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VEGETATION OF SKOKIE MARSH

BY

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ERRATA AND ADDENDA

Page 54, lines 3 and 2 from bottom, and elsewhere in Article III, for *Cassia chamaechrista* read *Cassia chamaecrista.*
Page 62, between lines 4 and 5 from bottom of table insert *Erigeron annuus.*
Page 101, table, after *Croton glandulosus* read var. *septentrionalis;* and for *Equisetum laevigatum* read *Equisetum hyemale* var. *intermedium.*
Page 131, line 3, for *coerulea* read *caerulea.*
Page 138, last line, for *Ziza* read *Zizia.*
Page 141, line 21 from bottom, dele *Diodia teres.*
Page 169, between lines 3 and 4, insert as follows:
Erigeron annuus (L.) Pers. An interstitial in the bunch-grass association in the Hanover area.
Page 177, line 5, for *eastward* read *westward.*
Page 209, line 3 from bottom, for *copalina* read *copallina.*
Page 210, line 13 from bottom, for *Diospyrus* read *Diaspyros.*
Page 211, line 5, for *Foresteria* read *Forestiera.*
Page 256, line 3 of table, for Dr. H. *M.* Pepoon read H. *S.* Pepoon.
Page 278, line 16, the fifth word should be in Roman type.
Page 286, line 6 (second column), page 295, list of secondary species (second column), and page 353, line 8 from bottom, for *hiemalis* or *hiemale* read *hyemale.*
Page 313, line 4 from bottom (first column), for *pedicularis* read *pedicularia.*
Page 315, line 10, second column, for *Apoeynum* read *Apocynum.*
Page 323, line 3 from bottom, for *Cyperus* read *Scirpus.*
Page 330, line 14, for *virginianum* read *virginicum.*
Page 336, lines 3 and 2 from bottom, for *virginicum* read *virginianum.*
Page 337, line 2 from bottom, for *philadelphicum* read *philadelphicus.*
Page 339, in first list of invading species, for *Rhus hirta* read *Rhus typhina.*
Page 351, line 4 from bottom, for *xerophtic* read *xerophytic.*
Page 355, above line 6 from bottom, insert *Scirpus heterochaetus* Chase.
Page 356, line 14 from bottom, for *Symlocarpus* read *Symplocarpus.*
Page 360, line 14, for *Pirus* read *Pyrus.*
Page 362, after line 7, insert *Acer saccharinum* L.
Page 363, line 2 from bottom, for *quadiflorum* read *quadriflorum.*
Page 365, line 14, for *thapus* read *thopsus.*
Page 369, last line, for *Tanecetum* read *Tanacetum.*
Page 417, line 1, dele *the.*
Page 497, line 9 from bottom, for *neglible* read *negligible*, and in foot-note, for *Austalt* read *Anstalt.*
Page 498, line 4 from bottom, for *Lockport* read *Chillicothe.*
Page 500, line 13 from bottom, after *up* insert *in.*
Page 501, line 2 from bottom, for *dissolving* read *dissolved.*
Page 504, line 23, for *gryina* read *gyrina;* line 17, for *dentata* read *knickerbockeri.*
Page 506, line 11, for *vernata* read *ternata.*
Page 507, line 3 from bottom, for *Mazon* read *wagon.*
Page 513, line 19, for *Nepa* read *Zaitha;* line 18, and page 517, line 13 from bottom, page 520, line 12 from bottom, and page 532, line 4, read *naid* or *naids* for *naiid* or *naiids.*
Page 517, line 6 from bottom, for *pondweed* read *pickerel-weed.*

Page 519, for first sentence of last paragraph read as follows:

We have no exactly comparable chemical data for July; but analyses for August give percentages of saturation for Morris and Marseilles as follows: 20.4 per cent. at Morris on the 11th and 11 per cent. at Marseilles on the 12th; 16.35 per cent. at Morris on the 22d and 23d and 7.4 per cent. at Marseilles on the 24th and 25th.

Page 521, line 6 from bottom, and page 529, line 9, for *chrysoleucas* read *crysoleucas.*

Page 525, line 22, and page 536, lines 21 and 24, for *Ekmann* read *Ekman.*

Page 532, line 1, for *Ancyclus* read *Ancylus.*

Page 551, line 7, for *00* read *512.*

Page 615, second line above foot-note, for *106* read 94.

Page 616, line 1, for the second *Bündeln* read *Bündel;* line 2, for *Bündeln* read *Bündels;* line 3, for *aussern* read *ausseren;* line 6, for *zweierlie* read *zweierlei.*

Page 629, line 12, for *kein* read *keinen.*

Page 634, line 9, for *unternommen* read *unternommenen;* and in line 14 from bottom, after *575* insert *13 fig.*

Plate III, Fig. 1, after the word *mixed* in legend insert *consocies of the.*

Plate IX, Fig. 2, dele the legend and read instead: Root-system of *Tephrosia virginiana,* exposed by blowing of the sand.

Plate X, Fig. 2, dele the legend and read instead: A blowout almost stabilized by bunch-grasses, especially *Leptoloma cognatum.*

Plate XXXIX, for *Calamogrostis* read *Calamagrostis.*

Plate LIV, exchange places of cuts, but not the legends.

Plate LXXXV, for *7* read *7c.*

ARTICLE XI.—*Vegetation of Skokie Marsh.* BY EARL E. SHERFF.

With the rapid encroachment of city and town upon the outlying districts about Chicago, and the consequent despoilation of the native flora, it has seemed to the writer advisable to undertake a careful study of a certain restricted area, while there is yet an opportunity, and to place these results on record. For several reasons, Skokie Marsh was deemed most worthy of study. During the past few years the so-called "North Shore" towns situated in the vicinity of the marsh have grown at a phenomenal rate. Much land but recently used in farming is now occupied by residences. Moreover, with further increases in population it appears certain that the whole marsh area will be thoroughly drained and, as a result, its floristic complexion be entirely changed. However, at the present time the flora is still essentially virgin in many places, and it is reasonably sure that the general survey here presented approximates closely to a truthful statement of natural conditions.

The general features of the flora and topography were studied mainly in the autumn of 1910 and the spring of 1911. From May to October, 1911, rather intensive taxonomic and ecological studies of the flora were pursued. Again, in 1912, frequent trips were made through various parts of the marsh to secure additional information as a check upon that already obtained.

Numerous specimens of plants were gathered from time to time. Of these a considerable number are now in my private herbarium; and many duplicates are in the Herbarium of the Field Museum (Chicago), the Missouri Botanical Garden Herbarium (St. Louis), Gray Herbarium of Harvard University (Cambridge), the United States National Herbarium (Washington), and the Herbarium of the Royal Botanic Garden (Edinburgh). The data secured, and here published for the first time in collected form, have already appeared in part in several other publications, which are cited in the appended list of literature. The map (Pl. LXXXVI, Fig. 1) is intended to portray merely the general location and extent of Skokie Marsh; hence certain of the roads running across the marsh are omitted. All the illustrations were made by the writer, resort being had to pen sketches where photographs were found impracticable.

Grateful acknowledgment is here made of my indebtedness, for many valuable suggestions and much helpful advice, to Dr. Henry C. Cowles and Mr. George D. Fuller, of the University of Chicago,

under whose joint supervision the main part of the investigation was pursued, and also to Dr. J. M. Greenman, of the Missouri Botanical Garden, for certain assistance in taxonomy.

General Features of Skokie Marsh

Skokie Marsh* is intimately associated with Skokie Stream—a small sluggish meandering stream beginning west of Waukegan, Ill., and extending southeast. Years ago this stream doubtless flowed on until it at last joined the East Branch of the North Branch of the Chicago River. Today, however, its identity as a stream is lost at a point west of Glencoe, Ill., where much of the water spreads itself over the marsh or enters some of the artificial drainage ditches. Figure 17, Plate XCIV, shows a more or less artificial basin at the south end of the marsh (west of Winnetka), in which water collects, flowing thence southward through a ditch. Southwest of Winnetka (west of Kenilworth and Wilmette), several broad drainage ditches may be seen. These receive much of their water, in circuitous ways, from Skokie Marsh and pass it on, all of it coming sooner or later into the North Branch of the Chicago River. One of these drainage ditches is shown in Figure 14, Plate XCII.

In recent years drainage and cultivation have been carried on to such an extent along the margins of the marsh that its areal limits can be defined only arbitrarily. As shown in the accompanying map (Pl. LXXXVI, Fig. 1) however, it is approximately 12 km. long, and at its southern end becomes 1.5 km. wide. For the naturalist, access to the marsh may be had at all times by means of the several roads running east and west directly across it. The scenery along certain of these roads (Pl. XCIII, Fig. 15) is particularly pleasing. During spring and autumn, the ditches running along either side of the roads are usually filled with water. In some of these the water is deep enough to permit the passage of a small boat. In the spring of 1912, when the marsh was in many places under water, a boat (Pl. XCIII, Fig. 16) was found very convenient for penetrating to the interior.

In early postglacial times, the marsh was an embayment (Atwood and Goldthwait, '08, p. 58), which later disappeared and gave place to a system of drainage. At present the surface soil almost throughout the marsh consists of a black muck or partially decayed peat, 1 m. or less in thickness. Underneath is a subsoil of glacial clay.

*For many additional data and photographs of Skokie Marsh, see Baker ('10), who has given also an account of its zoological aspects, with special reference to the molluscan fauna.

General Features of the Marsh Vegetation

Upon analysis, the vegetation at Skokie Marsh is found to consist of three rather pronounced formations.* Along the course taken by Skokie Stream, the plants constitute distinctly a reed swamp formation (Pl. LXXXVII, Fig. 2). Extending along on either side of the reed swamp is a broad level expanse, intermediate between reed swamp and meadow. This may be designated swamp meadow (Pl. LXXXVII, Fig. 3; Pl. XCIV, Fig. 18; Pl. XCV, Fig. 19). At the outer edges of the swamp meadow, in narrow areas that have not been too much disturbed by cultivation, true meadow is commonly present. At certain places, however, there is an abrupt transition from swamp meadow, or even from reed swamp, to forest. Such a case is shown admirably in Plate XCV, Fig. 20, which pictures a small piece of forest containing *Quercus rubra, Q. macrocarpa, Q. alba, Juglans nigra*, etc., separated from a branch of the reed swamp by a distance of only about 15 m.

In the reed swamp the plants belong to five easily recognized associations. Where the stream is deepest (as in Pl. LXXXVII, Fig. 2), aquatic or amphibious species, such as *Myriophyllum humile*,† *M. heterophyllum, Ranunculus delphinifolius,* and *Potamogeton* (*zosterifolius*?) are common near the center. In the shallower parts, the species are supplemented or replaced by *Polygonum Muhlenbergii, P. hydropiperoides, Veronica Anagallis-aquatica, Radicula aquatica, Sium cicutaefolium, Sparganium eurycarpum, Glyceria septentrionalis, Alisma Plantago-aquatica, Rumex verticillatus, Callitriche heterophylla,* and *C. palustris.* As *Polygonum hydropiperoides* and *Sium cicutaefolium* are among the most abundant stream plants and appear to be dominant, we may classify the plants growing in the stream or upon its bed, except along the margins, as the *Sium-Polygonum* association; or, using Schouw's method of nomenclature (Schouw, '22, pp. 148-150), we shall call this the *Sio-polygonetum* On either side of the Sio-polygonetum a narrow or sometimes broad girdle‡ of *Nymphaea advena* and *Castalia odorata* occurs in many

*The words "formation" and "association" are used throughout this paper in the sense accepted by Warming ('09, pp. 140, 144).

†All plant names given in this paper conform, unless otherwise noted, with the nomenclature of Gray's Manual (see Robinson and Fernald, '08).

‡The word "girdle" is here equivalent to the "zones" of many recent authors, and conforms with the recent proposal of Flahault and Schröter ('10), except that it is here used for "bands" that are not "concentric." Professor Schröter kindly informs me by letter that this use of their word is perfectly justifiable, and further says, "we should have made provision for such a use."

places along the stream. Usually these species are accompanied by species characteristic of the Sio-polygonetum; but the soil and light conditions present in the girdles of *Nymphaea* and *Castalia* are peculiar to them and justify their treatment as a separate association, the *Nymphaeetum*. Landward from the Nymphaeetum are found dense and either intermixed or almost pure growths of *Typha latifolia, Sparganium eurycarpum, Scirpus fluviatilis,* and *S. validus*. Scattered to a varying extent among these species are *Sagittaria latifolia* and *Sium cicutaefolium*. Here and there are a few isolated patches of *Dulichium arundinaceum*, of *Decodon verticillatus,* and of certain other species. This association will be referred to as the *Scirpotyphetum*. Again, in certain parts of the reed swamp, at stations slightly less hydrophytic, *Phragmites communis* is prominent. It forms exceedingly compact, nearly pure colonies that may reasonably be treated as an association, the *Phragmitetum*. Finally, we must mention the many large but somewhat scattered patches of *Iris versicolor* and *Acorus Calamus,* occurring in the outer parts of the reed swamp and often extending into the swamp meadow formation. These constitute an association of a very definite stamp, the *Irido-acoretum*. A general comparison of the reed swamp associations shows that in the Sio-polygonetum and Nymphaeetum, where hydrophytism is greatest, the dominant plants are dicotyledonous. In fact, of the 15 species found to any considerable extent in these two associations, the 10 most abundant (*Sium cicutaefolium, Polygonum hydropiperoides, P. Muhlenbergii, Nymphaea advena, Castalia odorata, Rumex verticillatus, Veronica Anagallis-aquatica, Myriophyllum humile,** *Callitriche palustris,* and *C. heterophylla*) are dicotyledons.† In the other three associations the most abundant species are chiefly monocotyledons.

The swamp meadow differs from the reed swamp in being more uniform, owing to greater parallelism between the water-table and the soil surface, and does not admit of logical subdivision into associations. The plants are principally such grasses as *Calamagrostis canadensis, Glyceria nervata, Phalaris arundinacea, Poa triflora, Sphenopholis pallens,* and *Agrostis perennans*. These are frequently interspersed with *Carex lupuliformis, C. vesicaria monile, C. riparia, Scirpus atrovirens, S. Eriophorum,* etc. The swamp meadow is used by farmers of the district for the production of marsh hay, and many of them customarily burn over the areas in the late autumn. Most of the shrubs and young trees are killed in this way, and so forest

*But see Nos. 136 and 137 in Annotated List.

†See Henslow ('11), however, regarding the supposed monocotyledonous nature of *Nymphaea* and *Castalia*.

development is hindered. Trees occur only in small groups, consisting chiefly of *Salix* (*S. fragilis, S. nigra,* and other species), *Fraxinus nigra, F. americana, Populus tremuloides,* and *Ulmus americana.* Frequently associated with these are such shrubs as *Cornus stolonifera, Cephalanthus occidentalis,* and *Sambucus canadensis.*

Throughout the reed swamp and swamp meadow are many species which, though very abundant, share only to a small extent in giving to the several associations their distinctive appearance. Thus, *Ludwigia palustris, Proserpinaca palustris, Penthorum sedoides,* and *Stenophyllus capillaris* are low in habit and obscured by taller plants in the shade of which they may thrive. Again, *Aster Tradescanti, Boltonia asteroides, Lobelia cardinalis, Teucrium occidentale,* and *Scutellaria galericulata,* while extremely common, are nevertheless conspicuous only during the latter part of the summer. The names of such species are here reserved, so far as possible, for the annotated list of species, at the end of this paper.

The meadow formation, as already stated, is narrow and more or less interrupted. The soil surface slopes mildly upward, away from that of the swamp meadow. The vegetation is much diversified at different places and from month to month during the vegetative season. *Poa pratensis* and *Agrostis alba* are the dominant grasses, but *Danthonia spicata* and *Agropyron caninum* are frequent. Scattered among the grasses are *Carex stipata, C. vulpinoidea, C. scoparia,* and *Eleocharis palustris.* In some parts of the meadow *Viola cucullata, V. papilionacea, Senecio aureus,* and *S. Balsamitae* are conspicuous in May and June, while later such species as *Lilium canadense* and *Rudbeckia hirta* are the most noticeable.

The stretches of forest present in many places at the edge of the marsh, while not usually considered as belonging to the marsh, are of interest because of the light that they throw upon the successional development of vegetation with the passing away of marsh conditions. Along the east side of the marsh, the ground surface slopes gently upward toward a rather high morainic ridge that roughly parallels the marsh; and as one proceeds toward this ridge, he leaves behind him such woody species as *Cornus stolonifera, C. Amomum, Cephalanthus occidentalis,* and *Salix longifolia,* and passes in turn thickets composed of *Sambucus canadensis, Populus tremuloides* and taller species of *Salix,* forest composed largely of *Quercus bicolor, Q. rubra, Fraxinus nigra, F. americana,* and *Ulmus americana,* finally reaching forest composed of *Quercus rubra* and such upland species as *Q. alba, Q. coccinea,* and *Carya ovata.*

Livingston, in his well-known studies of transpiration, found that, in a general way, the measure of transpiration in plants was fairly indicative of their respective environmental conditions. The transpiration rate for most plants being roughly proportionate to the rate of evaporation of water from a partially open receptacle, he introduced the porous-cup atmometer for measuring the evaporation rate of water. Four of these atmometers* were set out May 21, 1911, at different stations indicated on the map: an instrument at station 1, near the edge of Skokie Stream; one at station 2, in the outer part of the reed swamp; one at station 3, in the outer part of the swamp meadow; and one at station 4, in a stretch of forest east of the marsh. Instrument No. 1 was in the center of a dense growth of *Typha latifolia.* As the summer advanced, plants of *Scutellaria galericulata* and *Teucrium occidentale* grew up in the shelter of *Typha.* No. 2 was surrounded by *Iris versicolor, Sium cicutaefolium,* and a few plants of *Typha.* No. 3 was in a dense growth of *Calamagrostis canadensis,* and No. 4 in a small area of pastured forest, composed chiefly of *Quercus bicolor* and *Fraxinus americana,* but with a moderate proportion of *F. nigra.* The unglazed part of each porous-cup extended from about 22 cm. to about 28 cm. above the ground, giving a mean height of 25 cm. Readings were taken weekly, up to and including October 15, 1911. After correction according to the method outlined by Livingston, they were plotted graphically,† appearing as shown in Plate LXXXVIII, Fig. 4. The ordinates represent the number of cubic centimeters of water lost per day by a standard atmometer, while the abscissæ represent the intervals between the weekly readings.

A study of this figure (4, Pl. LXXXVIII) shows the periods of maximum and minimum evaporation to have been fairly harmonious at the four stations. And, again, the evaporation rate for the center of the reed swamp (Fig. 4, *a*), where hydrophytism is greatest, was usually lowest; in the swamp meadow (Fig. 4, *c*), it was somewhat higher; in the outer part of the reed swamp (Fig. 4, *b*), still higher; and in the *Quercus bicolor-Fraxinus americana* or swamp white oak-white ash forest (Fig. 4, *d*), it was highest of all. These differences become perhaps even more evident if we compare the following aver-

*None of the atmometers used were provided with a rain-excluding device, such as is recommended by Livingston ('14).

†A summarized account of these results first appeared in the *Botanical Gazette* (Sherff, '12), and later a more complete account, substantiallly as presented here, was published in the *Plant World* (Sherff, '13).

age daily evaporation amounts for the several stations for the entire period of 147 days: *a*, 3 cc.; *c*, 4.27 cc.; *b*, 4.5 cc.; and *d*, 7.91 cc. Or, taking the rate for *d* as 100%, then the rate for *a* was 38%; for *c*, 54%; and for *b*, 57%.* Expressed in general terms, the evaporation rates were inversely proportionate to the hydrophytism of the station. This is due chiefly to the greater amount of moisture in the air where the station is hydrophytic; and again, the greater amount of atmospheric moisture was due, in many places, not merely to the greater sources of supply (soil moisture or surface water) but to the more difficult means of escape (because of the tall rank vegetation evoked by hydrophytism). It will be noted that the average rate in the outer part of the reed swamp (*b*) slightly exceeded that in the swamp meadow (*c*). This may be explained easily, however, by the fact that in the swamp meadow the vegetation remained more dense and compact in late summer than in the outer part of the reed swamp, thus retarding evaporation.

Transeau ('08) has obtained in a mesophytic forest on Long Island, N. Y., an average daily evaporation rate of 8.5 cm. This was based upon readings taken during a period of less than one month. More recently, Fuller ('11) has obtained for typical mesophytic forest, based upon readings extending over 155 days, the average daily rate of 8.1 cc. While we are not justified by the data at hand in attempting final comparisons, yet, so far as they go, these data indicate that evaporation is slightly less rapid in the swamp white oak - white ash forest than in climax mesophytic forest. If this indication is sustained by further study, as it undoubtedly will be, it will coincide quite closely with the fact that in the normal development of mesophytic forest from hydrophytic formations *Quercus bicolor*, *Fraxinus americana*, *F. nigra*, etc., are antecedent to trees of the climax mesophytic type (*Fagus grandifolia*, *Acer saccharum*, etc.). By way of comparison, it is interesting to note here the very recent paper of M'Nutt and Fuller ('12), in which the oak-hickory forest association is maintained (because of its intermediate evaporation rate) "midway between the black oak dune association and the

*In interpreting these data, however, allowance must be made for the fact that in different associations the percentage of species which start out each year in the delicate and hence more critical seedling stage, varies. For young seedlings, dependent as they are upon their own photosynthetic activity for food, growth up to about 25 cm. (the height at which these comparative readings were taken) is accompanied undoubtedly by much more risk than is the growth of young shoots from old, well-established perennial rhizomes, bulbs, tubers, etc. Hence the evaporation rate for an entire association can not show with precision the extent to which each species, as such, is influenced during its most critical stages, viz., the first seasonal growth of its aerial shoots.

climax beech-maple forest, the position already assigned to it by Cowles and others in the forest succession of Indiana and Illinois."

In the autumn of 1911, a study of evaporation at different levels above the soil surface was made. Beginning September 3, weekly readings were taken with four atmometers arranged at different heights in a dense growth of *Phragmites communis,* and with three atmometers added to the one already at station I, among *Typha.* The last readings were taken on October 22. After correction to correspond with the readings of a standard atmometer cup, the data were plotted graphically. Among *Phragmites* (Pl. LXXXVIII, Fig. 5) the average daily evaporation for the 7 weeks, at 0 cm. (the soil surface), was 2.5 cc.; at 25 cm., 4 cc.; at 107 cm., 5.3 cc.; at 198 cm., in the uppermost atmospheric stratum among the *Phragmites* plants, 7.5 cc., or just three times as great as at the soil surface. Among *Typha* (Pl. LXXXVIII, Fig. 6)*, the average daily evaporation for the 7 weeks, at 0 cm., was .64 cc.; at 25 cm., 1.5 cc.; at 107 cm., 2.7 cc.; at 175 cm., in the uppermost stratum, 6.4 cc.—or just ten times as great as at the soil surface. These differences in the rates among *Typha* were strongly accentuated because the readings were taken in autumn, when many of the *Typha* leaves had started to wither and bend over, thus giving greater exposure in the upper strata and greater shelter in the lower. Then, too, numerous plants of *Scutellaria galericulata, Teucrium occidentale, Polygonum Muhlenbergii,* etc., absent among *Phragmites,* were present among *Typha* and acted as a further check to evaporation in the lower strata (in which, to a very great extent, they vegetated).

The data plotted in Figures 5 and 6, Plate LXXXVIII, corroborate very emphatically those of Yapp ('09), who found that during a total of about 15 days, the evaporation rate just above (*not,* as at Skokie Marsh, *in the upper strata of*) tall "sedge vegetation" was over fifteen times as great as it was at 12.5 cm. above the soil surface. They conform likewise with the more recent results of Dachnowski ('11), who obtained during about five days, at a height of 150 cm. in an American bog, an evaporation rate twice as great as at a height of 7.5 cm.; also with those of Fuller ('12) who obtained, during six months at a height of 2 m. in climax mesophytic forest, an evaporation rate 2.34 times as great as at a depth of 4 m. below the forest floor, in a ravine. Obviously, we must conclude,

*Because of the faulty working of the atmometer at 0 cm., the results for the first two and the last weeks are not plotted, and the average here given (.64 cc.) is for the remaining four weeks. Enough certain data were obtained however for the other three weeks to show that the total average would have been even less than .64 cc.

with Yapp, that plants may grow in proximity to each other and yet, if vegetating in different strata above the soil surface, be subject to widely different growth conditions. Thus, for example, *Riccia natans* and *Typha latifolia*, which may be found together in great quantity but vegetate mostly in different atmospheric strata, live under evaporation conditions differing much more than do those under which *Teucrium occidentale* (of the reed swamp) and *Aster salicifolius* (of the swamp white oak - white ash forest), plants of similar height and growth form, live.

The depth of the water-table in the reed swamp and the swamp meadow was observed each week from May 21 to October 22, 1911. The water in Skokie Stream was about 1 m. deep in May, after which it gradually declined until in July, when the stream bed was in most places fairly dry. In August the water began to rise again, and by October had reached an average depth of about 1.1 m. In the rest of the reed swamp and in the swamp meadow the water-table during May was coincident with or above the soil surface; thereafter it sank, until in early September the maximum depth of 1 m. in the reed swamp and 1.75 m. in the swamp meadow was reached; and then, rising rapidly, it reached the surface again by the middle of October. During 1912, water was much more abundant throughout the marsh. Seldom could the reed-swamp be traversed without the use of boots, even in midsummer. According to farmers in the vicinity of Glencoe, Skokie Stream has sometimes in the past risen until a depth of about 3 m. was reached, when the entire marsh was of course deeply submerged. Various attempts have been made to classify the constituent species of a formation with relation to the optimum water-table depth for each species. But where the water-table varies greatly in depth from month to month and from year to year, data must be secured through many years if they are to show more than merely the relative degrees of hydrophytism to which plants in different places are subject.

Litmus tests each week, from May 21 to October 22, 1911, showed the water in Skokie Stream to be either neutral or slightly alkaline. Similar tests showed the soil water in the outer parts of the reed swamp and in the swamp meadow to be usually neutral or slightly alkaline, except that for a few days in August acid was present, although the amount was almost negligible.

Subterranean Organs and their Interrelationships

A study of the subterranean organs of the reed swamp plants showed that in many cases their depth is roughly proportionate to the depth of the water-table. Yapp ('08) arrived at a similar conclusion concerning the plants at Wicken Fen. And since the depth of the water-table may influence the depth of the subterranean organs, the latter in turn may be a potent factor in the success or failure of various species. Thus, for example, the rhizomes of *Polygonum Muhlenbergii*, where this species occurs in the Sio-polygonetum are usually at or near the surface of the stream bed. As King ('97, p. 240) and others have pointed out, saturated soil like that of the stream bed does not admit oxygen freely; and so in the Sio-polygonetum, the rhizomes of *Polygonum* and their roots appear advantageously placed. But in the Scirpo-typhetum (Pl. LXXXIX, Fig. 7), where the surface soil is occupied by an extremely dense mat composed of the rhizomes of *Typha, Sparganium,* and *Scirpus,* the rhizomes of *Polygonum* average about 10 cm. in depth; hence in the Scirpo-typhetum, although the rhizomes of *Polygonum* are lower, evidently in response to the greater average depth of the water-table, they have the additional advantage of being able to travel with less interference from the other rhizome systems.

An examination of *Typha, Sparganium, Scirpus fluviatilis,* and *S. validus* shows these species to be very similar in growth-form and hence capable of keen competition. Where any one of these species becomes more abundant in the Scirpo-typhetum, the others become less so. Because of the thick, strong rhizomes, the subterranean competition is to some extent mechanical; but it is probably to a much greater extent, as Clements ('05, pp. 285–289) maintains, physiological (or "physical"), especially in the case of the roots proper. The opposition that any or all of these species can offer to the intrusion of other species makes their hold upon the soil very effective. With *Sagittaria* (Pl. LXXXIX, Fig. 7), however, the case is different. Its growth-form favors a less compact arrangement of the individual plants, as its rhizomes can not produce a thick mat. Obviously, as the plants of *Sagittaria* are developing vegetatively, other species, such as *Typha, Sparganium,* and *Scirpus,* may easily invade and occupy the soil with their densely matting rhizomes. Subsequently the rhizomes of *Sagittaria,* if they are to establish new plants at proper distances away from the parent plant, must either plough their way through the surface mat of rhizomes or travel underneath it. They usually do the latter. As a rule, several rhizomes start growth from each plant in early summer in a downward direction; at a depth of 10–15 cm. they assume a horizontal direction for some distance; and then grow upward again, with a tuberous, propagative thickening near the distal end, and finally resemble somewhat a shallow, inverted arch.* Thus, interference from surface rhizomes and roots is to a great extent avoided. In this case, then, while it is not certain that the inverted arch of the *Sagittaria* rhizome is a direct adaptation to this particular struggle, it is certain that it is here of the greatest value, however induced originally.

Pieters ('01) found among the plants of western Lake Erie that even where *Sagittaria latifolia* was most abundant, *Sparganium* (and *Zizania*) had secured a foothold. On the other hand, throughout all the broad "zones" of *Sparganium, Scirpus validus* ("*S. lacustris*"), and *S. fluviatilis* that he describes, he says *Sagittaria latifolia* was common. Thus, in these cases, *Sagittaria* was found able to associate successfully with *Sparganium* and other species having a *Sparganium* growth-form, even where these species formed dense "zones". A study of the subterranean organs of *Sagittaria, Sparganium* (or *Typha* or *Scirpus*), and *Polygonum* shows that because of differences in direction or in depth they conflict but little. Again, because of differences in growth-form, their aerial parts do not conflict seriously. Thus a given area can usually support a greater mass of vegetation if these three growth-forms be present in fair mixture than if only one be present. Spalding ('09) has described the mutual relationships of *Cereus giganteus* and *Parkinsonia microphylla,* two desert species which thrive together because the occupation of different depths by their root systems enables them "to utilize to the utmost the scanty rainfall." Woodhead ('06) found *Holcus, Pteris,* and *Scilla* forming a noncombative "society or sub-association." For a group of plants mutually competitive, Woodhead uses the term "competitive association." Recently Wilson ('11) likewise speaks of a "complementary association" or "society." But the use of the words "association" and "society" in this connection is unfortunate. These words have been used already by Cowles ('01) and others (see Warming '09, p. 144) to denote a primary subdivision of a formation. As will be seen later (and in fact as Woodhead's interchangeable use of "sub-association" and "association" might imply), not all complementary or competitive groups are coextensive with a true association. We shall here substitute the word community, which is of less restricted application. Thus *Sagittaria* and *Polygonum*, where occurring in the Scirpo-typhetum with either *Typha* or *Scirpus fluviatilis* or *S. validus*, constitute a complementary community; but *Sparganium, Typha, Scirpus fluviatilis,* and *S. validus,* where they occur intermixed, form a competitive community.

*For illustrations of the similar rhizomes of *Sagittaria sagittifolia* see Glück ('05, pl. 6 and figs. 35, 39).

Species that are plainly complementary in one association may be less so in another. Thus, *Polygonum Muhlenbergii* and *Sparganium* are complementary in the Scirpo-typhetum; but in the Sio-polygonetum, where their rhizomes lie in common near or at the surface of the stream bed, they are "edaphically" (see Woodhead, '06) competitive, and hence complementary only in an aerial way. In this particular case, however, the frequently open appearance of the vegetation in the Sio-polygonetum indicates that the mutual biotic struggle of the two species is less keen than their separate struggles against somewhat adverse environmental conditions.

In the reed swamp certain mints become conspicuous during midsummer, particularly so in the Scirpo-typhetum, where they thrive in the shelter of *Typha* and other tall plants. *Teucrium occidentale* and *Scutellaria galericulata* are very common. They produce from their basal nodes numerous slender stolons that run out at different depths in the soil, and these stolons may produce new plants. These species tend to have their root systems 3–6 cm. lower in wet situations than in dry, although exceptions to this rule are not rare. But whether growing from plants in dry or from those in wet situations, the new stolons exhibit a remarkable power of changing their direction of growth, in response to numerous obstructions, and thus they may proceed further without serious results. Considering the strength and size of the rhizomes of *Typha*, *Sparganium*, and *Scirpus*, also the delicate nature of the stolons of *Teucrium* and *Scutellaria* and their capacity for altering growth-direction, it is probable that mechanical competition between such rhizomes as those of *Typha* and such stolons as those of *Teucrium* is practically absent. Again, the aerial parts of the *Typha* form vegetate chiefly in higher atmospheric strata than do those of the *Teucrium* form. Evaporation readings show that in higher strata evaporation is much greater; and while plants of relatively xerophytic structure (e. g., *Typha*, *Sparganium*, and *Scirpus*) are fitted to withstand acute drying conditions, plants with foliage of looser texture (e. g. *Teucrium* and *Scutellaria*) can vegetate better in lower strata, where the effect is that of greater humidity, the abundance of the latter plants among the former at Skokie Marsh tending to confirm this statement. Further, the persistence with which tall plants like *Typha* become dominant under favorable soil conditions shows that they are not, at least not noticeably, harmed by plants like *Teucrium*. If, finally, we allow for the great availability of nitrogenous foods in the soil and for the differences in food requirements, it becomes clear that the numerous communities of *Typha* and *Teucrium, Typha* and *Scutellaria, Sparganium* and *Teucrium*, etc., are complementary.

The purity of the Phragmitetum has already been mentioned. Many species that flourish elsewhere in the reed swamp under a wide range of light, moisture, and other shelter conditions fail to thrive here. Only *Calamagrostis canadensis* gains noticeable entrance, and then imperfectly. The dead *Phragmites*, the growth of previous years, makes a considerable but loose covering near the soil, its decay not being facilitated as in the Scirpo-typhetum, where water is more abundant. This dead cover may perhaps act as a partial check upon the invasion of other species; but a study of the rhizomes of *Phragmites* (Pl. LXXXIX, Fig. 8) shows another fact which probably is more important. They do not occupy one particular level, but rather several different levels of soil. As a result, there is formed a dense mat of rhizomes and roots, about 2.5 dm. deep. Obviously, the subterranean organs of other species which might start growth here must compete with the extraordinarily large number of *Phragmites* roots and rhizomes. Where other factors are suited equally to *Phragmites* and to competing species, this biotic factor in the subaerial struggle ought usually to be decisive in favor of *Phragmites*.

No cases were found where *Phragmites* had regularly produced rhizomes (or stolons) upon the surface of the ground. Frequent instances were met with, however, in which the entire aerial shoot had fallen over upon wet, mostly nude soil and, having produced numerous roots, had elongated at a much more rapid rate than before.

The Nymphaeetum displays many complementary communities. The rhizomes of *Nymphaea advena* (Pl. XC, Fig. 9) are usually 5–10 cm. thick and lie mostly at a depth of 8–25 cm. below the soil surface. The rhizomes of *Castalia odorata*, while smaller, lie at a similar depth. Where the Nymphaeetum intergrades with the Scirpo-typhetum, as is commonly the case, the rhizomes of *Typha, Sparganium*, and *Scirpus validus* lie higher in the soil. In many places the soil surface itself is occupied by the stolons of *Ranunculus delphinifolius* and the creeping stems of *Polygonum hydropiperoides*, with a large, upright stem base of *Sium cicutaefolium* present here and there. In other places, *Ranunculus* is replaced by *Myriophyllum humile* or by young plants (growing chiefly from detached leaves) of *Radicula aquatica*, while *Polygonum* is replaced by *Veronica Anagallis-aquatica*, and *Sium* by *Rumex verticillatus*. And while it is true that *Nymphaea* and *Castalia*, or *Typha* and *Sparganium* and

Scirpus, or *Ranunculus* and *Myriophyllum* and *Radicula*, or *Polygonum* and *Veronica*, or *Sium* and *Rumex* are mutually competitive, yet a complete community (as shown, e. g., in Pl. XC, Fig. 9) is complementary; the basal parts chiefly because of different depths, and the upper parts chiefly because of different growth-forms.

An inspection of the Nymphaeetum shows that only where *Nymphaea* is nearly or quite absent does *Sagittaria latifolia* successfully invade from the Scirpo-typhetum. As is commonly known, the rhizomes of *Nymphaea* in many habitats are usually decayed to within a short distance of the growing apex. An investigation during August, 1911, showed that generally where the rhizomes of *Sagittaria* had penetrated these decayed parts, they themselves had started to decay.* Frequent cases were found where the decayed *Nymphaea* rhizomes lay nearer the surface and the *Sagittaria* rhizomes had proceeded underneath, unharmed. In many instances, however, where the stem-tubers had been mechanically impeded (by woody roots, etc.) in the encasing soil, they had decayed. And here, while the decay must have been due to some one or more physiological causes, yet these causes could not have operated had not mechanical impediments first retarded the stem-tubers for a sufficient length of time. As our knowledge of the interrelationships of subterranean organs progresses in the future, we shall probably find that often, in the case of certain species with large subterranean parts, there is offered or received mechanical resistance which is immediately decisive in competition because of the physiological processes that it promotes.

Speaking in a general way, while *Nymphaea* and *Sagittaria* thrive better in the Nymphaeetum and Scirpo-typhetum, respectively, yet along the line of tension between these two associations the injury done by the decayed *Nymphaea* rhizomes to the rhizomes of *Sagittaria* is a factor that appears to be decisively in favor of *Nymphaea*. The inverted rhizome arch of *Sagittaria*, useful in the Scirpo-typhetum, is here more often harmful.

In many parts of the Irido-acoretum, *Polygonum Muhlenbergii* and *Galium Claytoni* abound, and these form with *Acorus* a complementary community (Pl. XC, Fig. 10). The creeping stems of *Galium* root upon the soil surface, the rhizomes of *Acorus* lie just beneath, and those of *Polygonum* are deepest of all. The bushy shoot of *Galium* appears not to harm the slender, ensiform leaves of *Acorus*, and they in turn do little harm to it. In late summer, the

*Many litmus tests uniformly showed the decayed parts of the *Nymphaea* rhizomes to be strongly acid. Enough cultural experiments have not been performed, however, to determine whether the effect upon the *Sagittaria* rhizomes, as above noted, was due to acid or to other causes.

shoots of *Polygonum* rise above those of *Acorus* and *Galium* without apparent harm to either of them. And while *Polygonum* might increase in abundance if *Acorus* and *Galium* were entirely absent, still to a great extent the community, viewed as a whole, is complementary. Elsewhere in the Irido-acoretum the rhizomes of *Acorus* are replaced by those of *Iris;* and very often the rhizomes of *Galium* are replaced by those of *Ludwigia palustris, L. polycarpa, Proserpinaca palustris, Penthorum sedoides, Veronica scutellata,* or *Campanula aparinoides.*

The basal parts of the various swamp meadow species are usually more slender than those of the reed swamp species, and hence the texture of the surface mat of rhizomes, roots, etc., is finer. Then, too, reproduction by seeds becomes more common. *Polygonum Muhlenbergii* is present in the swamp meadow, and by means of its extensively creeping rhizomes, which lie rather low, it forms in some places large patches. Certain other perennials, e. g., *Asclepias incarnata* and *Sium cicutaefolium,* which root near the surface, may reproduce largely by seed or by new shoots arising from the old stem base of the preceding year. In the middle and latter parts of the summer, when the surface soil is no longer saturated with water, such annuals as *Panicum capillare, Echinochloa crusgalli, Eragrostis hypnoides, Stenophyllus capillaris, Polygonum Persicaria, Acnida* sp. (see Annotated List, No. 89), *Amaranthus paniculatus,* and *Erechtites hieracifolia* take possession of all exposed surface soil and become exceedingly abundant. Much of the surface soil that has been denuded by burning or by other causes is already occupied, however, by the rhizomes of perennials such as *Ludwigia palustris, L. polycarpa, Proserpinaca palustris,* etc. In these cases *Boltonia asteroides, Callitriche heterophylla,* and *C. palustris* are often abundant. Both species of *Callitriche,* however, die away in midsummer, being replaced by annuals. Figure 11, Plate XCI, shows such a community. *Callitriche,* maturing earliest, is "seasonally" (Woodhead '06) complementary with the other species. *Boltonia* roots lowest, while its aerial shoot grows much the highest; and since it is not harmed very much by *Proserpinaca, Ludwigia,* and *Penthorum,* while they derive, if anything, benefit from its shelter, *Boltonia* is complementary both aerially and subaerially. *Proserpinaca, Ludwigia,* and *Penthorum* are very similar throughout in growth form and they constitute mutually a competitive community; but, even though mutually competitive, they form with *Boltonia* and *Callitriche* a community that may properly be called complementary.

As has been stated already, the flora of the meadow is highly diversified. A very large number of definite interrelationships, similar to those detailed for the reed swamp and the swamp meadow, are found to exist, but lack of space precludes more than a brief description of a few examples. In the moist parts of the meadow, the soil at a depth of 3–12 cm. frequently contains the tuberous thickened roots of *Cicuta maculata* and *Oxypolis rigidior,* and also the tuber-bearing rhizomes of *Equisetum arvense.* In drier situations the bulbs of *Lilium canadense* occur at a similar depth (most often about 10 cm. deep). Higher in the soil may be found (Pl. XCI, Fig. 12) roots of such species as *Asclepias incarnata, Thalictrum revolutum,* and *Lathyrus palustris,* while the surface soil contains a mixture of the root systems of *Poa pratensis, Agrostis alba, Eleocharis palustris, Acalypha virginica,* etc. In the community shown in the figure just mentioned, *Equisetum* is edaphically complementary, but (considering only the aerial sterile shoots) aerially competitive with *Poa, Agrostis, Eleocharis,* and *Acalypha.* To a moderate extent, the plants rooting near or at the surface appear to be complementary with the plants rooting deeper.

Small, apparently open depressions are numerous in the moist parts of the meadow. These generally contain (Pl. XCII, Fig. 13) such plants as *Iris, Acorus, Viola conspersa, V. cucullata, V. papilionacea, Cardamine bulbosa,* and seedlings of *Lycopus americanus.* And while the rhizomes of *Cardamine* and *Lycopus* occur almost invariably just below those of the other species, and while the different species doubtless make different demands upon the soil, yet edaphic competition is undoubtedly sharp. Their rhizomes are mostly short and thick, lie just below or at the soil surface, and form a dense mat. Nevertheless, when one or more square feet of this mat were carefully removed and the soil in the interstices among the rhizomes was taken away, it was estimated that the interstices, as viewed from above, constituted from 35 to 60 per cent. of the total. Evidently, then, so far as mere room was concerned, several other species could have grown—in fact, did grow—in these interstices. But they were plants which rooted higher or lower; or, if at the same level, they were species not largely dependent upon rhizomes or stolons for multiplication. Thus, where *Iris versicolor* had reached a maximum of frequency, *Polygonum Muhlenbergii,* with a low [illegible] system, and *Galium Claytoni,* with a high root system, might live, but *Acorus Calamus,* with rhizomes similar to those of *Iris versicolor* and lying at a similar depth, and dependent largely on rhizomes for multiplication, was absent.

The almost complete absence, in these small areas, of stoloniferous or loosely spreading species makes it seem certain that there exists some mechanical competition in which species of compact and frequently cespitose habit or species capable of reproducing extensively from seed are successful. The extent, however, to which their success is achieved because of their growth-form or because of their superior adaptation to the particular complex of soil and moisture conditions in these small areas, is of course incapable of accurate estimation without further study. The idea of mechanical competition (*i. e.*, a struggle either among the various species because of the mutual bodily resistance of any or all of their growing parts, or of individual species because of the resistance offered by the soil's compactness to the locomotion of their subterranean organs) is opposed by Clements ('05, pp. 285-289); but Warming ('09, p. 324), in accounting for the usual absence of vegetative locomotion among perennial herbs of the meadow formation, seems inclined to accept this idea in part.

Summary and Conclusions

1. Atmometer readings at a uniform height of 25 cm., taken for a period of 147 days at four different stations, show that the evaporation rate is lowest in the center of the reed swamp and gradually increases as conditions approximating those of forest are reached.

2. The evaporation rate found to obtain in the swamp white oak - white ash forest, conforms with the commonly known fact that with successive increases in the mesophytism (attended with decreasing hydrophytism) of a forest, trees such as *Quercus bicolor*, *Fraxinus nigra*, and *F. americana* are antecedent to trees like *Fagus grandifolia* and *Acer saccharum*.

3. Atmometer readings, taken for seven weeks at four different levels among *Phragmites* plants and at five different levels among *Typha* plants, show that among marsh species of compact social growth evaporation is proportionate to the height above the soil. These results thus coincide with those of Yapp ('09).

4. Data accumulated at Skokie Marsh support the conclusion of Massart ('03) that it is a matter of importance to perennial plants that their hibernating organs occupy a definite level in the soil.

5. Certain observed cases of variation in this level (*Teucrium occidentale*, *Polygonum Muhlenbergii*, etc.), corresponding to changes in the water-level, indicate that with certain species, at least, the depth of the water-table is much the most potent controlling factor (cf. Yapp, '08).

6. Two or more species may live together in harmony because (1) their subterranean stems may lie at different depths; (2) their roots may thus be produced at different depths; (3) even where roots are produced at the same depth, they may make unlike demands upon the soil; (4) the aerial shoots may have unlike growth-forms; or (5) even where these growth-forms are similar, they may vegetate chiefly at different times of the year. According as one or more of these conditions control the floristic composition of a given community the community may be called complementary.

7. The root depth having been determined by various factors for the different species in a community, the specifically different root systems then function in a complementary or a competitive manner as the case may be. But even if the root systems be complementary, the community may be competitive because of marked competition among the aerial parts. Likewise, competitive root systems may render competitive a community otherwise complementary.

8. Through the ability of certain species to utilize different strata in the soil, the aerial portions of these plants are brought into a closer competition. And with closer competition, the chances in the past for further adaptation of similar aerial shoots to dissimilar growth conditions must have been greatly increased. Hence communities formerly complementary in a purely edaphic way, may have been largely instrumental in the evolution of completely complementary communities. In so far as they have been thus instrumental, the fact deserves great emphasis, especially when we consider the far-reaching changes in form and anatomical structure necessarily developed as a prerequisite to living in a completely complementary community.

Annotated List of Plant Species

As a matter of taxonomic interest to botanists in the future, it seems worth while to present here an annotated list of all the species of the *Pteridophyta* and *Spermatophyta* found growing to any extent in Skokie Marsh. Stray species (especially weeds), occasionally observed, have not been included in the list, except where evidence indicated that they were regular inhabitants. Also, many weeds which occur along the roads traversing the marsh and which do not properly belong to the marsh flora, are omitted. As the following list stands, then, it includes only the established species found in the reed swamp, swamp meadow, and meadow of Skokie Marsh proper.

Polypodiaceae

1. *Aspidium Thelypteris* (L.) Sw.
   Mostly in the swamp meadow and outer parts of the reed swamp; fairly frequent.

2. *Onoclea sensibilis* L.
   In the swamp meadow and reed swamp; rather rare.

Equisetaceae

3. *Equisetum arvense* L.
   In the meadow; frequent.

Typhaceae

4. *Typha latifolia* L.
   In the reed swamp; abundant.

Sparganiaceae

5. *Sparganium eurycarpum* Engelm.
   In the reed swamp; very abundant, in many places almost choking up the streams and ditches. In late summer, 1911, after the water in Skokie Stream had fairly well disappeared, great quantities of young aerial shoots were put forth by this species where it occurred upon the stream bed. When these shoots flowered and fruited, they manifested a striking appearance, in that they were yellowish green in color,—not dark green, as was the species elsewhere (cf. Harshberger, '04, p. 136).

Najadaceae

6. *Potamogeton* sp.
   Potamogeton material was found in 1911 in several of the deeper places in Skokie Stream from the county line (Braeside) road as far north as to Lake Forest. This was not in fruit, but appeared on careful comparison with herbarium specimens to be *P. zosterifolius*.

Alismaceae

7. *Sagittaria latifolia* Willd.
   Very common in the reed swamp and frequent in the swamp meadow. Occasionally, detached stem-tubers from this species were found being carried along slowly in Skokie Stream, indicating that *Sagittaria* may at times migrate considerable distances in a purely vegetative way.

8. *Alisma Plantago-aquatica* L.
In reed swamp; common. Confined mostly to the very wet places.

Gramineae

9. *Panicum capillare* L.
Along ditches, stream-banks, etc. Very common in late summer.

10. *Echinochloa crusgalli* (L.) Beauv.
Prominent in late summer in open or mown areas.

11. *Leersia oryzoides* (L.) Sw.
In reed swamp and swamp meadow; frequent.

12. *Phalaris arundinacea* L.
In the outer reed swamp, also in swamp meadow; abundant. Yapp, ('08, p. 67) has pointed out that the leaves of *Phragmites,* because of the slippery inner surface of their sheath, can easily turn about so as to stream with the wind. The same was found at Skokie Marsh to be true, though in a lesser degree, of *Phalaris arundinacea.*

13. *Phleum pratense* L.
In the meadow, where it was more or less frequent, probably because of its occasional cultivation in certain fields near the marsh.

14. *Alopecurus geniculatus* L.
In the swamp meadow and outer parts of the reed swamp, west of Glencoe; sparsely scattered.

15. *Agrostis alba* L.
Common in many parts of the meadow; occasional in the more open parts of the swamp meadow.

16. *Agrostis perennans* (Walt.) Tuckerm.
In meadow and swamp meadow; abundant, especially west of Glencoe.

17. *Calamagrostis canadensis* (Michx.) Beauv.
The dominant grass of the swamp meadow and frequent in the reed swamp; forms the bulk of the hay obtained in Skokie Marsh.

18. *Sphenopholis pallens* (Spreng.) Scribn.
In the swamp meadow; scattered in very small patches.

19. *Danthonia spicata* (L.) Beauv.
In dry parts of the meadow, west of Glencoe; found sparingly.

20. *Spartina Michauxiana* Hitchc.
Along ditches, in moist depressions, etc.; found only rarely.

21. *Phragmites communis* Trin.
In conspicuous dense patches in the reed swamp; abundant west and southwest of Glencoe.

22. *Eragrostis hypnoides* (Lam.) BSP.
Very common in the wet open places of the reed swamp; fairly frequent in the swamp meadow.

23. *E. Frankii* (Fisch., Mey. & Lall.) Steud.
In moist open places of the reed swamp; found sparingly.

24. *Poa compressa* L.
In the meadow; rare.

25. *P. triflora* Gilib.
Very common in the swamp meadow. West of Glencoe this grass forms a fair percentage of the marsh hay obtained each summer.

26. *P. pratensis* L.
In the meadow; abundant.

27. *Glyceria nervata* (Willd.) Trin.
In the swamp meadow; common, especially west of Glencoe. Often occurring in almost a pure growth.

28. *Glyceria septentrionalis* Hitchc.
Along Skokie Stream or upon the stream bed; frequent.

29. *Agropyron caninum* (L.) Beauv.
Found in only one part of the meadow, west of Glencoe.

30. *Hordeum jubatum* L.
Commonly with *Poa triflora* and *Agrostis perennans,* in the swamp meadow; frequent along the roadsides.

31. *Elymus virginicus* L.
Along ditches; occasional.

Cyperaceae

32. *Dulichium arundinaceum* (L.) Britton
Only one patch found, this in the reed swamp west of Braeside.

33. *Eleocharis obtusa* (Willd.) Schultes
In the swamp meadow and reed swamp; scattered mostly in open moist places.

34. *E. palustris* (L.) R. & S.
In grassy places of the meadow and swamp meadow; common. West of Winnetka this species was found growing in Skokie Stream, where it was much stouter and attained an average height of .6 to .7 m.—a fact conforming wtih the observations of others (cf. Gray's Manual, Robinson and Fernald, '08, p. 183).

35. *Stenophyllus capillaris* (L.) Britton
Everywhere in the reed swamp and swamp meadow; common.

36. *Scirpus validus* Vahl.
In very wet parts of the reed swamp; common.

37. *S. fluviatilis* (Torr.) Gray
In the center of the reed swamp, where it frequently fringes Skokie Stream in large patches.

38. *S. atrovirens* Muhl.
Scattered here and there, often abundantly, in outer parts of the reed swamp and swamp meadow.

39. *S. lineatus* Michx.
Found with the last species, but only rarely.

40. *S. cyperinus* (L.) Kunth.
In the swamp meadow; rare.

41. *S. Eriophorum* Michx.
In the outer reed swamp and in the swamp meadow; common.

42. *Carex scoparia* Schkuhr.
In the swamp meadow and moister parts of the meadow; common.

43. *C. cristata* Schwein.
Same range; common.

44. *C. vulpinoidea* Michx.
Same range; common.

45. *C. stipata* Muhl.
Same range; common.

46. *C. cruscorvi* Shuttlw.
Occurring in two small patches west of Glencoe, in wet soil. Mr. E. J. Hill informs me that many years ago he found a considerable quantity of this species there.

47. *C. aurea* Nutt.
In swamp meadow, west of Glencoe; found sparingly.

48. *C. lanuginosa* Michx.
In swamp meadow; in some places, covering considerable areas.

49. *C. riparia* W. Curtis
Mostly in the swamp meadow; abundant.

50. *C. lupuliformis* Sartwell
Observed west of Braeside, in the outer part of the reed swamp.

51. *C. lupulina* Muhl.
In the swamp meadow; seemingly rare.

52. *C. vesicaria* L., var. *monile* Tuckerm.
Mostly in the swamp meadow; fairly common.

NOTE.—Several other species of *Carex*, among them probably *C. granularis*, were found, but because of their immature condition or complete lack of flowers and fruit, positive determination could not be made.

Araceae

53. *Acorus Calamus* L.
In the reed swamp; common.

Lemnaceae

54. *Spirodela polyrhiza* (L.) Schleid.
Abundant in some places upon the surface of the water in Skokie Stream.

55. *Lemna trisulca* L.
In Skokie Stream west of Glencoe; found in 1911 and 1912, at only one place.

Juncaceae

56. *Juncus tenuis* Willd.
In the meadow; occasional.

57. *J. Dudleyi* Wiegand
Same range; occasional.

Liliaceae

58. *Lilium canadense* L.
In the meadow; common, especially west of Glencoe.

Iridaceae

59. *Iris versicolor* L.
In the reed swamp and swamp meadow; common.

Orchidaceae

60. *Habenaria leucophaea* (Nutt.) Gray
Observed in the meadow, west of Glencoe; only one small colony of plants found.

Salicaceae

61. *Salix nigra* Marsh.
Here and there in wet soil, mostly along the roads.

62. *S. amygdaloides* Anders.
The most abundant of the willow trees in Skokie Marsh; preferring the wet places.

63. *S. alba L.*, var. *vitellina* (L.) Koch
Occasional as a large tree in rows along ditches west of Glencoe and Winnetka, where it was evidently planted by man.

64. *S. longifolia* Muhl.
Frequently covering low wet depressions in the swamp meadow. Flowering in frequent cases until late autumn. (Pl. XCVI, Fig. 21.)

65. *S. cordata* Muhl.
In wet places; frequent.

66. *S. discolor* Muhl.
In wet places; common.

S. discolor var. *prinoides* (Pursh) Anders.
Several shrubs in the marsh, appearing as hybrids between *S. discolor* and *S. cordata*, are referred to this variety.

67. *S. petiolaris* J. E. Smith
In meadow and outer part of swamp meadow; occasional.

68. *S. humilis* Marsh.
In the meadow; found only sparingly.

69. *S. rostrata* Richards
West of Glencoe and Ravinia; rare.

Note.—Two or three other forms of *Salix* were found, which were not typical of any known species, but appeared to be hybrids between certain species enumerated above. In the absence of expert opinion concerning their status, separate treatment is here omitted. *Salix fragilis*, occurring in the swamp meadow along certain roads and apparently adventive recently, is likewise omitted in the list.

70. *Populus tremuloides* Michx.
In thickets, small patches of forest, etc.; frequent.

71. *P. grandidentata* Michx.
With the last, but rather rare.

72. *P. deltoides* Marsh.
Along ditches and roads; merely a few scattered trees.

Urticaceae

73. *Ulmus americana* L.
A few large trees here and there. (Pl. XCVI, Fig. 22.)

Polygonaceae

74. *Rumex britannica* L.
In the reed swamp; frequent.

75. *R. crispus* L.
Occurring sparingly in the meadow (but common along the roadsides).

76. *R. altissimus* Wood
In the swamp meadow; occasional.

77. *R. verticillatus* L.
Very abundant at many points in Skokie Stream; frequent in other parts of the reed swamp.

78. *Polygonum aviculare* L.
In the meadow, where principally along paths; occasional.

79. *P. lapathifolium* L.
In the swamp meadow; rather common.

80. *P. Muhlenbergii* (Meisn.) Wats.
Abundant in the reed swamp; frequent in the swamp meadow.

81. *P. pennsylvanicum* L.
In a few open, fairly dry areas of the reed swamp; not common.

82. *P. Hydropiper* L.
Mostly in the Irido-acoretum of the reed swamp; common, becoming very abundant at certain points.

83. *P. acre* HBK.
Occurring with *P. Hydropiper*, but less abundant.

84. *P. Persicaria* L.
Scattered, in open parts of the swamp meadow; frequent.

85. *P. hydropiperoides* Michx.
Confined mainly to Skokie Stream, in which, at some points (especially west of Braeside and Glencoe), it occurs in great abundance, to the almost complete exclusion of other species.

86. *P. sagittatum* L.
In the outer parts of the swamp meadow; rare.

87. *P. scandens* L.
Rare in the marsh proper; confined mostly to roadside thickets.

Chenopodiaceae

88. *Chenopodium album* L.
In open spots of the meadows; frequent.

Amaranthaceae

89. *Acnida* sp.
Very common along Skokie Stream and in more open spots of the swamp meadow. Material was originally determined according to the older manuals as *A. tamariscina* (Nutt.) Wood. Absence of pistillate plants among my specimens makes it impossible now to apply positively the more precise nomenclature of Gray's New Manual (see Robinson and Fernald, '08, p. 373); but the Skokie Marsh plants probably belong to *A. tuberculata* Moq. and its variety *subnuda* Wats.

90. *Amaranthus paniculatus* L.
In open, fairly dry spots of the swamp meadow. In 1912, this species was found only rarely, and it is probable that much of the material considered in 1911 as *A. paniculatus* was the upright form of *Acnida* sp.

Caryophyllaceae

91. *Arenaria lateriflora* L.
About thickets in the meadow and outer swamp meadow; somewhat frequent.

92. *Stellaria longifolia* Muhl.
Among the grasses and sedges of the swamp meadow; frequent.

93. *Cerastium nutans* Raf.
In a few open, moist, shady spots in the swamp meadow; rather rare.

94. *Nymphaea advena* Ait.
In the Nymphaeetum of the reed swamp; abundant and conspicuous.

95. *Castalia odorata* (Ait.) Woodville & Wood
With *Nymphaea advena,* to which it appears ecologically equivalent; common or even abundant.

Ranunculaceae

96. *Ranunculus delphinifolius* Torr.
Abundant in Skokie Stream; the seedlings frequent in open or sheltered moist depressions of the swamp meadow.

97. *R. sceleratus* L.
In meadow and swamp meadow; rare.

98. *R. Pennsylvanicus* L. f.
Here and there in the swamp meadow; somewhat rare.

99. *Thalictrum revolutum* DC.
In the meadow; frequent.

100. *Caltha palustris* L.
In the swamp meadow; rare.

Cruciferae

101. *Radicula palustris* (L.) Moench
In the swamp meadow; abundant.
Radicula palustris, var. *hispida* (Desv.) Robinson
Growing with the species proper, and abundant. Of the hundreds of specimens examined, none was found showing any intergradation with the species itself.

102. *R. aquatica* (Eat.) Robinson
Abundant in Skokie Stream, especially west of Glencoe. Appearing to renew itself chiefly by its detaching leaves, which take root and propagate new plants,—a habit already noted by other observers.

103. *Cardamine bulbosa* (Schreb.) BSP.
In the reed swamp, swamp meadow, and moist parts of the meadow; common.

104. *C. pennsylvanica* Muhl.
In the reed swamp and swamp meadow; common. Numerous seedlings develop in late summer and flower until late autumn.

Crassulaceae

105. *Penthorum sedoides* L.
In the reed swamp and swamp meadow; common.

Saxifragaceae

106. *Ribes floridum* L'Hér.
In thickets; somewhat frequent.

107. *R. nigrum* L.
In thickets; apparently rare.

Rosaceae

108. *Fragaria virginiana* Duchesne
In the outer meadow; fairly frequent.

109. *Potentilla monspeliensis* L.
In the meadow and open spots of the swamp meadow.

110. *P. palustris* (L.) Scop.
Growing with *Typha latifolia,* west of Braeside and Glencoe; only two small patches observed. Aerially, this species is strongly complementary with *Typha;* it utilizes the lower atmospheric strata, where it flourishes among the aerial shoots of *Typha.*

111. *P. canadensis* L.
In drier parts of the meadow; occasional.

112. *Geum virginianum* L.
In open places of the swamp meadow; rare.

113. *Rosa blanda* Ait.
In the meadow; frequent.
Doubtless one or two other species of *Rosa* are present, but the scanty material obtainable did not admit of certain determination.

Leguminosae

114. *Trifolium pratense* L.
In the meadow; occasional.

115. *T. repens* L.
In the meadow; common.

116. *Lathyrus palustris* L.
In the meadow; frequent.

Oxalidaceae

117. *Oxalis corniculata* L.

In the meadow and open, drier places of the swamp meadow; occasional.

Euphorbiaceae

118. *Acalypha virginica* L.

In the meadow and near various thickets; frequent.

Callitrichaceae

119. *Callitriche palustris* L.

Very common (as also the next following species) in the reed swamp and moister parts of the swamp meadow in early summer, when water is abundant.

120. *C. heterophylla* Pursh

With *C. palustris*, the two species often entering mutually into the composition of a compact mat, the whole appearing to the naked eye as a single species.

Balsaminaceae

121. *Impatiens biflora* Walt.

In moist, shady spots; occasional.

Rhamnaceae

122. *Rhamnus Frangula* L.

Occurring in a thicket, west of Glencoe. The finding of this species in an established condition at Skokie Marsh has already been recorded elsewhere (Sherff, '12). Heretofore it has been frequent in cultivation, but our manuals list no place farther west than Ontario for the western limit of its established range.

Vitaceae

123. *Vitis vulpina* L.

In various thickets of the marsh; frequent.

Hypericaceae

124. *Hypericum majus* (Gray) Britton

In open spots in the swamp meadow; frequent.

125. *H. canadense* L.

In similar situations; frequent.

Violaceae

126. *Viola cucullata* Ait.
In the moister parts of the meadow; common.

127. *V. papilionacea* Pursh
In similar situations; common. Much of the material slightly different from the typical form; but Professor Ezra Brainerd, to whom some living specimens from Skokie Marsh were sent a year ago for cultivation in his own garden, kindly informs me that he considers them to be *V. papilionacea*.

128. *V. conspersa* Reichenb.
In the meadow; frequent.

Lythraceae

129. *Decodon verticillatus* (L.) Ell.
In the reed swamp; found at one station west of Glencoe. Its tough roots were observed in several cases to have impeded very effectively the progress, through the soil, of the stem-tubers of *Sagittaria* and *Sparganium*.

Onagraceae

130. *Ludvigia polycarpa* Short & Peter
In the reed swamp and swamp meadow; common.

131. *L. palustris.* (L.) Ell.
In the reed swamp and swamp meadow; very abundant.

132. *Epilobium angustifolium* L.
In the outer part of the meadow, west of Glencoe; rare.

133. *Epilobium coloratum* Muhl.
In the swamp meadow; common. Appearing to pass by various intergradations into the next species.

134. *E. adenocaulon* Haussk.
With *E. coloratum;* common.

135. *Oenothera muricata* L., var. *canescens* (T. & G.) Robinson
In open places in the swamp meadow; occasional.

Haloragidaceae

136. *Myriophyllum heterophyllum* Michx.
In Skokie Stream; abundant in 1912.

137. *M. humile* (Raf.) Morong
In the Skokie Stream; very abundant in 1911, but rare in 1912, having been almost entirely replaced by the above species.

138. *Proserpinaca palustris* L.
In the reed swamp and swamp meadow; very abundant.

Umbelliferae

139. *Osmorhiza longistylis* (Torr.) DC.
About thickets; rare.

140. *Cicuta maculata* L.
In the swamp meadow and moist parts of the meadow; frequent.

141. *Sium cicutaefolium* Schrank
In the reed swamp and swamp meadow.

142. *Oxypolis rigidior* (L.) Coult. & Rose
About thickets; somewhat rare.

Cornaceae

143. *Cornus Amomum* Mill.
In wet thickets along the marsh border, ditches, depressions, etc.; frequent.

144. *C. stolonifera* Michx.
With *C. Amomum;* somewhat rare.

145. *C. paniculata* L'Hér.
With *C. Amomum;* fairly frequent.

Primulaceae

146. *Lysimachia thyrsiflora* L.
In the reed swamp; very rare.

147. *Steironema ciliatum* (L.) Raf.
In shaded places in the meadow; rare.

Oleaceae

148. *Fraxinus americana* L.
Here and there in the small "islands" of forest.

149. *Fraxinus nigra* Marsh.
With the last species, but in wetter soil.

Gentianaceae

150. *Gentiana Andrewsii* Griseb.
In moist grassy thickets, west of Braeside; rare.

Asclepiadaceae

151. *Asclepias incarnata* L.
Along Skokie Stream and in various other wet places; common.

Convolvulaceae

152. *Convolvulus sepium* L.
In the swamp meadow and in the meadow; rare.

153. *Cuscuta Cephalanthi* Engelm.
On *Cephalanthus occidentalis,* southwest of Ravinia; seemingly rare.

154. *C. glomerata* Chois.
On *Solidago,* etc., in the meadow and outer swamp meadow; common.

Verbenaceae

155. *Verbena hastata* L.
In the meadow and swamp meadow; occasional.

156. *Lippia lanceolata* Michx.
In outer parts of the reed swamp, west of Highland Park; rare.

Labiatae

157. *Teucrium canadense* L.
In the swamp meadow; rare.

158. *T. occidentale* Gray
Mainly in the reed swamp; abundant.

159. *Scutellaria galericulata* L.
In the reed swamp and swamp meadow; common.

160. *Agastache scrophulariaefolia* (Willd.) Ktze.
In the meadow, near thickets and woods west of Glencoe; rare.

161. *Prunella vulgaris* L.
In the meadow; occasional.

162. *Physostegia formosior* Lunell.
In the reed swamp, west of Braeside; rare. The specimens do not fit descriptions of *P. virginiana* (L.) Benth., but match well the material collected by Dr. Lunell and described by him as new (Lunell, '08, p. 7).

163. *Stachys palustris* L.
In the reed swamp; occasional.

164. *Monarda fistulosa* L.
In the meadow; occasional.

165. *Pycnanthemum flexuosum* (Walt.) BSP.
In the swamp meadow and meadow; apparently rare.

166. *Lycopus americanus* Muhl.
In moist parts of the meadow, in the swamp meadow, and along various ditches; frequent.

167. *Mentha arvensis* L., var. *canadensis* (L.) Briquet
In the reed swamp; common.

Scrophulariaceae

168. *Verbascum Thapsus* L.
Here and there in a few open places of the meadow; rare.

169. *Chelone glabra* L.
In the meadow, near thickets; rare.

170. *Mimulus ringens* L.
In the reed swamp; common.

171. *Gratiola virginiana* L.
In open wet places of the swamp meadow; frequent.

172. *Veronica Anagallis-aquatica* L.
In Skokie Stream; at many points abundant.

173. *V. scutellata* L.
In the reed swamp and swamp meadow; frequent.

174. *V. peregrina* L.
On nude spots of soil in the swamp meadow; frequent.

175. *Pedicularis lanceolata* Michx.
In moist places about thickets; rare.

Plantaginaceae

176. *Plantago major* L.
In the meadow; occasional.

177. *P. Rugelii* Dcne.
With *P. major,* but apparently more frequent.

Rubiaceae

178. *Galium Claytoni* Michx.
In the reed swamp and swamp meadow; abundant.

179. *Cephalanthus occidentalis* L.
In wet thickets; occasional.

Caprifoliaceae

180. *Sambucus canadensis* L.
In thickets, mostly in outer parts of the marsh; frequent.

Campanulaceae

181. *Specularia perfoliata* (L.) A. DC.
On dry nude spots of soil in swamp meadow, in late summer; rather rare.

182. *Campanula aparinoides* Pursh
In certain parts of the swamp meadow, among grasses and sedges; common, especially west of Braeside.

Lobeliaceae

183. *Lobelia cardinalis* L.
In the reed swamp and along certain ditches; common at certain points, especially west of Glencoe.

184. *L. spicata* Lam.
In the swamp meadow; frequent.

Compositae

185. *Vernonia fasciculata* Michx.
About thickets, in the swamp meadow; frequent.

186. *Eupatorium purpureum* L.
In the swamp meadow; occasional.

187. *E. perfoliatum* L.
In the swamp meadow and moist parts of the meadow; frequent.

188. *Solidago canadensis* L.
In outer parts of the marsh, about thickets; common.
Var. *gilvocanescens* is present in similar situations; fairly frequent, at least west of Glencoe.

189. *S. serotina* Ait.
About thickets; frequent.

190. *S. graminifolia* (L.) Salisb., var. *Nuttallii* (Greene) Fernald
In similar situations; frequent. The rootlets of numerous specimens mainly pointing upward toward the soil surface, as if for oxygen.

191. *Boltonia asteroides* (L.) L'Hér.
In the reed swamp and swamp meadow; abundant.

192. *Aster Tradescanti* L.
In the reed swamp and swamp meadow; abundant.

193. *A. salicifolius* Ait.
In a few moist wooded spots near the margins of the marsh, where it is fairly plentiful.

194. *Erigeron philadelphicus* L.
In the swamp meadow; common.

195. *E. annuus* (L.) Pers.
In the meadow; occasional.

196. *E. ramosus* (Walt.) BSP.
In the meadow; occasional.

197. *Xanthium canadense* Mill.
In a few open spots of the meadow and swamp meadow.

198. *Rudbeckia hirta* L.
In the meadow; common.

199. *R. laciniata* L.
In a few moist places, especially near thickets.

200. *Helianthus grosseserratus* Martens
In outer parts of the marsh, near the thickets; frequent.

201. *Bidens frondosa* L.
In open spots of the swamp meadow and along ditches; frequent.

202. *B. vulgata* Greene
In similar situations but apparently less frequent.

203. *B. cernua* L.
In the reed swamp; abundant.

204. *Helenium autumnale* L.
Here and there in a few moist spots; scarcely frequent.

205. *Achillea Millefolium* L.
In the meadow; frequent.

206. *Artemisia biennis* Willd.
In reed swamp and swamp meadow; abundant, at least in 1911, when marsh was fairly dry.

207. *Erechtites hieracifolia* (L.) Raf.
In a few open spots in the swamp meadow; rather rare.

208. *Senecio aureus* L.
In various moist places; frequent.

209. *S. Balsamitae* Muhl.
With *S. aureus*, or in drier soil (where more abundant).

210. *Cirsium altissimum* (L.) Spreng.
In open, fairly dry places in the swamp meadow and the meadow; rare.

211. *C. arvense* (L.) Scop.
A few fair-sized patches in drier parts of the swamp meadow; scarcely frequent.

212. *Taraxacum officinale* Weber
In the meadow; frequent.

213. *Lactuca scariola* L., var. *integrata* Gren. & Godr.
In dry, open spots in the meadow and swamp meadow; occasional.

214. *L. canadensis* L.
In the meadow; frequent west of Braeside and Glencoe.

215. *L. campestris* Greene
In the meadow; frequent west of Braeside and Glencoe.
L. campestris × *canadensis*, an evident hybrid, occurs west of Glencoe among specimens of the two species proper. The plants resemble in general appearance *L. canadensis*, a few of the leaves, however, becoming slightly hispid-setose underneath the midnerve. The corollas in the fresh specimens are a bright blue, closely resembling those of *L. campestris*. Seed gathered in 1911 was planted in 1912 but did not germinate.

216. *L. spicata* (Lam.) Hitchc.
Along certain ditches; occasional.

217. *Prenanthes racemosa* Michx.
In the meadow, west of Glencoe; frequent.

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EXPLANATION OF PLATES

Plate LXXXVI

Fig. 1. Map of Skokie Marsh; the dotted line represents Skokie Stream.

Plate LXXXVII

Fig. 2. Skokie Stream at point west of Braeside, looking north. July, 1911.
Fig. 3. Skokie Stream at point west of Glencoe, looking south. July, 1911.

Plate LXXXVIII

Fig. 4. Average daily evaporation rates in (*a*) center of reed swamp, (*b*) outer part of reed swamp, (*c*) swamp meadow, and (*d*) forest.
Fig. 5. Average daily evaporation rates among *Phragmites communis:* at *a*, 0 cm.; at *b*, 25 cm.; at *c*, 107 cm.; and at *d*, 198 cm.
Fig. 6. Average daily evaporation rates among *Typha latifolia:* at *a*, 0 cm.; at *b*, 25 cm.; at *c* 107 cm.; and at *d*, 175 cm.

Plate LXXXIX

Fig. 7. *a*, *Sparganium eurycarpum; b*, *Sagittaria latifolia; c*, *Polygonum Muhlenbergii*. July, 1911.
Fig. 8. *Phragmites communis*. July, 1911.

PLATE XC

Fig. 9. *a*, *Ranunculus delphinifolius*; *b*, *Nymphaea advena*; *c*, *Sium cicutaefolium*; *d*, *Typha latifolia*; *e*. *Polygonum hydropiperoides*. July, 1911.

Fig. 10. *a*, *Acorus Calamus*; *b*, *Polygonum Muhlenbergii*; *c*, *Galium Claytoni*. July, 1911.

PLATE XCI

Fig. 11. *a*, *Boltonia asteroides*; *b*, *Penthorum sedoides*; *c*, *Proserpinaca palustris*; *d*, *Ludvigia palustris*; *e*, *Callitriche palustris*. July, 1911.

Fig. 12. *a*, *Asclepias incarnata*; *b*, *Poa pratensis*; *c*, *Agrostis alba*; *d*, *Equisetum arvense*; *e*, *Acalypha virginica*; *f*, *Eleocharis palustris*. July, 1911.

PLATE XCII

Fig. 13. *a*, *Lycopus americanus*; *b*, *Viola conspersa*; *c*, *Viola cucullata*; *d*, *Iris versicolor*. July, 1911.

Fig. 14. One of the broad drainage ditches southwest of Skokie Marsh (west of Kenilworth). *Sparganium eurycarpum* abundant on bed. June, 1912.

PLATE XCIII

Fig. 15. Looking east along the county line (Braeside) road, from Skokie Stream. Swamp meadow on either side and *Ulmus americana* conspicuous in the distance. May, 1912.

Fig. 16. Looking west along the road just north of the county line (Braeside) road. One of the ditches. May, 1912.

PLATE XCIV

Fig. 17. Looking north from the bridge west of Winnetka; showing a basin (largely artificial) in which part of the water from the marsh collects, flowing thence southward through the ditch visible in the foreground. June, 1912.

Fig. 18. Looking south in the west part of Skokie Marsh, west of Glencoe; showing the dense growth of sedges, grasses, etc., of the swamp meadow. June, 1912.

PLATE XCV

Fig. 19. Looking south over the swamp meadow, west of Glencoe; showing the later growth of herbs after the mowing of the tall grasses and sedges. August, 1911.

Fig. 20. View west of Glencoe; the reed swamp at this point separated from forest by only about 15 m. June, 1912.

PLATE XCVI

Fig. 21. View in swamp meadow, west of Ravinia; showing one of the characteristic thickets of *Salix longifolia*. June, 1912.

Fig. 22. Swamp meadow west of Glencoe, with *Ulmus americana*, a conspicuous tree in the landscape of the marsh, along ditch, stream, and marsh border. June, 1912.

PLATE XCVII

Fig. 23. View west of Highland Park, where Skokie Stream widens out but is filled with a dense growth of *Sparganium eurycarpum*, etc. The stream is bordered with *Salix* sp., etc. (on reader's left) and *Populus tremuloides*, *Fraxinus nigra*, etc. (at right). June, 1912.

Fig. 24. Skokie stream west of Glencoe, looking south; showing the numerous plants that grow rapidly upon the stream bed as the water subsides. June, 1912.

Plate LXXXVI

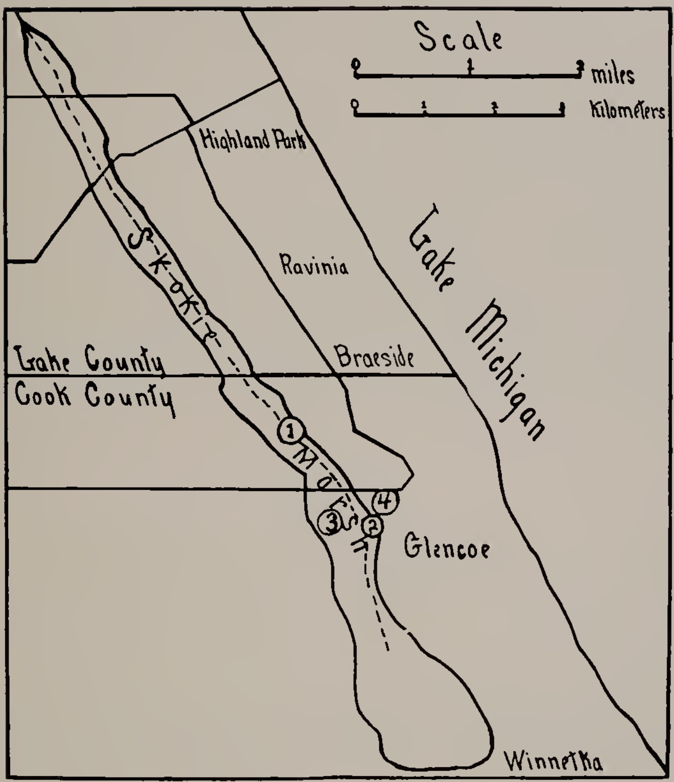

Fig. 1

Plate LXXXVII

Fig. 2

Fig. 3

Plate LXXXVIII

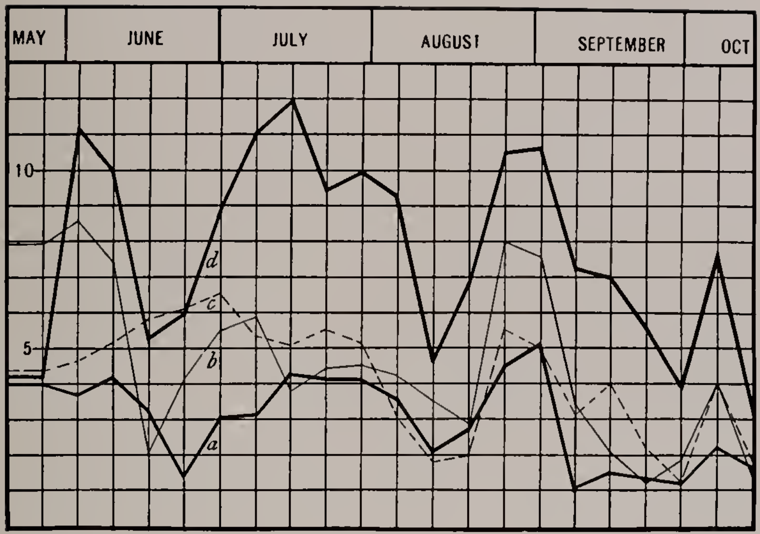

Fig. 4

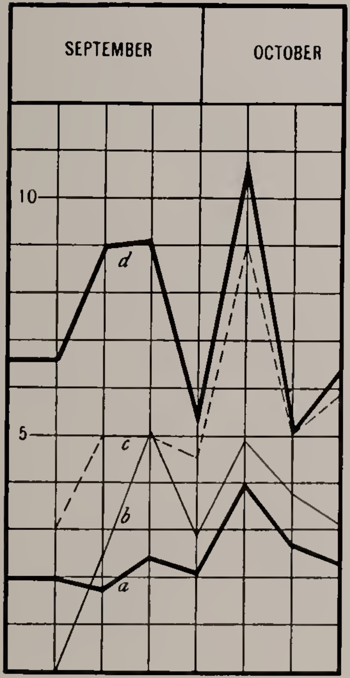

Fig. 5

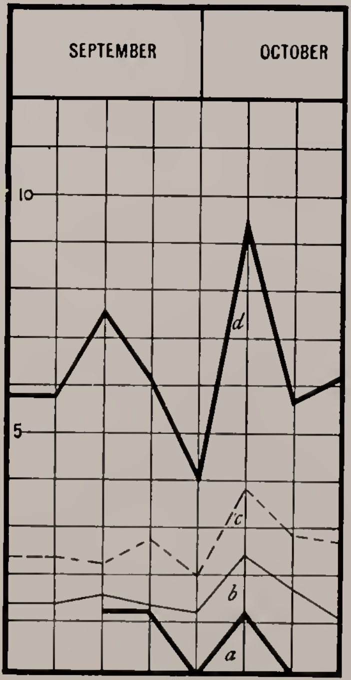

Fig. 6

Plate LXXXIX

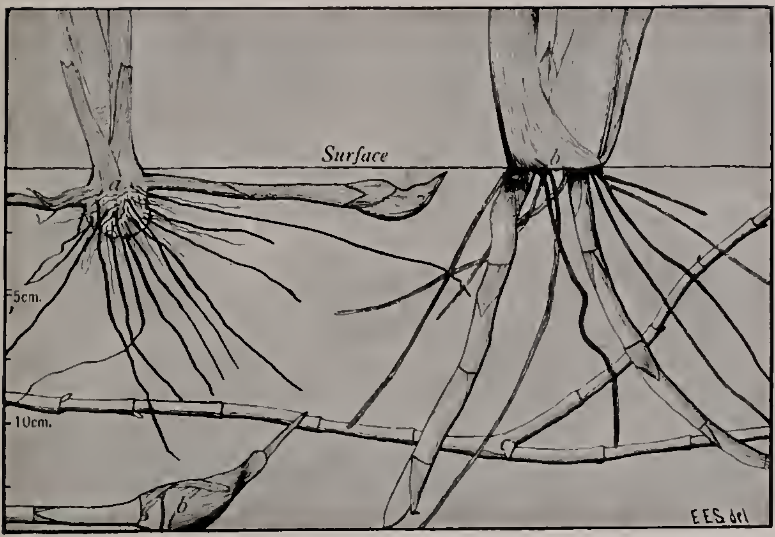

Fig. 7

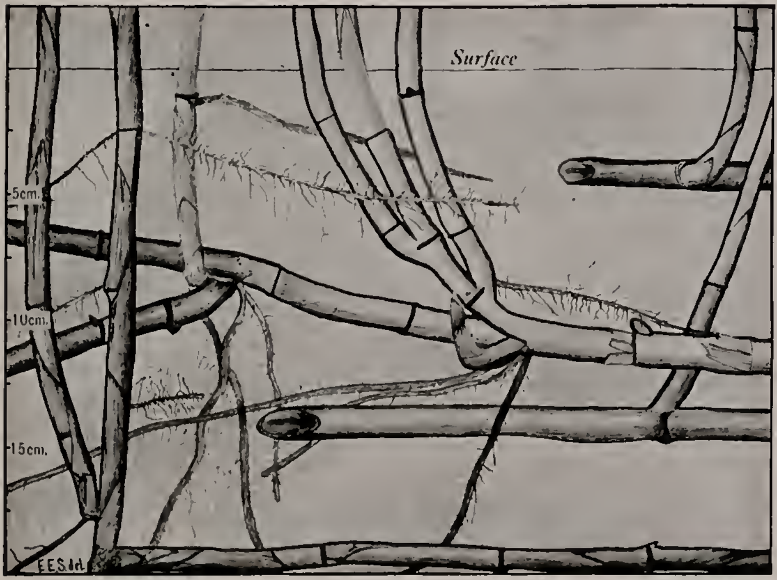

Fig. 8


Surface
e
d
a
5cm.
10cm.
b
15cm.
E.E.Shreff del.

Fig. 9

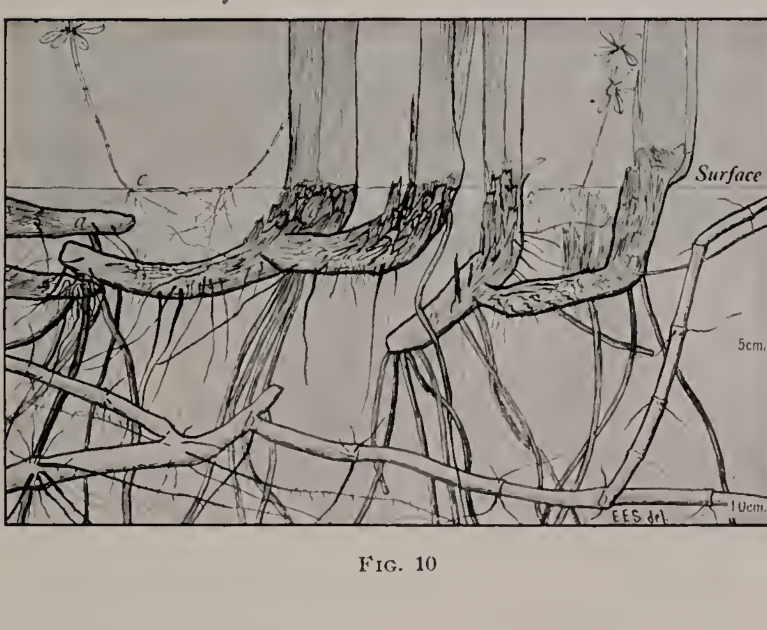
Surface
c
a
5cm.
10cm.
EES del.

Fig. 10

PLATE XCI

FIG. 11

FIG. 12

Plate XCII

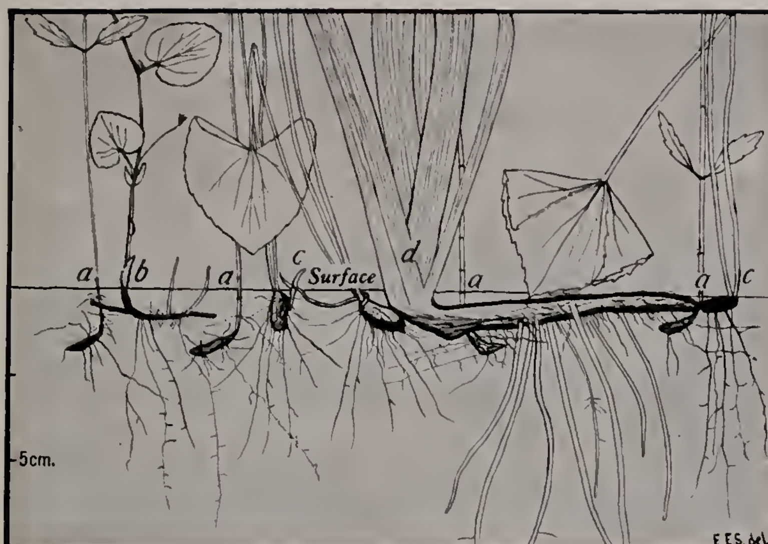

Fig. 13

Fig. 14

PLATE XCIII

FIG. 15

FIG. 16

Plate XCIV

Fig. 17

Fig. 18

Plate XCV

Fig. 19

Fig. 20

Plate XCVI

Fig. 21

Fig. 22

Plate XCVII

Fig. 23

Fig. 24