon mice.

20. **Red-shouldered Hawk.** Common summer resident, arriving March 1st and leaving Nov. 15th. Breeding season, April 1–May 10. A hawk of the woods, rather than the fields. Cry, a screaming "kee-you, kee-you." Nests in woods beyond Golf Links. Rarely attacks poultry; chief food is mice and insects; on the whole a beneficial species.

21. **Bald Eagle.** Fairly common transient visitor, occasionally nesting. Nests along the lake between Chautauqua and Jamestown; also between Mayville and Westfield. Sometimes seen flying over lake. Conspicuous white head and tail. Feeds chiefly on fish, usually obtained by robbing the fish hawk, or dead fish cast up by the waves.
22. **Sparrow Hawk.** Uncommon summer resident; occasionally resident throughout the year; arrives March 15th, departs Nov. 1st. Breeding season May 10–25. Does not feed much on sparrows or small birds, but chiefly on mice, grasshoppers, and large insects. Occurs in open country in vicinity.

10. OWL FAMILY

23. **Barred Owl.** Fairly common resident, restricted to deep woods in the vicinity, rarely appearing on Assembly Grounds. Nests in a hollow tree; sometimes uses an old crow or hawk nest. Food chiefly mice, small birds and animals, not poultry.
24. **Screech Owl.** Common resident; breeding season April 1 to 25. Frequently nests in the wooded ravines on Assembly Grounds, and appear from time to time, at dusk. Nests in hollow trees; eggs 4–6, white. A professional mouser, rarely touching poultry; occasionally attacking small birds.
25. **Great Horned Owl.** Fairly common resident, restricted to deep woodlands, and very rare on Assembly Grounds. A chicken thief, but also eating many rabbits, mice, and other rodents.

11. PARROT FAMILY

(Carolina Paraquet). The only member of the parrot family in the United States; formerly abundant in the Eastern States, but now practically exterminated. The northern limit of its range formerly was the southern border of the Great Lakes; now it is limited to the extreme southeast.

12. CUCKOO FAMILY

26. **Yellow-billed Cuckoo.** Uncommon summer resident; arriving May 10th, and departing late in Sept. Breeding period, June 10–30. Very fond of tent caterpillars and other insect pests. Called "rain crow." In orchards and woodlands in the vicinity; a shy, silent bird.
27. **Black-billed Cuckoo.** Common summer resident, arriving May 10, departing Sept. 25th. Breeding period June 1–30. Like the

former in appearance, habits, and habitat. Slender, dovelike, solitary birds; not parasitic, as are the European cuckoos. Very useful because of their insect diet.

13. KINGFISHER FAMILY

28. **Belted Kingfisher.** Abundant summer resident; arrives April 6th, departs Nov. 1st. Breeding season April 15 to May 20. Common along the lake-shore; a large, showy bird, with a loud, rattling callnote. Nests in a tunnel in a bank, about six feet deep; 5–8 white eggs.

14. WOODPECKER FAMILY

29. **Hairy Woodpecker.** Fairly common resident throughout the year. Breeding season April 20 to May 25. On Assembly Grounds, in orchard and ravines. The size of a robin.
30. **Downy Woodpecker.** Common resident throughout the year; breeding season April 25 to May 30. Frequent on Assembly Grounds. Valuable, as are all the woodpeckers, because of the enormous numbers of wood-boring grubs which they devour. These birds do not injure trees, nor attack live wood.
31. **Yellow-bellied Sapsucker.** Common transient visitor and occasionally a summer resident; arrives in April, departs in October. This is the only woodpecker that feeds upon the sap and soft inner bark of trees; sometimes this bird damages trees. Rare on Assembly Grounds.
32. **Northern Pileated Woodpecker.** A rare resident, inhabiting deep and unfrequented woodlands. Called "cock of the woods"; almost as big as a crow, with gaudy red, black and white color-pattern; a showy scarlet crest. Reported from deep woods in the Chautauqua region.
33. **Red-headed Woodpecker.** Common summer resident, arriving May 5th, departing Oct. 1st. Breeding season May 15–June 20. Abundant on Assembly Grounds on large trees, dead stubs, fence, etc.
34. **Flicker or Golden-shafted Woodpecker.** Common summer resident; arrives April 15th, leaves Oct. 15th. Breeding season May 10–June 30. Frequent on Assembly Grounds, often on the ground or in low bushes. The flicker eats ants, grasshoppers, and many other insects of the open fields, as well as tree-insects.

15. NIGHT-HAWK FAMILY

35. **Whip-poor-will.** Occasional summer resident; rarely seen in Assembly Grounds, but occurring in vicinity. Nocturnal; exclusively insectivorous; very useful; with exquisitely beautiful protective color pattern.
36. **Night Hawk.** An occasional transient visitor, sometimes remaining throughout the summer and nesting. Arrives May 10th, departs Sept. 25th. Habits, etc., similar to whip-poor-will. Perches lengthwise on large limbs, or among dead leaves on the ground. Food composed entirely of insects, mostly flies, mosquitoes, etc.

16. THE SWIFTS

37. **Chimney Swift.** Sometimes called "chimney swallow," although not related to the swallows, which it superficially resembles in structure and flight. Before there were chimneys this bird used hollow trees. Nest of twigs glued together with salivary secretion. Insect diet; a very useful bird. Common summer resident, coming at the end of April, and leaving in late September. Breeding season May 15th to July 10th.

17. THE HUMMING-BIRDS

38. **Ruby-throated Humming-bird.** Common summer resident; arrives May 10th, departs Sept. 10th. Breeding season June 5–July 20. Nests on Assembly Grounds; an exquisite lichen-covered nest, saddled on a limb; 2 white eggs. Female and young lack the ruby throat. Feeds on insects and nectar.

18. FLYCATCHER FAMILY

39. **King-bird.** Abundant summer resident; arrives May 1st, leaves Sept. 1st; breeding period May 20–June 15. Erroneously called bee-bird or bee-martin; they rarely feed on bees, and then select only the more palatable *drones*. On Assembly Grounds, in open places, as along the lake-shore and the fence.
40. **Crested Flycatcher.** Uncommon summer resident; comes May 14th, leaves about August 20th; breeding season May 20–June 15. Occurs casually on Assembly Grounds, usually in tops of high trees, near the Iron Bridge, or along lake-shore.
41. **Phœbe.** Abundant summer resident, arriving April 15th, departing Oct. 15th; breeding period April 20–June 15. Our most common flycatcher. Nests plentifully on Assembly Grounds, in

Hall of Philosophy, Amphitheater, etc. Call a rasping "zee-bee, zee-bee."

42. **Wood Pewee.** Abundant summer resident; comes May 7–15, leaves about the first of September. Breeding period, June 5–July 20. Not as common on Assembly Grounds as the phœbe. Nests in trees. Callnote "pee — ee — a — wee."
43. **Trail's Flycatcher.** Very rare; very difficult to distinguish in the field from the Alder Flycatcher. Chautauqua record doubtful.
44. **Least Flycatcher.** Common summer resident; arrives May 6–10; departs August 20; breeding season May 20–June 30. Also called Chebeck. Not frequent on Assembly Grounds, but occurs in orchards and open woods in vicinity.

19. THE LARKS

45. **Prairie Horned Lark.** Occasional summer resident; erratic in distribution, like the waxwings. Usually in small compact flocks on plowed land and old fields; for example, along the road to Prendergast. A ground bird, *running,* not hopping.

20. CROW FAMILY

46. **Blue Jay.** Fairly common in the southern part of the country; rare in the Chautauqua region; resident throughout the year; breeding period April 1–May 10. A saucy, bright-hued vagabond, often disturbing other birds; sometimes eating their eggs.
47. **Crow.** Abundant resident throughout the year; breeding season April 1 to May 15. Infrequent on Assembly Grounds, but common in the region. A sagacious, wary bird, with some faults and numerous virtues, not as black as he is painted.

21. BLACKBIRD FAMILY

48. **Bobolink.** Abundant summer resident; arrives May 5, leaves Sept. 15; breeding period May 20–June 10. Very irregular in abundance and distribution. Not on Assembly Grounds, but in open fields, etc., in vicinity. In flocks of from six to sixty; the "reedbird" of the South.
49. **Cowbird.** Common summer resident; arrives April 1st, leaves Oct. 25th. Breeding season, throughout the summer. A serious pest, *wholly* parasitic upon the smaller native birds, in whose nests the female deposits her eggs. Every adult cowbird thus represents the destruction of an entire nestful of some of the smaller

and more valuable native birds. The cowbird should be exterminated.

50. **Red-winged Blackbird.** Abundant summer resident; arrives March 20th, leaves Nov. 10th. Breeding season May 3–June 15. Nests along the lake-shore, in the cat-tail swamps; not on the Assembly Grounds. The females and young are gray and streaky, with no black or red shoulders.

51. **Meadow-lark.** Common summer resident, coming early in March and remaining until late November. Breeding season, May 10–July 10. In the open fields, on the Golf Links, and along roadways. A valuable bird, with a sweet clear whistle, and beautiful protective coloration.

52. **Orchard Oriole.** Rare summer resident; comes in early to middle May, departs in August. Breeding season, late May and early June. Occasionally seen on the Assembly Grounds.

53. **Baltimore Oriole.** Common summer resident; arrives May 2–5, and leaves about the first of Sept. Breeding period, May 15–June 15. Weaves a pensile nest in the terminal twigs of high trees. Fairly common on the Grounds, also in neighboring farmyards.

54. **Bronzed Grackle or Blackbird.** Abundant summer resident; comes March 12–30, leaves Nov. 10. Breeding season, April 20–June 1. Common on the Grounds, especially along the lake shore at early morn, when they feed upon snails, dead fish, etc. Large flocks seen flying to the rookeries at sundown.

22. SPARROW FAMILY

55. **English Sparrow.** A sturdy and permanent immigrant, ousting the native birds, and in many ways a pest. His food habits prove him to be an enemy of the farmer; his pugnacity and mobbing of native birds has had a disastrous effect upon the bird life of Chautauqua. He should be trapped until greatly reduced in numbers.

56. **Goldfinch.** Common summer resident; in many parts of western New York resident throughout the year. Breeding season, July 5–August 10. Also called Wild Canary and Thistle Bird. Undulating flight; sweet call-note during flight.

57. **Vesper Sparrow.** Common summer resident; arriving the first of April and leaving the first of November. Breeding season, May 2–June 30. On ground and in low bushes; white outer tail feathers. In the open places, not in the groves.

58. **Savannah Sparrow.** Fairly common summer resident; comes

April 10, departs Oct. 20. Breeding season, May 5–July 15. In grassy fields and along roads, never in groves. Very shy and keeping low in the grass.

59. **Grasshopper Sparrow.** Summer resident, fairly common in certain localities near the Grounds; shy and difficult to see. Comes in early May and leaves in early October. Song a weak, insect-like trill. Orchard, and North Addition.

60. **Chipping Sparrow.** The most abundant native sparrow on the Grounds; comes April 12–13 and leaves late in Oct. Breeding period, April and May. On all parts of the Grounds, often nesting about dwellings; familiar and fearless.

61. **Field Sparrow.** Common summer resident; arrives April 10–20; departs the first of Nov. Breeding period, May 15–June 20. In open fields and along roadsides; Golf Links, Orchard, North Addition.

62. **Junco.** Occasional summer resident; not on the Grounds, but in secluded woodlands; abundant in winter, but usually summering farther north.

63. **Song Sparrow.** Abundant summer resident, rarely remaining throughout the year. Comes in middle March and remains until middle November. Breeding period, May 1–July 20. Common on the Grounds, especially around shrubbery. A sweet songster, and a brave, happy bird.

64. **Swamp Sparrow.** Uncommon summer resident; arrives April 15, leaves Nov. 10. Breeds, May 15–June 10. Only found along the lake shore, in cat-tail swamps, and similar places. Shy and difficult to observe.

65. **Towhee** or **Chewink.** A fairly-common summer resident, arriving April 15–20, departing Oct. 20. Breeds, June 1–20. Not found on the Grounds, but in groves in the vicinity; there are several pairs every summer in the woods beyond the Golf Links.

66. **Rose-breasted Grosbeak.** A beautiful and fairly common summer resident; comes May 10, departs Sept. 15. Breeds, May 15–June 20. Occasionally on the Grounds; more numerous in secluded places,— ex. Prendergast Point.

67. **Indigo Bird.** Another beautiful and fairly common summer resident. Arrives May 10–12, departs Sept. 30. Breeds, May 30–July 20. Occasionally on the Grounds, but more frequent in thickets, woodlands and fence-rows, in the vicinity.

23. TANAGER FAMILY

68. **Scarlet Tanager.** A brilliant and fairly common summer resident. Arrives May 7, leaves Sept. 30; breeds, May 20–June 15.

The females and young are greenish. Uncommon on Assembly Grounds, but more numerous in woodlands in the region.

24. SWALLOW FAMILY

69. **Purple Martin.** Common summer resident at Jamestown and the southern part of the lake, but very infrequent at the north end. Season, April 18–Aug. 30; breeds May 15–June 20.
70. **Cliff Swallow** or **Eave Swallow.** Abundant summer resident, May 10–Sept. 8; breeds May 14–June 10. Field mark, a light patch on the rump. Nest a flask-shaped mud cup under the eaves of barns, etc. Plentiful on the Grounds, and flying over the lake at dusk.
71. **Barn Swallow.** Abundant summer resident, the most common of our swallows. Season, April 15–Sept. 12; breeds, May 5–July 30. Nesting place and habits very similar to Eave Swallow. Under parts rich chestnut red.
72. **Tree Swallow.** Common transient visitor, occasionally a summer resident, April 15–Sept. 28. Breeds, May 25–June 15. Nests in hollow trees; no records from the Assembly Grounds.
73. **Bank Swallow.** Abundant summer resident, May 8–Aug. 25; breeds, May 15–June 20. Often seen flying over the Grounds and over the lake. All of the swallows are highly insectivorous, and exceedingly useful birds. They consume incredible numbers of the lake flies.
74. **Rough-winged Swallow.** Uncommon summer resident; very difficult to distinguish, in the field, from the Bank Swallow, and often confused with the latter.

25. THE WAXWINGS

75. **Cedar Waxwing.** Common summer resident, erratic in arrival and departure, usually in small, roving flocks. Breeds, June 1–20. They have nested in the Orchard, and other places in and near the Grounds.

26. THE SHRIKES

76. **Migrant Shrike.** Fairly common summer resident, April 27–Oct. 1. Breeds, April 20–May 15. Always in open and exposed places; telephone lines, fences, etc., on the outlook for prey. Strong, hawk-like beak; feeds upon large insects, and occasionally, small birds.

27. VIREO FAMILY

77. **Red-eyed Vireo.** An abundant summer resident, the most common of our vireos, and plentiful throughout the Grounds. Season, May 8–Sept. 5; breeding period, May 25–June 30. Sings throughout the day, when other birds are silent.
78. **Warbling Vireo.** Fairly common summer resident, May 1 to Sept. 15. Breeds, May 18–June 10. Frequent on the Grounds, but more common in neighboring woods. Song richer and fuller than the preceding.
79. **Yellow-throated Vireo.** Fairly common summer resident, May 7–Sept. 1; breeding period, May 25–June 15. In thickets, the foliage of tall trees, shrubbery along the lake and similar places.

28. THE WOOD WARBLER FAMILY

80. **Black and White Warbler.** Common transient visitor; uncommon summer resident, from April 30 to Aug. 20. Frequently seen on the Grounds, on tree trunks, like a nuthatch.
81. **Golden-winged Warbler.** Rare; only one record for the Chautauqua region; probably a summer resident.
82. **Yellow Warbler.** The most abundant of our summer warblers; plentiful on the Assembly Grounds, in shrubbery and trees. Season, April 20–Sept. 25. This bird is yellow all over, including wings and tail.
83. **Black-throated Blue Warbler.** Common transient visitor; occasionally a summer resident, May 7–Oct. 12. In the summer plumages the black throat may be wholly obscured. Breeds June 1–15.
84. **Magnolia Warbler.** Fairly common transient visitor and occasional summer resident, May 7–Sept. 25. Breeds very early in June. Plentiful in 1915 in woods beyond the Golf Links.
85. **Chestnut-sided Warbler.** Fairly common summer resident, arrives May 7, leaves Sept. 5; breeding period, May 15–July 5. On Chautauqua Grounds, and in woodlands in the vicinity.
86. **Black-throated Green Warbler.** Locally a common summer resident, from May 5–Oct. 15; breeds, June 1–20. Frequent in shrubbery along the lake front, and in the woodlands.
87. **Oven Bird.** A common but very shy summer resident, from May 5–Sept. 10; breeds, May 20–June 10. On the floor of secluded woodlands; nest a covered dome, like an oven.
88. **Mourning Warbler.** Uncommon near Chautauqua; fairly common in western New York. Summer resident, May 15–Sept. 20;

breeds, May 30–June 20. Not seen on the Grounds, but in woods in the vicinity.

89. **Maryland Yellow-throat.** A beautiful and common summer resident, May 9–Oct. 10; breeds, May 25–June 15. Along the lake shore and in swampy places, thickets, and woodland tangles. Song —" wichery — wichery — wichery."

90. **Hooded Warbler.** A fairly common summer resident, in woodlands remote from the Grounds, May 10–Aug. 15; breeds, June 1–20.

91. **Canadian Warbler.** Fairly common transient visitor; local summer resident; season, May 8–Sept. 15. Breeds, May 30–June 10. In woodlands beyond the Golf Links; Prendergast Point.

92. **Redstart.** An abundant summer resident, May 7–Sept. 18; plentiful on the Chautauqua Grounds, in woodlands and along the streets. An active, beautiful bird; the male brilliant black and salmon-red.

93. **Northern Water Thrush.** Fairly common transient visitor; infrequently a summer resident; season, May to Sept. Wet woodlands.

29. WREN FAMILY

94. **Catbird.** Abundant summer resident; April 25–Sept. 30; breeds, May 15–July 5. Fairly common on the Grounds, in thickets and along the fence. Nests on the Grounds. More abundant in orchards, etc., in the region.

95. **Brown Thrasher.** Fairly common summer resident; season, April 24–Oct. 10; breeds, May 15–June 20. Not frequent on the Grounds; in thickets along the lake shore.

96. **House Wren.** Common summer resident; arrives April 28, departs Sept. 20; breeds, May 15 to July 5. Nests in boxes, hollow trees, and all sorts of cavities. A brave and familiar little bird, pugnacious; with a throbbing, throaty song. Sings all summer long, like the Song Sparrow and the Pewee.

97. **Winter Wren.** An occasional transient visitor, sometimes remaining throughout the summer and nesting. Not recorded from the Grounds, but in the region.

98. **Long-billed Marsh Wren.** A fairly common local summer resident; season, May 10 to Oct. 20; breeds, May 30–June 25. In swampy places along the lake shore; never inland; abundant at Prendergast Point.

30. CREEPERS AND THEIR KIN

99. **Brown Creeper.** Fairly common transient visitor, usually seen in April; rarely nesting in western New York.

100. **White-breasted Nuthatch.** Common resident throughout the year; plentiful on the Chautauqua Grounds. On the large branches and trunks of trees. Breeds, April 18–May 15.

101. **Black-capped Chickadee.** Abundant resident throughout the year, locally; occasionally frequent on the Grounds in midsummer. Breeds, April 18–May 25. A brave and cheerful little bird.

31. THRUSH FAMILY

102. **Wood Thrush.** Fairly common summer resident; season, May 5–Sept. 5. Formerly nested in the Grounds, but now has retired to adjacent woodlands; breeds, May 20–June 15.

103. **Veery.** Fairly common summer resident in the county, not common near the Chautauqua Grounds. Season, May 2–Aug. 26; breeds, May 20–June 20. This thrush has a very beautiful song.

104. **Robin.** Abundant summer resident, March to November; breeds, April 15 to July 8. Common on the Grounds; nesting in all parts, and sometimes rearing three broods in one summer.

105. **Bluebird.** Abundant summer resident, March to November; breeding season, April 15–July 8. Plentiful on the Grounds, nesting in boxes and hollow trees; should be protected from cats and squirrels.

III. A Key to the more Common Summer Birds of Chautauqua

Modified and greatly enlarged from the key of Dr. Schmucker

A. Much larger than the robin.

1. Black all over ..... **Crow**
2. Brown and green, long neck and legs..... **Green Heron**
3. Ashy blue, very large, very long neck and legs. **Great Blue Heron**
4. Large broad-winged hawk, tail light-chestnut red..... ..... **Red-tailed Hawk**
5. Small, chunky owl, red or gray..... **Screech Owl**

B. Somewhat larger than the robin.

1. Black all over, with shining plumage..... **Bronzed Grackle**
2. Slate blue, with black and white markings; large, crested head; along lake shore..... **Belted Kingfisher**
3. Yellowish-brown; round black spots below, wings lined with golden ..... **Flicker**
4. Yellowish-brown; black crescent on yellow throat; white outer tail feather ..... **Meadowlark**
5. Grayish-brown; no conspicuous markings; dove-like..... ..... **Mourning Dove**
6. Upper parts bright cinnamon brown; underparts heavily streaked; long round tail ..... **Brown Thrasher**

C. About the size of the robin (9–10½ ins.).

1. Slate gray with chestnut red breast; young with spotted breasts ..... **Robin**
2. Brownish, with black and white neck-bands, showy white wing bars ..... **Killdeer Plover**
3. Entire head bright red; on tree trunks. **Red-headed Woodpecker**
4. Black all over, with orange-red shoulder bars; usually along lake shore ..... **Red-winged Blackbird**

D. Smaller than the robin but larger than the English sparrow (7–9 ins.).

1. Breast and sides bright *rose-red;* other colors black and white ..... **Rose-breasted Grosbeak**

2. Upper parts, throat and breast *black;* tail black and white; sides chestnut red; female brown .....**Towhee**
3. Body *bright scarlet;* wings and tail black; female and young greenish .....**Scarlet Tanager**
4. Conspicuously *blue above;* below red or speckled.....**Bluebird**
5. *Black* with chestnut brown head and neck; walks; female plain gray .....**Cowbird**
6. Plain *slate gray,* cap darker; in thickets.....**Catbird**
7. Back grayish black; underparts pure white; *white band* across end of tail .....**Kingbird**
8. Back olive brown; underparts white with *round spots*..... .....**Wood Thrush**
9. Patchy black, white and *buff;* females and young streaky yellow brown; in open fields .....**Bobolink**
10. *Crested;* color grayish brown; yellow band at end of tail.. .....**Cedar Waxwing**
11. Body *gray;* wings and tail black; white wing bars; outer tail feathers white; hawk beak .....**Migrant Shrike**

E. About the size of the English sparrow (5½–7 ins.).

1. In flight most of the time, circling in the air; never in the woods; swallows and swifts.
   a. Sooty gray all over; never seen perching.....**Chimney Swift**
   b. Tail *deeply* forked; back deep blue; rich chestnut below.. .....**Barn Swallow**
   c. Underparts brown; conspicuous light patch on rump.... .....**Eave or Cliff Swallow**
   d. Underparts gray, conspicuous brown band across breast; no rump patch .....**Bank Swallow**
   e. Underparts pure white; upperparts very dark..**Tree Swallow**
2. Usually seen climbing the trunks or large branches of trees.
   a. Conspicuously black and white; male with red on head.. .....**Downy Woodpecker**
   b. Black blue-gray; underparts white; often head down.... .....**White-breasted Nuthatch**
3. Neither habitually circling in the air or climbing trees.
   a. Bright yellow; black cap, wings, and tail; female greenish ..... **Goldfinch**
   b. Deep indigo-blue; black wings and tail.....**Indigo Bird**
   c. Back olive green; black mask over eyes; throat and breast rich yellow .....**Maryland Yellow-throat**
   d. Light grayish-olive above; white beneath; white line over eye .....**Red-eyed Vireo**

e. Grayish-brown above, gray beneath; narrow light wing-bars; flycatchers.
   1. Song a firm " zee-bee — zee-bee " ..... **Phoebe**
   2. Song a soft " pee-a-wee " ..... **Wood Pewee**

f. Secluded woodlands; above brownish-olive; underparts streaked; song " teacher-teacher-teacher " ..... **Ovenbird**

g. Sparrow-like birds, streaked with brown, buff, and black.
   1. Male with black throat; female gray... **English Sparrow**
   2. Breast and sides heavily spotted..... **Song Sparrow**
   3. Sides streaked, outer tail feathers white.. **Vesper Sparrow**
   4. Unmarked below; head light brown; bill pink..... ..... **Field Sparrow**

F. Distinctly smaller than the English sparrow (less than 5½ ins.).

1. Wing-movement so rapid that wings are invisible in flight; male with ruby throat ..... **Ruby-throated Hummingbird**
2. Yellow; back greenish yellow; tail yellow.... **Yellow Warbler**
3. Gray, with black cap; call-note " chick-a-day "..... **Chickadee**
4. Brown and gray; body and beak slender; tail often tilted up ..... **House Wren**
5. Back brown-streaked; bright chestnut cap; underparts plain gray ..... **Chipping Sparrow**

IV. The Chautauqua Woodland

Chautauqua has two distinctive features, which give charm and beauty to the Assembly Grounds, and to the region. These features are, first the lake, and second, the woodlands. The woodlands are but remnants of the great primitive forest that once covered all of western New York. The primitive forest was mixed hardwoods and conifers,— white pine, hemlock, maple, beech, and birch were the common species.

In nature the tree rarely grows singly, by itself. The isolated tree is the result of man's clearing or planting. Naturally trees tend to form solid stands, either pure or mixed. Pure stands are trees all of the same species, as white pine, sugar maple, and beech. Pure stands are lumbered first, because of the larger quantity of timber of a kind. Mixed stands include a variety of species. Most of the Eastern woodlands are mixed stands. Some trees never form pure stands, but occur only here and there in the forest, ex. hornbeam, cherry, tulip-tree.

The Chautauqua Grove is a mixed stand, with sugar maple and beech predominant. The form of trees is greatly modified by their association in the woodland. The struggle for head-room and sunlight is unceasing. When a veteran falls, a score of saplings crowd into the opening. The woodland is a distinctive life unit, with many features differentiating it from adjacent areas. Contrast the life in a lake-side woodland with the life in the waters of the lake.

The woodlands have been stripped from most of our Eastern agricultural land. In the average region one may find every stage, from the original, or the second-growth, forest, through the clearings to the treeless tilled fields. The introduction of wire fences is even robbing the fence-rows of their last thin shred of forest.

Suggestions for individual work:

1. Is there any primitive forest or original growth in your region? Is it being cut at present? What kind of trees are being removed?

2. What kinds of trees predominate in the farm woodlots of your region? Has this always been the case? Are other kinds being planted?

3. Compare the fringe or edge of a woodland with the central or inner region. Do you find any differences in the amount of undergrowth? How would you account for this?

4. Compare the plant life of two woodlands; one in which cattle forage, and one which is not open to cattle.

5. Are there forest fires in your region? How do they start? How extensive is the damage? What may be done to prevent them?

6. Examine the mature trees in a woodland. Are there any dead trees? What killed them? Do you find many dead branches? Why dead? Do you find many bracket fungi? What are they doing?

V. The Chautauqua Woodland Floor

Because of its forest covering the woodland floor possesses many distinctive and interesting characters. Its soil, rich with leaf-mold and humus, differs markedly from that of the open field. It is protected from wind, and rain, and erosion. The plants that grow on the woodland floor are in the main well adapted for these quiet, shady, humid conditions. Ferns, mosses, liverworts, lichens, mushrooms, and other fleshy and woody fungi, and many beautiful flowering plants, large and small, make their home here. Many species of animals — minute crustaceans, spiders, thousand-leggers, beetles, moths, ants, wasps and bees, are found chiefly within or on the outskirts of woodlands. Under the decaying logs are salamanders and other batrachians. The squirrels rummage among the fallen leaves. The ovenbird and the chewink live on the woodland floor; there the woodcock and the night-hawk nest. It is a life-area teeming with interest and with good field problems.

The woodland wild flowers grow in well-defined habitats,— a rich mellow, leaf-mold soil; shade varying from considerable to very dense; little or no exposure to wind; and a humid atmosphere. They reflect these conditions in their own structure and adaptations. Many of these woodland plants are fragile, shallow rooted, and few-seeded; the invasion of man and cattle into their sanctuaries results in pathetically rapid extermination. They lack the versatility and ruggedness of the roadside plants. Just as many of our sturdy weeds can only be held in check by the most unrelenting repression, so many of our most beautiful and characteristic woodland flowers can only be preserved by the strictest guard,— fences for cattle, and educated public opinion and statutes for humankind.

Representative Woodland Plants: Jack-in-the-pulpit; Clin-

tonia; Twisted-stalk; False Solomon's-seal; Canada May-flower; Solomon's Seal; Bellwort; Trilliums; Adder's Tongue; Orchids; Wild Ginger; Wood Anemone; Hepaticas; Columbine; Blue Cohosh; Twin-leaf; Blood-root; Dutchman's Breeches; Tiarella; Wild Geranium; Oxalis; Polygala; Enchanter's Nightshade; Ginseng; Pyrola; Partridge Berry.

Suggestions for individual work:

1. Collect a goodly quantity, say a quart, of dead leaves, from the surface of the woodland floor. Then sort them, putting leaves of a kind together. What species are represented? In what proportions? Does this indicate the relative proportions of trees in the woods? Answer carefully.

2. What conditions do you find in the layer just below the loose surface-layer of leaves? Why? Dig down below this second layer. What do you find? Dig to the true earthy soil. How thick is the leaf mold layer? What are the characteristics of the true soil as to color, texture, moisture?

3. Turn over a decaying log. What plants and animals do you find beneath it?

4. Make a list, throughout the season, of the birds, mammals, reptiles and batrachians that you find inhabiting a given woodland or grove. Which of these live chiefly on the floor?

5. Follow one of the spring wild flowers through the various stages in its life cycle. In what form does it spend the summer? the fall? the winter?

6. What plants do you find in the woodland, under the snow in winter?

7. What are the characteristic flowers of your woodlands in the autumn? What preparations do they make for winter?

8. Are your woodland wild flowers mostly gregarious or solitary? flowers single or in large clusters? contrast with roadside plants.

9. What is being done in your region to preserve the woodlands as places of beauty? What can be done?

VI. The Life of the Tree

Each individual tree has an interesting and by no means uneventful life-cycle. Certain organs, tissues, and growth-processes are distinctive of each stage in the life history, for example, the seed-leaves of the seedling, the flowers of the mature tree, and the heavy wood formation of the "veteran." Every tree comes from some parent tree; the seed is the migration or motile stage. Once rooted, the tree must live its life as best it can; it cannot move to a more favorable environment.

Every tree is confronted with the two fundamental life problems: to maintain itself, and to reproduce its kind. On the Assembly Grounds may be found every stage in the life-cycle of a tree — flowers, fruit, seed, seedling, sapling, mature tree, veteran, the dead tree, the decaying log, the woodland soil. "Largest of living things, and longest of life are the trees. They have dominated the life of the greater part of the habitable earth by the sheer vigor of their growth. They have gone far toward making the world a fit place for us to live in. Our ancestors were woodsmen. The forests provided them homes and food."— Needham.

Suggestions for individual work:

1. Collect and split open the seeds of several species of trees. What evidence do you find within the seed of the presence of the embryonic tree?

2. Compare one of these embryo seedlings with a seedling of the same species. What important transformations have taken place in the latter?

3. Find a sapling that has been chopped off, or otherwise cut to reveal a cross-section; examine the seasonal rings. Compare with growth-rings on a large stump.

4. What is the largest individual tree in your region? height? girth? diameter? approximate thickness of bark? how old? history?

5. Find a moldering log. Are any other plants growing on the top? the sides? underneath? Make a list of the animals that you find under old logs.

6. Find some region where the roots of forest trees are exposed and examine carefully the appearance of these roots and their extent.

7. In some "cut" or similar place where tree roots are exposed collect a good specimen of a root — at least one inch thick and 5 or 6 inches long. Examine the cross section as to thickness of bark, arrangement of tissues. Split the piece, and examine for pith, wood and bark.

8. Examine a branch with its twigs and foliage,— ex. beech and sugar-maple — particularly the terminal six or eight feet. How does the upper or top side of the spray differ from the under side? What determines the number and arrangement of the twigs? of the leaves?

9. Examine a number of trees — ex. hickories, butternut, horse-chestnut, sumach — for their buds. How far along in development are the buds? Are they ready for winter?

10. What trees on the Grounds are now in flower? in fruit? Collect fruits of several species. What is the name or classification of each of these fruits?

11. Observe specimens of several species of trees that are growing in the open. Can you recognize each at a distance by the shape of its crown and the texture of its foliage?

VII. The Names of Trees

In the average Eastern region there are about one hundred species of native trees and shrubs. In addition to these native species there are a large number of introduced and cultivated trees and shrubs, that do not ordinarily occur in the native woods. In studying the kinds of trees, the first step is to begin a local tree-list, an inventory of the trees of your region. The second step is to recognize the larger tree groups — ashes, maples, willows, oaks, etc. Some species of trees are much easier to identify than others, ex. tulip-tree. Leave the difficult groups,— ex. willows, oaks,— until the last. Learning the name of a tree is but the introduction to its life. Common names are frequently not distinctive, and in such cases it is well to learn the scientific name, or at least the genus.

Suggestions for individual work:

1. Make a list of the common trees of your locality. What kinds occur on your school grounds?

2. Observe throughout the seasons the changes in a single tree, ex. chestnut, sugar maple. This date can be tabulated in a tree "calendar."

3. Collect and identify the sprays of three conifers, or three ashes, or three hickories, or three oaks, or three maples.

4. Compare carefully the fruits of the tulip-tree and the cucumber tree. What are the similarities? To what family do these trees belong?

5. Collect the fruits of several related trees, ex. oaks, maples, hickories. Can you identify the species by the fruit?

6. Specimens of fossiliferous rock, showing leaf-prints. What was the "Carboniferous forest"? See any standard geology.

7. Examine carefully, by feeling, the bark of five trees, ex. butternut, shagbark, tulip-tree, yellow birch, beech. Could you recognize these with your eyes shut, guided by touch alone?

VIII. A Key to the Chautauqua Trees

Modified and enlarged from the key of Dr. Schmucker.

I. Cone-bearing trees (mostly evergreen, with needle-like leaves).

A. Green only in summer (Tamarack) . . **Larch**
B. Evergreen.
1. Leaves springing singly from the stem.
D. Leaves short, blunt, pressed to the stem . . . . . **Arbor Vitae**
D′. Leaves long for their width.
E. Leaves without leafstalk . . . . . **Balsam Fir**
E′. Leaves with small leafstalk.
F. Leaves extending from stem in all directions . . . . . **Norway Spruce**
F′. Leaves extending from the stem in two directions . . . . . **Hemlock**
2. Leaves springing from the stem in clusters.
D. Five leaves to the cluster . . . . . **White Pine**
D′. Three leaves to the cluster . . . . . **Pitch Pine**
D″. Two leaves to the cluster . . . . . **Scrub Pine**

II. Not cone bearing, leaves not needle-like, summer green.

A. Leaves in circles of three about the stem, heart-shaped . . . . . Catalpa

B. Leaves springing from directly opposite sides of the stem.
1. Entire leaf in one piece (simple).
D. Leaves distinctly three lobed, with slight, if any, sign of 5 . . . . . **Red Maple**
D′. Leaves with 3 large and 2 small but plain lobes, tips stretched . . . . **Sugar Maple**
D′. Leaves plainly 5 lobes, but 2 somewhat smaller than other 3.
E. Indentations less than half way to midrib . . . . . **Norway Maple**
E′. Indentations more than half way to midrib . . . . . **Silver Maple**

2. Each leaf made of many leaflets (compound).
D. With leaflets arranged like fingers.
E. Leaflets widest near outer end, fruit pods prickly..... **Horse Chestnut**
E′. Leaflets widest near center, fruit pods smooth ..... **Buckeye**
D′. With leaflets arranged like a feather.
E. Leaflets 3, sometimes 5..... **Ash-leafed Maple**
E′. Leaflets more than 5..... **White Ash**

C. **Leaves springing one by one from the stem** (alternate).

1. **Entire leaf in one piece (simple).**
D. Base of leaves uneven on the two sides (oblique).
E. Leaves about half as wide as long (Elm).
F. Leaves smooth on upper surface.. **White Elm**
F′. Leaves rough on upper surface.
G. Lower branches pendulous..... **Wych Elm**
G′. Lower branches not pendulous.. **Slippery Elm**
E′. Leaves more than half as wide as long (Linden).
F. Leaves more than four inches long ..... **American Linden**
F′. Leaves less than four inches long. **Small-leaved Linden**

D′. **Base of leaf evenly developed on both sides of midrib.**

E. **Leaves without deep indentations (not lobed).**
F. Edge of leaf unbroken or very nearly so ..... **Cucumber Tree**
F′. Edge of leaf wavy, but not deeply so ..... **Witch Hazel**
F″. Edges of leaf toothed but not deeply lobed.
G. Leaves broadest quite near the base.
H. Bark peeling around the tree.. **White Birch**

H′. Bark not peeling around the tree .....
I. Leaves very wooly on under side ..... **White Poplar**
I′. Leaves slightly if at all wooly beneath.
J. Tree narrow and spire-like.. **Lombardy Poplar**
J′. Tree at least somewhat spreading ..... **Carolina Poplar**
G′. Leaves broadest near the middle.
H. Leaves bitter to the taste.
I. Leaves very slender..... **Willow**
I′. Leaves moderately broad (Cherry).
J. Old bark peeling around stem ..... **Wild Red Cherry**
J. Old bark crackly..... **Wild Black Cherry**
H′. Leaves not bitter to the taste.
I. Leaves less than 6 inches long.
J. Bark peeling into papery edges ..... **Yellow Birch**
J′. Bark peeling into leathery patches ..... **Red Birch**
J″. Bark splitting up and down in narrow strips..... **Hop Hornbeam**
J‴. Bark remaining smooth.
K. Tree trunk well rounded.. **Beech**
K′. Tree trunk fluted (sinewy) **Ironwood**
I′. Leaves more than 6 inches long ..... **Chestnut**

E′. Blade of leaf with deep indentations (lobed).

F. Tip of leaf cut straight across... **Tulip Tree**
F′. Tip of leaf not cut straight across.
G. Leaves plainly a five-pointed star ..... **Sweet Gum**
G′. Leaves plainly not a five-pointed star.
H. Leaves as wide as long, or nearly so.

I. Indentations less than half way to midrib..... **Scarlet Hawthorn**
I′. Indentations about half way to midrib ..... **Sycamore**
I″. Indentations reaching nearly to midrib ..... **English Hawthorn**
H′. Leaves distinctly longer than wide.
I. Lobes rounded at end.
J. Leaves whitish beneath..... **English Oak**
J′. Leaves not whitish beneath.. **White Oak**
I′. Lobes pointed at end..... **Red Oak**

2. Leaves made up of separate leaflets (compound).

D. Branches with thorns..... **Black Locust**
D′. Branches without thorns.
E. Leaflets 2 to 5 to each leaf..... **Shellbark Hickory**
E′. Leaflets 5 to 7 to each leaf..... **Pignut Hickory**
E″. Leaflets 7 to 11 to each leaf.... **Swamp Hickory**
E‴. Leaflets 11 to 17 to each leaf... **Butternut**
E⁗. Leaflets 15 to 40. **Black Walnut**
F. Branches woolly ..... **Staghorn Sumach**
F.′ Branches smooth ..... **Ailanthus**
Mountain Ash

IX. The Trees of the Chautauqua Grounds

1. CONIFER FAMILY

1. White Pine (*Pinus strobus*). Once very abundant; a few veterans remain.
2. Pitch Pine (*Pinus rigida*). Several trees near Amphitheater.
3. Jersey Pine (*Pinus virginiana*). Near Men's Club; also called Scrub Pine.
4. Tamarack (*Larix americana*). One only; planted; also called Larch.
5. * Norway Spruce (*Picea excelsa*). Planted in yards; European.
6. Hemlock (*Tsuga canadensis*). Once very abundant; numerous veterans on the Grounds.
7. Balsam Fir (*Abies balsamea*). A few trees.
8. White Cedar (*Thuja occidentalis*). Also called Arbor-vitae.

2. WALNUT FAMILY

9. Butternut (*Juglans cinerea*). Plentiful; also called White Walnut.
10. Black Walnut (*Juglans nigra*). One or two trees; planted.
11. Swamp Hickory (*Hicoria minima*). Plentiful; also called Bitternut.
12. Shagbark Hickory (*Hicoria ovata*). Plentiful; also called Shellbark.
13. Pignut Hickory (*Hicoria glabra*). Frequent.

3. WILLOW FAMILY

14. Cottonwood Poplar (*Populus deltoides*). Numerous.
15. * White Poplar (*Populus alba*). One only; planted.
16. * Lombardy Poplar (*Populus nigra*). A few; planted.
17. Shining Willow (*Salix lucida*). Along the lake; several other species occur in the region.

4. BIRCH FAMILY

18. Blue Beech (*Carpinus caroliniana*). A few trees; also called Hornbeam.
19. Hop Hornbeam (*Ostrya virginiana*). Plentiful throughout the groves.

* Means not native; introduced species.

20. Yellow Birch (*Betula lutea*). Plentiful; also called Gray Birch.
21. Red Birch (*Betula nigra*). Frequent; also called River Birch.
22. Gray Birch (*Betula populifera*). Frequent; also called White Birch.
23. * Cut-leaved Birch (*Betula laciniata*). Horticultural plant.

5. BEECH FAMILY

24. American Beech (*Fagus americana*). Abundant; a dominant tree.
25. Chestnut (*Castanea dentata*). Plentiful; many trees partly dead.
26. Red Oak (*Quercus rubra*). Plentiful; mostly second growth.
27. White Oak (*Quercus alba*). Rare; only one or two trees.
28. * English Oak (*Quercus robur*). One or two planted trees.

6. ELM FAMILY

29. White Elm (*Ulmus americana*). Abundant along lake; many old trees.
30. Slippery Elm (*Ulmus fulva*). Frequent; also called Red Elm.
31. * English Elm (*Ulmus campestris*). Several planted along streets.
32. * Scotch Elm (*Ulmus montana*). Several planted; also called Wych Elm.

7. MAGNOLIA FAMILY

33. Cucumber Tree (*Magnolia acuminata*). Frequent; several veterans.
34. Tulip Tree (*Liriodendron tulipifera*). Frequent; several veterans; erroneously called Yellow Poplar.

8. WITCH-HAZEL FAMILY

35. Sweet Gum (*Liquidambar styraciflua*). One only; planted.
36. Witch Hazel (*Hamamelis virginiana*). Frequent; Kellogg Hall.

9. SYCAMORE FAMILY

37. Sycamore (*Planatus occidentalis*). One only; also called Buttonwood.

10. ROSE FAMILY

38. Mountain Ash (*Sorbus americana*). Several; beautiful fruit.
39. Shad Bush (*Amelanchier canadensis*). Frequent; also called Shadbush.
40. * English Hawthorn (*Craetagus oxycantha*). Several; planted in yards.

41. Scarlet Hawthorn (*Craetagus coccinea*). Frequent.
42. Wild Red Cherry (*Prunus pennsylvanica*). Plentiful; called Bird Cherry.
43. Wild Black Cherry (*Prunus serotina*). Plentiful; called Rum Cherry.
44. Choke Cherry (*Prunus virginiana*). Frequent.

11. LEGUME FAMILY

45. Yellow or Black Locust (*Robinia psuedo-acacia*). Planted row.

12. SUMACH FAMILY

46. Staghorn Sumach (*Rhus hirta*). Plentiful; swale near Hall of Pedagogy.

13. MAPLE FAMILY

47. Sugar Maple (*Acer saccharum*). Abundant; dominant; called Rock Maple.
48. Silver Maple (*Acer saccharinum*). Frequent; called Soft Maple.
49. Red Maple (*Acer rubrum*). Frequent.
50. Dwarf Maple (*Acer glabrum*). Rare; probably planted.
51. Ash-leaved Maple (*Acer negundo*). Frequent; planted; called Box Elder.

14. BUCKEYE FAMILY

52. Ohio Buckeye (*Aesculus glabra*). One only; planted.
53. * Horse Chestnut (*Aesculus hippocastanum*). Several; planted.

15. BASSWOOD FAMILY

54. Basswood (*Tilia americana*). Plentiful; root-sprouts; called Linden.
55. * Small-leaved Basswood (*Tilia pubescens*). A few; planted.

16. DOGWOOD FAMILY

56. Red Osier (*Cornus stolonifera*). Frequent.
57. Alternate-leaved Osier (*Cornus alternifolia*). Frequent.
58. Kinnikinnik (*Cornus amonum*). A few; in the woodlands.

17. ASH FAMILY

59. White Ash (*Fraxinus americana*). Plentiful.

18. CATALPA FAMILY

60. Catalpa (*Catalpa catalpa*). Frequent; planted; also called Indian Bean.

X. The Shrubs of the Chautauqua Grounds

Enumerating the common kinds

1. European Barberry (*Berberis vulgaris*).
2. Scentless Syringa (*Philadelphus inodorus*).
3. Garden Syringa (*Philadelphus coronarius*).
4. Hydrangea. (There are three or more ornamental species here.)
5. Red Currant (*Ribes rubrum*).
6. Deutzia. (There are several cultivated varieties.)
7. Round-leaved Spiraea (*Spiraea rotundifolia*).
8. Mountain-ash Spiraea; Willow-leaved Spiraea.
9. Antony Waterer Spiraea (a cultivated form).
10. Purple-flowering Raspberry (*Rubus odoratus*).
11. Wild Red Raspberry (*Rubus strigosus*).
12. Wild Black Raspberry (*Rubus occidentalis*).
13. High Bush Blackberry (*Rubus nigrobaccus*).
14. Rose Bushes. (There are a number of cultivated species and varieties.)
15. Shrubby Althaea (*Hibiscus syriacus*).
16. Lilac (*Syringa vulgaris*).
17. Rhododendron. (There are several ornamental species and varieties.)
18. Button-Bush (*Cephalanthus occidentalis*).
19. American Elder (*Sambucus canadensis*).
20. Red-berried Elder (*Sambucus pubens*).
21. Coral Berry (*Symphoicarpus symphoicarpus*).
22. Bush Honeysuckle (*Diervilla diervilla*).
23. Tartarian Bush-Honeysuckle (*Lonicera tartarica*).
24. Nanny-berry (*Viburnum lantago*).
25. Arrow-wood (*Viburnum dentatum*).
26. Maple-leaved Arrow-wood (*Vibernum acerifolium*).
27. Cranberry Tree (*Viburnum opulus*).

XI. The Sugar Maple

The sugar maple is one of the most abundant trees in the Chautauqua Grounds and, unlike many other plants, its beauty is proportionate to its abundance here. In the olden days of the stave bucket and the sumac "spile," the grove on these Grounds would have been prosaically termed a "sugar bush," and thought of in terms of "sap," "boiling," "siruping down," "sugaring off" and pounds of "cake." As Mrs. Comstock reminiscently remarks —

"The old caldron kettle is broken, or lies rusting in the shed. In its place, in the new-fangled sugar-houses, are evaporating vats, set over furnaces with chimneys. But we may as well confess that the maple syrup of to-day seems to us a pale and anæmic liquid, lacking the delicious flavor of the rich dark nectar which we, with the help of cinders, smoke and various other things, brewed of yore in the open woods."

The technical name for sugar maple is *Acer Saccharum,* Acer being derived from a Celtic word meaning "hard," (referring to the hardwood, and Saccharum referring to the sugar juice). This maple is often called Rock or Hard Maple, to distinguish it from the Silver or Soft Maple. The tree is easily recognized by its leaves. They are arranged in pairs on the twigs, that is, opposite (the beech, for example, has alternate leaves). The maple leaf is 3 to 5 inches long and is broader than long. There are five spreading lobes (sometimes 3 or 7) separated from each other by rounded incisions. The two lower lobes are smaller and shorter than the others. Each lobe tapers to a slender point. The very young leaves are reddish-tawny and are covered with a fine wool or down, but these characters soon disappear. When full grown they are dark green on the upper surface and pale green on the lower; (compare with silver maple, whose leaves are silvery white underneath). The petioles or stems of the leaves are often reddish.

The flowers appear in May with the leaves. The young fruits are now (July) abundant. Each fruit consists of two winged " samaras," forming a maple " key." One capsule of the key is usually seedless. The fruits will mature in early September, and are abundantly disseminated by the wind.

The sugar maple has a fine big trunk, and in undisturbed forests often reaches a height of 120 feet. On old trees the bark is dark in color, shaggy, with deep longitudinal furrows. The wood is light reddish brown, heavy, hard, strong, tough and close-grained, and takes a fine polish. It is much used for furniture, fine flooring and interior finishing, bowling alleys, etc. The " curly " and " bird's-eye " types are choice and well-known varieties.

The sugar maple is the chief shade tree of Chautauqua, and fully deserves our utmost care in the matters of pruning and preservation.

XII. The Beech Tree

" Under the branches of the beech we flung
Our limbs at ease and our bent bows unstrung."
— *From the Spanish.*

The beech merits a high place among the shade trees of Chautauqua. It is a stately and beautiful tree. It can be readily recognized by certain characters of its foliage and bark.

The leaves are arranged alternately on the twigs. They are oval, sharply pointed at the apex, and with rounded or heart-shaped bases. The margin is coarsely toothed, and the blade of the leaf is feather-veined. The very young leaves are folded fan-wise, and are covered with fine dense silky hair. In autumn the leaves turn a beautiful clear golden-yellow.

The beech has a large, symmetrical, smooth-barked trunk. The bark is compact, not fissured or conspicuously checked, and is a beautiful mottled ash-gray in color. The tree frequently attains a height of 70 to 80 feet.

In mid-summer (July) the prickly, dark-green fruit-burs are abundant and conspicuous. The bur is exquisitely constructed, and may be compared with that of its close relative, the chestnut. The bur is made up of four segments of valves, and is lined with a dense wool. It contains three brown, triangular nuts, each about three-quarters of an inch long. The meat of these beech nuts is sweet and good to eat, and has been famous from the earliest times as food both for man and for animals. Indeed, some of us can remember turkey stuffed with beech nuts. The generic name of the beech is fagus, and this is derived from the Greek phago, to eat, referring to the esculent nuts.

Beech wood is light red, hard, strong, tough, with very close straight grain, which takes a high polish. A consider-

able proportion of the fire wood used on the Chautauqua grounds is beech.

It is interesting to know that various fossil species of beech have been found in rock formation in widely separated parts of the world, indicating that beeches once occupied great territories from which they have now largely disappeared.

The beech is mentioned repeatedly in classical literature, for example:

> "Or shall I rather the sad verse repeat
> Which on the beech's bark I lately writ?"
>
> — *Virgil.*

It must be remembered, however, that all classical allusions refer to the European beech, which closely resembles our American species.

The so-called purple or copper beeches advertised by nurserymen are ornamental varieties of the European beech, and are not natives to America. There are none of these varieties in Chautauqua, and this is rather fortunate, as they do not harmonize with the native vegetation.

The distinctive ornamental value of the American species is becoming more widely recognized every year, and Chautauqua is favored in possessing so many beautiful beeches.

XIII. Practical Suggestions for Chautauqua's Trees

I. Many of the trees contain a number of dead limbs which should be removed *at once.* At present they can be easily seen, as the living branches bear a marked contrast by reason of the generous growth of foliage. When the leaves fall, it will be almost impossible to tell which are dead and which are not. This is the reason why this particular kind of work should be done in the summer.

II. Other tree pruning should be done in the winter and care should be taken to saw the limb off close to the tree, thus giving the tree a chance to heal the wound by the new growth, which in time, takes place. A coat of paint or tar applied to the exposed portion of the limb will protect it from the insect enemies and decay.

III. All dead trees should be marked in the summer with a white ring around the tree three or four feet from the ground, then they can be removed later entirely and thus give the living tree a better chance for the struggle of life.

IV. Tree planting should be done in the fall from October 15 to November 15, or in the spring from April 1 to May 1.

This work should be done by one who understands the work thoroughly, as much depends upon the first year's growth and care.

For shade, trees, when grown, should be at least 40 feet apart. This assures ample opportunity for the development of a round, symmetrical crown and also, sufficient sunlight for the health and growth of the tree.

V. Some of our trees here need careful attention. A little tree surgery will do wonders and we are glad to report that some work is now being done. Vandalism should be stopped and care taken that no horses are hitched to trees.

VI. Many of our trees, especially the elms and lindens,

need spraying. Some of them are suffering from the ravages of the elm leaf beetle, tussock moth and other tree enemies.

On the whole, Chautauqua has good reason to be proud of her magnificent trees. With a few exceptions, they are in fairly good condition and, for generations to come, we feel sure the trees of Chautauqua will continue to be her crowning glory in the realm of nature.

— From Bird and Tree Club report by J. L. Hawk, B. H. Paul, S. H. Day.

XIV. The Wayside Plants of Chautauqua

The summer plants commonly found along our roadsides are frequently thought of as weeds. A weed is a plant out of place. These roadside plants belong to the roadside. That strip of land is their home; from the fields and gardens they have been expelled. How barren are the roadsides that lack them! These are vigorous, sturdy, tough-fibered plants, prolific and with many devices for wide dissemination. Roadside plants afford many excellent studies in plant competition, invasion, and successions. These plants should be studied not only as individuals, but in masses — they are gregarious, and stand together. These plants have interesting pedigrees — like our own human population, they have come from many lands; they have traveled all the seas. They exemplify many of the human virtues — fortitude, persistence, and the " fine determination to win " in the struggle.

Even in the cities, where " roadsides " in a botanical sense do not exist, there are, here and there, patches of wild plant life,— vacant lots, strips of idle land, backyard areas. These are populated, not only by " weeds," but often by many of the " roadside " plants. These places, apparently uninviting, may be made to yield much interesting nature-study material.

The open grasslands are of two types or classes,— first, those that are mown or pastured; second, those that are cut for hay (meadows). In the mown or pastured fields all of the plants save those that are noxious or thorny are kept cut down close to the sod. Thus many flowering plants may exist in the pasture or lawn, not as full sized normal plants, but as cropped, stunted, or prostrate, creeping or rosette form, flowering and fruiting as quickly as possible. In striking contrast to these repressed plants are the meadowland flowers, that grow up unhindered with the growing grass and assume their full form. Many flowers of the field are true invaders, that

is, their normal habitat is elsewhere; in contrast with these are the "left-overs" (ex. May apple) that originally dwelt in the forests which once covered the now treeless fields.

The common summer "wild flowers" or flowering plants are representatives of a number of large and important families. Thus the field buttercup represents the Crowfoot Family; the self-heal, the Mint Family; the Queen Anne's Lace, the Parsley Family; the white daisy, the Composite Family. The classification of the higher plants into families is based largely upon floral characters, so that the conspicuous summer flowers afford excellent opportunities for a beginning knowledge of these great natural groups.

Suggestions for individual work:

1. Study a mature burdock plant, and observe how it shades down and crowds out its neighbors with its great leaves, and does not shade itself.
2. Study the burdock fruit and its adaptation for distribution.
3. Collect the fruits or seeds of six roadside plants. Example: Spanish needles, milkweed, wild lettuce, golden-rod, cocklebur, ragweed. How is each disseminated?
4. Dig up several mature roadside plants and study the root-systems as to texture, penetration, and permanence.
5. Observe a selected bit of roadside throughout a season: spring, summer or fall. What changes take place in the plant population?
6. Are there any poisonous plants along the roadways in your region? How do you recognize them? How may they be exterminated?

XV. The Flowering Plants of Chautauqua

(Including the more common aquatic plants, but excluding grasses, rushes, etc., and trees and shrubs.)

CAT-TAIL FAMILY

1. Common Cat-tail (*Typha latifolia*); fls. June–July; frts. Aug.–Sept. The narrow-leaved cat-tail occurs in the region.

BUR-REED FAMILY

2. Broad-fruited Bur-reed (*Sparganium eurycarpum*).
3. Branching Bur-reed (*Sparganium androcladum*).

POND-WEED FAMILY

4. Common Floating Pond-weed (*Potomogeton natans*); July-Aug.; several other species occur in the shallow waters of the lake.

WATER PLANTAIN FAMILY

5. Water Plantain (*Alisma plantago-aquatica*); June–Sept.; muddy flats along the lake and streams.
6. Broad-leaved Arrow-head (*Sagittaria latifolia*); July–Sept.; several other species occur in the region, in wet places.

TAPE GRASS FAMILY

7. Tape Grass or Eel Grass (*Vallisneria spiralis*); submerged in the water.

GRASS FAMILY

None of the Grasses, Sedges, Rushes, etc., are included in this list, as their identification is exceedingly difficult for the amateur.

PICKEREL-WEED FAMILY

8. Pickerel Weed (*Pontederia cordata*); June–Oct.; swampy places along the shore, and in the shallow water.

ARUM FAMILY

9. Jack-in-the-pulpit (*Arisaema triphyllum*); April–June; moist woods.

10. Skunk Cabbage (*Symplocarpus foetidus*); Feb.–Apr.; wet fields and woods.

DUCKWEED FAMILY

11. Common Duckweed (*Lemna minor*); floating on the surface of the water.

PIPEWORT FAMILY

12. Seven-angled Pipewort (*Eriocaulon septangulare*); July–Oct.; in still water or on shores.

MELANTHUM FAMILY

13. White Hellebore (*Veratrum viride*); May–July; swamps and wet woods.
14. Perfoliate Bellwort (*Uvularia perfoliata*); May–June; shady woods.
15. Large-flowered Bellwort (*Uvularia grandiflora*); April–June; woods.

LILY FAMILY

16. Wild Onion (*Allium cernuum*); July–Aug.; there are several other species in the region.
17. Canada Lily (*Lilium canadense*); June–July; swamps, wet fields and woods.

LILY-OF-THE-VALLEY FAMILY

18. Asparagus (*Asparagus officinalis*); May–June; naturalized.
19. Yellow Clintonia (*Clintonia borealis*); May–June; moist woods and thickets.
20. Wild Spikenard (*Vagnera racemosa*); May–July; moist woods and thickets.
21. Canada Mayflower (*Unifolium canadense*); May–July; moist woods and thickets.
22. Clasping-leaved Twisted Stalk (*Streptopus amplexifolius*); May–July; moist woods.
23. Sessile-leaved Twisted Stalk (*S. rubens*); May–July; moist woods.
24. Solomon's Seal (*Salomonia biflora*); April–July; woods and thickets.
25. Purple Trillium (*Trillium erectum*); April–June; woods; there are several other species common in the region.

SMILAX FAMILY

26. Carrion Flower (*Smilax herbacea*); April–June; woods and thickets.
27. Green Brier (*S. rotundifolia*); April–June; woods and thickets.

IRIS FAMILY

28. Blue Flag (*Iris versicolor*); May–July; marshes, thickets, wet fields.
29. Blue-eyed Grass (*Sisyrinchium graminoides*); May–June; meadows and fields; there are several other species in the region.

ORCHID FAMILY

30. Ragged Orchis (*Blephariglottis lacera*); June–July; swamps and wet woods.
31. Purple-fringed Orchis (*Blephariglottis grandiflora*); June–Aug.; rich woods and meadows.

    There are several other orchids in the region; all should be strictly protected, as they are easily exterminated.
32. Large Coral-root (*Corallorhiza multiflora*); July–Sept.; in woods.

LIZARD'S-TAIL FAMILY

33. Lizard's-Tail (*Saururus cernuus*); June–Aug.; swamps and shallow water.

NETTLE FAMILY

34. Slender Nettle (*Urtica gracilis*); June–Oct.; in dry soil.
35. Small Nettle (*Urtica urens*); May–Sept.; in waste places; from Europe.
36. Wood Nettle (*Urticastrum divaricatum*); July–Aug.; in rich woods.

BIRTHWORT FAMILY

37. Wild Ginger (*Asarum candense*); April–May; in rich woods.

BUCKWHEAT FAMILY

38. Sheep Sorrel (*Rumex acetosella*); May–Sept.; dry fields; from Europe.
39. Curled Dock (*R. crispus*); June–Aug.; fields and roadsides; from Europe.

40. Fiddle Dock (*R. pulcher*); June–Sept.; waste places; from Europe.
41. Lady's Thumb (*Polygonum persicaria*); June–Oct.; waste places; from Europe.
42. Smart-Weed (*P. hydropiper*); July–Sept.; moist waste places; from Europe.
43. Knot-Grass (*P. aviculare*); June–Oct.; fields and waste places.
44. Climbing False Buckwheat (*P. scandens*); Aug.–Sept.; woods and thickets.
45. Erect Knotweed (*P. erectum*); July–Sept.; moist places.
46. Arrow-leaved Tear-Thumb (*P. sagittatum*); July–Sept.; in wet soil.

GOOSEFOOT FAMILY

47. White Goosefoot (*Chenopodium album*); June–Sept.; waste places; from Europe.
48. Strawberry Blite (*Blitum capitatum*); June–Aug.; dry soil.

AMARANTH FAMILY

49. Rough Pigweed (*Amaranthus retroflexus*); Aug.–Sept.; waste places; from tropical America.

POKEWEED FAMILY

50. Pokeweed (*Phytolacca decandra*); June–Sept.; woods and waste places.

PORTULACA FAMILY

51. Purslane (*Portulaca oleracea*); summer; fields and waste places.

PINK FAMILY

52. Bladder Campion (*Silene vulgaris*); summer; meadows and waste places; from Europe.
53. Bouncing Bet (*Sapindus officinalis*); summer; roadsides, etc.; from Europe.
54. Water Chickweed (*Alsine aquatica*); May–Aug.; wet places; from Europe.
55. Common Chickweed (*A. media*); fields and woods; from Europe.
56. Long-leaved Chickweed (*A. longifolia*); May–July; swamps and wet places.
57. Mouse-ear Chickweed (*Cerastium vulgatum*); May–Sept.; fields and woods.

WATER-LILY FAMILY

58. Water Shield (*Brasenia purpurea*); summer; in the lake and ponds.
59. Yellow Pond Lily (*Nymphaea advena*); April–Sept.; lake and ponds.

CROWFOOT FAMILY

60. Red Baneberry (*Actea rubra*); April–June; in woods.
61. White Baneberry (*Actea alba*); April–June; in woods.
62. Black Snakeroot (*Cimifuga racemosa*); June–Aug.; woods and roadsides.
63. Thimble-weed (*Anemone virginiana*); June–Aug.; woods and thickets.
64. Round-lobed Hepatica (*Hepatica hepatica*); Dec.–May; in woods.
65. Sharp-lobed Hepatica (*H. acutiloba*); March–April; in woods.
66. Rue Anemone (*Syndesmon thalictroides*); March–June; in woods.
67. Clematis (*Clematis virginiana*); July–Sept.; woodlands, thickets, etc.
68. Small-flowered Crowfoot (*Ranunculus abortivus*); April–June; woods.
69. Hooked Crowfoot (*R. recurvatus*); April–June; woods and waysides.
70. Bulbous Crowfoot (*R. bulbosus*); May–July; fields and roadsides.
71. Meadow Crowfoot (*R. acris*); May–Sept.; fields and meadows; abundant.
72. Early Meadow-rue (*Thalictrum dioicum*); April–May; in woods.
73. Tall Meadow-rue (*T. polygonum*); June–Aug.; woods and clearings.

BARBERRY FAMILY

74. Blue Cohosh (*Caulophyllum thalictroides*); April–May; in woods.
75. May Apple (*Podophyllum peltatum*); May; woods and fencerows.

POPPY FAMILY

76. Climbing Fumitory (*Adlumia fungosa*); June–Oct.; moist woods.

MUSTARD FAMILY

77. Hedge Mustard (*Sisymbrium officinale*); May–June; waste places; from Europe.

78. White Mustard (*Sinapis alba*); summer; waste places; from Europe.
79. Black Mustard (*Brassica nigra*); June–Nov.; waste places; from Europe.
80. Wild Radish (*Raphanus raphanistrum*); summer; waste places; from Europe.
81. Yellow Rocket (*Barbarea barbarea*); April–June; fields and roadsides.
82. Horse-Radish (*Roripa armoracia*); April–Nov.; moist places; from Europe.
83. Bitter-Cress (*Cardamine pennsylvanica*); April–June; moist places.
84. Shepherd's Purse (*Bursa bursa-pastoris*); Jan.–Dec.; waste places; from Europe.

ORPINE FAMILY

85. Orpine (*Sedum telephium*); June–Sept.; fields and roadsides; from Europe.
86. Stonecrop (*Penthorum sedoides*); July–Sept.; ditches and swamps.

SAXIFRAGE FAMILY

87. False Mitrewort (*Tiarella cordifolia*); April–May; rich, moist woods.
88. Bishop's Cap (*Mitella diphylla*); April–May; in rich woods.

ROSE FAMILY

89. Wild Strawberry (*Fragaria virginiana*); April–June; dry soil.
90. Rough Cinquefoil (*Pontentilla monspeliensis*); June–Sept.; dry soil.
91. Five-Finger (*P. canadensis*); April–Aug.; in dry soil.
92. Barren Strawberry (*Waldsteinia fragarioides*); May–June; woods.
93. White Avens (*Geum canadense*); June–Aug.; in shaded places.
94. Yellow Avens (*G. strictum*); June–Aug.; swamps and low ground.
95. Woodland Agrimony (*Agrimonia striata*); July–Sept.; in dry woods. Several other species also occur in the region.

LEGUME FAMILY

96. Alfalfa (*Medicago sativa*); summer; cultivated; from Europe.
97. White Sweet Clover (*Melilotus alba*); June–Nov.; fields; from Europe.

98. Red Clover (*Trifolium pratense*); April–Nov.; cultivated; from Europe.
99. White Clover (*T. repens*); May–Dec.; cultivated.
100. Alsike Clover (*T. hybridum*); May–Oct.; cultivated.
101. Hop Clover (*T. aureum*); May–Sept.; along roads; from Europe.
102. Meadow Pea (*Lathyrus pratensis*); June–Aug.; in waste places; from Europe.

GERANIUM FAMILY

103. Spotted Crane's-bill (*Geranium maculatum*); April–July; in woods.
104. Herb Robert (*G. robertianum*); May–Oct.; in rocky woods.
105. Small-flowered Crane's-bill (*G. pusillum*); May–Sept.; waste places; from Europe.

OXALIS FAMILY

106. Yellow Wood-Sorrel (*Oxalis corniculata*); Feb.–Nov.; fields, etc.
107. White Wood-Sorrel (*O. acetosella*); May–July; cool, damp woods.

SUMACH FAMILY

108. Poison Ivy (*Rhus radicans*); May–June; thickets and along fences.
109. Poison Sumach (*R. vernix*); June; in swamps; very poisonous.

STAFF-TREE FAMILY

110. Bittersweet (*Celastrus scandens*); in rich soil; June.

JEWEL-WEED FAMILY

111. Spotted Jewel-Weed (*Impatiens biflora*); July–Oct.; moist ground.
112. Pale Jewel-Weed (*I. aurea*); July–Sept.; moist ground, shady places.

VINE FAMILY

113. Wild Grape (*Vitis labrusca*); May–June; thickets and woods.
114. Virginia Creeper (*Parthenocissus quinquifolia*); July; woods and thickets.

MALLOW FAMILY

115. Common Mallow (*Malva rotundifolia*); May–Nov.; waste places; from Europe.

116. Musk Mallow (*M. moschata*); summer; waste places; from Europe.

ST. JOHN'S-WORT FAMILY

117. Common St. John's-wort (*Hypericum perforatum*); June–Sept.; fields, etc.; from Europe.
118. Elliptic-leaved St. John's-wort (*H. ellipticum*); June–Aug.; swamps and along streams.
119. Spotted St. John's-wort (*H. maculatum*); July–Sept.; moist soil.

VIOLET FAMILY

120. Meadow Violet (*V. papilionacea*); April–June; woods and meadows.
121. Canada Violet (*V. canadensis*); May–July; woods, shaded slopes.
122. Downy Yellow Violet (*V. pubescens*); April–May; dry woods.
123. Sweet White Violet (*V. blanda*); April–May; swamps and wet woods. There are numerous other species in the region.

EVENING PRIMROSE FAMILY

124. Great Willow-herb (*Epilobium hirsutum*); June–Sept.; waste places; from Europe.
125. Purple-leaved Willow-herb (*E. coloratum*); July–Sept.; low ground.
126. Northern Willow-herb (*E. adenocaulon*); July–Sept.; moist ground.
127. Fire Weed (*Chamaenerion angustifolium*); June–Sept.; dry soil.
128. Evening Primrose (*Onagra biennis*); June–Oct.; dry soil.
129. Common Sundrops (*Kneiffia fruticosa*); June–Aug.; dry soil.
130. Small Sundrops (*K. pumila*); June–Aug.; dry soil.
131. Enchanter's Nightshade (*Circaea lutetiana*); June–Aug.; in woods.

GINSENG FAMILY

132. Wild Sarsaparilla (*Aralia nudicaulis*); May–June; in woods.
133. Spikenard (*A. racemosa*); July–Aug.; in rich woods.
134. Ginseng (*Panax quiquefolia*); July–Aug.; in rich woods.
135. Dwarf Ginseng (*P. trifolium*); April–June; moist woods and thickets.

CARROT FAMILY

136. Black Snakeroot (*Sanicula marylandica*); May–July; rich woods.
137. Sweet Cicely (*Washingtonia Claytoni*); May–June; in woods.

138. Poison Hemlock (*Conium maculatum*); June–July; waste places; from Europe.
139. Golden Meadow-Parsnip (*Zizia aurea*); April–June; fields and swamps.
140. Honewort (*Feringa canadensis*); June–July; in woods.
141. Wild Parsnip (*Pastinaca sativa*); June–Sept.; roadsides, etc.; from Europe.
142. Wild Carrot (*Daucus carota*); June–Sept.; fields and waste places; very abundant; from Europe.
143. Bishop-weed or Striped-leaved Carrot, a cultivated plant extensively used on the Chautauqua Grounds for a border plant.

WINTERGREEN FAMILY

144. Round-leaved Wintergreen (*Pyrola rotundifolia*); June–July; dry woods.
145. Shin-Leaf (*P. elliptica*); June–Aug.; rich woods.
146. Pipsissewa (*Chimaphila umbellata*); June–Aug.; dry woods.

INDIAN PIPE FAMILY

147. Indian Pipe (*Montropa uniflora*); June–Aug.; moist, rich woods.

PRIMROSE FAMILY

148. Moneywort (*Lysimachia nummularia*); June–Aug.; moist places; from Europe.
149. Fringed Loosestrife (*Steironema ciliatum*); June–Aug.; moist places.
150. Bulb-bearing Loosestrife (*Lysimachia terrestris*); July–Sept.; swamps and moist thickets.

DOGBANE FAMILY

151. Periwinkle (*Vinca minor*); Feb.–May; escaped from gardens; European.
152. Spreading Dogbane (*Apocynum androsaemifolium*); June–July; fields and thickets.

MILKWEED FAMILY

153. Purple Milkweed (*Asclepias purpurascens*); June–Aug.; dry fields.
154. Swamp Milkweed (*A. incarnata*); July–Sept.; in swamps.
155. Common Milkweed (*A. syriaca*); June–Aug.; fields and waste places.

MORNING-GLORY FAMILY

156. Hedge Bindweed (*Convolvulus sepium*); June–Aug.; moist fields and thickets.
157. Small Bindweed (*C. arvensis*); May–Sept.; fields and waste places.

DODDER FAMILY

158. Dodder (*Cuscuta spp.*); there are several species of this parasite in the region, on willow, etc.

WATER-LEAF FAMILY

159. Water-leaf (*Hydrophyllum virginicum*); May–Aug.; in woods.

BORAGE FAMILY

160. Hound's Tongue (*Cynoglossum officinale*); May–Sept.; fields and waste places.
161. Stickseed (*Lappula virginiana*); June–Sept.; dry woods and thickets.
162. Forget-me-not (*Myosotis palustris*); May–July; brooks and marshes; escaped from gardens; European.

VERBENA FAMILY

163. White Vervain (*Verbena urticifolia*); June–Sept.; fields and waste places.
164. Blue Vervain (*V. hastata*); June–Sept.; fields and waste places.

MINT FAMILY

165. Giant Hyssop (*Agastache scrophulaeiaefolia*); July–Oct.; woods, etc.
166. Catnip (*Nepeta cataria*); July–Nov.; waste places; from Europe.
167. Ground Ivy (*Glecoma hederacea*); March–May; waste places, woods, etc.
168. Self-Heal (*Prunella vulgaris*); May–Oct.; fields, etc.; from Europe.
169. Hemp-Nettle (*Galeopsis tetrahit*); June–Sept.; waste places; from Europe.
170. Hedge Nettle (*Stachys palustris*); June–Sept.; moist soil.
171. Bee Balm (*Monarda didyma*); July–Sept.; moist soil, along streams.
172. Wild Bergamot (*M. fistula*); June–Sept.; dry hills and thickets.

173. Pennyroyal (*Hedeoma pulegioides*); July–Sept.; dry fields and woods.
174. Wild Basil (*Clinopodium vulgare*); June–Oct.; fields and woods.
175. Purple Bugle-weed (*Lycopus virginicus*); July–Sept.; moist soil.
176. Cut-leaved Water Hoarhound (*L. americanus*); June–Oct.; wet soil.
177. Horse Mint (*Mentha longifolia*); July–Oct.; waste places; from Europe.
178. Spearmint (*M. spicata*); July–Sept.; moist fields, etc.; from Europe.
179. Horse-Balm (*Collinsonia canadensis*); July–Oct.; moist woods.
180. Peppermint (*Mentha piperita*); July–Sept.; wet soil; from Europe.
181. Motherwort (*Leonurus cardiaca*); June–Sept.; waste places; from Europe.

POTATO FAMILY

182. Ground Cherry (*Physalis pruinosa*); July–Sept.; in cultivated soil.
183. Horse Nettle (*Solanum carolinense*); May–Sept.; dry fields, etc.
184. Nightshade (*S. dulcamara*); May–Sept.; thickets, etc.; from Europe.
185. Jimson Weed (*Datura stramonium*); June–Sept.; from tropical Asia.

FIGWORT FAMILY

186. Mullen (*Verbascum thapsus*); June–Sept.; fields, etc.; from Europe.
187. Moth Mullen (*V. blattaria*); June–Nov.; fields, etc.; from Europe.
188. Yellow Toad-flax (*Linaria linaria*); June–Oct.; fields, etc.; from Europe.
189. Hare Figwort (*Scrophularia leporella*); May–July; woods and roads.
190. Turtle-Head (*Chelone glabra*); July–Sept.; swamps and streams.
191. Monkey-Flower (*Mimulus ringens*); June–Sept.; swamps and streams.
192. Brooklime (*Veronica americana*); April–Sept.; brooks and swamps.
193. Common Speedwell (*V. officinalis*); May–Aug.; dry fields and woods.
194. Purple Foxglove (*Digitalis purpurea*); June–Aug.; escape from cultivation.
195. Wood Betony (*Pedicularis canadensis*); April–June; dry woods.

BROOM-RAPE FAMILY

196. Squaw-root (*Conopholis americana*); April–Aug.; in rich woods.
197. Beech-drops (*Leptamnium virginianum*); Aug.–Oct.; in beech woods.

LOPSEED FAMILY

198. Lopseed (*Phryma leptstachya*); June–Aug.; woods and thickets.

PLANTAIN FAMILY

199. Common Plantain (*Plantago major*); May–Sept.; waste places; from Europe.
200. Narrow-leaved Plantain (*Plantago lanceolata*); April–Nov.; fields and waste places; from Europe.

MADDER FAMILY

201. Partridge-Berry (*Mitchella repens*); April–June; in woods.
202. Wild Liquorice (*Galium circaezans*); May–July; in woods.
203. Fragrant Bedstraw (*G. triflorum*); June–Aug.; in woods.
204. Rough Bedstraw (*G. asprellum*); June–Aug.; in moist soil.
205. Shining Bedstraw (*G. concinnum*); June–Aug.; dry woodlands.
206. Torrey's Bedstraw (*G. lanceolatum*); June–Aug.; in dry woods.

HONEYSUCKLE FAMILY

207. Coral Honeysuckle (*Lonicera sempervirens*); April–Sept.; low grounds, and hillsides.

TEASEL FAMILY

208. Wild Teasel (*Dipsacus sylvestris*); July–Sept.; in waste places; from Europe.

GOURD FAMILY

209. Wild Cucumber (*Micrampelis lobata*); July–Sept.; along streams and in waste places.

LOBELIA FAMILY

210. Cardinal Flower (*Lobelia cardinalis*); July–Sept.; moist soil.
211. Great Lobelia (*L. syphilitica*); July–Oct.; moist soil.
212. Spiked Lobelia (*L. spicata*); June–Aug.; dry soil and meadows.
213. Indian Tobacco (*L. inflata*); July–Nov.; fields and thickets.

CHICKORY FAMILY

214. Chickory (*Cichorium intybus*); July–Oct.; roadsides and waste places.
215. Dandelion (*Taraxacum taraxacum*); Jan.–Dec.; abundant everywhere. Europe.
216. Sow-Thistle (*Sonchus oleraceus*); May–Nov.; fields and waste places. Europe.
217. Prickly Lettuce (*Lactuca scariola*); Aug.–Sept.; fields and waste places; from Europe.
218. Wild Lettuce (*L. canadensis*); June–Nov.; moist, open places.
219. Arrow-leaved Lettuce (*L. sagittifolia*); July–Sept.; in dry, open soil.
220. Orange Hawkweed (*Heiracium aurantiacum*); June–Sept.; fields, woods, etc.; a serious pest; from Europe.
221. Panicled Hawkweed (*H. paniculatum*); July–Sept.; dry woods.
222. Canada Hawkweed (*H. canadense*); July–Sept.; dry woods and thickets.
223. White Lettuce (*Nabulus ablus*); Aug.–Sept.; in woods.

RAGWEED FAMILY

224. Ragweed (*Ambrosia artemisiaefolia*); July–Oct.; dry soil; plentiful.
225. Great Ragweed (*A. trifida*); July–Oct.; moist soil.
226. Spiney Cocklebur (*Xanthium spinosum*); Aug.–Nov.; waste places; from Europe.

THISTLE FAMILY

227. Joe-Pye Weed (*Eupatorium purpureum*); Aug.–Sept.; moist places.
228. Spotted Joe-Pye Weed (*E. maculatum*); Aug.–Sept.; moist soil.
229. Boneset (*E. perfoliatum*); July–Sept.; in wet places.
230. White Snake-root (*Eupatorium ageratoides*); July–Nov.; rich woods.
231. Silver Goldenrod (*Solidago bicolor*); July–Sept.; dry soil.
232. Hairy Goldenrod (*S. hispida*); Aug.–Oct.; in dry soil.
233. Ohio Goldenrod (*S. ohioensis*); Aug.–Sept.; in moist soil. Numerous other species of Goldenrod occur in the region.
234. Crook-stemmed Aster (*Aster prenanthoides*); Aug.–Oct.; moist soil.

235. White Wood Aster (*A. divaricatus*); Sept.–Oct.; open woods and thickets. Numerous other species of Aster occur in the region.
236. Daisy Fleabane (*Erigeron ramosus*); May–Nov.; in fields and roadways.
237. Mouse-ear Everlasting (*Antennaria plantaginifolia*); April–June; dry soil.
238. Pearly Everlasting (*Anaphalis margaritacea*); summer; dry soil.
239. Elecampane (*Inula helenium*); summer; roadsides and fields; from Europe.
240. Black-eyed Susan (*Rudbeckia hirta*); May–Sept.; fields and meadows.
241. Wild Sun-Flower (*Helianthus decapetalus*); Aug.–Sept.; moist woods and along streams. Several other species in the region.
242. Spanish Needles (*Bidens bipinnata*); July–Oct.; very common as a weed.
243. Galinsoga (*Galinsoga parvifolia*); June–Nov.; dooryards, fields, etc.; from tropical America.
244. Yarrow (*Achillea millifolium*); June–Nov.; fields, etc.; from Europe.
245. Mayweed (*Anthemis cotula*); June–Nov.; fields and waste places; Europe.
246. White Daisy (*Chrysanthemum leucanthemum*); May–Nov.; pastures, fields, etc.; from Europe.
247. Burdock (*Arctium lappa*); July–Nov.; waste places; from Europe.
248. Canada Thistle (*Carduus arvensis*); June–Sept.; fields and waste places; from Europe; a pernicious weed.
249. Bur Thistle (*Carduus lanceolatus*); summer; fields, etc.; from Europe.

XVI. Pollination Methods of Some Chautauqua Wild Flowers

Name of Flower	Insect Visitors	Method of preventing or limiting self pollination, etc.
1. Tall Meadow-Rue	Many insects	Some flowers perfect, some staminate, others pistillate.
2. Wild Columbine	Bumble Bees and humming birds	Anthers mature before stigma. Flower has lost the power of self-pollination.
3. Yellow Water-Lily	Small bees, flies and beetles	Stigma matures before anthers.
4. Shepherd's Purse	Flies	Self-fertilization very common.
5. St. John's Wort	Pollen-gathering bees, pollen eating flies and beetles	Self-fertilization very common.
6. Bouncing Bet	Sphinx Moth Pollen-gathering bees	Anthers mature before stigmas, 2 sets of stamens maturing at different intervals.
7. Spotted Jewel-Weed	Bees Humming birds	Stigma concealed beneath stamens. Anthers mature first. Produces also cleistogamous beds.
8. Staghorn Sumack	Short-tongued bees and flies	Pistillate flowers generally separate from staminate.
9. Purple - flowering Raspberry	Bumblebees	Outer anthers mature a little before stigmas, but self-fertilization from the inner row of anthers is common.
10. Enchanter's Nightshade	Bees and flies	Stigma a landing place for incoming insects. Self-fertilization infrequent.
11. Evening Primrose	Moths, bumble-bees, humming birds	Anthers mature before stigma.
12. Sweet Cicely	Flies and bees	Some flowers perfect, others staminate. In perfect flowers anthers mature before stigmas.
13. Elder-berry	Pollen gatherers, flies, beetles, small bees	Stamens radiate away from stigmas.
14. Joe-Pye Weed	Butterflies, bees and flies	Anthers mature before stigma.

Pollination Methods of Some Wild Flowers

Name of Flower	Insect Visitors	Method of preventing or limiting self pollination, etc.
15. Black-eyed Susan	Many insects	Disk-flowers perfect, self-fertilization usual.
16. Shin-leaf	Bees and flies	Stigma protrudes and strikes incoming insect.
17. Mullein	Pollen collecting bees and flies	Stigma protrudes and strikes incoming bee.
18. Monkey-flower	Long-tongued bees	Two sets of stamens, and sensitive stigma which rolls up after contact with visitor, exposing stamens which then shed their pollen.
19. Forget-me-not	Flies and bees	Anthers and stigmas so arranged that they are touched by opposite sides of the tongue of visiting insects.
20. Blue Flag	Bees and bumble bees	Stigmatic surface covered by a flexible flap, which insect opens as it withdraws proboscis and body from flower, anthers face away from stigma.

For further data see Gibson's "*Blossom Hosts and Insect Guests.*"

XVII. Concerning Poison Ivy

Poison ivy is a common climbing or shrubby plant occurring along roadsides and in woodlands throughout the Chautauqua region. There is some poison ivy within the Chautauqua Assembly Grounds. Every person should be familiar with the appearance of this noxious pest. The leaves are compound with three leaflets irregularly toothed and notched. The Virginia creeper, a beautiful harmless vine that is often confused with the poison ivy, has compound leaves with five leaflets each. The leaves of the poison ivy are bright red when they appear in the spring and turn red again in the fall. Through ignorance children often pluck the leaves for bouquets, and are terribly poisoned. The poison is a heavy, gummy oil contained in all parts of the plant and exuded from leaves, bark and fruit. Imperceptible amounts coming in contact with the skin, cause the characteristic painful blisters. Susceptible persons are affected by merely walking near the plants. In case of poisoning bathe affected parts with a strong solution of lead acetate in dilute alcohol (secured from a physician).

XVIII. The Chautauqua Insects and Their Allies

The Chautauqua region, with its diversity of lake and stream, woodland and swamp, field and ravine, has an unusual variety and abundance of insect life. Its geographic location, moreover, is such that a number of life-zones overlap at this place, giving to the district the fauna and flora of several regions. The following synopsis will point out the chief groups of the insects and their allies, with some notes as to their prominent characteristics. An itemized list would run into the thousands of names, for the species of insects are vastly more numerous than those of any other animal group.

I. THE CRUSTACEANS

The Crawfish, or Crayfish, plentiful in the streams, ponds, and lake, is a familiar example of this group. There are very many minute and microscopic crustacea abundant in quiet and stagnant waters. Daphnia, Cypris, and Cyclops are common examples of these. They are economically important as food for fishes and higher aquatic animals. The Sow-Bugs, or Pill-Bugs, that are plentiful under damp boards, stones, and logs, are excellent examples of the crustacean type. Crabs and lobsters are marine crustaceans.

II. THE SPIDERS

In the body of the spider the head and thorax are grown together, forming one piece; there are *four* pairs of legs, whereas true insects have but three pairs. Abundant Chautauqua representatives of this interesting and harmless group are:

1. *The Daddy-Long-Legs* or Harvestmen; perfectly harmless; webless species, feeding on plant lice and other small insects.
2. *The Clubionid Spiders;* living in flat tubular nests, in rolled-up leaves.
3. *The Drassid Spiders;* dark-colored; nocturnal; webless; hiding under leaves and stones.
4. *The Funnel-Web Weavers;* exceedingly abundant in grassy fields; brown, long-legged spiders.

5. *The Dictynid Spiders;* irregular webs with a peculiar curly thread; common on asters, golden-rod, etc.
6. *The Cob-Web Spiders;* small; abundant in corners, ceilings of barns, sheds, etc.
7. *The Orb Weavers;* the beautiful and symmetrical orb webs are made by these plentiful and interesting spiders.
8. *The Uloborid Spiders;* regular webs with curly-thread; fairly common.
9. *The Crab Spiders;* crab-like in appearance and gait; webless; lie in wait for prey; some brightly colored.
10. *The Running Spiders;* large, dark-colored, hairy spiders; webless; swift runners, pursuing prey.
11. *The Jumping Spiders;* small; quick, jumping movements; bright markings; common on plants, logs, etc.

III. THE MITES

Many minute species, infesting plants and animals; many acting as scavengers. The "Red Spider" of house plants is a mite; several kinds produce plant galls.

IV. THE MYRIOPODS

Many-legged, worm-like creatures; centipedes and millepedes; the Chautauqua species all harmless, and living under damp stones, logs, and bark; predaceous, feeding on small insects.

V. THE TRUE INSECTS

The true insects have three pairs of legs in the adult stage.

1. The Thysanurans

These are small, inconspicuous insects, without metamorphoses; living under stones, decayed wood and leaves, etc., or in the house. The common "Silver Fish," destructive to books and wall-paper, is perhaps the most common example.

2. The May Flies

Delicate, graceful insects; the fore wings much larger than the hind wings; the nymphs are aquatic; the adults aerial and living but a few hours or days. There are many species in Chautauqua Lake, brooks, and ponds, and the adults are abundant in early summer.

3. The Dragon-Flies

Graceful, strong-winged insects; the hind wings as large or larger than the fore wings; nymphs aquatic; adults aerial; mouth-parts biting.

Often called "Snake Feeders," but perfectly harmless. There are a number of species in the Chautauqua region, all very useful as destroyers of gnats, flies, mosquitoes, etc. The more delicate-winged kinds are called Damsel Flies.

4. The Stone Flies

With four wings, the hind wings large and plaited; nymphs aquatic, adults aerial; plentiful under stones in swift currents of brooks and streams.

5. The White Ants or Termites

Social insects, with a caste system like that of the true ants and bees. Rare in this region; abundant in the tropics; our species lives in old stumps and logs; color, a dirty, yellowish white.

6. The Grasshoppers and Crickets

A large group of large and easily recognized insects; very abundant in the middle and late summer; biting mouthparts; life cycle comprises: egg, nymph, adult. The group includes cockroaches, locusts, long-horned grasshoppers, katydids, crickets, and tree crickets. The musical songs of the males are produced by the rubbing together of the fore-wings or wing-covers; these parts are beautifully specialized for this purpose.

7. The Thrips

Minute insects, living chiefly in the bases of flowers and florets; four delicate fringed wings; very lively; mostly vegetarians.

8. The Bugs

Sucking mouthparts; three stages in life cycle: egg, nymph, adult. A very large and diversified group; some of the important groups represented in the Chautauqua region are: Water Boatmen, Back-Swimmers, Water Scorpions, Giant Water-Bugs, Water Striders, Thread-legged Bugs, Assassin Bugs, Lace Bugs, Bed Bugs, Leaf Bugs, Chinch Bugs, Squash Bugs, Stink Bugs, Lice, Cicadas, Spittle Bugs, Leaf-Hoppers, Tree-Hoppers, Jumping Plant-Lice, Plant Lice or Aphids, Scale Insects and Mealy Bugs. Many highly destructive and obnoxious species belong to this group.

9. The Ant-Lions and Their Kin

Four wings; biting mouthparts; four stages in life cycle: egg, larva, pupa, adult. The larvæ of several kinds inhabit swift streams; example, the Dobson, coveted by fishermen for bait. This group includes the Aphis-Lions and the Ant-Lions, both fairly common in the Chautauqua region.

10. The Caddice Flies

Four wings; rudimentary mouthparts; four stages in life cycle: egg, larva, pupa, adult; the early stages are aquatic, in brooks, swamps, lake, etc. The larvæ encase themselves in little houses of plant fragments or sand. There are many species in the Chautauqua region.

11. The Moths and Butterflies

A large and well-known group, many with showy colors; four wings, covered with scales; sucking mouthparts; four stages in life cycle: egg, larva or caterpillar, pupa, chrysalis or cocoon, and adult.

The moths have feathery antennae, are chiefly nocturnal, and fold wings flat over the back. Some of the important groups are: Swifts, Flannel Moths, Bag-Worm Moths, Carpenter Moths, Slug-Caterpillar Moths, Smoky Moths, Pyraustid Moths, Pyralid Moths, Bee Moths, Close-Winged Moths, Phycitid Moths, Plume Moths, Tortricid Moths, Grapholithid Moths, Tineid Moths, Clear-Winged Moths, Prominent Moths, Geometrid Moths, Canker-worm Moths, Ennomid Moths, Hydriomenid Moths, Sterrhid Moths, Hook-Tip Moths, Cymatophorid Moths, Owlet Moths, Tussock Moths, Wood-Nymph Moths, Tiger Moths, Footman Moths, Hawk or Sphinx Moths, Giant Silk-Worm Moths, Royal Moths, Tent-Caterpillar Moths.

The Skippers have a darting flight, and antennae recurved at the extreme tip. They fly about in daylight, and when at rest fold their wings erect over their backs. This group includes the Giant Skippers, the common Skippers, and several other lesser groups.

The Butterflies have clubbed antennae; fly only by day; and fold their wings erect over their back when at rest. They feed chiefly on nectar, and are common around flowers. The group includes the Swallowtails, Pierids-Whites, Orange-tips and Sulphurs; Gossamer-Winged Butterflies, Coppers, Blues, and Hair-streaks; Monarchs, Crescent-Spots, Fritillaries, Angel-Wings, Sovereigns, Meadow-Browns, and Gray-Wings.

12. The Flies

A large group, including many obnoxious species. Two wings; sucking mouthparts; complete metamorphoses. Includes such groups as the Crabe Flies, Net-Winged Midges, Mosquitoes, Midges, Lake Flies, — the Chautauqua Lake Fly is one of these, — Fungus Gnats, Gall Gnats, March Flies, Black Flies, Horse Flies, Soldier Flies, Snipe Flies, Robber Flies, Bee Flies, Stiletto Flies, Window Flies, Dance Flies, Long-Legged Flies, Syrphus Flies, Bot Flies, Tachina Flies, House Flies, Pomace Flies.

13. The Beetles

Another large group, comprising a great variety of "hard-shelled" insects; the wing-covers are much thicker than the delicate plaited hind wings, which are folded under the covers; biting mouthparts; complete metamorphoses. The following are groups, representatives of which may be found in the Chautauqua region; some of them are very common: Tiger Beetles, Ground Beetles, Predaceous Diving Beetles, Whirligig Beetles, Water Scavenger Beetles, Carrion Beetles, Rove Beetles, Lady Bugs, Water Pennies, Click Beetle, Metallic Wood-Borers, Fire Flies, Checkered Beetles, Stag Beetles, Tumble Bugs, Lamellicorn Beetles, May Beetles, Rhinoceros Beetles, Long-Horned Beetles, Sawyer Beetles, Leaf Beetles, Flea Beetles, Weevils, Darkling Beetles, Blister Beetles, Snout Beetles, Bill Beetles, Engraver Beetles.

14. Ants, Bees and Wasps

These insects stand at the top of the ladder of insect evolution, and many exhibit a highly-organized social habit. Four wings, hind wings smaller than the fore wings; mouthparts for biting and sucking; metamorphoses complete; abdomen of female with sting, piercer, or saw. Representative groups are: Saw Flies, Horn-Tails, Gall Flies, Ichneumon Flies, Braconids, Ensign Flies, Chalcis Flies, Pelecinus, Cuckoo Flies, Ants, Spider Wasps, Thread-Waisted Wasps or Mud-Daubers, Bembecids, Pemphredonids, Crabonids, Solitary Wasps, Social Wasps, Short-Tongued Bees, Long-Tongued Bees, Carpenter Bees, Bumble Bees, the Honey Bee.

XIX. Insects which Live on the Grape

The most important commercial crop of the Chautauqua region is the grape, the belt lying along the shore of Lake Erie is famous for its grape and its grape-juice. It is not generally realized that the grape is attacked by a considerable variety of insects. The following list admirably illustrates the diversity of insect life to be found on a single crop-plant.

1. Grape Flea-Beetle.
2. Grape-Blossom Midge.
3. Rose-Chafer.
4. Grape Root-Worm.
5. Grape Leaf-Hopper.
6. Grape Berry-Moth.
7. Grape Blotch Miner.
8. Grape Serpentine Miner.
9. Eight-Spotted Forester.
10. Yellow Bear Moth.
11. Diverse-Lined Moth.
12. Hog Sphinx Moth.
13. Checkered Grape-Vine Sphinx.
14. Pandorus Sphinx Moth.
15. Grape Plume Moth.
16. Common Tree Cricket.
17. Argus Beetle.
18. Red-Headed Systena.
19. Vine Chafer.
20. Grape-Vine Colapsis.

XX. The Orders of Mammals and their Chautauqua Representatives

I.	*The Egg-laying Mammals.* Confined to Australasia.	
II.	*The Pouched Mammals.* Kangaroos and Opossums.	1. **Opossum**
III.	*The Diggers.* No American forms; confined to Africa and the East.	
IV.	*The Toothless Mammals.* South and Central America only.	
V.	*The Sea-Cows.* Tropical and subtropical waters.	
VI.	*Whales and Porpoises.* Marine.	
VII.	*The Hoofed Animals.* A very large group, richly represented in America, and comprising the Cattle and Sheep Family, Antelope Family, Deer Family, Peccary and Tapir Families. In early times in the Chautauqua region were	
		2. **American Elk**
		3. **White-tailed Deer**
		4. **Moose**
VIII.	*The Rodents, or Gnawing Mammals.* A very large and widely distributed order, including:	
	a. The Squirrels.	5. **Gray Squirrels**
		6. **Fox Squirrels**
		7. **Red Squirrels**
		8. **Chipmunks**
	b. Prairie Dogs, etc.	9. **Woodchuck**
	c. Beavers.	10. **Beaver, extinct here.**
	d. Flying Squirrels.	11. **Flying Squirrel**
	e. Mice and Rats.	12. **Muskrat**
		13. **Lemming Mouse**
		14. **Meadow Mice**
		15. **Red-backed Mice**
		16. **White-footed Mice**

	f. Pouched Mice and Rats (western).	
	g. Jumping Mice.	17. Jumping Mouse
	h. Pocket Gophers (western).	
	i. Porcupines.	18. Canada Porcupine, extinct here.
	j. Pikas (western).	
	k. Hare and Rabbit Family.	19. Varying Hare
		20. Cotton-tail Rabbit
IX.	*The Bats.*	21. Little Brown Bat
		22. Lucifugus Bat
		23. Silver Bat
		24. Brown Bat
		25. Red Bat
		26. Hoary Bat
X.	*The Moles and Shrews.*	
	a. Moles.	27. Common Mole
		28. Hairy-tailed Mole
		29. Star-nosed Mole
	b. Shrews.	30. Common Shrew
		31. Short-tailed Shrew
		32. Smoky Shrew
		33. White-bearded Shrew
		34. Mole Shrew
XI.	*The Seals and Sea-Lions.* Marine.	
XII.	*The Flesh-eating Mammals.* Comprising these families:	
	a. The Cat Family. Lynx, Bob-cat, etc., now extinct here.	
	b. The Dog Family. Wolf, Fox, Coyote; local species now all extinct.	
	c. The Marten Family.	35. Mink
		36. Weasel
		37. Skunk
	d. The Bear Family. Local species all extinct here.	
	e. The Raccoon Family.	38. Raccoon
XIII.	*The Apes and Monkeys.* Tropical.	

XXI. Some Common Fishes of the Chautauqua Brooks

These are the smaller fishes likely to occur in brooks, small streams, and ponds in the northwestern states. The data is gathered chiefly from Jordan's " Manual of the Vertebrates."

1. *Pirate Perch.* Dark olive, profusely dotted with black. Abounds in sluggish grassy lowland streams. New York to Louisiana, and north to Minnesota and Lake Erie.
2. *Rock Bass* (Red Eye — Goggle Eye). Eye very large, red. Olive-green sides brassy, much mottled with dark green. Vermont to Manitoba, south to Louisiana and North Carolina Commonwealth.
3. *Common Sunfish* (Bream — Pumpkin-seed). Greenish-olive, sides bluish, belly and lower fins orange, sides profusely mottled with orange. Minnesota and Great Lakes to Maine, and south to South Carolina. There are several abundant species of sunfish.
4. *Johnny Darter.* Pale olive, black speckled with brown. Dakota to western Pennsylvania and Missouri; very abundant in small brooks. There are numerous other species of Darter. They prefer clear running water, where they lie on the bottom concealed under stones. They rarely leave the bottom, and are never seen suspended in the water. Some species are brilliantly colored.
5. *Common Bullhead* (Horned Pout — Catfish). Dark yellowish brown. New England to Wisconsin, Virginia and Texas. Common, the best known of the smaller catfishes. Fond of the mud, liking weedy ponds and sluggish streams. There are several other species of catfish.
6. *Stone Cat.* Yellowish brown. Ontario to Virginia, Nebraska and Tennessee. Abound in small brooks among logs and weeds. Possess sharp stinging, poisonous spines that produce painful wounds.
7. *Chub Sucker.* Dusky, brassy below. Massachusetts to Dakota and south; very common. There are several other suckers.
8. *Common Red Horse.* Olive, tail and lower fins always red. Great Lakes, and south; abundant. There are several other species.

9. *Stone Roller.* Brownish, spring males with many tubercles on head and body. Western New York to Texas and Tennessee; in small streams; everywhere abundant.
10. *Silver-fin Minnow.* Steel-blue, sides silvery. In all brooks from Maine to Iowa and Alabama; very abundant in all clear brooks.
11. *Common Shiner.* Steel-blue, sides silvery. In all brooks from Maine to Rocky Mountains; excessively abundant and variable.
12. *Black-nosed Dace.* Blackish, black or brown lateral band. Maine to Iowa and Alabama. Very abundant in all clear brooks.
13. *Horned Dace.* Dusky. Massachusetts to Dakota, Virginia and Louisiana. Very abundant, especially in small clear brooks.
14. *Golden Shiner.* Greenish above, sides silvery with golden reflections, fins yellow. Maine to Dakota and Louisiana; everywhere abundant in sluggish or weedy waters.
15. *Common Killifish.* Dark green, sides banded. Great Lakes and tributaries, east to Massachusetts, south to northern Indiana, west to Colorado. Carnivorous surface swimmers.
16. *Top-Minnow.* Olive, dark streak along side. Michigan to Alabama and Texas. Abundant in quiet waters.
17. *Brook Stickleback.* Black or olive. New York to Kansas and Greenland. Abundant northwest in small brooks. There are several species.

For the large lake fishes, see Jordan and Evermann, " American Food and Game Fishes."

XXII. The Fishes of Chautauqua Lake

1. *Long-nosed Gar,* Lepidosteus osseus; common.
2. *Short-nosed Gar,* L. platostomus; uncommon.
3. *Dog-Fish,* Amia calva; very abundant.
4. *Small Cat-Fish,* Ameiurus nebulosus; very common.
5. *Common Bullhead,* A. melas; uncommon.
6. *Stone Cat,* Schilbeodes miurus; common.
7. *Common Sucker,* Catastomus commersonii; common.
8. *Hog Sucker,* C. nigricans; common.
9. *Red Horse,* Moxostoma aureolum; abundant.
10. *Stone-Roller,* Campostoma anomalum; abundant.
11. *Blunt-nosed Minnow,* Pimephelas notatus; common.
12. *Small Creek-Chub,* Semotilus atromaculatus; common.
13. *Cayuga Minnow,* Notropis cayuga; common.
14. *Shiner,* N. hudsonius; fairly common.
15. *Silver-Fin,* N. whipplii; fairly common.
16. *Red-Fin,* N. cornutus; quite common.
17. *Black-nosed Dace,* Rhinichthys atronasus; common.
18. *Brook Trout,* Salvelinus fontinalis; rare.
19. *Chautauqua Muskallunge,* Lucius ohioensis; fairly common.
20. *Brook Silver-side,* Labidesthes sicculus; abundant.
21. *Rock Bass,* Ambloplites rupestris; abundant.
22. *Blue-Gill,* Lepomis pallidus; common.
23. *Sun-Fish,* Eupomotis gibbosus; common.
24. *Small-mouthed Black Bass,* Micropterus dolomieu; not common.
25. *Large-mouthed Black Bass,* M. salmoides; fairly common.
26. *Yellow Perch,* Perca flavescens; not common.
27. *Sand Pike,* Percina caproides; common.
28. *Blue Darter,* Etheostoma coeruleum; not common.
29. *Fan-tailed Darter,* E. flabellare; uncommon.
30. *Blob,* Cottus ictalops; uncommon.
31. *German Carp,* Cyprinus carpio; introduced; common.

XXIII. The Chautauqua Mascalonge or Muskalunge

The mascalonge is the prize fish of Chautauqua Lake, owing to its gamy qualities and to the great size which it attains. Its high rank as a game fish is due to its large size rather than to its actual fighting power. It is usually taken by trolling either with spoon or minnow. Specimens have been caught weighing fifty pounds, and for many years twenty- to thirty-pound fish were quite common.

This splendid fish is known chiefly from Chautauqua Lake, although specimens have been reported from a few other places in the Ohio Valley, notably the Mahoning River, the Ohio at Evansville, and Conneaut Lake. According to Jordan, " In the early part of the last century, when Rafinesque wrote about the fishes of the Ohio River, the muskallunge was apparently more frequently seen in that river than now."

The name " mascalonge " is apparently derived from the language of the Ojibwa or Cree Indians, and is variously spelt,—muscallonge, muskellunge, maskinonge, etc., all being variations of the same term. According to Mr. H. W. Henshaw the roots are probably " *mask,*" meaning ugly, and " *kinonge,*" meaning fish, the ugly fish. Mascalonge seems to be the preferred spelling among ichthyologists.

This splendid fish belongs to the Pike Family, a large family of game fishes, which is represented in New York State by the following species:

1. The Banded Pickerel.
2. The Little Pickerel.
3. The Chain Pickerel or Green Pike.
4. The Common Pike or Pickerel.
5. The Lake Mascalonge.
6. The Chautauqua Mascalonge.

Formerly the Chautauqua Mascalonge was classified as a sub-species or variety of the Great Lakes form. It differs

greatly, however, in appearance from the Great Lakes species, the two are not known to intergrade, their habits are entirely distinct, and so according to the best authorities they are regarded as distinct species.

In summer the fish frequent nearly the same localities as in winter, being found in the vicinity of water plants. When the lake becomes very clear in February they go into deep water, but they also live in deep water more or less throughout the year. As soon after the first of April as the ice leaves the lake the fish begin to spawn, and continue until the latter part of April. They go into shallower water for spawning; most of them spawn in from ten to fifteen feet of water. They do not resort to the gravel, as do many other species of fish, but seem to prefer the muddy places, generally going up into bays.

For more than twenty-five years the State of New York has been propagating the Chautauqua mascalonge with notable success. The fry have been planted chiefly in Chautauqua Lake, but large and frequent plantings have been made in the other waters of New York, in Lake Ontario, and in the Saint Lawrence River. In some of this State fish-cultural work single female fish were found to yield as high as 60,000 eggs. In the hatchery these eggs are placed in boxes, all of which are provided with screens at top and bottom. The bottom has an extra screen to prevent minnows from injuring the eggs. The boxes are sunk from one to two feet under the surface of the water. Every day or two they are drawn up, inspected, and all bad eggs and sediment are cleaned out.

The mascalonge is well known as an excellent food fish, and with the exception of the lake trout and some of the salmon, this species is the largest fresh-water game fish in the United States. Jordan and Evermann state:

"Writing of this species in 1818 Rafinesque said: 'It is one of the best fishes in the Ohio; its flesh is very delicate and divides easily, as in salmon, into large plates white as snow. It is called salmon pike, white pike, white jack, or white pickerel. . . . It reaches a length of

five feet.' Another affirms that 'as a food-fish there is nothing superior to it. It ranks with the salmon and speckled trout, and surpasses the black and striped bass. The meat is almost as white as snow, fine-grained, nicely laminated, and the flavor is perfect.' The quality of the flesh improves upon keeping, and is very much more juicy and of better flavor after a day or two on ice."

XXIV. The Swampy Places of Chautauqua

The swamp-land is rich in certain distinctive forms of plant and animal life. These forms have been modified and adapted to their chosen habitat. Many show strikingly the stages in this evolutionary process. Swamp-lands are commonly avoided by beginners in nature study, because of the difficulty in getting about in such places. However, old clothes and old shoes (or rubber boots), solve the physical side of the problem. An afternoon of intensive observation in the swamp is usually richly rewarded with unique sights and experiences.

In the swamps the following may be distinguished:

1. The floor or bottom, made of water saturated mud and ooze.
2. The bases of the swamp plants that grow partially submerged (cat-tails).
3. The aerial parts of the amphibious plants.
4. The deeper channel ways, here and there through the swamps.
5. The fringe or margin of shrubbery.
6. The tall swamp-land trees.

Each of these regions has its own life, that is, its own distinctive fauna. Every nature-student should carefully plan a visit to a swampy portion of the lake-shore, observing the zones of life and the characteristic inhabitants of each.

Suggestions for individual work:

1. Spend an afternoon, or several hours, in a swampy place (without more than one or two other persons about). Could you make a map or ground-plan of this swamp showing the various regions?

2. Make a list of the distinctive swamp-land plants and animals of your home region.

3. What important differences are there between life conditions in the swamp and those of the brook?

4. What becomes of the swamp animals during the winter season?

The Swale near the Hall of Pedagogy: "Let us study the swale a bit — that most interesting and most productive of

waste areas. We will find it among the tilled fields, where their gentle slopes run together, forming a depression that is poorly drained. In such places the crops that we know how to raise on farms will not thrive. There is too much water. The soil is soft underfoot. Though black with humus, and enriched with washings from surrounding slopes, it is sour, and unavailable to our field crops.

" It has its own crops, and they are never-failing. It is a place of rushes and sedges, rather than of grasses. It is a place of abundant flowers the whole season through, from the cowslips and cresses of spring to the asters and gentians of autumn. It is a place where crawfish sink their wells, a place where rabbits hide, and where song-birds build their nests, a place where the meadow-mice and shrews spread a network of runways over the ground, in short a place where rich soil and abundant light and moisture support a dense population, among which the struggle for existence is keen.

" No two swales are alike in the character of their plant population. But all agree in their meadowlike appearance, in being made up of patches of rather uniform character, where uniform conditions prevail, and in having each of these areas dominated by one or two species of plants, with a number of lesser plants as ' fillers ' in its midst, and a great variety of miscellaneous plants growing about its edge."

— Needham's *Natural History of the Farm.*

XXV. The Batrachians of Chautauqua

THE FROGS, TOADS, AND SALAMANDERS

I. FROGS AND TOADS. Tailless Batrachians

1. The Water Frogs.

1. Common Leopard Frog.
2. Pickerel Frog.
3. Green Frog.
4. Wood Frog.
5. Common Bull-Frog.

2. The Tree Frogs.

6. Common Tree Frog; erroneously called tree toad.
7. Spring Peeper.

3. The Toads.

8. The Common Toad. A very useful, clean, and harmless creature.

II. THE SALAMANDERS. Tailed Batrachians

4. The Newts.

9. Newt or Red-spotted Salamander. Two distinct forms.

5. Dusky Salamanders.

10. Dusky Salamander.

6. Many-toothed Salamanders.

11. Yellow Cave-Salamander.
12. Red Cave-Salamander.
13. Purple Salamander.
14. Red-backed Salamander.
15. Sticky Salamander.
16. Brown Salamander.

7. Blunt-nosed Salamanders.

17. Spotted Salamander.
18. Tiger Salamander.

8. The Giant Salamanders.

19. Hell-Bender.

9. The Mud Puppy.

20. Mud Puppy.

XXVI. The Reservoir Pond

This is the pond near the western margin of the Golf Links, near the woodland. The water is shallow and warm, and the habitat of many interesting insects and small aquatic animals. The margin of the pond is fringed with typical swamp plants,—arrowleaf, cattail, sedges, willows, etc., and in the pond itself is a number of aquatic plants. Such birds as the killdeer, spotted sandpiper, green heron, and great blue heron, frequent the pond. The region abounds with life.

One of the most interesting groups of aquatic animals, abundant in ponds, are the water-inhabiting insects. These are abundant; they represent many diverse families and types of insects; they vary greatly in their food habits and life cycles; some of them pass their entire existence under the water, and others are aquatic only for a short season. These aquatic forms are particularly useful for the school aquarium; they can endure more unfavorable conditions than the fishes and tadpoles; and the stock is the more easily replenished.

The field work on aquatic insects is confined largely to studies of habitat and collecting. Detailed observations of structure, habits, life cycle, etc., can be made most satisfactorily in the aquarium. The following are aquatic insects that occur plentifully in the Chautauqua Pond:

Dragonfly, damsel fly, whirling beetle, water-spider, water-strider, back-swimmer, water-boatman, diving beetle, larvæ of gnats, midges, lake-fly, and mosquitoes.

Outline:

1. The zones of vegetation that surround and fringe the pond.
2. The various plants that live within the pond itself.
3. Frogs and salamanders, including early stages.
4. The "water" snakes.
5. The birds that frequent the pond and its vicinity.
6. The muskrat; (the beaver, a fascinating story).
7. The drainage basin of the pond; inlet and outlet.

8. The economic values of the pond.
9. Landscape beauties of the pond.
10. Fishes of the pond.

Suggestions for individual work:

There are so many excellent outlines for this work that it is unnecessary to add further material. See, for example, any of the following:

Comstock, "Handbook of Nature Study," Aquarium, p. 380; Dragon Flies, p. 382; Caddice Flies, p. 387 (brooks); Mosquito, p. 400.

Comstock, "Insect Life." (Several excellent chapters.)

Needham, "General Biology." (Several excellent chapters — advanced.)

Eggeling and Ehrenberg, "The Fresh Water Aquarium."

Hodge, "Nature Study and Life."

XXVII. The Snakes of the Chautauqua Region

1. *Ground Snake.* Back, chestnut-brown; belly, salmon-red; harmless.
2. *Red-Bellied Snake.* Back, chestnut-brown; belly, salmon-red; three pale blotches on head; pale vertebral band; harmless.
3. *Riband Snake.* Chocolate with three yellow stripes; belly, light brown; about streams and swamps; harmless.
4. *Common Garter Snake.* Olive-brown; small dark spots along the sides; sides and belly greenish; many variations in color pattern; our commonest snake; harmless.
5. *Water Snake.* Brownish, back and sides with large, square, dark blotches; belly with brown blotches; abundant along streams and swamps, and along the lake shore; unpleasant and ill-tempered, but harmless.
6. *Pilot Snake.* Shining black; belly, slaty-black; one of our largest snakes; often climbing trees; harmless.
7. *Fox Snake.* Light brown, with square, chocolate patches; harmless.
8. *Grass Snake.* Deep green all over; a beautiful snake; harmless.
9. *Black Snake, "Blue Racer."* Back shining pitch black; greenish below chin and throat white; common; harmless.
10. *Ring-Necked Snake.* Blue-black above; orange beneath; conspicuous yellow ring around neck; harmless.
11. *Spreading Adder.* Brownish or reddish, with dark blotches on back; variable in color pattern; when angry it lowers and flattens the head, hissing and threatening; this is pure "bluff," as the snake is perfectly harmless.
12. *Copperhead or Cotton-Mouth.* Hazel-brown; top of head, copper-red; belly, yellowish; in swamps and damp places; *poisonous* and dangerous. This and the next are the only two poisonous snakes in northeastern United States, and these two are rare in most regions.
13. *Common Rattlesnake.* Yellowish-brown, with dark spots; rattle on end of tail; poisonous; once common, but now nearly exterminated in settled regions.

XXVIII. The Turtles of the Chautauqua Region

1. *Common Soft-Shelled Turtle.* Olive-brown with black spots; body flat, nearly orbicular; skin thick, leathery.
2. *Common Snapping Turtle.* Dusky brown; head with dark spots.
3. *Mud Turtle.* Dusky brown; head dark, with light spots.
4. *Musk Turtle or "Stink Pot."* Dusky; neck with two yellow stripes; strong musky odor.
5. *Map Turtle.* Dark olive green with greenish and yellow markings; legs and neck showily marked.
6. *Red-Bellied Terrapin.* Dusky, with irregular red markings above; plastron red or partly yellowish; head and neck brown, with reddish lines.
7. *Painted Turtle.* Greenish black; marginal plates marked with bright red; plastron yellow; a very common turtle.
8. *Wood Tortoise.* Shell carinated, the plates marked with concentric striæ and radiating black lines; reddish brown; in woods and fields; fairly common.
9. *Speckled Tortoise.* Black, with round orange spots; plastron yellow blotched with black; fairly common.
10. *Common Box Turtle.* Yellowish or blackish; body high and box-like; plastron with a hinge or joint; in dry woods.

XXIX. Ferns and Mosses

In the average Eastern region there are about fifty species of fairly abundant ferns and fern " allies " (ex. scouring rush). Some of these are tough, durable " weeds," ex. bracken and sensitive fern; the majority are shade — and moisture-loving woodland dwellers; a few are markedly localized in their habitats. Because of their size the ferns are the most satisfactory of the spore-plants for elementary study. On the fertile fronds the spores are produced in great abundance. These spores do the same work as do seeds, but are quite unlike seeds in structure,— a spore is one-celled; a seed is made up of numerous many-celled tissues, and contains an embryonic plant. Both seed and spore contain a quantity of food ready for the new plant.

The fern spore germinates and develops, not directly into a fern plant but into a minute prothallus. This is the first generation. The offspring of the prothallus is the leafy fern plant. Each generation in the fern life-cycle is like its grandparents, and not like its parents, thus — spore, prothallus, leafy plant, spore, etc. Like many woodland flowers, ferns are easily exterminated. Public sentiment needs strengthening and direction in this matter. The pure beauty of a fern foliage merits adequate protection.

Mosses are among the most widely distributed of land plants; they occur in all regions, even in the crowded parts of the cities, yet the majority of people are quite ignorant of their structure or their life-cycles. Mosses usually grow in tufts or cushions, so that one sees the moss clump as a whole, rather than the individual plants. It is a relatively simple matter to isolate a single plant and to observe its parts. Although small, they are not microscopic, and a simple lens is adequate for elementary study. To observe the details of the spore-capsule mechanism, a compound microscope is neces-

sary. Like the fern plant, the moss reproduces by spores; these are borne in an erect stalked capsule, and are scattered by the wind. The ex-organs of the moss are in distinct heads; fertilization is effected somewhat as in flowers, and from the fertilized egg-cell arises the spore-capsule. The spores are asexually produced within the capsule.

XXX. A Synopsis of the Chautauqua Ferns

I. Vegetable leaves and spore fronds totally unlike; spore fronds not leaf-like in appearance.

1. SENSITIVE FERN (*Onoclea sensibilis*). Swale near Hall of Pedagogy. The *obtusilobata* variety also occurs.
2. OSTRICH FERN (*Onoclea Struthiopteris*). No. 21 Vincent Avenue. The root-stocks send out slender underground shoots, which bear leaves the next year.
3. CINNAMON FERN (*Osmunda cinnamonea*). No. 1 Roberts Avenue. The spore fronds quickly wither.

II. Spore fronds, partially leaf-like; the spore portion unlike the rest of the frond.

4. ROYAL FERN (*Osmunda regalis*). No. 21 Vincent Avenue. Osmunda is a Saxon name for the God Thor.
5. INTERRUPTED FERN (*Osmunda Claytoniana*). No. 7 Roberts Avenue. Produces spores as the leaves unroll.
6. GRAPE FERN (*Botrychium Obliquum*). South of Quoit Grounds.
7. DISSECTED GRAPE FERN (*B. obliquum* Var. *dissectum*). South of Quoit Grounds. This variety often occurs with the typical form.
8. LANCED-LEAVED GRAPE FERN (*B. lanceolatum*). South of Quoit Grounds.

III. Spore fronds uniformly somewhat leek-like in appearance, yet differing noticeably from the vegetative leaves.

9. CHRISTMAS FERN (*Polystichum acrostichoides*). Near Hall of Pedagogy.

IV. Leaves all alike; sporangia within a reflex portion of the leaf margin.

10. BRACKEN FERN or Brake (*Pteris aquilina*). Fredonia Cottage, corner Miller and Pratt.
11. MAIDEN-HAIR FERN (*Adiantum pedatum*). No. 7 Roberts Avenue.
12. HAY-SCENTED FERN (*Dickinsonia punctilobula*). No. 6 Pratt Avenue.

V. Leaves all alike; sori linear or oblong.

13. LADY FERN (*Asplenium Filix-femina*). Sori variously curved; at length confluent. No. 7 Roberts Avenue.
14. NARROW-LEAVED SPLEENWORT (*Asplenium angustifolium*). No. 6 Pratt Avenue.
15. SILVERY SPLEENWORT (*Asplenium acrostichoides*). No. 9 Bowman Avenue.

VI. Leaves all alike; sori round.

16. COMMON POLYPODY (*Polypodium vulgare*). Abundant in the woods.
17. COMMON BEECH FERN (*Phegopteris polypodioides*). No. 6 Pratt Avenue. Several other species occur in the region.
18. MARSH ASPIDIUM (*Aspidium Thelypteris*). Near P. R. R. freight house; marshy places.
19. NEW YORK ASPIDIUM (*Aspidium noveboracense*). No. 7 Roberts Avenue.
20. GOLDIE'S ASPIDIUM (*Aspidium Goldianum*). No. 9 Bowman Avenue.
21. BOOTT'S ASPIDIUM (*Aspidium Boottii*). No. 9 Root Avenue.
22. SPINULOSE ASPIDIUM (*Aspidium spinulosum*). No. 6 Pratt Avenue.

23 & 24. THE BLADDER FERNS (*Cystopteris bulbifera* and *C. fragilis*); indusium arched, hood-like, or bladder-like.

25. THE WOODSIAS. Several species; small, tufted, pinnate-leaved ferns.

XXXI. Mushrooms and Other Spore Plants

Mushrooms and toadstools are the fruiting or spore-producing parts of fungi. The main body of the fungus is the leaf-mold or tree-trunk, with only the mushroom visible above the surface. The term mushroom is used in a popular sense to designate edible species, toadstool to designate poisonous or inedible species. There is no sure way of distinguishing between these two artificial groups except to *know the species.* Many of the popular " rules " are sadly fallible. The food value of mushrooms is not great, so that unless one is sure of the species, they are not worth the risk. Cultivated and canned mushrooms are safe, for the species are known. Mushrooms produce vast quantities of spores, and are widely distributed in moist places. They are all strictly parasitic and dependent upon elaborated food prepared by other plants.

The spore-plants, algæ, fungi, lichens, mosses, liverworts, ferns, ground-pines, scouring rushes,— form a vast assemblage, widely differing in structure and appearance but alike in their mode of reproduction by spores and never by seeds. Many are parasitic; many are independent. Many of them are of enormous importance to human welfare, and cannot be overlooked in any adequate system of education. For example,— the disease-producing bacteria; the plant-disease-producing fungi; the great seaweed industry; the primitive fern-allies that formed part of the gigantic Coal Forests, and thus helped to give to us our present Age of Industrialism. Many of these spore plants are attractive and beautiful; for example, every year more ferns are planted at Chautauqua. The abundant moss is a charming feature of our moist woodland.

Plant diseases are very abundant, both in cultivated places, and in Nature. These diseases occur in all parts of the plant body, both internally and externally. The diseases are pro-

duced by a wide variety of specific agents,— fungi, bacteria, worms, insects, weather, soil conditions, etc. Of these various causes, the fungi are among the most conspicuous, widely distributed, and diversified. There are vast numbers of disease-producing fungi. The life-cycles of many of these are not yet completely known. Three important stages, however, may be recognized in the life cycle of any fungus,— the plant body (a mass of parisitic threads penetrating and feeding upon the tissues of the host); the "fruiting" or spore-producing part (ex. bracket fungus); and third, the incredibly abundant microscopic spores. The spores are carried great distances by the wind, and can long resist unfavorable conditions. These features have much to do with the universal distribution and abundance of the fungus diseases.

"A conservative estimate of the damage caused by fungi attacking corn, wheat, oats, barley and rye is said to be $200,000,000 annually; and this amount is stolen so steadily that few realize their loss."— Hodge.

XXXII. The Mushrooms of Chautauqua

The cool, moist woodlands of the Chautauqua region, with their shady floors and abundance of decaying leaf-mold, are rich in the larger fleshy and woody fungi. There are probably several hundred species in the county; some of these are rare, but the majority occur in considerable abundance. Many species are edible, but as there are also numerous poisonous species, great care should be taken to accurately identify the species, before using it as food.

The following is a suggestive list of the more abundant and widely distributed species. The scientific names are placed first, as many of the mushrooms do not have English names. For descriptions and photographs of these fungi, see any of the standard books on mushrooms, or United States Department of Agriculture, Bulletin No. 175, "Mushrooms and Other Common Fungi."

1. The Agaric Family

1. Amanita muscaria, Fly Amanita; very poisonous.
2. Amanita phalloides, Death Cup; deadly poisonous.
3. Lepiota americana; edible.
4. Lepiota morgani, Green Gill; poisonous.
5. Lepiota procera, Parasol Mushroom; edible.
6. Armillaria mellea, Honey-colored Mushroom; edible.
7. Pleurotus ostreatus, Oyster Mushroom; edible.
8. Pleurotus ulmarius, Elm Mushroom; edible.
9. Cantharellus cibarius, Chanterelle; edible.
10. Clitocybe dealbata; edible.
11. Clitocybe illudens, Jack-o-Lantern; poisonous.
12. Clitocybe multiceps; edible.
13. Omphalia campanella; edible.
14. Tricholoma personatum; edible.
15. Collybia platyphylla, Broad-gilled Mushroom; edible.
16. Collybia radicata, Rooting Collybia; edible.
17. Mycena pura, Radish Mushroom.
18. Lactarius deliciosus; edible.

19. Lactarius indigo; edible.
20. Lactarius piperatus, Pepper Cap; edible.
21. Russula emtica; poisonous.
22. Russula roseipes; edible.
23. Russula virescens; edible.
24. Hygrophorus chrysodon; edible.
25. Hygrophorus conicus; edible.
26. Hygrophorus eburneus; edible.
27. Marasmius oreades, Fairy-Ring Mushroom; edible.
28. Marasmius rotula, Collared Mushroom.
29. Lentinus lecomtei, Hairy Lentinus; edible.
30. Lentinus lepideus, Scaly Lentinus; edible.
31. Claudopus nidulans.
32. Volvaria bombycina.
33. Pluteus cervinus; edible.
34. Paxillus involutus; edible.
35. Pholiota adiposa; edible.
36. Pholiota caperata; edible.
37. Pholiota squarrosa; edible.
38. Cortinarius cinnamoneus; edible.
39. Cortinarius violaceus; edible.
40. Naucoria semiorbicularis; edible.
41. Galera tenera; edible.
42. Agaricus arvensis, Common Field Mushroom; edible.
43. Agaricus campestris, Cultivated Mushroom; edible.
44. Agaricus subrufescens; edible.
45. Hypholoma sublateritium; edible.
46. Coprinus atramentarius, Inky Cap; edible.
47. Coprinus comatus, Shaggy Mane; edible.

2. The Polypore Family

48. Boletus edulis; edible.
49. Boletus felleus.
50. Boletus luteus.
51. Strobilomyces strobilaceus.
52. Fomes applanatus.
53. Fomes lucidus.
54. Polyporus betulinus.
55. Polyporus frondosus.
56. Polyporus sulphureus.
57. Fistulina hepatica, Beefsteak Mushroom; edible.
58. Daedalea quercina, Oak Bracket.
59. Merulius lacrymans, Timber Fungus.

3. The Hydnum Family

60. Hydnum coralloides, Coral Fungus; edible.
61. Hydnum erinaceum, Satyr's Beard; edible.

4. The Jelly Fungi

62. Hirneola auricula-judæ, Judas'-Ear.
63. Tremella frondosa.
64. Exidia glandulosa, Witches' Butter.

5. The Coral Fungi

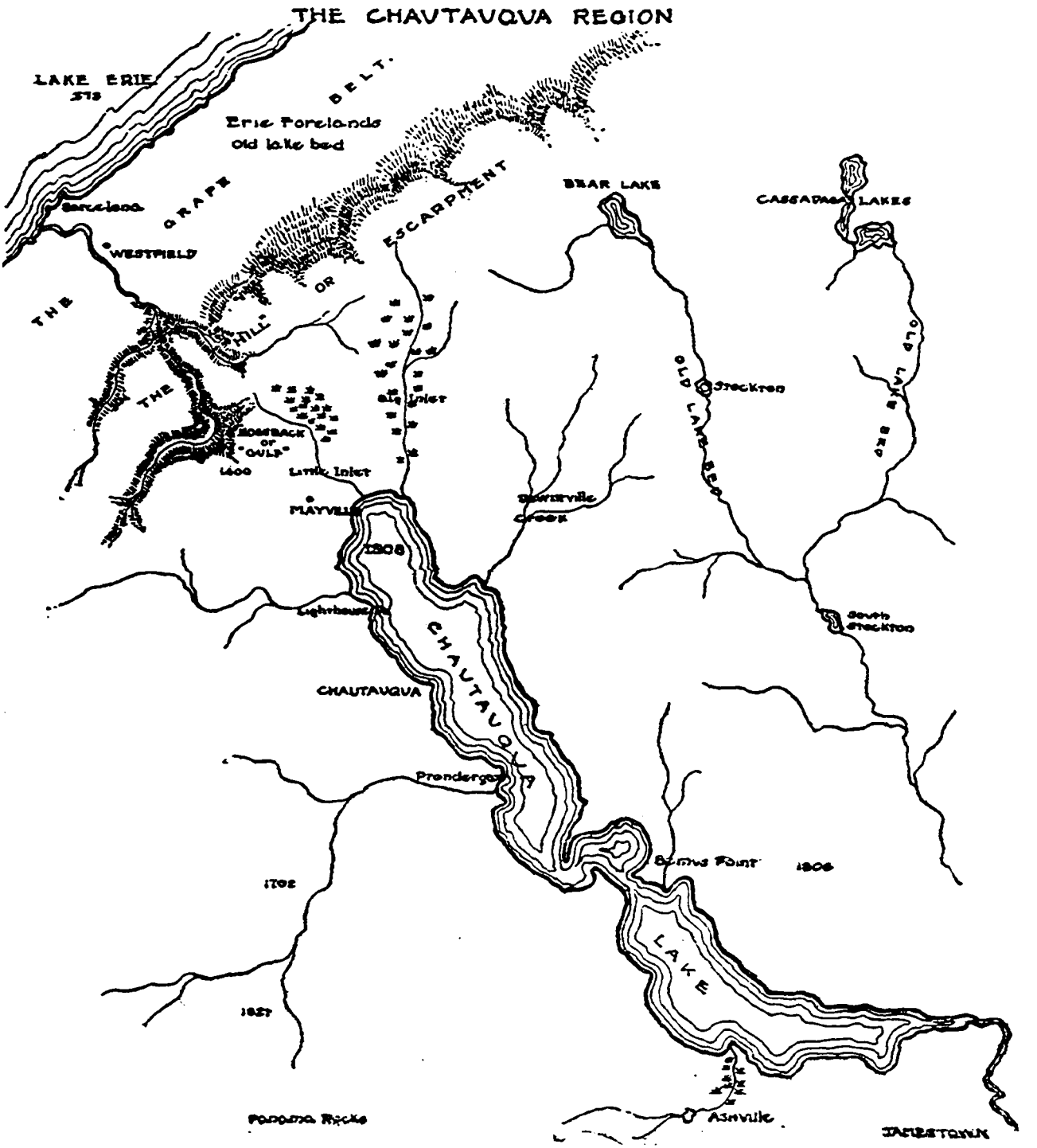
65. Sparassis crispa, Leaf Coral; edible.
66. Clavaria pistillaris; edible.

6. The Stink-Horn Fungi

67. Dictyophora duplicata.
68. Ithyphallus impudicus.
69. Mutinus caninus.

7. The Puff-Balls

70. Lycoperdon gemmatum; edible.
71. Lycoperdon pyriforme; edible.
72. Calvatia cyathiformis; edible.
73. Calvatia gigantea, Giant Puff-Ball; edible.


THE CHAUTAUQUA REGION
LAKE ERIE
573
DELT
Erie Forelands
old lake bed
GRAPE
ESCARPMENT
Barcelona
WESTFIELD
THE
HILL
OR
THE
BEAR LAKE
CASSADAGA LAKES
OLD LAKE BED
Stockton
Old Inlet
Rossback or "Gulf"
1400
Little Inlet
MAYVILLE
1308
Dewittville Creek
Lighthouse Pt.
CHAUTAUQUA
CHAUTAUQUA
Prendergast
South Stockton
Burms Point
1308
1700
1827
LAKE
Panama Rocks
Ashville
JAMESTOWN

XXXIII. The Story of the Chautauqua Region

The First Period. Chautauqua Under the Primitive Sea

In ancient geological times the ocean covered many of the regions of the world that are now dry land. One of these regions was the Chautauqua section of western New York. For enormously long periods of time this entire district was a portion of an ancient sea-bottom. This epoch of submergence, many times longer than the recent period of emergence, can be divided into three periods, as follows: The Paleozoic Islands; The Period of Earth Wrinkling; The Shallow Sea.

The Paleozoic Islands

Our earliest knowledge of New York State presents a picture of a vast sea, covering all of the land with which we are now familiar, and showing above its horizon-sweeping expanse only two island masses. One of these great islands lay to the north; it is now the Adirondack Highlands. The other lay to the south; it is now the Jersey Highlands. These two great islands were the only land in this region visible above the sea. They were composed of crystalline rocks of the plutonic and metamorphic classes, and gave evidence of their fiery and volcanic ancestry. Perhaps these two islands were connected; there is lack of definite knowledge on this point. To the eastward this island series was continued far beyond the present coastline; to the south it extended far into what are now the Southern States.

To the westward a great ocean occupied the mighty basin of the Mississippi, and extended far north into Canada. Chautauqua was a part of the vast floor of this primitive continental sea, that on the one hand washed the Adirondack Island and far to the West surged against the Rockies.

The Period of Earth Wrinkling

The second stage in the submarine history of Chautauqua did not affect Chautauqua itself so much as it did the island highlands to the east. In this stage occurred a great overturning, folding, and faulting of the rocks parallel to and near the New Jersey highlands. This earth-wrinkling, with the accompanying earthquake shocks and readjustments, profoundly influenced southeastern New York and all of western New England. One of the most striking results of these stupendous earth shifts was the development of a great mountain system, the Taconic

Mountains. This epoch of crustal movements and folding was the most intense in northern New York; towards the west and Chautauqua the folding did not occur. The evidences extend certainly as far west as Little Falls, and perhaps farther.

The Shallow Sea

A shallow sea of great extent covered all of New York State, except the Adirondack and New Jersey Islands, during the remainder of the Silurian and Devonian times. This sea received huge quantities of sediment from the adjacent highland regions. Adirondack, Taconic, and Canadian sections through representative portions of this heavy sediment, which covered the ocean floor, will serve to indicate the long time and vast bulk of the erosive work,— Catskill section, ten thousand feet thick; Central New York section, seven thousand feet thick; Chautauqua County Highlands section, six to six and a half thousand feet thick. These sections show that during this epoch sediments were deposited on the floor of the ocean, to a thickness of from one to two miles.

Under the increasing pressure of these huge deposits, the sea-bottom slowly sank. Beds of shale and limestone accumulated over much of this subsiding floor, with sandstone and conglomerate beds along the shores and beaches.

The Great Salt Lake

During this period of prolonged deposition there was a broad general uplift in Ohio and neighboring states. This resulted in making still more shallow the already shallow New York sea, so that it became a great salt lake, without permanent outlet. This condition resulted in the deposition of extensive beds of rock salt, from fifty to one hundred and fifty feet thick, and later covered by strata of very fine mud. During this period the Helderberg and Corniferous limestone beds were laid down.

The Panama Conglomerate; "Panama Rocks"

After this period of the Salt Lake, throughout the Devonian, extensive beds of shale were deposited. Upon these shales, in the Panama region of Chautauqua County, the upper Devonian conglomerate was laid down. These conglomerate beds have attracted considerable attention because of their fancied resemblance to ruined cities. In such places as Panama, where the beds have broken along the joint planes, and then tumbled apart as a series of huge confused and fantastic blocks, they have been given the name "rock cities." The blocks have been undermined by denudation, which eats away the softer underlying shales

and allows the huge fragments of conglomerate to assume various attitudes.

The Panama Rocks are located in a ridge that lies in a north-and-south axis, and which rises just west of the Little Broken-Straw Creek. This ridge is cut through by a branch of the creek which is cutting back into the highlands to the northwest. The Panama rock is made up from top to bottom of alternating layers of sandstone and conglomerate, blending with one another as the proportions of sand and pebbles varied intermittently during the deposition of the materials. Frequently a layer of pebbles consisting of only one course may be seen running horizontally for rods along the face of the cliff. The pebbles lie flat, and the sandstone having weathered from above and below them, their projecting edges jut out and glisten in the sunlight like a string of beads suspended in front of the sandstone. In some cases two or three courses of pebbles in immediate contact have been deposited between purely sandy masses, a foot or more in thickness.

The rock is a massive conglomerate composed of quartz pebbles and sand, with a high percentage of sand to pebbles. The pebbles are invariably lens-shaped, and are mostly under an inch in diameter. They are generally of very pure white quartz, sometimes pink. Occasionally one finds red or slate-colored jasper. The whole aspect of the rock suggests the story of a gravel heap along an ancient shore line reached by occasional storms, the waves of which have reached into the beach, the " back tow " bringing out and distributing systematically the pebbles over a smooth and sandy floor.

This remarkable conglomerate rests upon a series of richly fossiliferous blue and bluish-green shales. Through the disintegration of these soft shales under the conglomerate the latter has been broken and fissured. Glacial action has perhaps assisted in this work. These cracks are two to ten feet wide, and occur about every forty feet, breaking the bed into blocks seventy to eighty feet long. The layer is about seventy feet thick.

All of the " rock cities " of southern New York and northwestern Pennsylvania have been formed in this way. Many of them are situated on the highest hilltops,— Panama Rocks are 1671 feet above sea-level,— but they are always composed of rocks *in situ*. They have neither been brought from a distance, nor have they been thrown up to their present position, as popularly imagined, by " convulsions of nature." Their formation has been as slow and as quiet as the operations of frost and water amid which we live. The rocks are merely the last remnants of thick and extensive deposits of coarse sandstone that once covered this portion of the country, and are now everywhere else removed.

It is entirely probable that this great conglomerate extended over a considerable portion of the high Chautauqua plateau. Perhaps it has been the cause for the great height of this area, the hard overlying conglomerate protecting the soft shales from rapid denudation.

The Second Period. Chautauqua Raised Above the Sea

During the Carboniferous time the entire state of New York, including its western, Chautauquan end, was slowly raised above the sea, where it has remained ever since. This gradual elevation was associated with the general uplifting of the Appalachian Mountain system. During the uplift considerable erosion and denudation of the newly exposed land surfaces took place. Then, in the mid-Tertiary period, there came a very pronounced uplift, which enabled all the rivers of central New York, for example, to cut deep conspicuous valleys.

The Third Period. The Wearing Away of the Land

Both during and after the uplift the land was worn away and cut by deep valleys. Any rock strata that may have overlain the Devonian strata have been removed. Over a very large part of New York State the Devonian and older strata are deeply cut by valleys, so that the plateau is conspicuously dissected, particularly near the divides. These valleys are fairly well rounded and matured, but extensive hilly masses remain between them, showing that but a mere beginning has been made toward the removal of the Devonian and older rocks.

This great dissected plateau slopes southward, thus exposing the outcrop edges of its strata toward the north. The hard upper rock layers protected the soft under ones, just as in the case of the Panama conglomerate; but as these were undermined, the hard strata were cut back in the direction of the dip, that is, toward the south, and always with a tendency to maintain an elevated position. The hard Helderberg limestone and its outcrop has in this way produced the great "escarpment" between Mayville and Westfield.

The Fourth Period. The Glacial Invasions During the Ice Age

The Glacial Period succeeded the Tertiary uplift and practically the entire state of New York, like many other regions in the northern United States, was covered with a thick sheet of ice. The Chautauqua region is but a small portion of the great district covered by glaciers during the Ice Age.

When these ice sheets finally retreated, many changes were evident. Over the surface was strewn a sheet of glacial deposits of variable thickness. Some of the hills were planed down and rounded, others were

built up. Some valleys were deepened, others were more or less completely filled. Some streams were turned completely out of their valleys, some were only partly interfered with, and many valleys were locally transformed into lakes. Chautauqua Lake was formed in this last-mentioned manner.

Glacial deposits cover the entire Chautauqua region, and extend along Lake Erie, through northwestern Pennsylvania, and down into Ohio. These deposits were laid down and re-worked during a long series of glacial and interglacial stages. Some of the deposits are much older than others. The younger or later deposits are referred by geologists to the "Wisconsin Drift Sheet." It is this "Wisconsin" drift that is the prevailing surface material,—soil and loose rock,—around Chautauqua Lake. The Wisconsin drift comprises three kinds of glacial drift, as follows:

a. *Till or ground moraine.* This is the drift most abundant in Chautauqua County. All of the bed rock covered by the glacier was first scoured by the grinding ice-front, and then covered with this deposit as the ice melted. The drift was deposited mainly underneath the ice sheet; in the places where it is mixed and unassorted it is known as *"till"*; wherever it has been stratified and assorted by water action it is called *"ground moraine."*

b. *Terminal moraines.* These deposits were formed at various points along the melting front of the ice sheet, where the rate of melting was about as rapid as the onward movement of the ice, so that the ice marging remained nearly stationary. Under these conditions the materials carried by the ice accumulated over a long period of time in a small area, and were heaped up in irregular hillocks. The city of Jamestown is built upon a cluster of these morainic hills, which were dumped into the ancient valley at this point, in consequence of the valley's peculiar position in relation to the various glacial sheets.

c. *Outwash.* From the margins of the terminal moraines, both during and after the ice invasion, large quantities of rock and soil were washed out and spread over the adjacent lowlands. This condition is general through the Chautauqua region, and is strikingly shown in the Warren, Pennsylvania, area, just to the south of Chautauqua.

Chautauqua Lake and Its Basin in Relation to the Ice Age

The Chautauqua basin appears to have been filled with bodies of ice and water possessing all the powers and motions requisite for lake-making. Under their actions streams were cut together, valleys were broadened, bowl-shaped basins were formed among the hills. Had not the processes been interrupted, either by the failure of the ice supply or by the wearing down of its outlet (which resulted in drainage), it is

evident that the agencies at work would have here formed a lake in the same manner as they formed one in the Lake Erie basin, where owing to lower levels and a more favorable situation they continued to operate for a much longer time.

As the glaciers did not withdraw from the basins with a slow and uniform rate of retrogression, but evacuated only after long periods of alternating advances and retreats, moraines were formed in many places; and hence, when the ice disappeared, chains of small lakes stretched all along the broad valleys north of the outlets. Periodical freshets, bringing down the water accumulating from broad surfaces, eventually cut channels through the moraine barriers. Thus, one after another, many of these glacial lakes were drained, but their old outlines may be traced in many places by the terraces and beaches which surrounded them, and by the lacustrine deposits left in their beds.

It is often remarked as a curious fact that nearly all our small lakes lie on summits at the heads of streams. This should cause no surprise. They remain there as lakes to-day, because they have always received the drainage of but small areas, and have not been seriously affected by annual freshets; consequently their outlets cut down very slowly, and they have not yet had time to drain. There are evidences, however, in nearly all of them, that the water once stood at a higher level than it stands at present.

Chautauqua Lake may be taken as an illustration of these changes. It has cut down an outlet through about fifty feet of stratified rock. This has, of course, reduced its surface level by that much. A higher water-level than the present has been maintained in comparatively recent times. Its level would not be nearly as large as it is, were its outlet through drift instead of solid rock. The rock strata at the outlet of Chautauqua Lake have saved it from rapid disappearance.

The elevation of Chautauqua Lake is 1299 feet; maximum depth, about one hundred feet. Its present outlet has cut a narrow channel fifty feet deep through solid rock, between Jamestown and Dexterville. There can be no doubt that this is a post-glacial excavation, and that an ancient channel, deeper than the present lake-bed, exists to the north of it. Chautauqua Lake, on the whole, is very shallow, and is partially filled by stream deposits. The depth of the drift-filling is not known, but, judging by the depth of the drift in other valleys in this section, it must be great. While it cannot be considered established, there is some topographic evidence in favor of the view that at least the northern end of the Chautauqua Valley was in pre-glacial times tributary to the Lake Erie Valley; the cause of the diversion being an extensive morainic deposit across this valley. There is a constriction of the valley near the middle of the lake, which suggests that this may have been the

pre-glacial divide. If this view be true, Chautauqua Lake is made up of parts of two valleys, one north-sloping, the other south-sloping, and each dammed by heavy morainic accumulations.

— Adapted and modified from Carroll, Second Geological Survey, State of Pennsylvania; and Tarr, Physical Geography of New York State.

XXXIV. Résumé of the Geological History of the Chautauqua Region

1. Before the last geological period, the northern part of New York had valleys and hills, plains and escarpments, very much as at the present, though the details of topography were quite different. Among the more important differences was *the absence of the Great Lakes,* which occupy valleys that have been transformed to lakes largely by the action of the glacier.

2. Over this country *the glacier* ice slowly advanced until practically the whole of New York was covered, and for a time this ice sheet ground its way over the rocks, carrying fragments southward and wearing down the valleys and the hills as it passed. All life was, of course, exterminated from the region and the land was transformed to *a dreary icy plateau* like that of central Greenland.

3. At last, by some change in the condition of the climate, the *ice sheet began to melt* away and to uncover the buried land. It seems to have done this quite rapidly, though somewhat intermittently. That is, it would stand for a time with its front edge along a certain line, then quite rapidly melt away and transfer its front to a distance of a dozen or so miles to the north, where it would again take a stand. This is indicated by *the moraines,* which are irregular hills of glacial deposits that were accumulated at the front of the ice. The glacier was carrying a load of rock materials, and when these reached the front they were dropped from the melting ice and therefore accumulated. If the ice stood long enough a moraine was built along the margin; if its stand was brief no moraine accumulations were made. One of these moraines passes through Jamestown, another past the northern end of Lakes Chautauqua, Bear, and Cassadaga, and in a general east and west line back of the crest of the escarpment. Another line passes just east of Silver Creek, one near Hamburg, and another through Crittenden.

4. Beneath and in the ice was *a load of rock fragments* which were moving southward. They were being ground over one another and over the bed-rock, so that they were being reduced to clay by the scouring action of the ice, which worked somewhat like a great sandpaper. When the glacier disappeared, this material was left where it happened to be, and so a soil was deposited which was composed of clay and pebbles derived from various sources to the north. This *till or bowlder clay* was dragged into many of the old valleys, either wholly or partially filling them, so that the streams have often been obliged to cut new channels in the shale. Sometimes these rock gorges end abruptly

where the stream crosses or flows into the old drift-filled valleys, and then the shale wall is changed to one of till in which the bowlder clay is sometimes one or two hundred feet deep, as is the case in parts of the "Gulf" near Westfield.

5. As the ice withdrew, with a south-facing front, it naturally interfered with all north-flowing streams. It formed a dam and caused many *reversals of drainage.* The St. Lawrence Valley was occupied by the ice when the front had retreated north of the escarpment which partly encloses the "grape belt." Therefore these north-flowing streams could not drain by the present outlet but were empounded and forced to take another place of outflow, and this was, of course, the lowest point in the enclosing hills, a point which was naturally higher than the present outlet. While Lake Erie was held at its upper place of outflow it was building the upper beach, which has been called *the Sheridan beach.* The outflow of this lake was then at Fort Wayne, Indiana, into the Wabash, and the beach may be traced continuously to this outlet. However, in the east this beach ends just southeast of Silver Creek; and near its eastern end there is a tract of moraine.

6. To the southward of the town of Hamburg, on the road to New Boston, there is *another morainic belt,* and *a second beach,* which can be quite continuously traced from west of Silver Creek nearly to Hamburg, begins to disappear as this town is neared. The last place at which it could be distinctly determined is near Eden Church, southwest of Hamburg; but *a third beach* from the top passes directly through Hamburg, and has been found to disappear near Crittenden. In each case, as the moraine is approached, the beach becomes less distinct and finally can be traced no further.

7. This shows that while these beaches were being built at their respective levels, the ice was standing at different places and was bringing materials which were being laid down at its front in the form of moraines. At first the ice front passed near Silver Creek and then the upper beach was made, while the outflow of the lake was past Fort Wayne. Then the edge of the ice withdrew for a distance until some lower outlet was formed, and again to a still lower, more northern point, when another and still lower outlet was established. One of these last two outlets was past Chicago.

8. At last the ice retreated far enough for the Erie Basin to take its present outflow past Buffalo; but the valley of the St. Lawrence was still ice-dammed, and Ontario was raised to the level of the overflow of the Mohawk Valley. Thus temporarily the several Great Lakes had their level raised by ice dams; and during this time distinct shorelines were formed.

— Adapted from R. S. Tarr, Cornell Bulletin 109.

XXXV. Topography and Geology of the Chautauqua Region

1. This region has two great physiographic divisions. These are separated by what is known as the "Hill" or escarpment, which extends east and west, parallel to Lake Erie. The lakeward division is known as *the Erie forelands,* while that portion to which the Erie escarpment acts as a frontal bluff is known as *the uplands.*

2. The surface features of *the forelands* are very regular. They present a slightly undulating ascent from the present wave-cut bluff of Lake Erie towards the escarpment, in which the gradient will vary from 100 to 200 feet to the mile.

3. From the crest of the escarpment *the Chautauqua uplands* are of a rolling character. The hills are elongated in form, their major axis lying north and south, while they rise in successive tiers east and west, varying in altitude from 100 to 500 feet above the upland valleys.

4. The *surface geology* of this region is typical of a glaciated area. In the uplands the physiographic features plainly show the action of the great continental Ice Sheet that at some former time covered the region. Erratic bowlders from a few inches to 3 or 4 feet in diameter are thickly scattered over the northern slopes of the hills. The crests of the hills are elongated in form, sloping in convex curves to the valley.

5. Along the crest of the escarpment there is a belt of *glacial debris* of sand, gravel, and bowlders known as a moraine, which varies in width from two to three or four miles and extends in a line approximately parallel to the shore of Lake Erie. This belt probably marks a point where the ice tarried in its recession. Numerous kames, terraces, and kettle-holes occur throughout the valleys.

6. The Erie forelands also present a very interesting feature of glacial geology in *the ancient beach lines.* These rise in successive terraces from the present lake level to the base of the escarpment. The number varies from one to four or five, but usually there are two which are quite distinct and well defined. The material is usually a typical beach gravel, which in some places has been entirely carried away by the forces of erosion, leaving only the shore topography to mark the former location of the beach.

7. Between these beach lines and the present shore of Lake Erie are found finer sediments, which were laid down as *offshore deposits* at the time the beaches were formed. In a number of instances the streams have cut down through these sediments, exposing the underlying bowlder clay that marks the former presence of the Ice Sheet.

8. *The bed rock* of this area belongs to the Upper Devonian system. In the western portion of the uplands all outcrops show a bluish mud shale, while in the eastern portion the shale is quite sandy and is interbedded with thin layers of sandstone.

9. *The soils of the uplands* are roughly spoken of as glacial in origin, but the close conformity of the soil texture to the underlying rock of the two sections would seem to indicate that, though mixed with bowlders and a quantity of foreign material, the soils are still largely of local origin.

10. The Erie escarpment forms a divide between the St. Lawrence and Mississippi *drainage* systems. The upland surface drainage shows the effects of glaciation in numerous kettle-holes and marshy spots most unfavorable for agriculture. The forelands are well drained.

— Adapted from U. S. Bureau Soils, Annual Report, 1901.

XXXVI. The Chautauqua Soil

All of the soil in the vicinity of Chautauqua was at one time a deep, rich, mellow, leaf-mold, made and preserved under the dense shade of the primitive forest that engirdled the beautiful lake. Under natural conditions this rich leaf-mold would have been preserved indefinitely; each autumn would have added its bounty of leaves to the unwasted compost. As soon as clearings were made, the leaf-mold was washed away and destroyed, vanishing with remarkable rapidity, and exposing the infertile subsoil below. There are at the present time only a few places in Chautauqua where there are any vestiges of the original soil of the forest floor.

The soil that was originally the subsoil, but that by the clearing away of the forests has become the surface soil, is known technically among soil experts as "Volusia loam." It is so named because the first samples to be accurately classified came from the Volusia region, in this county. The Volusia loam is a light-brown soil about eight inches deep. It contains a considerable quantity of finely divided shale chips, popularly called "shale gravel" or "black gravel." The subsoil is a yellow or mottled yellow silty loam. Both soil and subsoil contain a large percentage of shale and sandstone fragments.

This Volusia loam is the common soil in the vicinity of Chautauqua and Mayville. It was formed during the Great Ice Age, through the action of the glaciers. The glaciers pulverized the underlying shales and sandstones. In some places near Chautauqua the glacial soil, or glacial "till," is so thin that the underlying shale and sandstone are reached by the ordinary three-foot soil-auger.

Volusia loam is widely distributed in New York, Ohio and Pennsylvania; the area mapped by the Federal Soil Survey up to the present time already amounting to over one million, one hundred thousand acres. The Volusia loam is but one of a large series of glacial loams, and these soils are recognized to be the best general-purpose soils of the northeastern United States. They are well adapted, not only to the general farm crops, but also to many of the heavier truck and market-garden products.

The topography of these soils is gently undulating to rolling, insuring fair to good drainage, although crop yields are usually enhanced by tiling or ditching. In most sections where the loams are found their development is usually so uniform that there is little real waste-land.

A noticeable characteristic of these soils is the presence of considerable quantities of stones. These are angular or partly rounded, and are composed of limestone, shale, or quartzite, granite, and other crystalline rocks. Most of these pebbles or bowlders have been transported for very long distances by glaciers during the Ice Age.

The soils on the Chautauqua grounds are naturally fertile, and if properly handled will be suitable for the raising of flowers and ornamentals for an indefinitely long period. In some places drainage is needed, in others the lost leaf-mold must be replaced with stable manure. The soil itself, however, is a good soil, and merits our attention and consideration.

XXXVII. The Chautauqua Region with reference to the Physiographic regions of New York State

1. Most of the physiographic provinces of New York are merely portions of larger areas which extend into it from the neighboring States. The provinces are:

a. Long Island.
b. Gneissic Highland.
c. Taconic.
d. Catskill.
e. New York-Pennsylvania Plateau (*Chautauqua*).
f. Lake Shore Plains.
g. Mohawk Valley.
h. Adirondack.

The Chautauqua region is the most westerly New York portion of the New York-Pennsylvania Plateau. This great plateau region occupies fully one-third of the State, and is deeply dissected by numerous broad river valleys.

2. It is made entirely of *Devonian rocks,* mostly upper Devonian shales and sandstones, in which, however, there are some strata of limestone. The strata of this province are in a nearly horizontal position, which determines the extensive plateau character of the province, a feature which extends southward across the Pennsylvania line, along the western base of the Appalachians.

3. Throughout the New York section of the plateau the hilltops frequently rise to elevations of 1,500 to 2,000 feet, and their average elevation above sea-level cannot be less than 1,000 to 1,200 feet. From the valleys the region does not resemble a plateau, but rather a mountainous country; for the hills often rise to heights of 1,000 to 1,200 feet above the low valleys. But from the tops of the hills one is able to see that it is really *a plateau region* very much cut by stream action and carved by denundation into a maze of hills, many of which are capped by the harder layers of the nearly horizontal strata.

4. Considered as one great dissected plateau, *its surface undulates* somewhat. Where the branches of the Susquehanna head against the headwaters of the Finger Lake streams, the plateau level is somewhat depressed. It sags in the middle, being higher near the western base of the Catskills and lower in the Finger Lake region; then rising again,

it reaches a high elevation in Cataraugus County, in western New York. Beyond this, in Chautauqua County, and westward in Pennsylvania, the plateau level again descends.

5. On its northern face the plateau ends in *an escarpment* which though irregular and somewhat serrated, is commonly quite pronounced. Its position in the east is determined by the hard *Helderberg Limestone;* but in the extreme west it is located where hard shales overlie lower fragile beds, though its condition is possibly determined by a bed of conglomerate now almost completely removed. Along the Erie shore, near the boundary between New York and Pennsylvania, the escarpment is about two or three miles from the lake; but toward the east the escarpment recedes from the lake. In some cases the slope is very abrupt, and in Chautauqua County it ascends to a height of 500 feet in a very short distance. The escarpment is less distant in Erie County, but becomes more pronounced towards the east, in Seneca and Cayuga counties, while still further east it becomes sufficiently high to form the " Helderberg Mountains." Therefore, for some distance, the northern boundary of the Plateau province, as well as that of the Catskill region, is a single deposit of limestone, which forms an escarpment in some places rising a thousand feet above the lower plain.

— Modified from Tarr, Physical Geography of New York State.

XXXVIII. The History of the Early Settlement and Agricultural development of the Chautauqua Region

The earliest Indian tribe to occupy this area, so far as we have any record, were the Eries, a tribe of the Huron Iroquois family. They were in possession of the land when La Salle, the French explorer, penetrated the forest and discovered Chautauqua Lake.

The county was a part of the disputed area in the French-English colonial war, and in 1749 De Celeron, a French captain, landed at Barcelona Harbor, crossed the ridge to Chautauqua Lake and passed by the Allegheny into the Ohio River, taking possession in the name of France.

The first settlement was made in 1802, at a point about three-quarters of a mile west of the present site of Westfield, where a stone monument has been erected to mark the spot. A clearing of about 10 acres was made and planted to corn — the beginning of agriculture in this fertile county.

The year following settlers began coming in more rapidly. The tide of immigration from eastern New York and the New England States brought many pioneers, who found in the fertility of the soil and in the favorable climate a promise of certain reward for their labors. They purchased their claims, for which they paid about $2.50 per acre, from the Holland Land Company. These frontiersmen built their rude huts of logs, chinking them with mud to keep out the cold. Of necessity they gained a subsistence chiefly by hunting and fishing. Many engaged in trade with the Indians, while lumbering was an important industry in the southern part of the county. But soon the gun and rod gave place to the plow, sawmills and gristmills were built, and in place of log shanties comfortable frame houses were erected.

As fast as the land could be cleared of its timber the soil was put under cultivation. In 1820 the largest clearings and best cultivated farms were within 3 or 4 miles east and west of Fredonia. These did not contain more than 30 to 60 acres each and were worth from $10 to $20 per acre. The principal crop was corn. There is record of a New England farmer who brought with him into the wilderness a quantity of apple seed, from which he started a nursery and set out an orchard. And so at this early time fruit growing was begun in the county that has since become one of the important centers in the country for the raising of fruit.

In 1811 county officers were appointed by the Governor of the State and Chautauqua became a fully established county. Towns were divided into school districts and a free school system was established. An agricultural society was organized at Mayville, and every effort was made to advance the interests of the farmer. The county made rapid progress and development, until in 1830 the population exceeded 34,000.

— From U. S. Bureau Soils, Annual Report, 1901.

XXXIX. The Cloud World

Clouds are our index of the weather; from them we receive rain, snow, hail, fog; with them, we associate thunder and lightning, the calm radiance of the morning, the gorgeous splendor of the sunset sky. We are all familiar with the clouds in a general way; it is well to know somewhat in detail their origin, composition, height above the earth, swiftness of motion, and final destination. All clouds are not water vapor, some are of snow or ice particles; some trail over the earth, others sail at dizzy heights; some move sluggishly, others at speeds that make the express train seem a snail. A classification of the clouds, as used by the Government Weather Bureau, is given on another page; from the United States Weather Bureau at Washington may be obtained a beautiful colored chart of the kinds of clouds, with a descriptive pamphlet.

An excellent practice that may be carried on with all kinds of field work is that of observing the clouds, noting the kinds, direction of motion, relative altitude, and to make provisional forecasts. These may be checked later with actual developments. It is habit of mind, unconsciously developed by farmers and similar out-of-door folks, that makes many countrymen wise in weather-lore.

Our daily occupations and activities cause us to spend too large a portion of our lives looking down at things; we incline to be stoop-shouldered and saggy; it is good hygiene, good art, and good philosophy, to look from time to time at the free, inimitable and tranquil beauties of the sky.

XL. The Kinds of Clouds

1. CIRRUS. Made of slender fibers, in long parallel lines or in feathery, curled, tangled or clotted arrangements. Cirrus clouds change slowly in form; do not appear to move as rapidly as do clouds at lower levels, but as their altitude is commonly 5 to 10 miles above sea-level, their actual velocities may be rapid, from 50 to 200 miles an hour. Usually drift eastward, but occasionally advance slowly to the west in connection with storms.

2. CIRRO-STRATUS. True cirrus clouds are sometimes associated with other horizontal cloud layers, as if formed by the matting together of growing filaments. These layers frequently form bands of great length, sometimes in parallel trains, straight or greatly curved; they may reach all across the sky and seem to converge at nearly opposite points of the horizon, being then called polar bands or "Noah's Ark." These bands are often more or less fibrous, striated, or rippled; they frequently show a tendency to break up into separate clots (Cirro-cumulus). *Cirrus haze* is applied to a thin overcasting of the sky at high levels, below which various other clouds float. Cirro-stratus and haze produce halos around the sun and moon; from this, and from their great altitude, they are known to be composed of ice crystals and not of water drops. Alto-stratus is low, heavy cirro-stratus.

3. CIRRO-CUMULUS. The separate clots or cloud balls into which lofty cloud layers often break up. They often closely resemble the form taken by the foam in the eddying wake of a steamer. When well-defined and closely grouped, they are called "Mackeral" clouds.

4. CUMULUS. These are the familiar heavy white clouds of the summer sky, flat-bottomed, and cushion-topped. The flat cumulus, often grouped closely together so as nearly to overcast the sky and common in fair, windy weather, is called *strato-cumulus*. Its still lower ragged forms, often assumed during the early stages of cloud growth and in storms, are called fracto-cumulus. Higher, smaller forms are called alto-cumulus.

5. CUMULO-NIMBUS. The large overgrown cumulus clouds that have reached the dimensions of thunder storms, having above the "thunder heads" an outflow of cirro-stratus. The under-surface of these extended overflows is sometimes curiously festooned.

6. STRATUS. Low-lying fogs, such as form at night or in cold quiet winter weather on lowlands or in valleys; also low foggy cloud sheets floating overhead. The name should not be applied to thin cloud sheet

commonly seen at sunset at great altitude, these being fading alto-stratus or strato-cumulus. When lying on the earth, stratus is called *fog*.

7. NIMBUS. Any extended cloud from which rain or snow is falling; it is generally preceded by stratus, and still earlier by alto-stratus.

XLI. The Summer Meteoric Showers

"Falling Stars" of July and August, Likely to be Seen at Chautauqua

Name of Shower	*Date*	*Radiant Point*	*Characteristics*	*Location*	*Other dates of observations*
1. Volpeculids or Eta Sagittids	July 4	Between Cygnus and Delphinus	Sw.	E	June 13–July 7 Apr. 20–May 30
2. Cynids	July 19	Near Denet (a) Cygni	Sh. Sw. F.	E.	July 11–19, Apr. 22 July 6–Aug. 16
3. (a)–(b) Perseids	July 25	Between (a) and (b) Persei	Sw. B. Sk. after 10 P. M.	N. E.	July 23–Aug. 4 Sept. 15–Nov. 13
4. Aquarids, a conspicious shower	July 28	Near the water jar of Aquaris	Sl. B.	E.	
5. Perseids, fine shower	Aug. 10	near (a) Persei	V. Sw. Sk.	N. E.	
6. Kappa Sygnids	Aug. 17	Near the Dragon's Head	Sw B. T. Sh.	S. E.	Jan. 17, Aug. 4 Aug. 21–25

Note — The August meteors are known as the "Tears of St. Lawrence." The Perseids are yellow, and have medium velocity, moving from N. E. to S. W. They are visible from latter July to late August.

Abbreviations — V. very; Sw, swift; Sl, slow; B, bright; F, faint; Sk, streak-leaving meteors; T, training-leaving meteors; Sh, short meteors.

XLII. Stars of the Chautauqua Summer Sky

The following is a suggestive list of the conspicuous stars and constellations which appear in the Chautauqua summer sky. The positions designated are for nine o'clock on the evening of July seventh; however, the daily change in the positions is so slight that the list is applicable to any part of the mid-summer season. The stars rise about four minutes earlier each evening; four minutes of time corresponds roughly to one degree of space measured on the arc of the sky. Thus the whole sky apparently shifts about one degree westward every twenty-four hours. The quarterly divisions refer to the four quarters of the heavens, as the observer looks directly up into the dome,— i.e. the east of a map becomes west, and west becomes east. The list is given merely to suggest the large possibilities and interest of star-study, and only the most conspicuous bodies are enumerated. For further information see Serviss, Round the Year with the Stars, and Olcutt, Field Book of the Star.

Constellations	*Quarter*	*Stars*
	NORTHEAST	
Hercules		Polaris
Lyra		Vega
Draco		Altair
Aquila		
Capricornus		
Pegasus		
Cassiopeia		
Cygnus		
Delphinus		
	NORTHWEST	
Corona		Arcturus
Bootes		Denebola
Ursa Major		Regulus
Ursa Minor		Cor Caroli
Draco		

Constellations	*Quarter*	*Stars*
Leo		
Camelopardalis		
	SOUTHEAST	
Scorpio		Antares
Sagittarius		
Ophiuchus		
	SOUTHWEST	
Serpens		Spica
Libra		
Hydra		
Virgo		

XLIII. A Synopsis of the Common Rocks

1. THE COMMON ROCK-FORMING MINERALS AND THEIR CHIEF CHEMICAL INGREDIENTS.

1. Quartz — silicon, oxygen.
2. Orthoclase Feldspar — potassium, aluminum, silicon, oxygen.
3. Plagioclase Feldspar — sodium, aluminum, silicon, oxygen, calcium.
4. Muscovite Mica — hydrogen, potassium, aluminum, silicon, oxygen.
5. Biotite Mica — hydrogen, potassium, magnesium, iron, aluminum, silicon, oxygen.
6. Hornblende — calcium, magnesium, iron, silicon, oxygen, aluminum.
7. Augite — calcium, magnesium, iron, oxygen, aluminum, silicon.
8. Calcite — calcium, carbon, oxygen.
9. Dolomite — calcium, magnesium, carbon, oxygen.
10. Salt — sodium, chloride.
11. Gypsum — calcium, sulphur, oxygen, hydrogen.
12. Pyrite — iron, sulphur.
13. Magnetite — iron, oxygen.
14. Hematite — iron, oxygen.
15. Limonite — iron, oxygen, hydrogen.
16. Siderite — iron, carbon, oxygen.
17. Kaolin — hydrogen, aluminum, silicon, oxygen.

2. THE SEDIMENTARY ROCKS.

a. *Fragmental Rocks:*

Gravel beds — made of pebbles derived from other rocks.
Conglomerates — consolidated masses of pebbles.
Sand beds — finer fragments, usually quartz grains.
Sandstones — consolidated sand beds.
Clay beds — disintegrated feldspar, hornblende, etc.
Shale — consolidated clay beds, splitting readily.

b. *Chemically-formed Rocks:*

Stalactites, etc.— carbonate of lime, deposited in water.
Iron deposits — some iron ores, ex. bog iron.
Silicious sinter — silica deposited in water.
Salt — sodium chloride.
Gypsum — sulphate of lime.

c. *Organic Rocks:*

Most Limestones — carbonate of lime, made of shells, etc.
Dolomite — magnesian carbonate of lime.
Coal — made of plant remains.

3. THE IGNEOUS ROCKS.

a. *Coarse-grained:*

Granite — quartz, orthoclase feldspar, and hornblende or mica, or both.
Syenite — orthoclase feldspar, and either mica or hornblende, or both.
Diorite — plagioclase feldspar, and either mica or hornblende, or both.

b. *Either fine- or coarse-grained:*

Diabase — plagioclase feldspar and augite.

c. *Fine-grained:*

Rhyolite — quartz, orthoclase feldspar, and hornblende or mica, or both.
Trachyte — orthoclase feldspar, and hornblende or mica, or both.
Andesite — plagioclase feldspar, and either hornblende, mica, augite, or two of these.
Basalt — plagioclase feldspar and augite; often with other minerals.

4. THE METAMORPHIC ROCKS.

Name	*Source*	*Mineral Composition*
Quartzite.	Altered sandstone.	Quartz.
Slate.	Altered clay rock.	Partially crystallized micaceous particles.
Marble.	Altered limestone.	Calcite.
Anthracite.	Altered coal.	Mainly carbon.
Schist.	Altered from various rocks.	Variable.
Gneiss.	Altered from various rocks.	Variable; gneiss and schist usually contain two or more of the following: feldspar, quartz, hornblende, or mica.

5. A TABLE OF GEOLOGICAL TIME.

Showing the great epochs in the evolution of life upon the earth; modern time is at the top of the list.

Synopsis of Common Rocks

1. CENOZOIC TIME: THE AGE OF MAMMALS.

Quaternary or *Pleistocene.*

Man assumes importance, particularly in the latter part of the Quaternary which is known as the Recent Period. Glacial Period in the first half.

Tertiary: Pliocene, Miocene, Oligocene, Eocene.

Mammals develop in remarkable variety, and to great size, while reptiles diminish.

2. MESOZOIC TIME: THE AGE OF REPTILES.

Cretaceous.

Birds begin to be important; reptiles continue; and higher mammals appear; land plants and insects of high type.

Jurassic.

Reptiles and amphibia predominate.

Triassic.

Amphibia and reptiles develop remarkably; low forms of mammals appear.

3. PALEOZOIC TIME: AGE OF INVERTEBRATES.

Permian, Carboniferous.

Land plants assume great importance.

Devonian.

Fishes are abundant. They began in the Silurian and continue, though with many changes, to the present time.

Silurian, Ordovician.

Invertebrates prevail. They continue abundant to the present time, but are of different kinds.

Cambrian.

No forms higher than invertebrates.

4. PRE-CAMBRIAN TIME.

Few fossils known.

Algonkian, Archean.

Mostly metamorphic rocks; perhaps, in part, original crust of earth.

The data in this section has been derived, in large part, from the College Physiography of Tarr and Martin, which is recommended as a reference work for those who desire to make first-hand studies of earth features.

XLIV. Some Suggestions for Natural History Field Work with Children

1. Small groups do the best work. One well-planned trip per term, by squads, is better than frequent "picnics," by larger disorganized classes. Much work can be planned on the "home project" basis.

2. If you are not familiar with the region to be visited, first make a careful preliminary trip by yourself, planning the route, points of observation, stopping places, etc.

3. Have a lesson period on some day before the trip, in which you explain, and the class discusses, the region to be visited, objects to be observed, etc. Frequently several explanations are necessary. This involves local geography, local maps, compass, lists, etc.

4. Field equipment need be neither elaborate nor expensive. Paper bags, baskets, small boxes and bottles, jackknives, tin pails, nets, etc., as the trip requires. Each child should have something. In upper grades the pupils may each bring according to individual preference,—kodak, insect net, botany can, geology hammer, etc.

5. Plan so that the pupils will be comfortably occupied with work throughout the trip, neither long idle gaps, nor rigid "schoolroomishness." Individual problems may be provided — one squad list the trees seen, another the birds, etc. Restless older pupils may be put in specific charge of small squads of the younger pupils.

6. Do not expect to accomplish too much; field work makes large demands upon the "time-element," and cannot be crammed. Keep fairly close to a few specified lines of observation and study; do not discourage individual study outside of these lines, but do not permit undue dissipation of interest. The work is to be done seriously, neither over-solemnly nor as a mere pastime.

7. Pupils must come dressed suitably for such a trip — clothing that will not be injured by a dusty road, a slight shower or a marshy field.

8. A short trip is usually better than a long one, unless some distant place is to be visited. Two hours is a safe limit. The older the pupils the longer the trip may be. All-day trips are apt to become "picnicky" especially during the period after lunch.

9. Train the pupils to be well mannered out-of-doors, to shut gates, avoid injuring property, clean up after lunch, start no fires, etc. This is largely a matter of suggestion and thoughtfulness.

10. The results of the trips should be used at the next class periods, while impressions are fresh and accurate. This affords excellent drill

in oral, written and pictorial expression, and in checking for accurateness and completeness.

11. If collecting is done, pupils should take good care of whatever they collect, bringing it to the class room in good condition, and giving it whatever treatment is pertinent. Each pupil should have full credit for individual work, " at the same time sharing the find," with the rest of the class.

12. Throughout the work must be recognized the principle that identificational or recognition work is but a small part of nature-study. " How does it live its life? " is the great question.

XLV. The Place of Natural History in the Educational Program

The past century has been characterized by an unprecedented evolution in the realm of the natural sciences. Obedient to the fundamental law of rhythm that dominates all human progression, these sciences have passed through epochal alternations of specialization and synthesis. In the days of Lamarck, Darwin and Agassiz, the subject-matter of the natural sciences was comparatively undifferentiated. An investigator or teacher of these subjects was properly designated as a "naturalist," a student of Nature.

The paths of science were few and direct. Microscopic technique was in its infancy. The record of human achievement in this field was compact and accessible. The known laws were few and apparently sufficient. The "Special Creation" dogma enchained a veritable Pandora's box of soon-to-be vexatious questions. There were not many books and even fewer periodicals. The bewildering labyrinthine chaos of modern scientific journals was unknown. Learned societies were small and select. Apparatus and laboratory paraphernalia had not attained the commercial exploitation with which it is favored to-day.

The days of the old-fashioned "naturalist" were good and balmy days. He himself was an unique character. His knowledge extended into many fields; his tastes were diverse and liberal, set in a sound classical matrix. His studies were catholic. All was game that came to his net. In his simple work-shop was a case of pinned insects, a box of marine shells, portfolios of dried herbarium specimens, stuffed birds over the bookshelves; geological hammer and knapsack under the table; some chemical tubes and vials on the marble-topped stand; and on the shelves, the quaint-bound volumes of Buffon, Swammerdam, Cuvier, Owen, Linnæus, Pliny.

Then came, not without a fermentive period of preparation, the tremendous tumult of "Darwinism" and the evolution theory. Old ideas were suddenly disjointed and thrown into the corners. A confusing and belligerent horde of new problems ranged themselves squarely across the pathway of the sciences, and with reiterating insistence clamored for detailed investigation. The well-trod highways were suddenly discovered to lead into foggy by-paths, indeed into thorny and rough-floored jungles — over the shivering verges of black-shrouded precipices — into the very murkiness of the Great Night itself.

The naturalist soon learned that his comfortable old tools and easy methods were inadequate in the grapple with this vast new array of unsolved problems. He must have new and differentiated equipment. He must develop fresh modes of attack. Laboratory technique — miscroscopic work — manipulations of physics and chemistry — the collection, preservation, and indentification of material — all these underwent rapid and profound specializations.

The naturalist himself was deeply affected by these transformations. He could no longer browse leisurely throughout the realm of nature. The subject-matter had vastly outgrown him — had become unwieldy and inaccessible. The old ways became smattering and superficial. To make any headway, he must specialize,— choose a single problem or small group of problems — divest himself of all incumbrances — and apply himself strictly and vigorously to his own minute segment of the wide-boundaried whole. He was no longer a "naturalist,"— a student of all nature,— that had become out of the question. He must be an embryologist, plant pathologist, meteorologist, invertebrate zoölogist, vulcanologist, bacteriologist, ichthyologist, entomologist, or what not.

He no longer wrote delightfully rambling accounts of the Natural History of the Amazons, the vegetation of East Africa, the "Compleat Angler." He now published, in the innumerable technical journals, painfully minute records,— in

a stereotyped professional phraseology,— of his investigations on the chromosomes in the epidermal cells of *Amblystoma punctatum;* the preparation of neutral ammonium citrate; the bacterial flora of the intestinal tract of white mice. This technical literature, bearing directly and narrowingly upon his own investigations, became the bulk of his reading matter, — he had no time to range far from it. His discussions took place in a society of other highly specialized investigators. He lived, worked, talked and wrote in a minute fragment of the great Nature-World.

The enormous value to human thought and progress of this investigational epoch cannot be over-estimated. It has revolutionized all modern life and industry. It was necessary and appropriate that for the time being the old-school naturalist should tranquilly make way for the high-geared specialist. Minutely differentiated research work now has a permanent place in the laboratories of the world's great institutions of learning, and in the multitude of governmentally-supported research bureaus. The precisely-recorded harvest of research increases annually, much of this fruitage is of the highest market value, directly and indirectly, to human welfare. Research is the life-blood of all instruction of university rank. Its intricate ramifications, like the sensitive cells of the deeply hidden root, grope their way further and further into the darkness of ignorance and send back a steady current of newly acquired raw fact-materials. These are gradually elaborated and made available for general use throughout human society.

Very significant, however, is the gradual return of the spirit of the old-time naturalist. The pendulum is swinging forward through a new arc. It becomes evident, in the readjustments of the times, that there is plenty of work in the natural sciences,— both research and instruction,— for the two types of workers, the analytic type and the synthetic type, the "investigator" and the "naturalist." Indeed, it is found to be more than merely a matter of plenty of work,— it is evident

that the naturalist of to-day has a highly important function as the uniter and interpreter of the isolated threads of specialized research. He stands at the crossroads of the sciences and points out the large, vital, and significant facts and laws of each.

In all factories where complicated machines of any kind are made, there is an "Assembling Room." Here the many parts are brought together and properly united, and the machine as a useful whole is finished and tested. So in the realm of the natural sciences the naturalist is the assembly-man. He takes the irregular fragments of research, meaningless and unavailing in themselves, assorts and aligns them, and with them constructs a coördinated chain of facts, an applicable law.

So to-day the term "Natural History" is again coming into general usage, after a long recessive period. It is returning with a new content and a fresh and inspiring point of view. Natural history is not biology, not zoölogy, nor nature-study, nor popularized physical geography, although it comprises elements from all of these. It draws its materials from all the network of the sciences, but remains distinct from, and independent of, any one of its contributaries. It represents the wide outlook,— it comprehends the salient facts, it looks towards the realm of nature with the sweeping vision of the generalist, rather than the myopic peering of the specialist.

Natural history is again evolving its own distinctive literature and records. Significant titles are "The American Natural History," "Nature," "Science," "The American Naturalist," "The Nature Library," "The Natural History of the Farm," "The Handbook of Nature-Study."

In the educational program of the schools, including elementary, secondary, and collective instruction, courses in general natural history are supplanting or supplementing the fragmentary and specialistic courses of yesterday. The general science courses in the secondary schools are everywhere proving of great value. They afford an excellent introduction to

the scientific method for those students who plan to study chemistry, physics, botany, or any other of the subdivisions; and secondly, those students who have the general course as their *only* science work gain a substantial elucidation of the great principles and laws of Nature, giving perspective and a working-knowledge of the methods of science.

Professor Bigelow, in the Cyclopedia of Education, has concisely distinguished between the natural history work of the high schools and the nature-study lessons of the elementary grades:

"The term nature study was for many years criticized, because etymologically it suggests all scientific studies of nature, and hence is co-extensive with the combined natural sciences; but this objection is no longer urged by prominent scientists, for it is now generally understood in both England and America the nature study means a special type of study adapted primarily to pupils of elementary school age.

"The fact that nature study and natural history deal with the same objects and processes has led to much investigation. . . . It is now agreed among the leaders of the nature study movement that a satisfactory division of the field between nature study for elementary schools and science courses for higher schools has been found in theory and is rapidly becoming successful in practice."

Over forty colleges and universities in the United States now recognize high-school courses in general introductory science for entrance credit as counting towards admission for the A. B. degree. Many colleges and universities are now requiring a first-year course in general natural history or general science, for those students who are not specializing in the science group. The cultural value of this type of survey course is also evidenced by its wide introduction into the curricula of normal and training schools. At sessions of the National Education Association there was delivered a notable series of addresses on the scope and function of the general science course.

It is unquestionable that natural history will continue to enlarge its influence in the education programs of the twentieth century. So many of the common problems of every-day life

are natural history problems; so profoundly does the natural environment affect the development of the child; so intimately related to individual welfare and happiness are our contacts with the nature background; that natural history is rapidly coming to have adequate recognition in the educational policies of to-day and of to-morrow.

THE END

INDEX

To Main Headings Only

Batrachians, 85
Beech tree, 46
Birds, list of summer, 13
Birds, key to common summer, 26
Brooks, fishes of, 77

Chautauqua Lake and the Ice Age, 104
Chautauqua region, story of, 100
Chautauqua soil, 111
Children, field work with, 126
Cloud World, 117
Clouds, kinds of, 118

Diagram of Chautauqua region, 99

Ferns, 90
Ferns, synopsis of, 92
Field work with children, 126
Fishes of the brooks, 77
Fishes of the lake, 79
Flowering plants, list of, 52
Frogs, 85

Geological history of the Chautauqua region, 107
Grape, insects of, 74

History of Chautauqua region, 115

Insects and their allies, 69
Insects of the grape, 74
Ivy, poison, 68

Lake, fishes of, 79

Mammals, 75
Maple, sugar, 44
Mascalonge, 80
Meteoric showers, the summer, 120
Mosses, 90
Mushrooms, 94
Mushrooms, list of, 96
Muskalunge, 80

Natural history background, 11
Natural history in educational program, 128

Panama rocks, 101
Physiographic regions of New York State, 113
Plants, flowering, 52
Plants, spore, 94
Plants, wayside, 50
Poison ivy, 68
Pollination of Wild Flowers, 66
Pond, Reservoir, 86

Reservoir Pond, 86
Rocks, synopsis of common, 123

Salamanders, 85
Shrubs, list of, 43
Snakes, list of, 88
Soil, Chautauqua, 111
Spore plants, 94
Stars of summer sky, 121
Swampy places, 83

Toads, 85
Topography of Chautauqua Region, 109
Tree, life of the, 33
Trees, key to Chautauqua, 36
Trees, list of, 40
Trees, names of, 35
Trees, practical suggestions, 48
Turtles, list of, 89

Wayside plants, 50
Wild flowers, pollination of, 66
Woodland, 29
Woodland floor, 31